Decentralised finance: the latest generation of crypto-assets

Rationale

This article is intended as an introduction to the world of decentralised finance (DeFi). To this end, the focus is to explain, in a simplified manner, its key characteristics and most common use cases, along with the main risks.

Takeaways

- DeFi is one of the latest developments in the crypto-asset space and also the segment where most of the recent bouts of sector turmoil have taken place. It is a complex, but still largely endogenous, ecosystem and therefore its interaction with the real economy is limited.

- DeFi is actually less decentralised than it purports to be. Its real benefits are limited, while the potential risks are considerable. Although the risks are not substantially different from those in the traditional financial sector, their drivers, speed of propagation and scale can differ entirely, compromising the authorities' room to manoeuvre.

- Although the policy and regulatory effort is, for now, focused on traditional crypto-assets, there is a growing debate as to what mix of measures would best contribute to mitigating the risks of DeFi. More specific action in this regard is expected in the years ahead.

Keywords

DeFi, decentralised finance, crypto-assets.

JEL classification

G18, G28, O33.

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Introduction

Of all the pieces in the crypto-asset puzzle, "decentralised finance" (DeFi) is perhaps the most controversial. In a single year (November 2020-November 2021)[2] its size increased 16-fold.[3] Six months later, the DeFi ecosystem had shrunk by 80%,[4] triggering the unprecedented turmoil that prompted the "crypto winter".

Conceptually speaking, decentralised finance is a set of new initiatives whose common denominator is the intent to bypass traditional intermediaries in the provision of financial products and services and related agreements and activities (Financial Stability Board, 2023). In other words, the difference between traditional finance (or TradFi) and DeFi lies less in which services are available than in how they are provided.

Accordingly, in DeFi protocols the role previously assigned to a trusted third party (a bank, an insurance firm, etc.) is played by an autonomous software code (smart contract). DeFi developers use a series of key technological resources to make this happen. First, a distributed ledger technology or similar platform (blockchain). Second, dedicated programs to articulate the value propositions aimed at users (protocols). Lastly, a set of decentralised applications (dApps) that act as interfaces with the protocols.

To be fully functional, the DeFi ecosystem relies heavily on other components, both crypto and non-crypto alike. These include, among other elements, stablecoins, along with a myriad of agents playing different roles, from serving as a bridge between the fiat and digital economies (e.g. centralised crypto exchanges or CEX) to sending information to smart contracts or providing the required ancillary services (digital wallets, off-chain asset custody, cross-blockchain bridges, etc.).

This article offers an introductory and simplified view of the DeFi universe. First, the most characteristic features of DeFi are examined. The main use cases are then identified, before a discussion of the main benefits and risks. The article ends with a brief reflection on the future of DeFi and the potential regulatory measures that might be deployed. For reasons of space, this article does not delve at length into any of the subjects discussed. However, more detailed information can be found in the references.

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1 The author thanks Juan Ayuso, Carlos Conesa, José Manuel Marqués, Ana Fernández and Paula López Urruchi for their comments.

2 MakerDAO, launched in 2017, is usually cited as the first major example of a DeFi protocol. However, the real tipping point for the DeFi phenomenon came in mid-2020 and the start of what is now known as the "crypto summer", an 18-month period that saw a flurry of new initiatives.

3 Measured in terms of the overall change in total value locked (TVL) in DeFi protocols. Despite its limitations, TVL is the most widely accepted indicator. As detailed in the section "Main use cases", these locked crytpo-assets serve two main purposes: to act as collateral and to provide the ecosystem with the liquidity it needs.

4 Caused by both a decline in trading activity and the sharp drop in the prices of the locked crypto-assets.

Anatomy of the DeFi universe

One fairly common way of describing the DeFi ecosystem is as a succession of interconnected layers, like Lego blocks (Schär, 2021). Each layer serves a particular purpose and, in turn, provides the foundations for the next one (see Figure 1). This interoperability enables the whole to function cohesively. Further, this configuration provides the flexibility inherent in open architectures, allowing for a much faster pace of innovation.[5]

Not all authors define the layers in the same way. However, they do agree that the foundations of the building are its infrastructure. Typically, this is a public blockchain platform on which smart contracts can be deployed. This property can be harnessed to develop bespoke applications and services that push the boundaries of what "crypto-currencies", as they are popularly known, are able to offer. Further, the ownership details of digital assets are recorded at this infrastructural level, attesting the transfer of ownership when the asset is sold.

The digital assets themselves are also deployed on this infrastructure, be they native to the blockchain network[6] (e.g. the crypto-asset Ether) or some other kind of token. Next come the protocols. These are the vehicles that define the specific terms and conditions of the financial products and services offered (e.g. loans). The rules governing these use cases are precisely those employed by the smart contracts.

In order to access these protocols and, by extension, the specific financial product, applications need to be used. These applications (dApps) are deployed on the blockchain and thus outside the control of any centralised organisation. Although potential users can develop code to interact with these applications, most rely on the tools offered by the creators of the dApps themselves.

More recently, a group of applications aimed at institutional investors has also emerged. Unlike the previous applications, these need participants' identities to be verifiable in order to comply with anti-money laundering and counter terrorist financing regulations. Indisputably, these agents' demand for DeFi services has driven much of the growth observed in both trading volumes and average holdings (Organisation for Economic Co-operation and Development, 2022b).
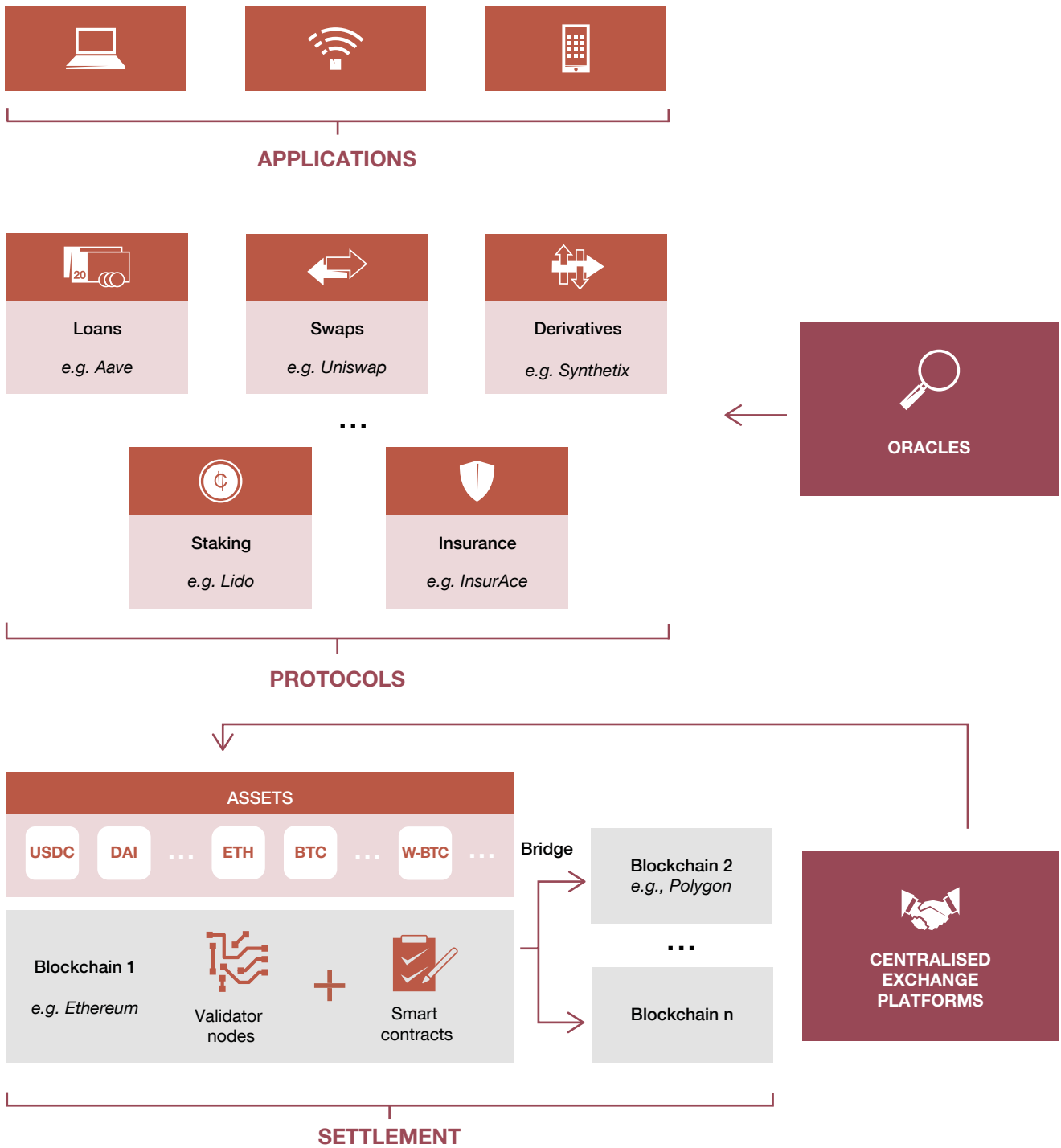
The final layer in the architecture comprises a series of aggregation services. These provide customers with tools to simplify the user experience and help unlock the full potential of the DeFi ecosystem (e.g. to compare offers of the same product or service before signing up to them).

Aside from the structure described above, the DeFi ecosystem draws on an array of peripheral elements that are key to its functioning. First, digital wallets, which offer users a simple means of accessing, viewing and mobilising their digital assets. In the case of DeFi, most of these wallets

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5   This is known as composability, in reference to the ability to combine and recombine different pieces of software at will, to thus create new value propositions. For instance, one smart contract can call another in order to capitalise on its particular properties, thereby creating a more complete and sophisticated product or service.

6   Specific units of account typically used to pay for services provided via a given network.

Figure 1
Decentralised finance: the latest generation of crypto-assets

APPLICATIONS

Loans
e.g. Aave

Swaps
e.g. Uniswap

Derivatives
e.g. Synthetix

...

Staking
e.g. Lido

Insurance
e.g. InsurAce

ORACLES

PROTOCOLS

ASSETS

USDC   DAI   ...   ETH   BTC   ...   W-BTC   ...

Bridge

Blockchain 2
e.g., Polygon

...

Blockchain n

Blockchain 1
e.g. Ethereum

Validator nodes   +   Smart contracts

CENTRALISED EXCHANGE PLATFORMS

SETTLEMENT

SOURCE: Banco de España.

are "unhosted" (self-managed and private), which means giving customers full control over their credentials. However, it also makes them responsible should something go wrong, such as the loss of those credentials.

A smart contract also needs access to the proper data to objectively determine when the triggering conditions are met (e.g. when to settle a position because the price of the associated collateral falls below the threshold value). This information is often not stored in the blockchain. Therefore, an external service is needed to fetch the data from reliable sources and share it through the blockchain in real time. These agents are known as oracles and come in a variety of configurations intended to ensure data accuracy and quality.

In the same vein, "bridges", as they are known, are key to overcoming interoperability issues between different blockchains.[7] These software solutions allow digital assets to move across different networks, thereby broadening the options available to developers and users alike. The growth of DeFi owes largely to these vehicles.

In addition, the DeFi universe would make little sense without stablecoins. Not only are stablecoins the main form of collateral for DeFi, they are also its largest source of liquidity since they are associated with the bulk of the transactions in this space (Born, Gschossmann, Hodbod, Lambert and Pellicani, 2022). Furthermore, stablecoins play one of the roles reserved for fiat currencies in the traditional monetary system: offering, within the same ecosystem, a form of protection against crypto-volatility (Adachi et al., 2021).

Needless to say, this has been a major boon for them and has also fostered the emergence of a broad range of novel stablecoins, associated with decentralised protocols. In other words, in recent years demand for stablecoins has mainly been driven by the dynamics prompted by DeFi services themselves.[8] As discussed in the fourth section ("Promises, paradoxes and other obstacles"), this has serious implications for the sustainability of the underlying business model.

Lastly, "governance tokens" are a second class of digital asset unique to this space. These tokens are used to govern decision-making and entitle the members of a community (a protocol) to raise and vote on proposals. These may cover technical matters (e.g. which blockchain to use), operating aspects (e.g. the interest rate on a loan) and even more strategic issues.

In keeping with the spirit of decentralisation, any proposal must be written into code and executed automatically based on the outcome of the vote. This decision-making arrangement is known as a decentralised autonomous organisation (DAO). Governance tokens also confer economic rights and, like any other crypto-asset, can be freely exchanged on the market. Accordingly, they offer their holders economic incentives, either in the form of direct rewards or through expected price gains. In practice, therefore, they are not always used for the purposes of governing a particular
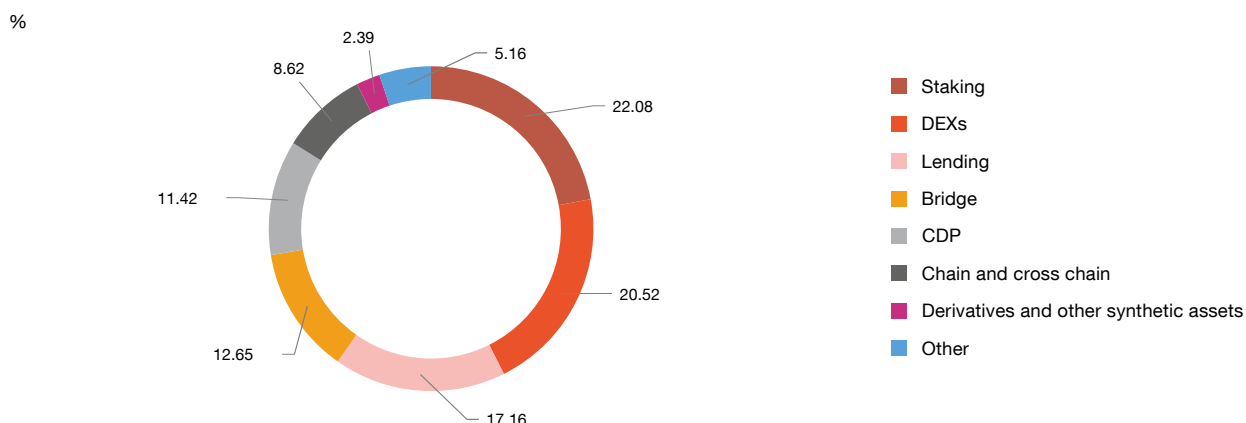
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7 Interoperability problems between different blockchains are one of the ecosystem's main friction points and essentially owe to differences in their operating rules, protocols and consensus mechanisms.

8 A case in point is TerraUSD: until its collapse, the bulk of its supply (75% of its market capitalisation) was linked to the Anchor lending protocol.

1.a Relative weight in TVL terms

%

Legend:
- Staking
- DEXs
- Lending
- Bridge
- CDP
- Chain and cross chain
- Derivatives and other synthetic assets
- Other

Values: 5.16, 22.08, 20.52, 17.16, 12.65, 11.42, 8.62, 2.39

SOURCE: DefiLlama (5 June 2023).

protocol and may instead be used for speculative ends. Some of the ramifications of this are explored in the section "Promises, paradoxes and other obstacles".

Main use cases

While there is a nominally large offering of DeFi products and services, the market has so far been concentrated around a relatively narrow group of activities and actors (Fliche, Uri and Vileyn, 2023) (see Chart 1). Because of their design, these business lines are mostly confined to feeding back into the DeFi ecosystem itself, thereby creating a markedly speculative and self-contained dynamic that has little impact on the real economy. The more significant activities tend to pivot around a key figure for the DeFi universe known as the liquidity pool.

Put simply, a pool is a pile of crypto-assets contributed individually by different users. In exchange, these users hope to earn the rewards stipulated in each protocol for participating in this pool. Thus, these assets remain available to the protocol so that it can act as an autonomous counterparty in the transactions that it executes.

In this setting, lending is one of the longest-standing and most consolidated products in the DeFi world. Functionally, it is similar to a securities loan or repo agreement in traditional finance, with the difference being that, in principle, neither the borrower nor the lender needs to prove their identity. As a result of this lack of information between the parties, the need to know customers for the purpose of assessing credit risk is replaced here by the need for overcollateralisation, with the exact amount and interest applicable being specified in the corresponding protocol (EU Blockchain Observatory and Forum, 2022).

Another notable use case relates to token trades or swaps which, in the DeFi universe, take place on special exchanges. Specifically, these are arranged with the help of decentralised exchanges (DEX), which directly and automatically facilitate buyer-seller matches. In this scenario, the traditional order book is replaced by another model that runs on dynamic pricing algorithms.[9]

To this end, DEXs take into account the changes in the stock of crypto-assets deposited in the pool (Auer, Halshofer, Kitzler, Sagesse and Friedhelm, 2023) and the reference market data delivered through the oracles. To calculate the final prices, the protocols follow different formulas[10] and ultimately use smart contracts that execute the entire trade.

A third line of business that has seen sustained growth in recent years is staking. This practice entails users temporarily pledging a certain amount of crypto-assets[11] for use as collateral in validating transactions on a blockchain. The higher the amount staked and the longer the period of time the crypto-assets are locked, the more likely the user is to ultimately be chosen as a validator.[12] In this case, users will receive potentially substantial economic compensation.

The rate of return for staking can be considerable, particularly in the case of less mature protocols. Returns take the form of governance tokens, which sets staking apart from other asset management solutions that are equally as popular, such as yield farming. In yield farming, tokens are also temporarily locked, but with the underlying aim of investing them in different protocols to earn a passive income, typically in the form of different types of crypto-assets.

This array of products and services is rounded out with others that have a smaller market share but that help define a broad and cohesive panorama. To some extent, this is what makes DeFi functionally comparable to what we understand as the traditional financial system. For instance, it is possible to find offerings such as derivatives (both on crypto-assets and on conventional financial assets), other synthetic assets, decentralised insurance, crowdfunding and many more.

Promises, paradoxes and other obstacles

The parallels between traditional financial channels and the DeFi ecosystem serve to identify and better understand their respective advantages and vulnerabilities. However, it is worth bearing in mind that the scale of, and the factors underlying, the two worlds may be very different (Born and Vendrell-Simón, 2022). As a result, the form, speed and depth with which they manifest vary depending on the scenario, as does the authorities' ability to limit its risks and harness its benefits.

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9 In practice, this process is gradual, as there are still DEXs that use both online and offline order books (where the blockchain is only used for settlement).

10 For an exhaustive analysis of the different mechanisms available, see Mohan (2022).

11 Specifically, the native tokens of the blockchains underlying the DeFi protocols.

12 In reality, this function is performed by delegation, as the tokens are allocated to an agent that has the technical skills but not the financial muscle needed to carry out this process.

Category	Potential triggers	Examples
Operational	Concentration of providers	Bonq protocol (BonqDAO)
	Interdependencies	Wormhole bridge
	Erroneous or malicious codes	Wintermute
	Scalability	
	Cyber threats	
	Infrastructure stability and scalability	
	Composability	
Financial	Maturity transformation	Terra/Luna
	Excessive leveraging	Celsius
	Automatic settlements	
	High volatility	
	Procyclicality	
Governance	Concentration of tokens	Beanstalk
	Scant participation	
	Administrative privileges	
	Forks in the network	
Conduct	Market manipulation	FTX
	Fraud	Mango Markets
	Lack of transparency	
	Ambiguous, biased, partial advertising, etc.	
	Absence of claim mechanisms	
	Disproportionate validation costs	
Legal	Breach of applicable regulation	Ooki DAO
	Changes to regulatory framework	
	Regulatory arbitrage	
	Limitations of smart contract clauses	
Financial system integrity	Pseudonymity	Tornado Cash
	Ransomware	Blender.io
	Mixers	
	Chain-hopping	
Other	Interconnections with the financial system	
	Environmental footprint	
	Reliability of third-party information	

SOURCE: Devised by authors (2023).

As regards the potential benefits, DeFi users see boundless opportunities. They point to, for example, the possibility of facilitating access to financial services, reducing the cost of such services and increasing competition. They also emphasise its potential for improving operational resilience, boosting transparency and preventing arbitrary government interference. However, the reality is different, as these promises are often limited in scope, but the associated risks are significant (see Table 1).

Operating risks are perhaps the most evident, whether due to the specificities of the technology or because of governance model weaknesses. For instance, because DeFi is based on combining

different components of the ecosystem to create value, it entails a higher number of interconnections and, therefore, greater complexity (Meegan and Koens, 2021). This also increases the likelihood of all manner of incidents (including those derived from cyber threats), testing resilience and potentially amplifying their repercussions.

Added to this, among other matters, are performance limitations that cause network congestion, increase costs and constrain potential business developments, as well as creating asymmetries between participants. Further, the lack of generally adopted good coding practices, regular security audits or just network supervision undermines the efficacy of software component production, maintenance and evolution. Such problems are exacerbated in smart contracts, bridges and oracles, and distort the normal and impartial functioning of the markets.

The financial risks are also significant. These relate to factors that are already known within the traditional financial sector, such as conflicts of interest, the potential for price manipulation, excessive leveraging, etc., all of which contributed to the recent collapse in the sector. Moreover, the DeFI system has several automatisms that cause crises to accelerate and become amplified in a short period of time.[13]

In other words, the existence of automated actions makes the prices of the underlying assets more volatile, and ultimately exacerbates the tensions that arise naturally. Given the endogenous nature of the DeFi universe (Aramonte, Wenqian and Schrimpf, 2021), the foregoing can also have systemic consequences within the ecosystem itself. Owing to the high degree of leverage involved and the lack of shock absorbers, such consequences are, a priori, unpredictable in terms of their scope, and can, for instance, lead to trading being temporarily suspended in emergency cases, as occurs in some centralised markets.

Governance is also another major Achilles' heel for the ecosystem. The promises of what, in principle, should be an equitable and disintermediated, consensus-based management system stand in contrast to reality. For example, it is not uncommon for a small number of agents to hold the bulk of governance tokens, either due to market dynamics or as a result of abusing certain operational practices (flash loans)[14] (Barbereau, Smethurst, Papageorgiou, Sedlmeir and Fridgen, 2023).

In other instances, on the pretext of greater efficiency, critical aspects are decided by a small number of agents (founders, developers, etc.), without investors necessarily being aware. These agents sometimes even hold the right to veto certain agreements, supposedly to maintain the project's original purposes. Something similar occurs with those that hold the administrator keys, as they are able to change the operating rules without any further ex ante control (Flinche, Uri and Vileyn, 2023).

Moreover, the lack of explicit regulation erodes investor protection. DeFi facilitates consumer access to complex products and services without simultaneously offering safeguard mechanisms

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13 Such as closing open positions in a lending protocol and settling the associated collateral.

14 A type of loan within the DeFi ecosystem that enables borrowers to temporarily obtain liquidity with no need for collateral. A chain of actions is programmed in such a way that they are all ultimately completed with repayment of the amount in the same transaction.

equivalent to those available for traditional finance. Individuals can take significant decisions for their wealth without having sufficient information to understand the nature and characteristics of the associated risks. Decentralisation also makes it difficult to have a legitimate authority for making possible complaints and claims.

Another source of concern is conduct that is dishonest or, as a minimum, not aligned with client interests. For example, some communications to clients offer partial, if not downright deceptive, information of the products. Similarly, there have been cases of assets linked to protocols being misused, not to mention the insufficient quality or coverage of stablecoin reserves. The existence of opaque links between players that perform complementary functions (e.g. token issuers and exchange platforms) is also the cause of numerous conflicts of interest.

Lastly, the DeFi environment is also prone to market manipulation and fraud. One of the most notable examples of such behaviour is maximum extractable value,[15] which entails deliberately altering the validation sequence for pending transactions so as to generate artificial arbitrage opportunities. This practice can occur in many ways, and takes advantage of access to insider information, triggers price movements and, for certain counterparties, imposes an extra cost (Auer, Frost and Vidal-Pastor, 2022).

Many other criminal behaviours have the same effect, such as wash trading, which seeks to create a false impression of market activity, and pump and dump schemes, which take advantage of false or misleading information and fear of missing out, to inflate market growth expectations and create a speculative bubble. A third example would be rug pulls, in which a project developer launches a token, attracts investors and defrauds them by taking all the liquidity, resulting in the near total loss of the token's value.

As can be seen, the list of risks is long and extends to other equally important aspects too broad to be covered in this article.[16]

Conclusion

DeFi is and will continue to be an emerging phenomenon. However, as the recent crisis has shown, it presents significant structural weaknesses, and has the capacity to destabilise the other ecosystems to which it is linked.

Although most regulatory initiatives today address more traditional crypto-assets, the concern surrounding DeFi is continuously growing. Authorities across the world are in the midst of a lively debate about the best regulatory and/or public policy measures to ensure proper oversight of this activity and contain its potential risks (European Systemic Risk Board, 2023).

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15 Previously known as "miner extractable value".

16 For example, those deriving from possible changes in legislation, from the environmental impact or from breaches of financial system integrity.

In general, the starting point for all these approaches is an in-depth understanding of how the production and distribution chain for DeFi products and services is organised, so as to ultimately propose a combination of proportionate and effective action that takes into account the specific features of the sector.

In this context, the discussions address several aspects, such as distinguishing the existing points of centralisation in this environment and identifying those agents involved as potential targets for requirements and supervision. For example, agents that influence or control the functioning of the ecosystem or that act as gatekeepers for a majority of users.

Other proposals would complement such measures. These include establishing voluntary or mandatory certification frameworks for products or technological components that are essential to the DeFi universe (e.g. smart contracts, oracles), implementing regular technical audits, prescribing – and even bringing under public management – certain base infrastructures, and potentially writing instructions into the protocol code to facilitate automatic reporting to the authorities (embedded supervision).

In sum, DeFi represents the next frontier in the field of international regulatory activity for the financial sector.

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