

DeFi: Decentralized Finance - An Introduction and Overview

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Abstract

DeFi, short for decentralized finance, is a new paradigm that enjoys increasing popularity in the financial world. DeFi posits that financial services should not rely on centralized intermediaries but should be provided by users for users. This is done by deploying software components to a decentralized peer-to-peer system which is grounded on blockchain technology. This introductory text discusses the origins of DeFi and delineates DeFi characteristics from those of traditional finance. Several examples of DeFi applications are given, the disadvantages resulting from this paradigm are discussed, and an outlook is provided.

Keywords: DeFi, Decentralized Finance; Financial Institution; Banking; Credit; Financing; Investment; Insurance; New Technology; Business Organization.

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1 Introduction

Decentralized finance or simply «DeFi» is taking the Fintech domain by storm. In a true open innovation style, it fosters a distributed innovation process that lets knowledge flow across organizational boundaries in a purposefully managed fashion (Chesbrough, Vanhaverbeke, & West, 2014). DeFi is a new paradigm shaping the way how financial services are being created, distributed, and used. It rests on the notion that financial services should not depend on centralized intermediaries such as banks, brokers, stock exchanges or insurers. Instead, financial services should be provided by users for users by deploying software in a decentralized manner throughout a peer-to-peer network, yet without counterparty risk (Schär, 2021). DeFi thus seeks to enable users as individuals to financially interact with each other, let that be through lending-borrowing, asset speculation, diversification, earning returns or obtaining insurance without intermediaries (Chohan, 2021). DeFi can therefore be seen as a natural continuation of the Fintech trajectory that not only permits new and more agile organizations to enter areas that were previously reserved to licensed credit institutions, but these neophytes also deliver a greater diversity of products, more inclusivity, transparency and improved risk management (Mention, 2019).

Two indicators highlight the steep growth that DeFi has already experienced in a rather short period of time (Katona, 2021): First, the market capitalization of DeFi crypto tokens ranges roughly between 60 and 70 billion US-Dollars of which the top five tokens make up roughly half (Coingecko, 2021; CoinMarketCap, 2021; DeFi Market Cap, 2021). Secondly, the total value of crypto assets currently deployed to the DeFi systems is estimated to be 56 billion US-Dollars (DeFi Pulse, 2021).

2 Origins

Almost in a textbook case DeFi exemplifies a phenomenon that Diaz-Rainey, Ibikunle, and Mention (2015, p.277) described after assessing the impact of technology on financial markets, namely that technology “is not only changing existing markets, it is expanding the scope of markets”. The technologies that DeFi is based on push the very scope of the financial services industry itself. In particular, two technologies have an increasingly formative effect on how financial services are created, distributed, and used: automation and blockchain.

The automation of processes in finance has been around for decades (Pardo-Guerra, 2012). Be it standing orders, credit checks or security trading orders, many processes - or at least large parts thereof - are already carried out automatically and largely without human intervention.

The original Bitcoin blockchain as the second precursor of DeFi enables users to send and receive money from each other on a peer-to-peer basis for more than a decade (Nakamoto, 2008). In the meantime, the Ethereum network has expanded this pure transfer functionality to include smart contracts in the blockchain (Wood, 2014). With the help of this programming logic business processes can be carried out devoid of the intervention of intermediaries, leading to the “rise of peer-to-peer financial contracting” (Chen & Bellavitis, 2020, p.6).

The Ethereum protocol is by far the most popular technology used by DeFi proponents (Chohan, 2021) and that is reflected by the value of total capital deployed to the DeFi system or “the total value of crypto-assets locked (TVL) in smart contracts” (Katona, 2021, p.84).

3 Putting DeFi into Practice

What DeFi actually means to the financial world can be illustrated with the help of an exemplified security purchase: In the past, customers first had to establish a business relationship with a bank. Subsequently they would need to contact their bank and place the buy order. The bank in turn placed the order with a broker. The broker then deposits the order with the stock exchange. The broker thus acquired the security for the customer on the stock exchange (Casu, Girardone, & Molyneux, 2006). In this example, which exemplifies the purchase of securities in a highly simplified fashion, three intermediaries were involved: bank, broker, and stock exchange. On the sell side, however, also three intermediaries were involved: bank, broker and - admittedly - the identical exchange. Each of these five intermediaries not only charge the customer for their services but are also potential sources of error throughout the buy and sell process.

The corresponding process in the DeFi world looks as follows: Any customer independent of his or her geographic whereabouts surfs with a smart phone or computer to a so-called “Decentralized Exchange” or “DeX” as these types of DeFi-exchanges are called. There he or she places the purchase order for a digital asset or a «token». Such tokens essentially represent a property title for any type of asset (Schueffel, Groeneweg, & Baldegger, 2019). Smart contracts execute the order as soon as the parameters match the purchase order. As the user is the also the custodian of the assets, the token is transferred directly from the seller’s wallet to the buyer’s wallet. At no point does the token come into the possession of an intermediary. Instead, first the seller is the owner and custodian of the asset and so is the buyer after the trade. What is more, this business transaction is completely anonymous.

4 DeFi Characteristics

The trading example illustrates what is important and what not in the DeFi world: the technology

is important while the intermediary is unimportant. The automation and immutability of the order is important, while the type of product being traded is unimportant.

In addition, those features of DeFi that distinguish it from conventional finance become clear: DeFi is not only automatic but also decentralized, i.e. it runs on the blockchain which is replicated on numerous nodes (Pilkington, 2016). Since the data security of the blockchain is extremely high, this system does not require any trust in a counterparty. It is therefore labelled trustless. In addition, there is no single point of failure in such a decentralized system, i.e. no single point that could cause the system to fail. Conversely, however, this also means that it is autonomous, i.e. there is no party that could censor or subsequently manipulate data in the system, not even governmental authorities. From the afore mentioned characteristics it also follows that DeFi poses a relatively lower counterparty risk to participants than traditional or centralized finance. Furthermore, DeFi is anonymous per se. Anyone can participate in this system without having to identify themselves beforehand. This property makes it accessible, i.e. usable and thus inclusive for billions of people who otherwise have no access to financial services. Furthermore, DeFi is completely transparent - from the underlying software components to data and processes. Since the software is largely open-source, DeFi is also permissionless which means that no user must ask for permission to program DeFi applications. DeFi's open-source base also makes the system highly flexible so that any user can contribute to expanding and improving the network. All things being equal, DeFi is also more secure than conventional systems in finance, since processes must be executed as programmed, for the system cannot be manipulated. The system also derives its security from its transparency and thus eliminates middlemen as source of error.

Finally, DeFi is also unregulated. This necessarily follows from the characteristics mentioned above: If a system is decentralized and anonymous, meaning if there is no central party that can decide who can participate in the system, then no regulatory authority can enforce laws and regulations.

A *ceteris paribus* comparison of the features of traditional financial services and DeFi is provided in the following table:

5 DeFi Examples

Numerous examples exist showing how DeFi principles have been put to action already. When looking at a stylized financial services value chain, it becomes apparent that various fields have been covered already. Figure 1 shows a schematic financial services value chain which is ordered along the degree of complexity of the services delivered.

Examples of how each of these blocks of the value chain can be covered in a DeFi environment are given in the following paragraphs.

5.1 Accounts - Wallets

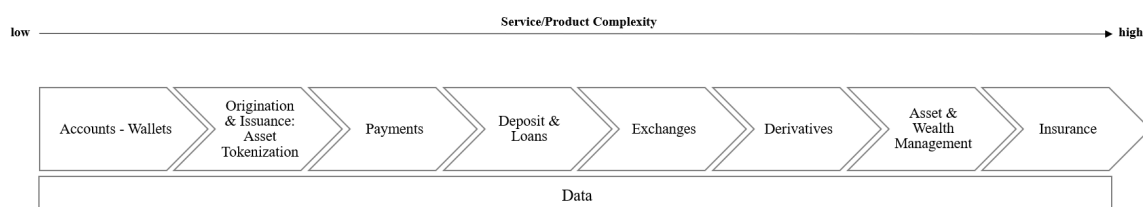
What an account is to the world of conventional finance, an "address" is to the DeFi sphere. It is a digital address where tokens and smart contracts can be transferred to and stored (Schueffel et al., 2019). The owner is in direct possession of the digital assets contained in these addresses. Due to the absence of a custodian this system is denoted as self-custodial. The software to generate and manage addresses is called wallet. These wallets along with the addresses they contain then provide the necessary functionality to receive, hold, and send digital assets (see e.g. Ledger, 2021; Metamask, 2021; MyCrypto, 2021).

Table 1. : A relative comparison of characteristics: DeFi vs. Traditional Finance

Characteristic	Traditional Financial Services	DeFi - Decentralized Finance
Degree of automation	Low	High
Network Structure	Centralised	Decentralized
Self-custodial	No	Yes
Trustless	No	Yes
Technology importance	Low	High
Intermediary importance	High	Low
Costs of service	High	Low
Product Focus	High	Low
Single Point of failure	Yes	No
Counterparty risk	High	Low
Anonymous	No	Yes
Inclusive	No	Yes
Transparent	No	Yes
Open Source	No	Yes
Permissionless	No	Yes
Flexibility	Low	High
Security	Low	High
Regulated	Yes	No

5.2 Origination & Issuance: Asset Tokenization

In order to be able to process securities or goods in a decentralized environment, a digital token must first be created that represents this security or good. This process which is best comparable to origination and issuance activities in traditional banking is called “asset tokenization” or “dematerialization”. It is often decentralized and enables illiquid goods to be traded. From shares in a new venture to barrels of crude oil, from services to diamonds, from cattle to pieces of art – anything can be tokenized and tendered to investors via so called “initial coin offerings” (Salampasis, Pickering, & Klausser, 2020). This also opens up entirely new asset classes for small investors. But even highly liquid assets such as legal tender and stocks can be tokenized and deployed to a decentralized environment as a digital asset (see e.g. AlphaPoint, 2021; Polymath, 2021; Tokeny, 2021).

**Figure 1.** The stylized financial services value chain.

5.3 Payments

The oldest and most prominent example of a DeFi application is the Bitcoin blockchain (Chuen, 2015). Designed as a peer-to-peer payment system, it has become the most widespread system that adheres to the DeFi principle, even though smart contracts were not incorporated as they had not been existing when Satoshi Nakamoto envisioned the network in 2008. In the meantime, various solutions emerged that build on the Ethereum network and smart contracts to enable truly decentralized payment services (see e.g. StablePay, 2021; Wyre, 2021; zkSync, 2021).

5.4 Deposits & Loans

Lending transactions are also offered in the DeFi environment. Transparent protocols enable the borrower to raise funds, while interest and amortization payments are ensured through smart contracts that govern the terms of the loan and the pledged collateral. Deposits of crypto assets can be pooled and interested parties can take parts thereof as a loan. Typically, the depositor receives the deposit back plus an interest which can be of different denomination than the deposit. The process is referred to as yield farming (see e.g. Compound, 2021; Salt, 2021).

Alternatively, pooled deposits can also be used by network participants that contribute to the operations of a blockchain. Such “validators” can make use of these deposits to increase the rewards that they receive for their validating services. In return parts of the rewards for the validation services are shared with the depositor. This process is called “staking” (see e.g. Cake DeFi, 2021).

However, smart contracts even allow for so called flash loans which are loans that are provided and repaid within one single transaction and therefore do not require any collateral. Such loans without counterparty risk allow to seize entirely new business opportunities such as arbitrage in high frequency settings (see e.g. Aave, 2021).

5.5 Exchanges

In addition to payment systems such as Bitcoin, the afore mentioned decentralized exchanges are probably the best-known example of applications in the DeFi world. On these platforms users can trade the previously tokenized goods directly with other users. It is completely secondary which goods are involved here. Moreover, services such as automated market making and trading bots can be directly deployed on those exchanges (see e.g. DDEX, 2021; dYdX, 2021; IDEX, 2021).

5.6 Derivatives

From options to futures and forwards, from swaps to structured products - virtually any conceivable derivative of a financial asset or token can be created in the DeFi environment. Even the most complex term sheets can be hard coded into smart contracts and then be executed as per the contractual parties' agreement (see e.g. FinNexus, 2021; Lien, 2021; Synthetix, 2021).

5.7 Wealth & Asset Management

Until recently assembling a portfolio of tokens or digital assets was a true “ordeal” (Schueffel, 2020, p.137). Now, that wealth and asset management services are offered in the DeFi world, however, the user friendliness has improved considerably. Users can now have their assets managed by third parties, which takes place transparently and automatically and is therefore relatively inexpensive. Here too, smart contracts guarantee property rights. (see e.g. Betoken, 2021; Melon, 2021; Tokensets, 2021).

5.8 Insurance

Since a large number of users can be connected quite easily in a DeFi network, this paradigm is also well suited for problems in the insurance sector. In this way, users can purchase insurance coverage from other users, which is then automatically paid out through smart contracts in the event of a clearly defined claim. Conversely, users who have to pay in the event of damage receive the insurance premium (see e.g. Cover, 2021; Etherisc, 2021; Nexus Mutual, 2021).

5.9 Data

Another field of application for DeFi is the area of data collection and management. Just like payment flows, data is currently still collected and controlled by a small group of dominating intermediaries which at times form cartels of collusive intermediaries (Allen & Gale, 1999). DeFi will enable the democratization of data by transparently incentivizing the procurement and sharing of data and by being able to fairly price the usage accordingly. Moreover, DeFi facilitates not only the collection and dissemination of historic or current data, but also of predictive information (see e.g. Ocean, 2021; Polymarket, 2021; Pulse, 2021).

6 Disadvantages of DeFi

DeFi not only has properties that make it superior to traditional banking and finance, but it also allows for completely new applications. However, systems based on this new paradigm have weaknesses that ought to be addressed as such.

DeFi systems are currently still quite illiquid since only relatively few clients use these systems despite its outstanding growth rates. As a consequence, users are offered for instance less favorable prices on a DeX than on centralized trading platforms. Furthermore, DeFi systems are less scalable than centralized systems due to their peer-to-peer architecture (Chauhan, Malviya, Verma, & Mor, 2018). This sometimes leads to bottlenecks in the network, so-called “network congestions” (Yu et al., 2018), which can massively slow down business processes and render them more expensive (Chen & Bellavitis, 2020). Furthermore, compatibility problems still exist between DeFi platforms that are based on different blockchains. However, incorrectly programmed smart contracts could prove to be the greatest and most fundamental weakness of a DeFi system. If such an integral part of the system is incorrectly programmed and then runs automatically and unstoppably it can have fatal consequences for the entire system. Properties such as automatic, trustless and autonomous, which normally represent strengths, turn into vast disadvantages in the event of a malfunction.

These problems may then be amplified by the fact that no counterparty can be held responsible as the system is anonymous and permissionless (Zetzsche, Arner, & Buckley, 2020). It is even conceivable that perpetrators intentionally use such characteristics to scam credulous investors (Chohan, 2021).

7 Conclusion and Outlook

Undoubtedly Fintech has caused shifts in how “[f]inancial services are perceived, developed, promoted, delivered and consumed” (Mention, 2021). DeFi will further intensify this development as it is bound to introduce a wealth of innovations to the financial services sector. Five DeFi key trends are forming that have the potential to significantly shape the sector and beyond: First, the Ethereum network is being improved as it switches from a proof-of-work to proof-of-stake validation mechanism, rendering it a more efficient and cost-effective platform for DeFi applications. Second,

cross-chain technologies will help to solve the current scalability issues that DeFi experiences as it will offer a widened range of protocols to use and thus further reduce network congestions. Third, stablecoins will play an increasingly important role in the DeFi world as they represent the interface to the traditional world of finance. Hence, it can be expected that we see not only an increase in volume of these tokens, but also more national currencies being tokenized and deployed to the DeFi sphere. Fourth, DeFi is expected to broaden its product scope: non-fungible tokens may soon be used as collateral in a DeFi setting and DeFi may shortly enable gamers to establish markets or even economies in computer game settings. DeFi may spur the creation and transferability of digital assets within and even between games. Fifth, with these improvements in place, it is foreseeable that DeFi will increasingly go mainstream.

Going one step further it is even conceivable that DeFi may lead to the breakthrough of financial concepts of the past that had to be abandoned due bad actors not fulfilling their contractual obligations. A case in point are tontine life insurances which are a blend of lottery and annuities where a group of savers pool their money to buy an investment portfolio and should they die, their stakes are surrendered with the savings being handed over to the remaining survivors (Forman & Sabin, 2014). Weinert and Gründl (2016) established that such tontines could be exceedingly advantageous to policyholders, especially in view of a progressively aging society and the current low-interest environment (Weinert & Gründl, 2016). In the future, the interests of all stakeholders participating in such a pension scheme could be safeguarded within a DeFi setting (Soland & Schueffel, 2021).

Without any doubt, DeFi is currently one of the most talked about topics in the crypto world. With a certain time-lag, it will soon attract the interest of the traditional financial services industry, not at least because it will pose competition to incumbent players and carve into their revenues and profits. DeFi thus highlights what Diaz-Rainey et al. (2015) had previously established: Technology is of paramount importance, yet it cannot be seen in isolation from other effects shaping the world of finance. In case of DeFi this means its permissionless nature ensures a steady flow of entrants, its truly decentralized organizational setup makes it autonomous, flexible and secure, and its anonymous character defies regulation.

It will take a while before the topic reaches the standard end-user or retail banking client. Like any other new technology, DeFi will see advances and setbacks along the way. However, any setback in which small customers lose money will call the regulator into action. Following the findings of Zetzsche et al. (2020, p.203) who concluded that "DeFi can never be total, but at best partial" it is quite possible that we will soon see a division of the DeFi world, into a sub-area that is still unregulated and into a regulated one for those users who want the regulator to provide protection. It is obvious which area will offer the more extensive product range and the greater chances of winning, but which will also involve the greater risks. At that point however, retail DeFi may require a new label.

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