



# Decentralised Finance (DeFi)

ECOM215

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# Summary

In this lecture, we introduce the principles of DeFi and their differences from traditional finance. We also discuss major DeFi protocols and platforms, such as borrowing and lending, exchanges, demand aggregations, and other innovations.

# Contents

1. Centralised Finance
2. Decentralised Finance
3. DeFi protocols
4. A risk for financial stability?

## Centralised Finance (CeFi)

# What is Finance?

Finance is the process that involves the creation, management, and investment of money and financial assets.

- This is typically achieved by managing and hedging risks.
- To this end, finance professionals offer borrowing/lending, insurance, banking, asset and risk management, trading and brokerage services.

By “financial” asset, we mean a non-physical asset whose value is derived from a contractual claim.

- Common examples are bank deposits, stocks, bonds, loans, derivatives, etc.

# Centralised Finance (CeFi)

Intermediary institutions like banks, insurance companies, trusts, and fund management companies are at the core of traditional financial systems.

These entities provide a wide array of services, such as:

- (i) Custody of customers' funds/assets.
- (ii) Serves as counterparty for transactions.
- (iii) Compliance with regulation (onboarding, anti-money-laundering).

The prerequisite is that customers trust the intermediary to operate correctly and securely.

- Customers typically give up their privacy to service providers and do not necessarily understand how the business operates.

# Centralised Finance (CeFi)

Key features of centralised finance (CeFi):

- (i) **Permissioned:** Closed-source system built on top of centralised databases/platforms.
- (ii) **Custodial:** Assets are custodied by licensed third parties.
- (iii) **Governance:** A single entity/body is responsible for governance and strategic decisions.
- (iv) **Trust:** Customers delegate operations to the service providers and trust the latter operate in the customers' interest.
- (v) **Identity:** Users register with real identity, e.g., know-your-customer (KYC) compliance.

# Pros and cons of CeFi

Some of the main advantages of CeFi include *stability* and *security*.

- A central authority controls service providers, and they are subject to regulatory oversight.
- The regulatory oversight often puts stability as a key prerequisite for service providers' operations.

Another advantage of CeFi is accessing a broader range of financial services.

- Traditional financial institutions can often offer a wider range of services, such as loans, credit cards, and investment products, all within a single entity.

# Pros and cons of CeFi



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# Pros and cons of CeFi

However, one of the main disadvantages is the lack of control for users.

- ↪ Traditional service providers are closed-source systems.
- ↪ This can impede users' ability to access and control their assets.

Another disadvantage is the potential for censorship:

- ↪ Transactions can be censored, and assets can be frozen.
- ↪ This could limit users' freedom and ability to access certain services.

Customers have very limited privacy and control over their data.

- ↪ Service providers know the real identity and full account/transactions record.

# The case for decentralisation

One of the best ways to see the potential of decentralisation is to understand today's problems in financial institutions.

There is a considerable number of people who, as of today, still are not granted access to set up a bank account or use financial services.

- Lack of access to financial services can prevent people from employment or starting a business.

A hidden charge of financial services is your freedom and privacy.

- Your money is held by central authorities and governments, which can close down accounts/markets.
- You have to trust companies not to mismanage your money, like lending to risky borrowers.
- Financial activity is tightly coupled with your identity.

# The case for decentralisation

Intermediary institutions need their cut to survive.

- Cross-border transactions can take days to clear and can be expensive.

There is also a series of frictions embedded in traditional financial services.

- Trading hours can be limited to business hours of specific time zones.
- Financial institutions are closed books. As a customer, you cannot ask for their loan history, a record of their managed assets, risk management models, etc.

# Decentralised Finance (DeFi)

# Defining DeFi

Decentralised Finance (DeFi) offers financial services such as borrowing, lending, or investing without relying on a traditional centralised financial intermediary.

- Rooted in blockchain technology, DeFi aims to address privacy and transparency issues in traditional (centralised) financial services.

Key features are:

**Permissionless:** Open-source system built on Blockchain ⇒ anyone can build on top or interoperate without third-party approval.

**Non-custodial:** Assets are not custody by a single third party.

**Trustless:** No single entity is responsible for governance.

**Privacy:** Financial activity is not tied to the individual identity.

# Defining DeFi

A popular view among DeFi's advocates is that decentralisation increases:

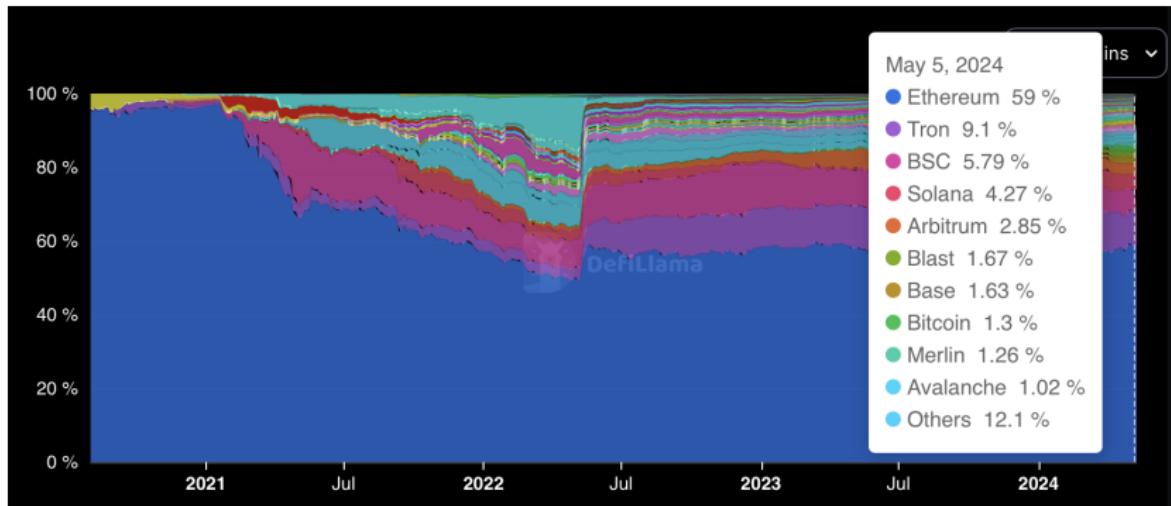
- (i) **Efficiency**: Transfers of funds between accounts happen in minutes, and markets are always open.
- (ii) **Transparency**: You hold your money and directly oversee its spending. Anyone can look at a product's data and inspect how the system works.
- (iii) **Innovation and inclusivity**: Based on open-source software that enables governance models where arbitrary stakeholders interoperate and build upon existing blockchains.

Although there is a clear logic to this, one must not forget that the reality of financial services is complex;

- Intermediaries often have a risk-sharing/smoothing/backstop function which is not easily replicable.

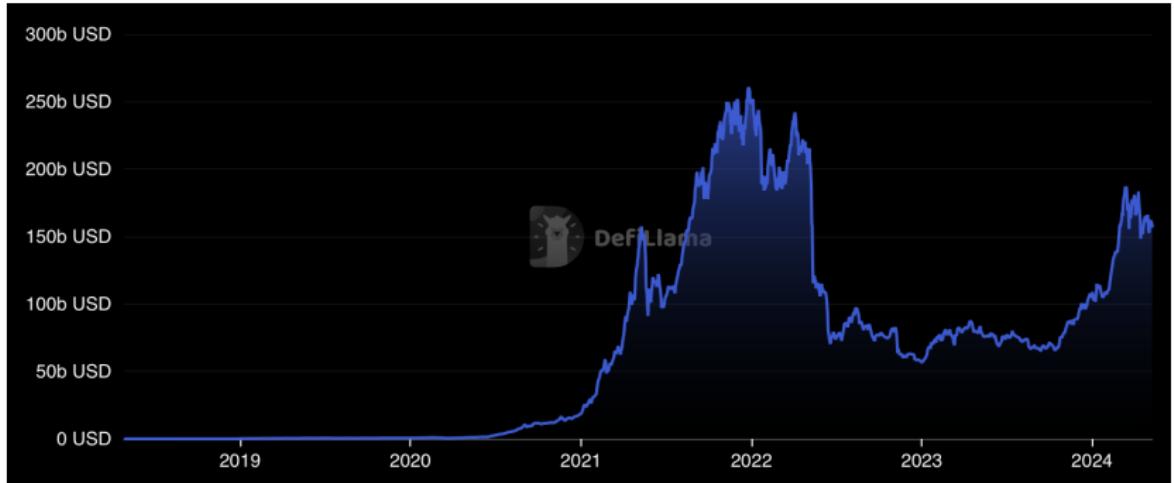
# Defining DeFi

The DeFi ecosystem is built on smart contracts, whose execution is automated, ensuring deterministic outcomes and re-usability.



These programs are then deployed on different blockchains, with most of the total value locked (TVL) concentrated in Ethereum (see Figure source: <https://defillama.com>).

# Defining DeFi



Interest in DeFi rose sharply in 2020 and, during its peak between 2021 and 2022, reached a total value locked (TVL) of approx. 250 billion USD.  
Source: [defillama.com](https://defillama.com).

# Defining DeFi

It is still unclear if and to what extent DeFi will reach widespread adoption and development.

- For e.g., today only about 20% of cryptocurrency trading happens on-chain on decentralised exchanges. The remaining still happens off-chain on centralised exchanges.

There is a lively discussion of whether and how DeFi should be regulated.

- The implications are not obvious. For instance, introducing KYC onboarding reduces the privacy advantage of DeFi vs CeFi.

Nevertheless, conventional wisdom suggests that DeFi represents a relevant development since it harnesses innovative technology that might shape the future of financial services.

# Defining DeFi

The innovation that DeFi brings to financial services can be traced back to three fundamental characteristics:

**Market making:** The algorithmic automation of market clearing might reduce inefficiencies and inventory risks while being transparent to all parties. This also allows users to retain full control over their funds, which are not necessarily deposited with a custodian.

**Competition:** Financial services can combine the functionality of several DeFi protocols to offer novel, complex, and deeply nested financial products without being dependent on a singular intermediary.

**Openness:** DeFi could offer a blueprint of how technology can enable financial openness.

# Defining DeFi

However, DeFi also brings risks.

- The complexity of DeFi products makes the interpretation, evaluation, and assessment of risks increasingly difficult.
- This resembles the “shadow banking” issue pre-great financial crisis, but potentially orders of magnitude more complex.

Recent research has shown how DeFi is subject to risks common to the broader financial system.

- Lending protocols can become insufficiently collateralised or insolvent

Recent events, such as the collapse of Terra's algorithmic stablecoin, also raise questions about the resilience of DeFi applications vs centralised systems.

DeFi protocols

# DeFi protocols

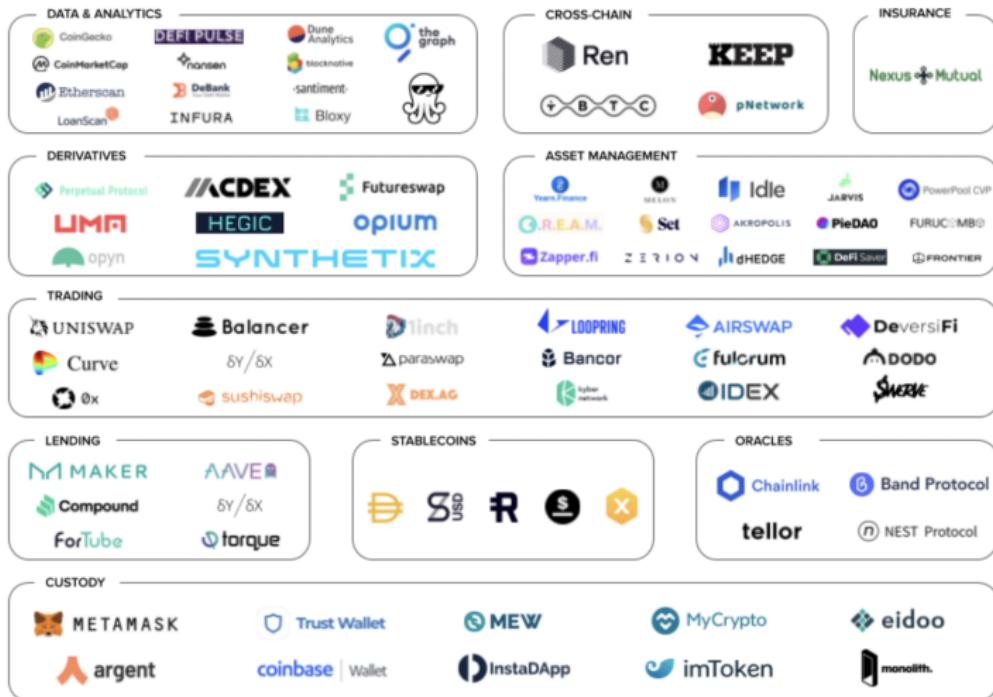
While it is not straightforward to set boundaries between protocols, due to the open-source nature of DeFi, we can identify four main categories that describe the most popular DeFi protocols:

- (1) Decentralised exchanges (DEX), which facilitate the exchange of digital assets.
- (2) Lending protocols allow users to lend and borrow cryptoassets.
- (3) Derivative protocols allow investors to track the value of an underlying crypto- or real-world asset.
- (4) Stablecoins are pegged to the value of a given fiat currency. More on this later in the course.

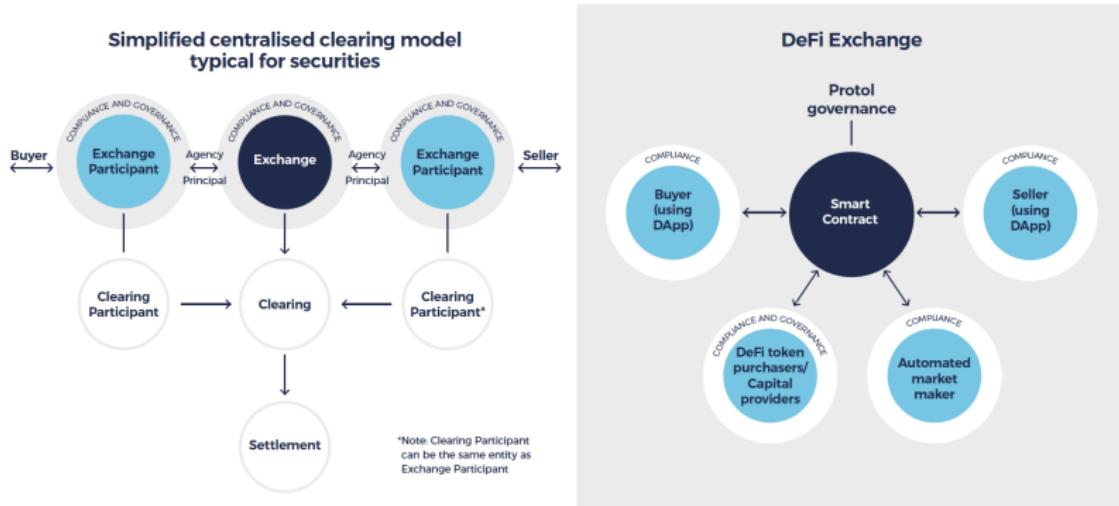
Other protocols include custody, asset management, insurance, and cross-chain interoperability.

# DeFi protocols

## ETHEREUM DeFi Map by Simone Conti



# Decentralised Exchanges



**Figure:** Simplified difference between centralised and decentralised exchanges. Source: Freshfields Bruckhaus Deringer.

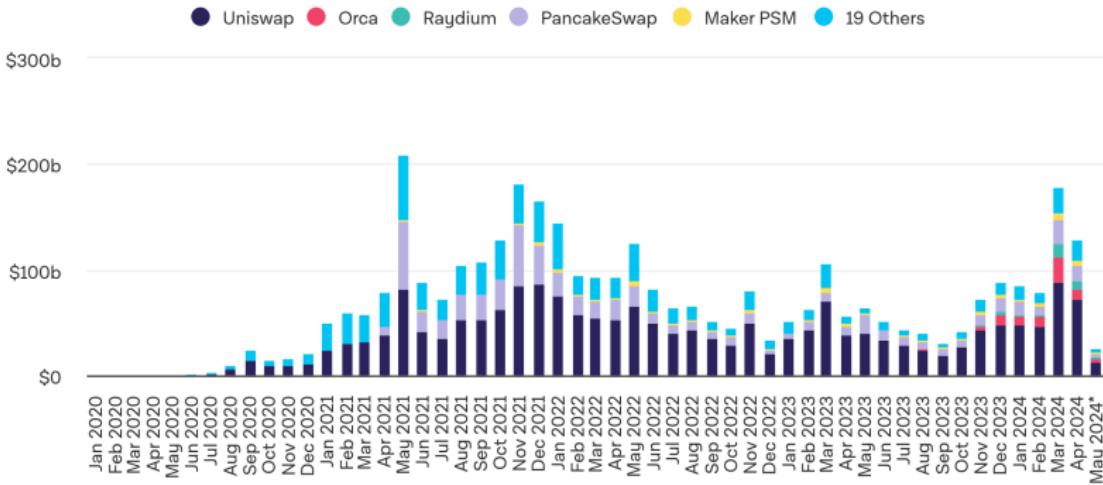
# Decentralised Exchanges

	Centralised Exchange (CEX)	Decentralised Exchange (DEX)
Description	Buyer and sellers connected by an exchange operator trusted to hold funds and match orders.	Peer-to-peer trading (or against a pool). Trust that transactions are automatically execution based on smart contracts.
Asset type	Any type of asset (stocks, commodities, FX, etc).	Assets that are native to or tokenised on a blockchain.
Transaction Processing	Exchanges match buyers and sellers. Order-driven, Quote-driven or brokered markets.	Automated market maker Algorithm that price buy and sell transactions based on orders and liquidity. Traders can contribute to liquidity by locking up funds (market making)
Custody	Traded assets are held by institutional custodians although arrangements vary.	No custody. Although custody-like arrangements can be used where a trader provides market liquidity.
Participants	Practices vary, although usually trading can only be conducted through a broker or other participants	Peer-to-peer trading based on smart contracts to execute trades. anyone can participate
Settlement	Exchanges typically operate post-trade settlement to ensure the transaction is finalised. This occurs over several days.	There is no division between trade and execution. The settlement takes place with the trade.

# DEX vs CEX



## DEX Volume



SOURCES: THE BLOCK, THE GRAPH, COINGECKO

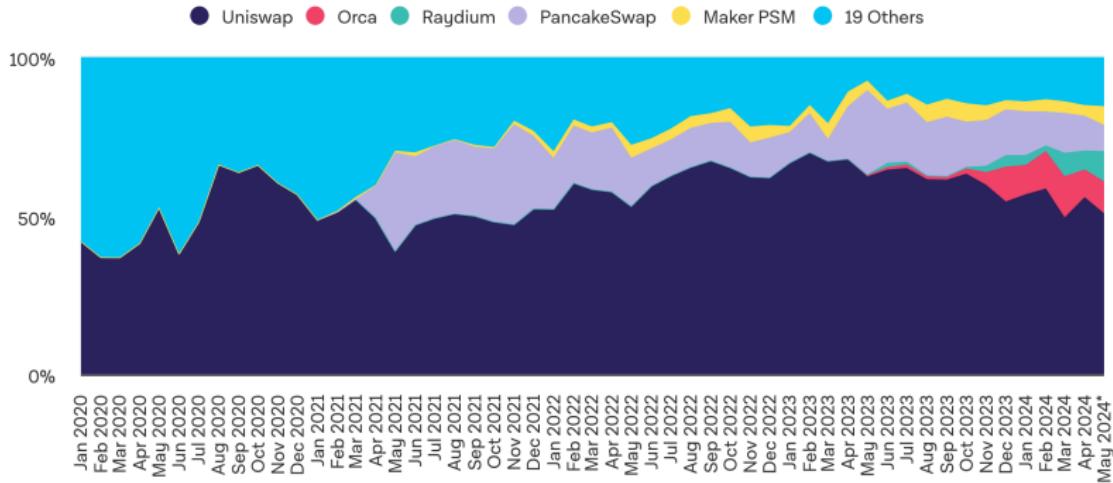
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**Figure:** DEX volume monthly. Source: [www.theblock.co](http://www.theblock.co).

# DEX vs CEX



## Share of DEX Volume

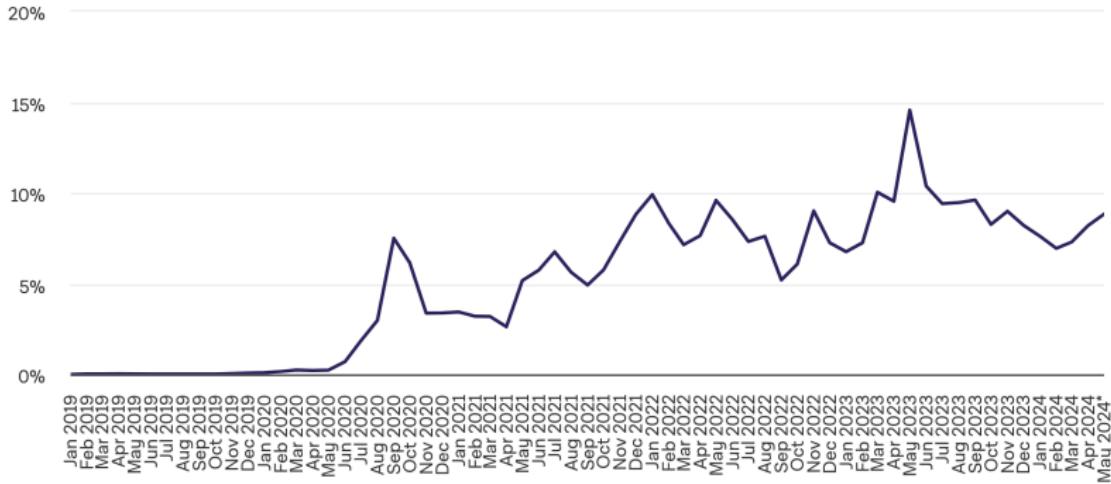


**Figure:** Share of DEX volume monthly across protocols. Source: [www.theblock.co](http://www.theblock.co).

# DEX vs CEX



## DEX to CEX Spot Trade Volume (%)



SOURCES: THE BLOCK, THE GRAPH, COINGECKO

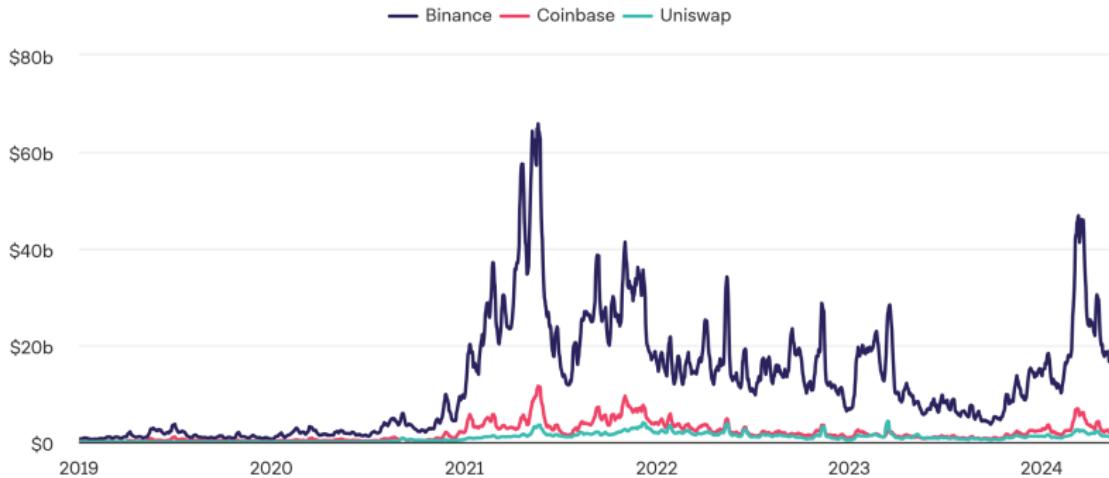
UPDATED: MAY 9, 2024

Figure: DEX to CEX volume monthly. Source: [www.theblock.co](http://www.theblock.co).

# DEX vs CEX



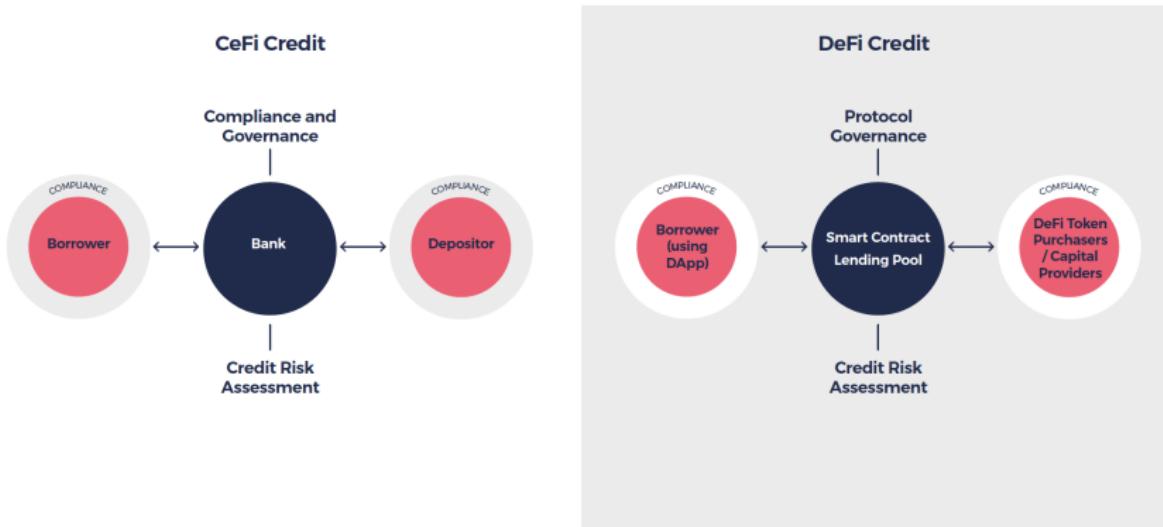
## Uniswap vs. Coinbase and Binance Trade Volume (7DMA)



SOURCE: THE BLOCK  
UPDATED: MAY 9, 2024

**Figure:** Monthly Uniswap vs Binance vs Coinbase volume. Source: [www.theblock.co](http://www.theblock.co).

# Lending protocols



**Figure:** Simplified difference between centralised and decentralised lending. Source: Freshfields Bruckhaus Deringer.

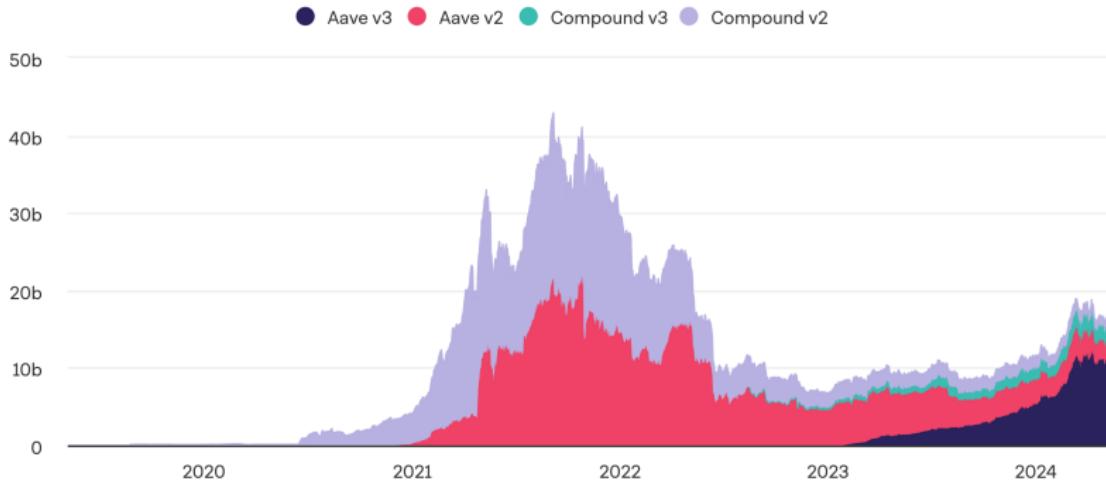
# Lending protocols

	Centralised lending	Decentralised lending
Description	<p>Usually provided by a bank.</p> <p>The bank loans out the money subject to paying an interest, and profits from the net interest margin.</p>	<p>Typically resembles more securities lending.</p> <p>Rather than banks intermediating, DeFi allows anyone to become a lender and generate interest on the loan.</p>
Parties	<p>A typical loan is provided by a single institution, although larger loans are provided by a syndication of lenders.</p>	<p>Lenders contribute to a pool of assets that can be borrowed.</p> <p>The lenders may change from day to day, and to maintain liquidity, it is common for algorithms to set interest rates to match supply and demand.</p>
Credit risk mitigation	<p>The banks makes an assessment as to the borrower's creditworthiness to avoid losses through defaults, and may seek additional collateral</p>	<p>Without an intermediary to conduct credit checks, in most cases borrowers are required to put more collateral than the value of the loan.</p> <p>The collateral is controlled by the protocol so that debt repayment is automatically enforced upon defaulting.</p>

# Ethereum TVL lending



## Ethereum Lending TVL



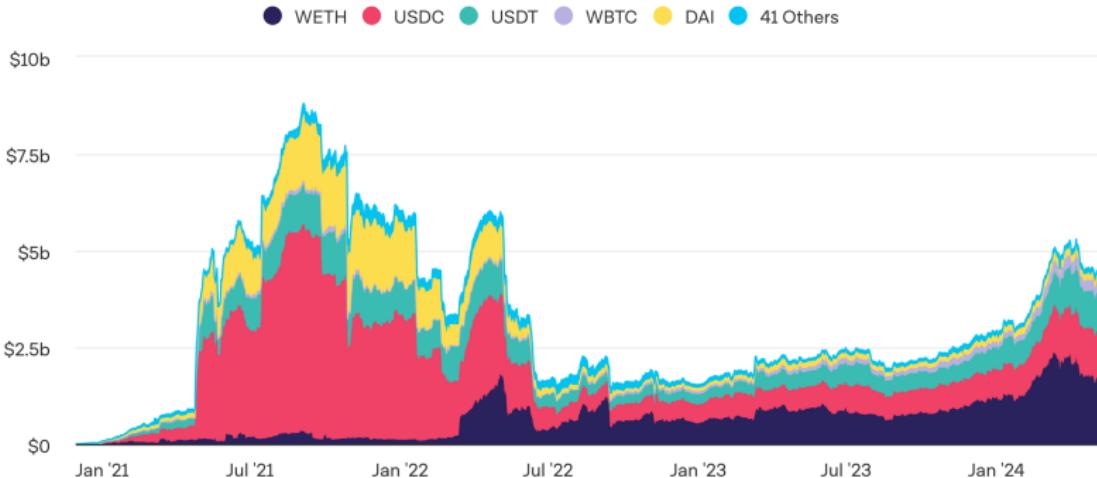
SOURCE: THE BLOCK  
UPDATED: MAY 9, 2024

**Figure:** Total Value Locked in lending protocols on the Ethereum blockchain. Source: [www.theblock.co](http://www.theblock.co).

# A snapshot of outstanding debt



## Aave Outstanding Debt



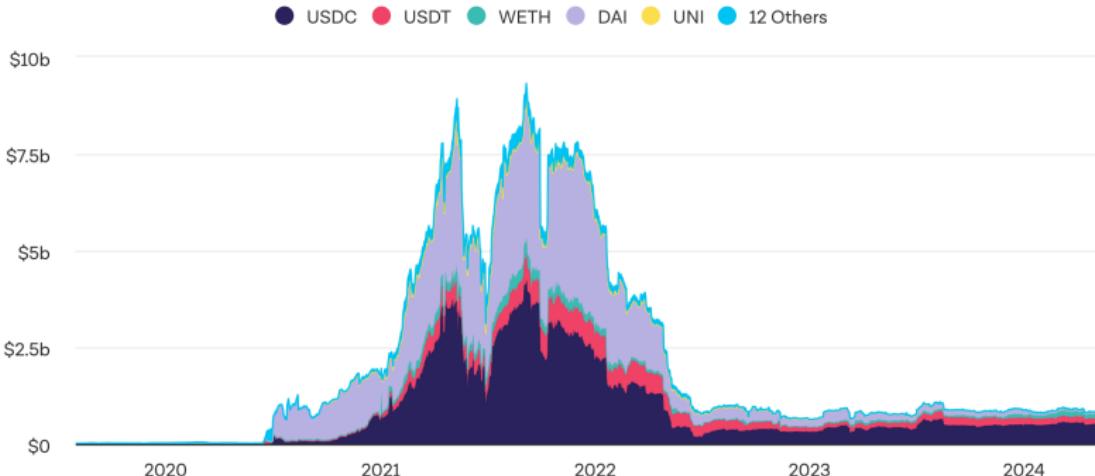
SOURCE: THE BLOCK  
UPDATED: MAY 9, 2024

**Figure:** Aave outstanding debt. Source: [www.theblock.co](http://www.theblock.co).

# A snapshot of outstanding debt



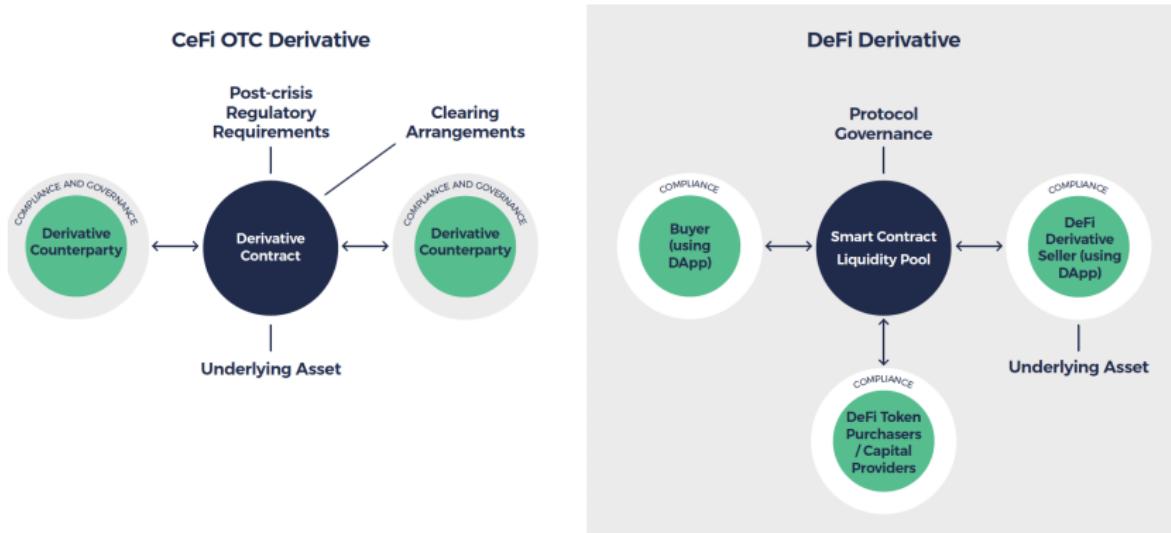
## Compound Outstanding Debt



SOURCE: THE BLOCK  
UPDATED: MAY 9, 2024

**Figure:** Compound outstanding debt. Source: [www.theblock.co](http://www.theblock.co).

# Derivatives protocols

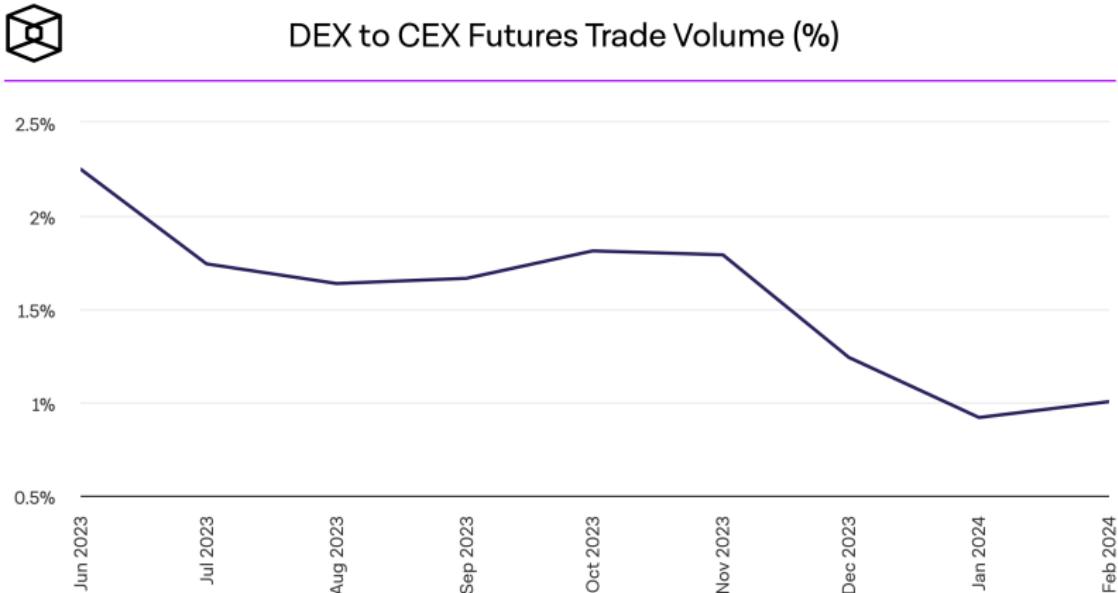


**Figure:** Simplified difference between centralised and decentralised derivative markets.  
Source: Freshfields Bruckhaus Deringer.

# Derivatives protocols

	CeFi derivatives	DeFi derivatives
Description	<p>Derivatives are typically contracts between two parties, the value of which are based on an underlying asset or basket</p> <p>Most common derivatives are futures/forwards and option contracts.</p>	<p>DeFi derivatives can be programmed and composed into any configuration.</p> <p>Popular contracts are synthetic assets that mimick stocks or other assets.</p> <p>Specific to DeFi are the perpetual futures.</p>
Underlying Assets	<p>Common underlying instruments include: bonds, commodities, currency pairs, interest rates, market indexes, and stocks.</p>	<p>DeFi derivatives can be programmed to provide synthetic exposure to the same assets as CeFi derivatives.</p> <p>However, DeFi derivatives typically have other digital assets are underlying.</p>
Parties	<p>Derivative contracts can be entered into by anyone, and many derivatives are traded over-the-counter. However, there is also a large centralised markets where standardised contracts are traded.</p>	<p>DeFi protocols have been used to allow anyone to create a synthetic asset that tracks the value of underlying assets, including crypto assets, fiat currencies, and commodities.</p>
Risk Management	<p>Since the 2008 financial crisis, derivatives markets have been subject to more regulation intended to reduce the systemic risk induced by an oversized derivatives market.</p> <p>This regulation usually involves higher margin and tighter capital requirements.</p>	<p>There is currently a lack of regulation for DeFi derivatives.</p> <p>It is not fully clear what regulation should look like, especially in terms of risk management.</p>

# DEX vs CEX derivatives trading



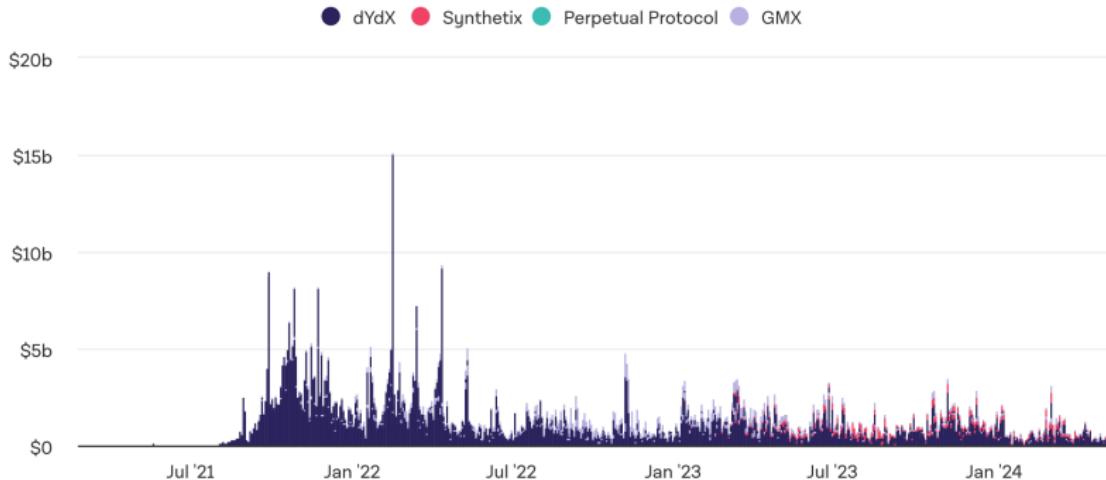
SOURCES: THE BLOCK, COINGECKO, GMX, THE GRAPH  
UPDATED: MAY 9, 2024

**Figure:** DEX vs CEX perpetual futures trading volume. Source: [www.theblock.co](http://www.theblock.co).

# DEX derivatives trading across protocols



## Perpetual Swaps Trade Volume



SOURCES: THE BLOCK, COINGECKO, THE GRAPH, GMX

UPDATED: MAY 9, 2024

Figure: DEX perpetual futures trading volume across major protocols. Source: [www.theblock.co](http://www.theblock.co).

A risk for financial stability?

# A risk for financial stability?

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## Crypto's Unregulated DeFi Boom Raises Shadow Banking Comparisons

- American's Allen says DeFi endangers broader financial system
- Biden executive order emphasized support for crypto innovation

By Olga Kharif

17 March 2022, 17:40 CET

From **Crypto**

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# A risk for financial stability?

While DeFi is still at an early stage, it offers services that are similar to those provided by traditional finance and suffers from familiar vulnerabilities.

The basic mechanisms giving rise to these vulnerabilities – leverage, liquidity mismatches and their interaction through profit-seeking and risk-management practices – are all well-known from traditional financial systems.

The relatively obscure nature of DeFi could make them particularly destabilising, though.

- Quantifying the exposure of banks and institutional investors to DeFi is crucial for policymakers and regulators.

# Leverage

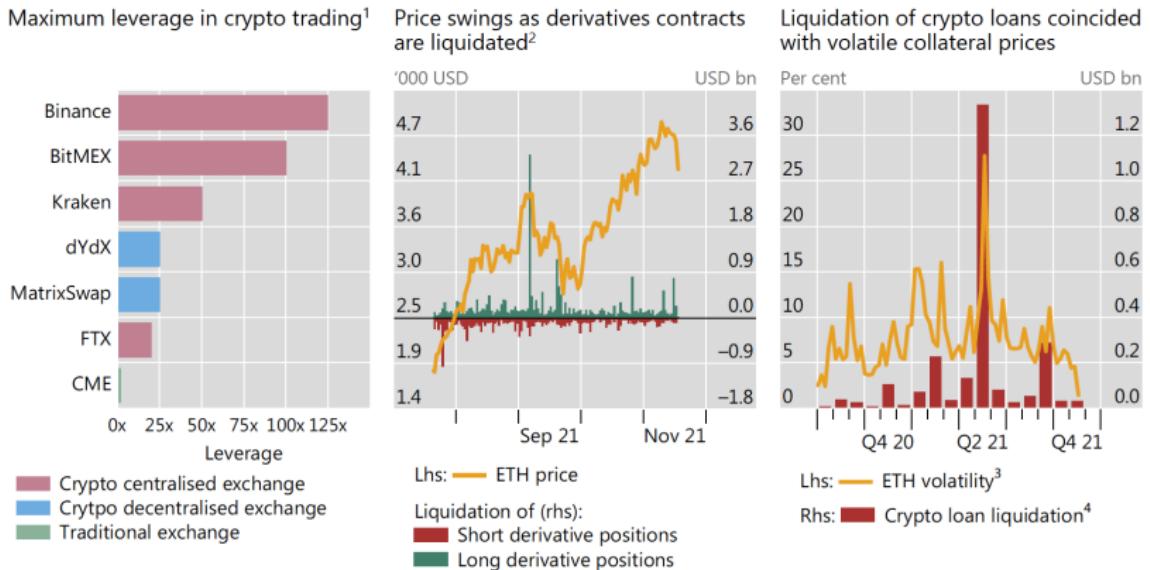
While loans are typically over-collateralised, funds borrowed in one instance can be re-used to serve as collateral in other transactions, allowing investors to build increasingly significant exposure for a given amount of collateral.

Derivatives trading on DEXs also involves leverage; the latter is usually higher than in traditional financial markets.

Higher leverage exacerbates volatility and procyclicality. When debt eventually has to be repaid, investors liquidate their assets, putting downward pressure on prices.

- The downward pressure can be huge for highly illiquid assets.

# Leverage



**Figure:** Leverage and procyclicality in crypto markets as of 2021. Source: Aramonte et al. (2021), “DeFi risks and the decentralisation illusion”.

# A risk for financial stability?

While DeFi is largely separate from the traditional financial system, connections could increase.

- This would raise the potential for spillovers.
- Spillovers would stem from linkages through both the asset and the liability side of banks and the activities of non-bank institutions.

A conservative regulatory approach has, to a larger extent, restricted banks' participation in digital assets.

- On the assets side, banks' exposure is rather limited.
- On the liability side, some banks could receive funding from DeFi, especially via stablecoins.

# A risk for financial stability?

Commercial Banks provide the natural starting point to assess the risks for financial stability.

Such exposure could arise from both direct and indirect linkages.

→ E.g., intermediation, custodian services, market clearing, lending.

There is currently only scattered data on the extent to which commercial banks are exposed to cryptocurrency investments.

# A risk for financial stability?

One exception is the Basel Committee on Banking Supervision (BCBS), which monitors the exposure of major banks to cryptocurrency markets half-yearly.

- ↪ 26 jurisdictions participate in the BCBS monitoring.
- ↪ 178 banks, of which 112 “Group 1” banks (27 systemically important) and 66 “Group 2” banks.
  - ↪ E.g., Group 1 = More than EUR 3bn of Tier 1 capital.

Results are as of Q42020.

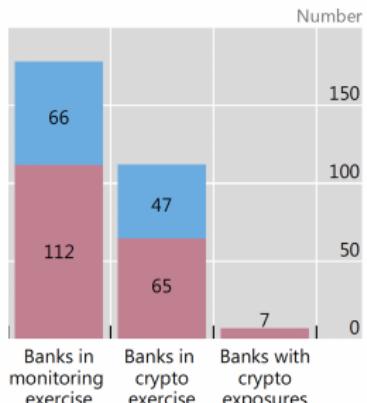
# A risk for financial stability?

## Bank holdings of cryptocurrency

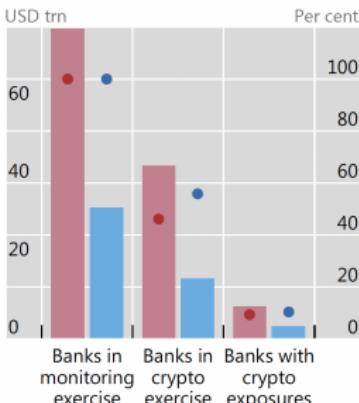
As of Q4 2020

Graph 3

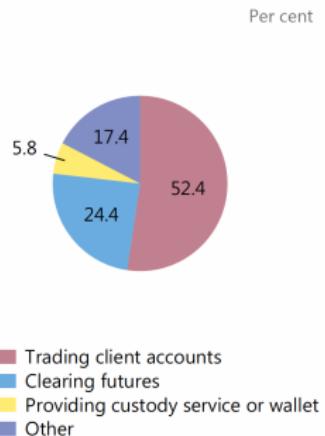
Number of surveyed banks



Size of surveyed banks<sup>1</sup>



Exposures by banking activity<sup>2</sup>



Major internationally-active banks (Group 1)<sup>3</sup>

Other banks (Group 2)

Total exposures LHS

RWAs LHS

Exposures (%) RHS<sup>4</sup>

RWA (%) RHS

Source: Auer et al. (2022), BIS Working papers.

# A risk for financial stability?

The data suggests that the direct exposure of large international banks to cryptocurrency markets is minimal as of Q42020.

Only seven out of 178 banks participating in the BCBS data collection reportedly have some direct exposure to cryptos. The amount of direct exposure totalled a mere \$188 mln.

The bank's exposures result primarily in client-related activities.

# What did we learn?

Intermediary institutions like banks, insurance companies, trusts, and fund management companies are at the core of traditional financial systems.

- The prerequisite is that customers trust the intermediary to operate correctly and securely.

Decentralised Finance (DeFi) offers financial services such as borrowing, lending, or investing without relying on a traditional centralised financial intermediary.

- Rooted in blockchain technology, DeFi aims to address privacy and transparency issues in traditional (centralised) financial services.

The conventional wisdom suggests that DeFi represents a relevant development since it harnesses innovative technology that might shape the future of financial services.

- However, DeFi brings potential risks, which should be considered.