UNIVERSITY of NICOSIA

Session 1

DeFi Fundamentals

BLOC 611: Introduction to Decentralized Finance

Objectives

- Provide a framework for understanding Decentralized Finance in the context of the history of finance.
- Cover the fundamental features of DeFi and compare and contrast those with traditional finance (TradFi).
- Cover the relationship between DeFi and blockchains, the benefits which DeFi strives for but also the risks involved with the DeFi space in its current (nascent) state.
- Showcase the size and growth rates of the DeFi ecosystem and its constituent elements. Look ahead to associated topics which are covered in later sessions of this course.

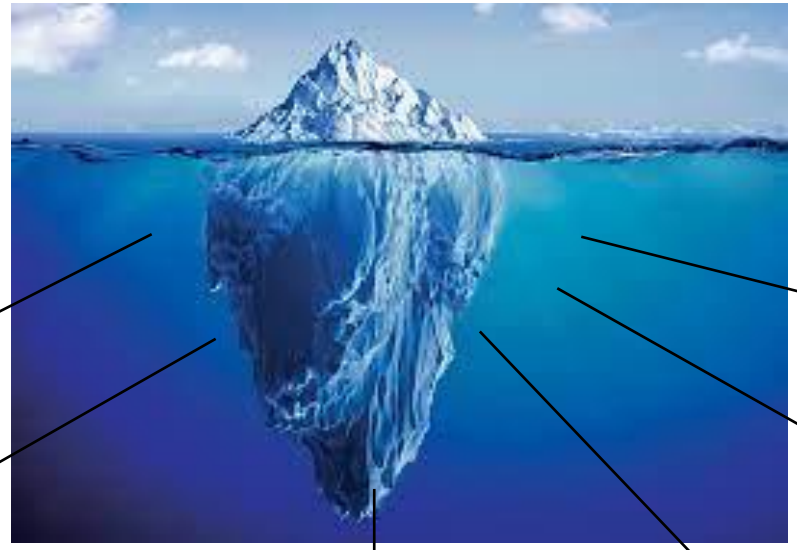
Disclaimer: As usual, the inclusion of any particular blockchain project or organisation is for educational purposes only. This should not be construed as an endorsement or investment advice.

Agenda

1. What is Finance?
2. Characteristics of Finance
3. Decentralized Finance
   - Definitions
   - Benefits and Risks
   - Market size and growth rate
4. Conclusions
5. Further Reading

Scope of DeFi today vs. later in the course: tip of the iceberg

DeFi → ← **Fundamentals**



Not in scope today

- L1 – L2 DeFi stack
- Non-Fungible Tokens (NFTs)
- Stablecoins Lending & Borrowing

But this course will also cover:

- Blockchain Derivatives
- Algorithmic Governance
- Decentralized exchanges

Session 1: DeFi Fundamentals

1. What is Finance?

A Definition of Finance

Finance is a broad term that describes the management of money. It is closely related to economics and encompasses a variety of activities that range from simple to complex.

The **core functions** of finance (all of which are important in today's world) include:

- **Value exchange**: A way of making payments.
- **Intermediation** – The flow of money to productive areas of the economy i.e., transferring resources from savers to borrowers.
- **Risk transfer**: a means for pricing and allocating certain risks. (via insurance policies and derivatives)
- **Liquidity:** A means of converting assets into cash without undue loss of value. (through markets)

Source: Reserve Bank of Australia

A Definition of Finance

Finance as a field can be broken down to specific categories, which include:

- Public finance
- Corporate Finance
- Personal finance

Finance also represents money management and the process of acquiring needed funds by individuals and institutions. In addition, the field of Finance encompasses the oversight, creation, and study of money, banking, credit, investments, assets, and liabilities that make up financial systems.

Source: Investopedia

A Brief history of Finance

Particular realms of finance—such as banking, lending, and investing, of course, money itself—are as old as human civilization.

- Credit was the first form of money according to Graeber - the first known records of debt from Sumer in 3500 BC. See also this review.
- "Banking" originated in the Babylonian/Sumerian empire around 3000 BC, where temples and palaces were used as safe places for the storage of financial assets—grain, cattle, and silver or copper ingots.
- The use of coins as a means of representing money began around 600 BC in the Greek empire.
- From the 6th century BC to the 1st century AD, the ancient Greeks enumerated six different types of loans; personal loans charged interest as high as 48% per month.
- In the Roman empire, interest rates were controlled by law and fluctuated between 0 and 12%.

- *The World Bank also has good information about the evolution of financial systems.*

Finance today

Finance has evolved into an all-encompassing field fueling, taking advantage of the explosive growth of technology.

Measuring the size of the financial sector is hard, yet some key metrics provide an indication of its size, growth, and impact.

- One such key metric is the size of the financial services industry, a major driver of growth in the economy.
- The Financial Services sector includes:
  - the activity of financial firms
  - their professionals, as well as the the goods, accounts, and investments they provide.
  - banks are the foundation of the sector.
- The metrics on the next slide give an indication for the size and importance of the Finance sector globally, in relation to the economic concept of **Gross Domestic Product (GDP).**
- GDP is the total monetary or market value of all the **finished goods** and services produced within a country's borders in a specific time period. As a broad measure of overall domestic production, **it functions as a comprehensive scorecard of a given country's economic health**.

Finance today

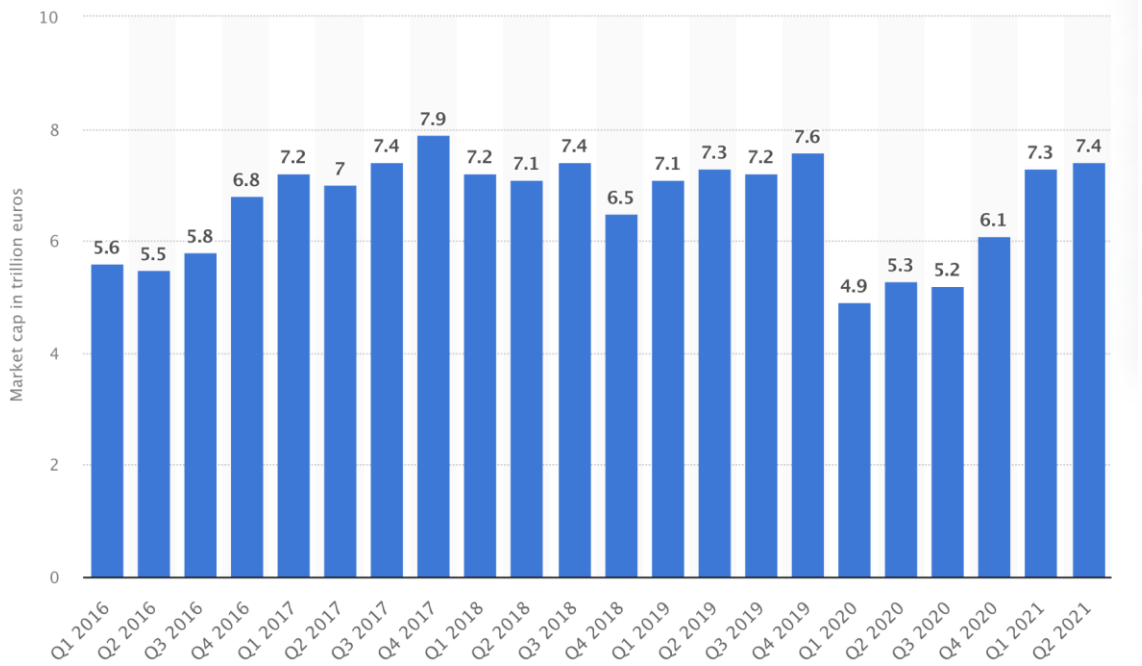
- The global financial services market is expected to grow from **$20.5 trillion in 2020 to $22.5 trillion in 2021** at a compound annual growth rate (CAGR) of 9.9%.
- With global GDP expected to reach $93 trillion in 2021, **the financial services will comprise ~25% of the world's economy.**
- For context, the China and the US account for ~19% and ~16% of the worlds GDP respectively
- The market is expected to grow even further to $28.5 trillion in 2025 at a CAGR of 6%.

- Western Europe was the largest region in the global financial services market, **accounting for 40% of the market in 2020**. North America was the second largest region **accounting for 27% of the global financial services market**. Africa was the smallest region in the global financial services market.
- The global banking sector had an estimated market capitalization of **7.3 trillion euros in the first quarter of 2021, equivalent to $8.58 trillion**.

Source1: Businesswire, Source2: Businesswire, Source3: Statista

Banking sector market cap

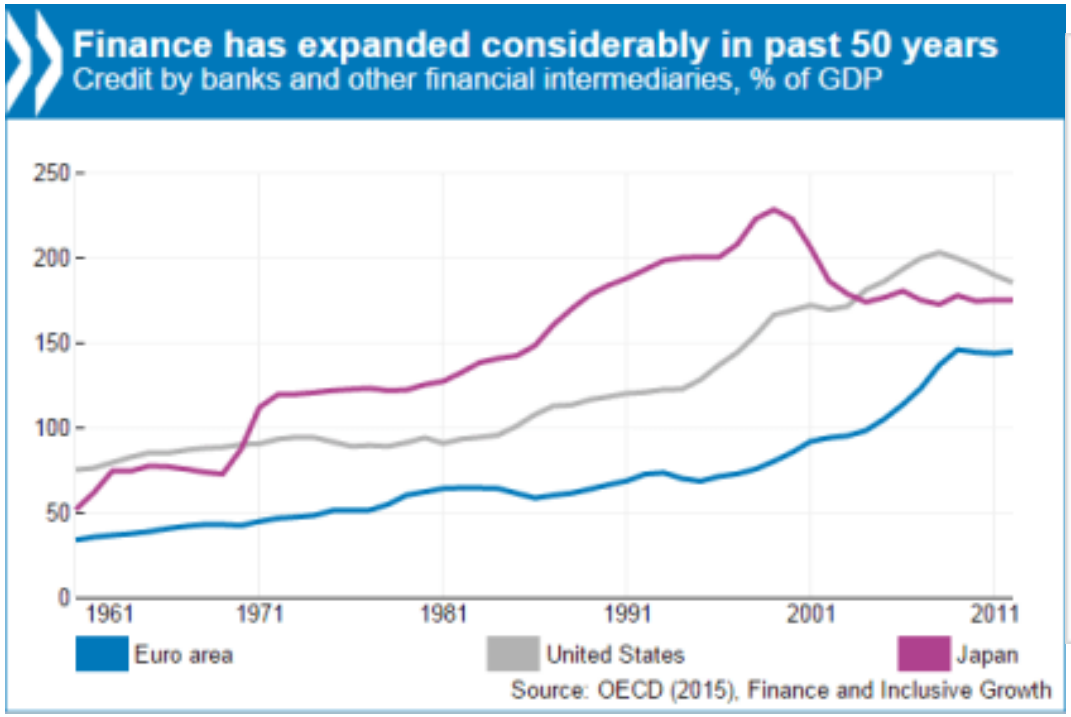
- The total market capitalization of the banking market (globally) is roughly $ 7 trillion USD.
- Whereas global GDP is roughly $85 trillion USD.

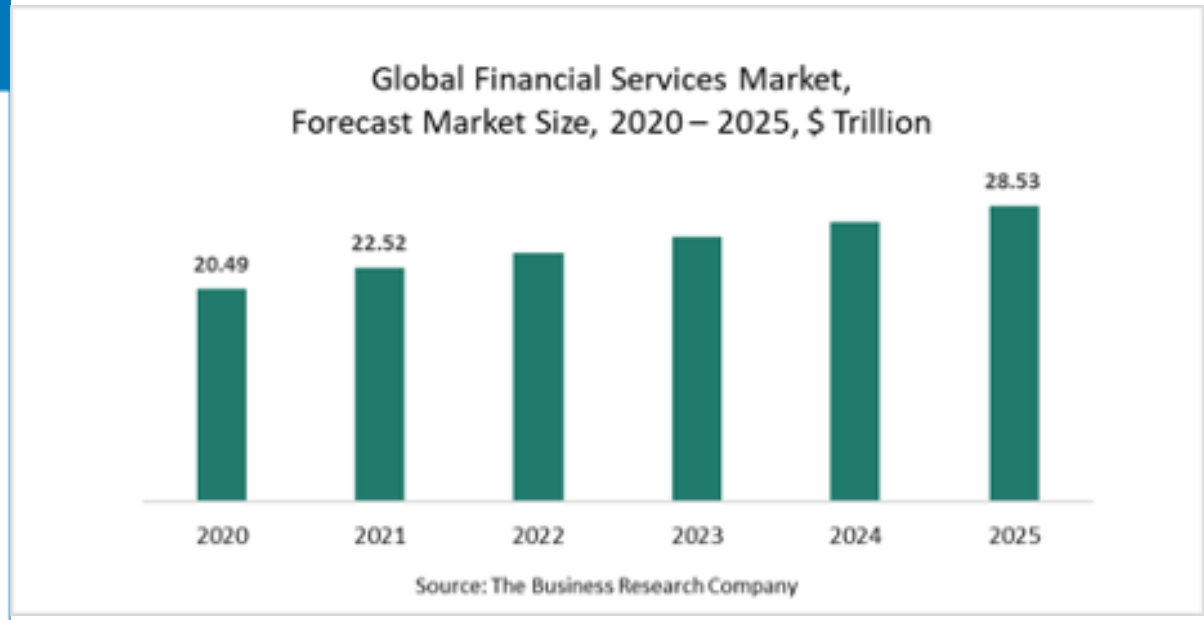


Source: Statista

FED balance sheet

Financial services size and growth





Source: OECD, Business Research Company

Session 1: DeFi Fundamentals

2. Characteristics of Finance

Traditional Finance

In the world of DeFi, the term used to refer to the 'other' (pre-existing) financial services sector is 'TradFi', which is short for 'Traditional Finance', or 'CeFi', short for Centralized Finance.

At the center of TradFi's services and activities lie **centralized** institutions that act as intermediators. The main types of institutions here are central banks, commercial banks, and financial service providers. Their main characteristics are:

- **Centralized** & Trusted entities
- **Custodial** approach (money is entrusted to them for safekeeping and managing)
- **Permissioned** - Only vetted individuals and organizations can participate in the financial system, and user activity is closely tied to identity.

This way of organizing the sector and the services that it provides, comes with some pro's and con's. Arguably, the banking system has been a great boon for commerce. The ability to store value over time, and the ability to trade with untrusted strangers through a trusted intermediary, has for centuries been a driver behind economic growth.

Traditional Finance

These characteristics of TradFi have resulted in several advantages for those able to participate, namely:

- Speed (of transactions)
- Efficiency (save for international transactions and remittances)
- Convenience
- Safety of funds (Central Bank Guaranteeds
- Lower poverty

This, however, the above come with a lot of caveats:
"The global financial system has created massive wealth, but its centralized nature means the spoils have gone to the people who are best connected to the financial centers of the world."

Given parallel trends of population growth (global) and increased tightening of access restrictions (with an aim at excluding malicious actors) a situation has resulted where TradFi is increasingly failing the societies in which it resides. Also, ironically, despite increased anti-money laundering (AML) regulations there are growing numbers of allegations and convictions for large scale money laundering. See for example this link.

Drawbacks of TradFi

- The deficiencies of TradFi are plentiful. Some of the most severe are the following:

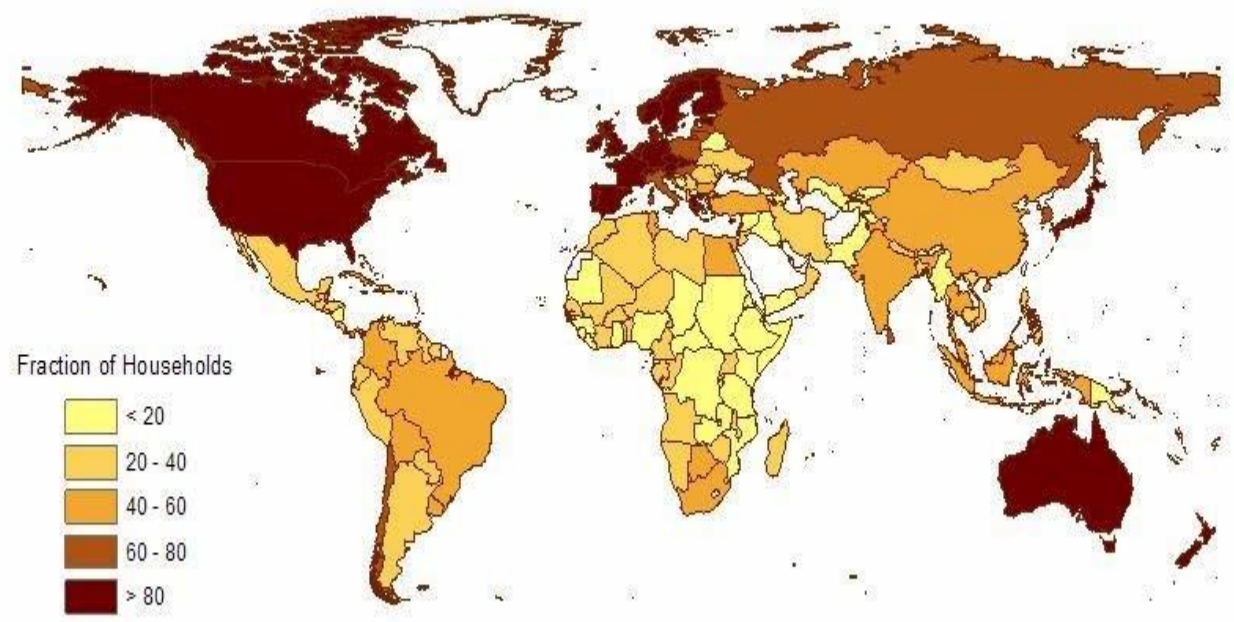
- Financial exclusion for the unbanked – 1.7 billion people have no account at a financial institution or through a mobile money provider. This is 26% of the population in Europe and 5.4% of US households. Sources: FDIC, World Bank, and *

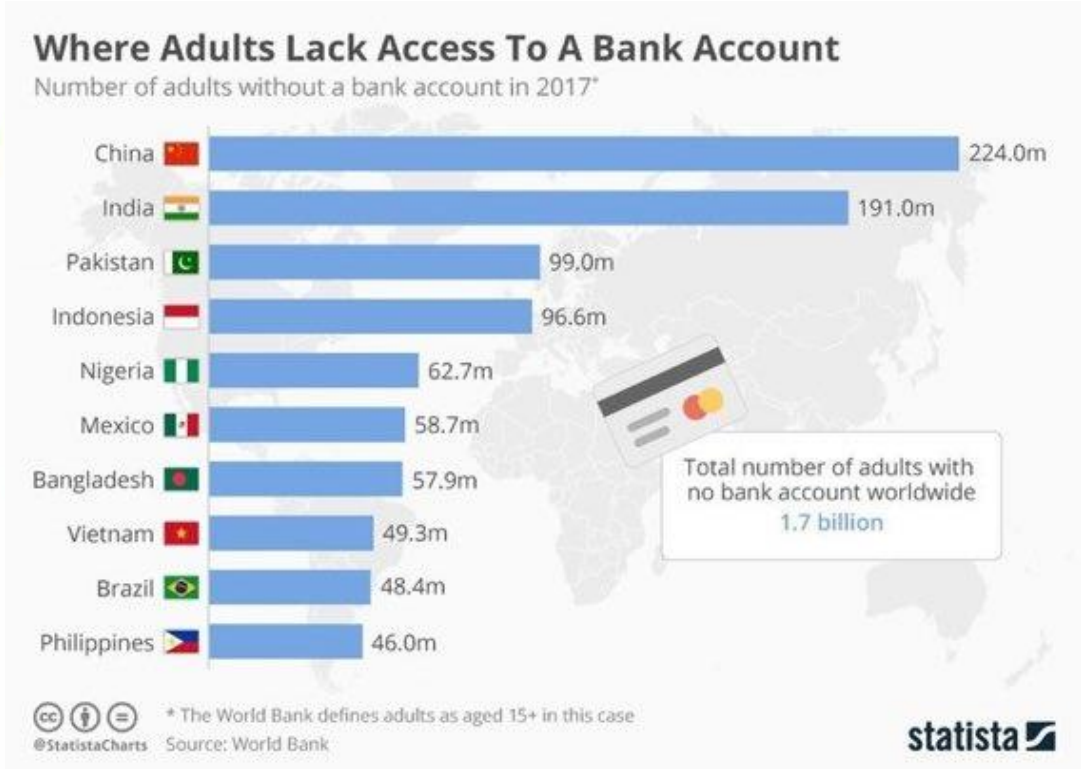
- Lower poverty but wealth inequality – A majority of 70% of the world's population make less than 10k$ per year, and this group collectively controls a mere 2.7% of the world's wealth. Source: Visualcapitalist
  - Even the argument for lower poverty is widely debated, see here for example.

- High intermediary costs and artificially slow speeds - average cost of a remittance is 7.01% in fees per transaction – and when using banks, that rises to 10.53%.

** The Unbanked, Financial Exclusion: (Asli Demirgüç-Kunt et al., 2017) (EC and TNS Opinion & Social., 2016)*

The unbanked

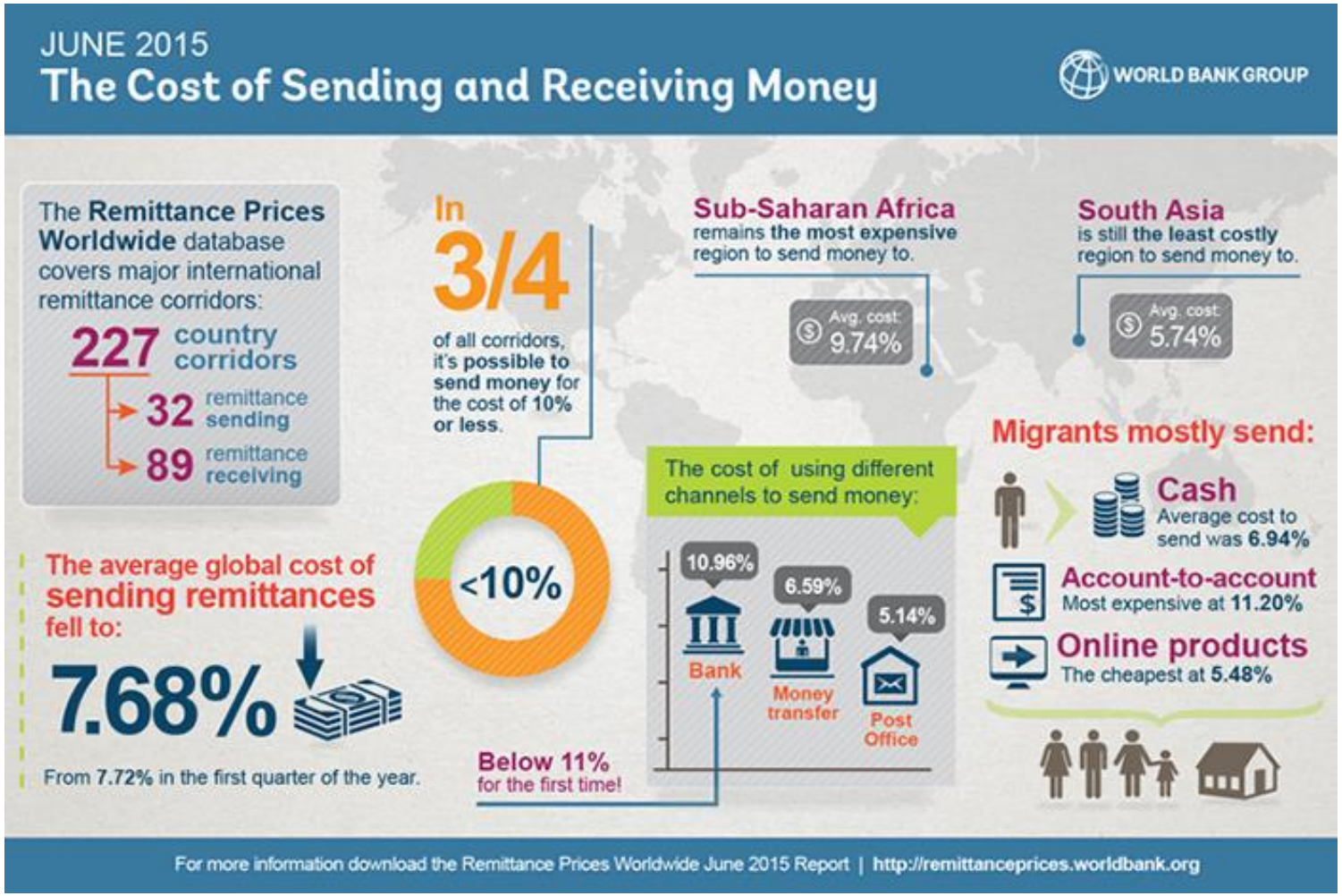




Percentage of households with an account in a financial institution

Source: Researchgate, Statista

The cost of money transfers



Source: World Bank

Drawbacks of TradFi (continued)

- Currency **manipulation** through unbridled money printing– Bloomberg
- **Censorship** – Capital controls and bank runs – the examples of Cyprus and Greece in 2014-2015
- **Lack of transparency** leading to information asymmetry which eventually gets **exploited**, see e.g. the Libor scandal, well covered in the Guardian
- High degree of **centralization** of clearing houses (CCP) which leads to single points of failure and systemic risk. Led to crisis in 1929 and 2008. Lehman brothers. See also the Bank for International Settlements (BIS) and the New York Times on Nasdaq Clearing.

** The Unbanked, Financial Exclusion: (Asli Demirgüç-Kunt et al., 2017) (EC and TNS Opinion & Social., 2016)*

Drawbacks of TradFi (a short story)

Alarmed by the events at Nasdaq Clearing in late 2018, some financial heavyweights recently sounded a 12-page warning. The group included Paul Tucker, a former deputy governor of the Bank of England; Paul A. Volcker, a former chairman of the Federal Reserve; and Sheila C. Bair, a former chairwoman of the Federal Deposit Insurance Corporation.

Central counterparties, they warned, “occupy a position in the financial system that leaves them **too important to fail**.” The lack of a clear plan to cope with a meltdown, the group said, is “one of the biggest gaps in the post-crisis regime for **financial stability**.” The irony here being that institutions like Nasdaq Clearing were supposed to have safeguards in place precisely to prevent another crisis like in 2008.

For more details on the Systemic Risk Council who sounded the warning, and their notable members, as well as the full content of the letter see: Systemic Risk Council.

In all fairness, DeFi also has some issues still with transparency and industry self regulation, recent examples can be found here. The size and scope of those issues is smaller though.

Session 1: Fundamentals of DeFi

3. Decentralized Finance

DeFi defined

- Decentralized Finance (DeFi), has emerged as **a new form of finance**, that leverages **new governance mechanisms** and **technological innovations** to enable fair, inclusive, and robust financial systems that do not rely on central intermediaries, such as banks, brokerages or exchanges.
- DeFi applications **disrupt** the existing financial services industry by allowing people to lend, borrow and trade financial assets without traditional intermediaries, in a **peer-to-peer manner**.
- DeFi is **distinct from Fintech**, as it focuses due to its open, permissionless, and transparent nature.

DeFi is part of the broader ecosystem of blockchain-backed financial innovations which started with Bitcoin's redefining of peer-to-peer payments, and the concept of store of value. Ethereum through smart contracts set the foundations for Decentralized Applications and Finance.

DeFi begun by replicating services found in the traditional financial sector, such as payments, exchanges, borrowing, and lending, but has since then introduced new innovations.

You can find a brief timeline of the DeFi history until early 2021 here.

DeFi defined

DeFi is built on top of decentralized blockchain networks. As such, it inherits the properties of those systems.

A blockchain is a special kind of ledger that uses math and game theory to enable:

- Time stamping
- Immutability
- Auditability

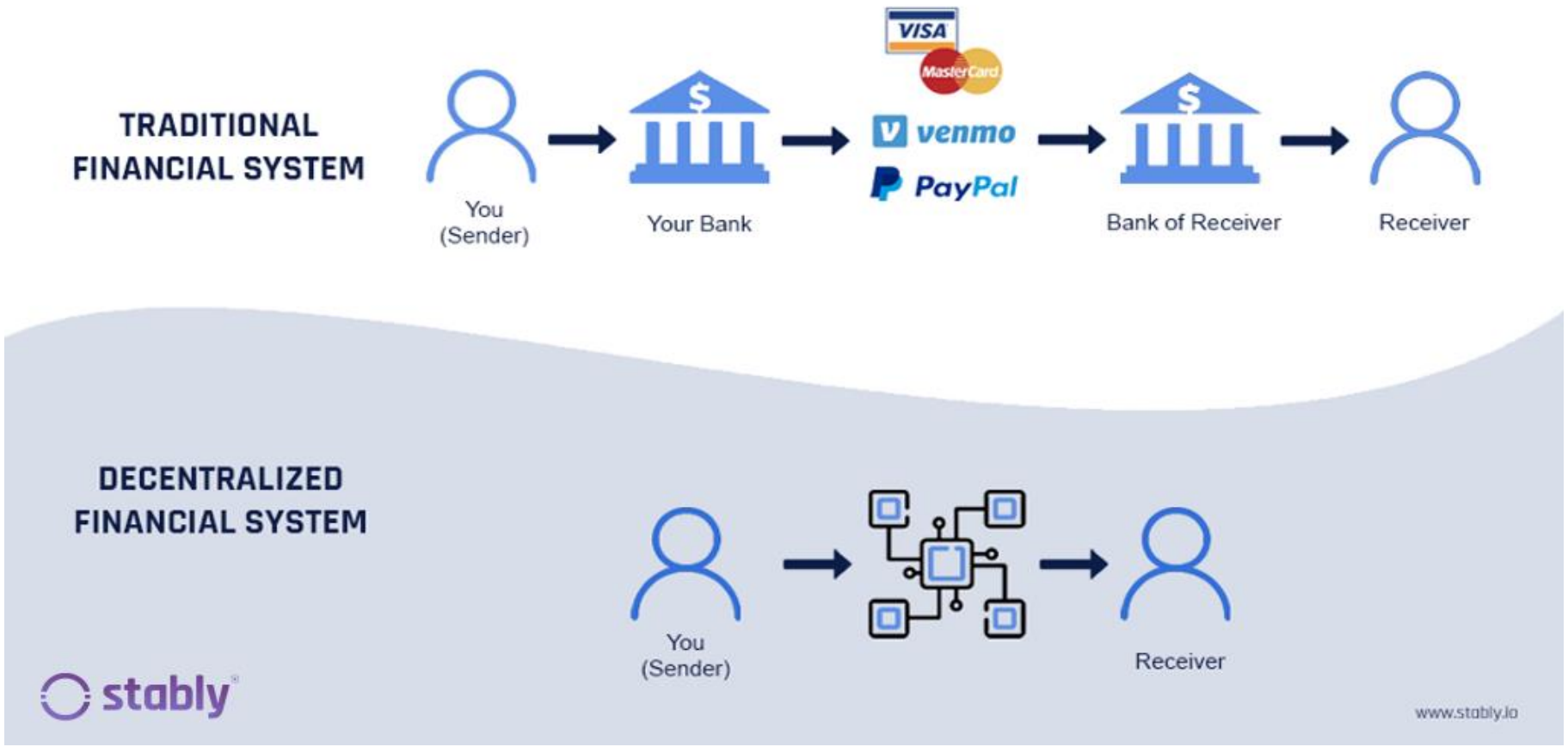
The properties above are important for value storage and transfer.

Short definition: A blockchain is an append-only ledger of transactions grouped into blocks, that is distributed between peers in a way that each participant can verify it on their own. Updating the ledger (usually) requires solving Byzantine Agreements with economically incentivized participation, secured by cryptography.

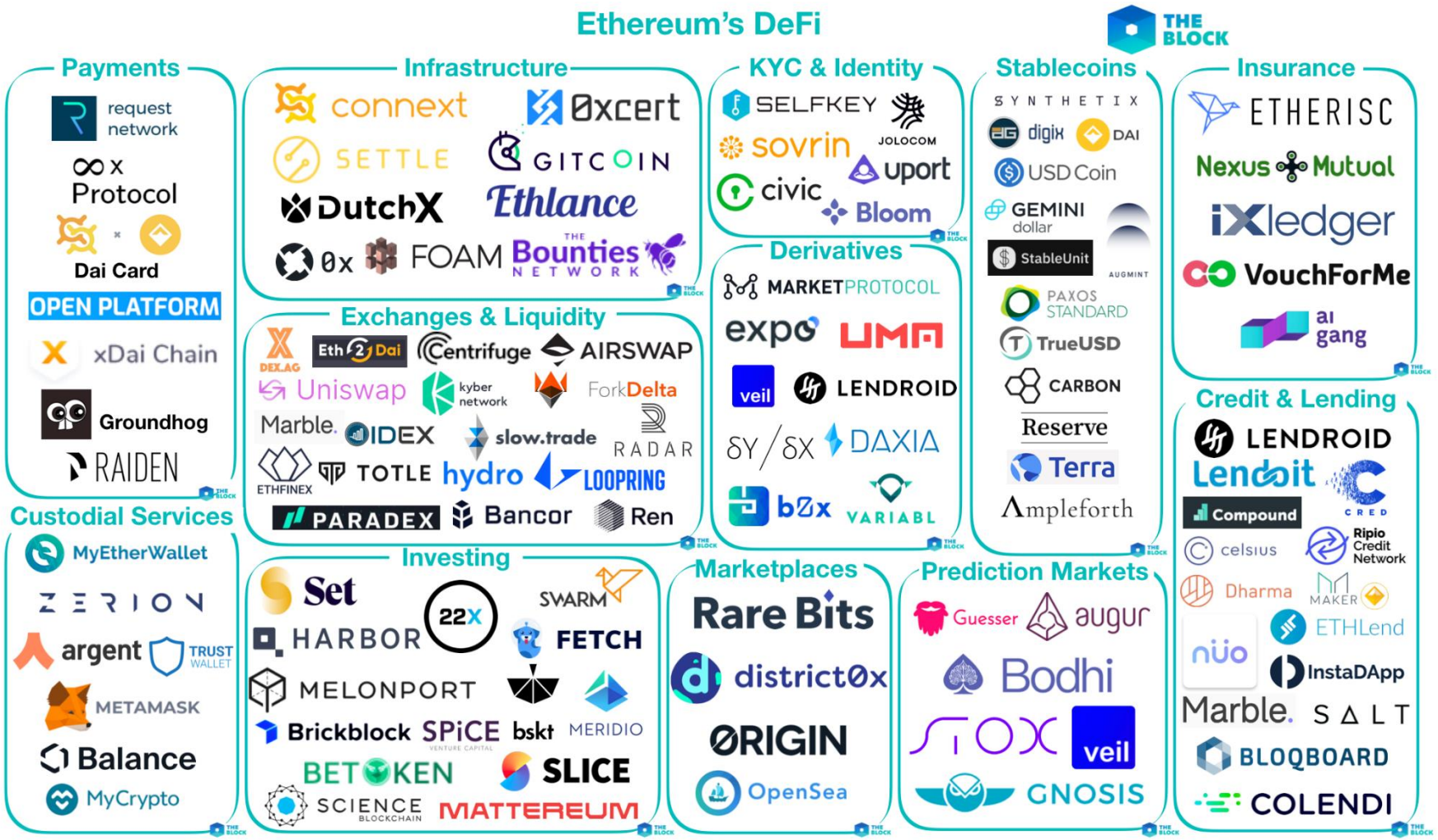
The first application was cryptocurrencies. The natural follow up was decentralised applications, which evolved into decentralised finance applications and the DeFi ecosystem.

For more coverage of blockchain itself and the cryptocurrencies it made possible, refer to our other free MOOC: Introduction to Digital Currencies.

DeFi and Disintermediation



DeFi ecosystem complexity



DeFi characteristics

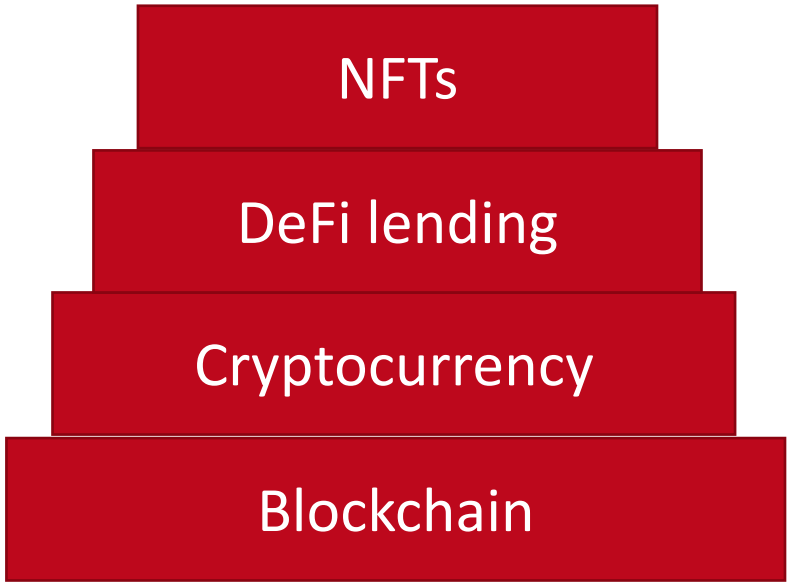
There are six primary features that differentiate public blockchains (on which DeFi runs) from the private networks used by governments and traditional financial institutions:

1. **Permissionless**: Anyone in the world can connect to the network, irrespective of wealth, status, location
2. **Decentralized**: Records are kept simultaneously across thousands of computers *
3. **Trustless**: A central party isn't required to ensure transactions are valid
4. **Transparent**: All transactions are publicly auditable, and immutable
5. **Censorship Resistant**: A central party cannot invalidate user transactions
6. **Programmable**: Developers can program business logic into low-cost financial services

* The degree of decentralization (which drives censorship resistance) is a variable and thus exists on a continuum . In some cases, effective control (validators, and/or multisig access to a treasury wallet) is still centralized in the hands of a dozen people or so. A variable decentralization framework for Lending protocols in DeFi can be found here.

Money stacks

Traditional Finance



Decentralized Finance

Source: Coindesk

Permissionless vs Permissioned blockchains = DeFi vs TradFi

Permissionless /DeFi	Permissioned (CBDC, Stablecoins)
Censorship resistance: (full)	Censorship resistance: (outside federation)
Immutability: (no fraud possible)	Immutability: (no fraud, within federation)
Accountability: (attribution of actions)	Accountability: (regulated by federation)
Transparency: (full, all transactions visible)	Transparency: (determined by issuer)
Openness: (no barriers to entry)	Openness: (access must be granted by federation)
Global: (no borders)	Global (geographic reach determined by issuer)
Trustless (at its core, regulated by code)	Centrally controlled
Often Deflationary (inherent supply scarcity)	Often Inflationary (no inherent supply scarcity)
Decentralized (no central governance)	Civilian rule of law

Different circumstances require different design choices.

Traditional Finance

Main benefits	Risks
Safe storage of funds	Access gatekeepers
Enables access to debit and credit cards	Custodial control over (release of) funds.
Access to international transactions	Counterparty risk, Transaction censorship
Convenience	Regulatory capture
Access to the system reduces poverty	Centralized, single points of failure, systemic risk
	High friction, intermediary costs and artificially slow transaction speeds
	Lack of transparency leading to scandals
	Institutions are less trusted since the 2008 financial crisis.

Decentralized Finance

Main benefits	Risks
Open to anyone irrespective of status, wealth, location.	Internet access required
Censorship resistant transactions	Market risk
Self-control over custody of funds. Better privacy & security	Technology risk
Accessible 24/7	Liquidity risk
Affordable cross border payments	Governance risk
Fast transaction settlement. Ease of use.	Validator and consensus risks
Transparent (e.g. order books)	Protocol risk
Hedge vs subpart monetary policy options	

Sources include: Visualcapitalist on DeFi and on Accessibility of investments

DeFi risks (1 of 3)

As promising as the DeFi technology is, like with anything else, there are risks involved.
In the next few slides, we cover some DeFi-specific risks. Throughout the next weeks, we will cover those in more detail, as they relate to the respective topic of the week.

- **Market Risk** (token prices can be highly volatile)
- **Technology Risk**
  1. Transactions such as on-chain auction or on-chain collateral liquidation cannot be processed due to blockchain's physical capacity limit.
  2. Smart contract bugs or programming errors
  3. Inaccurate oracle information or delayed oracle update

- **Liquidity Risk** E.g., the inability to obtain sufficient tokens in time or at a reasonable cost. A major source of DeFi's liquidity risk is that collateralized tokens lock up liquidity.

DeFi risks (2 of 3)

As promising as the DeFi technology is, like with anything else, there are risks involved.

- Governance risks are numerous, but the main one to highlight is key management as a real vulnerability for DeFi protocols. If key holders lose control of their keys, they lose access and effectively ownership, of their tokens.
- **Admin key abuse -** To address this vulnerability, multi-signature key approaches have been developed, placing user deposits in custody of consortiums. However, placing admin keys in multi-sig key arrangements enable discretionary and opaque control of user funds, which could be exploited.
- Protocol Risk (e.g. related to automated interconnections with TradFi).

- **Consensus attacks** – blockchains can be vulnerable to so-called 51% attacks, and/or Sybil attacks.

DeFi risks (3 of 3)

- **Validator and consensus risks** - if economic incentives are incorrectly aligned, validators/miners can collude and manipulate block formation and transaction histories. Miners/validators can also extract value **(MEV)** by frontrunning users and selectively reordering transactions.

- Rug pulls are a new type of exit scam where DeFi developers create a new token, pair it to a leading cryptocurrency such as tether or ether and set up a liquidity pool.

They then market the newly created token and encourage people to deposit into the pool, often promising extremely high yields. Once the pool has a substantial amount of the leading cryptocurrency in it, the DeFi developers then use back doors intentionally coded into the token's smart contract to mint millions of new coins that they use to sell for the popular cryptocurrency. This completely drains the popular cryptocurrency from the pool and leaves millions of worthless coins in it. The founders then disappear without a trace.

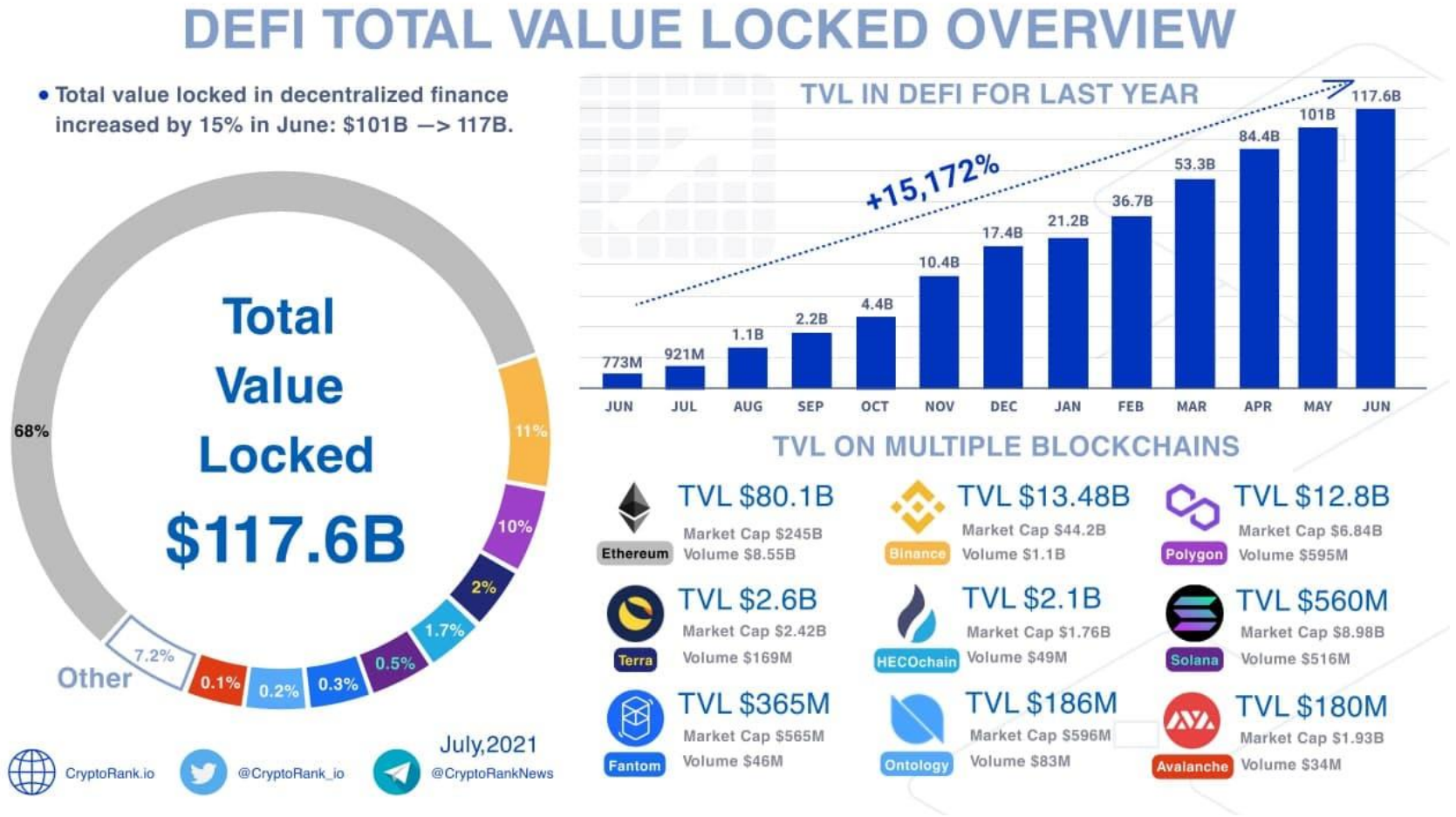
- **Software risks** include Distributed Denial of Service or DDoS attacks, injection, uncontrolled format strings, and buffer overflow attacks against DeFi platforms.

DeFi market size

- The rise of Decentralized Finance (DeFi) took the crypto world by surprise during the summer of 2020, so much that we refer to the period as DeFi Summer 2020.
- **Total Value Locked (TVL),** a measure of the amount of capital locked inside DeFi protocols, has been increasing at a breakneck speed, surpassing of **$1 billion in May 2020 and ending the year of 2020 with $15.7 billion in TVL**.
- Since then, DeFi has been growing non-stop and beyond its Ethereum roots. DeFi TVL surpassed the astounding figure of $200 billion in October 2021.

In most cases, the locked capital is used to offer services such as market making, lending, asset management, and arbitraging across the ecosystem, earning yields for the capital providers in the process.

Fast growth

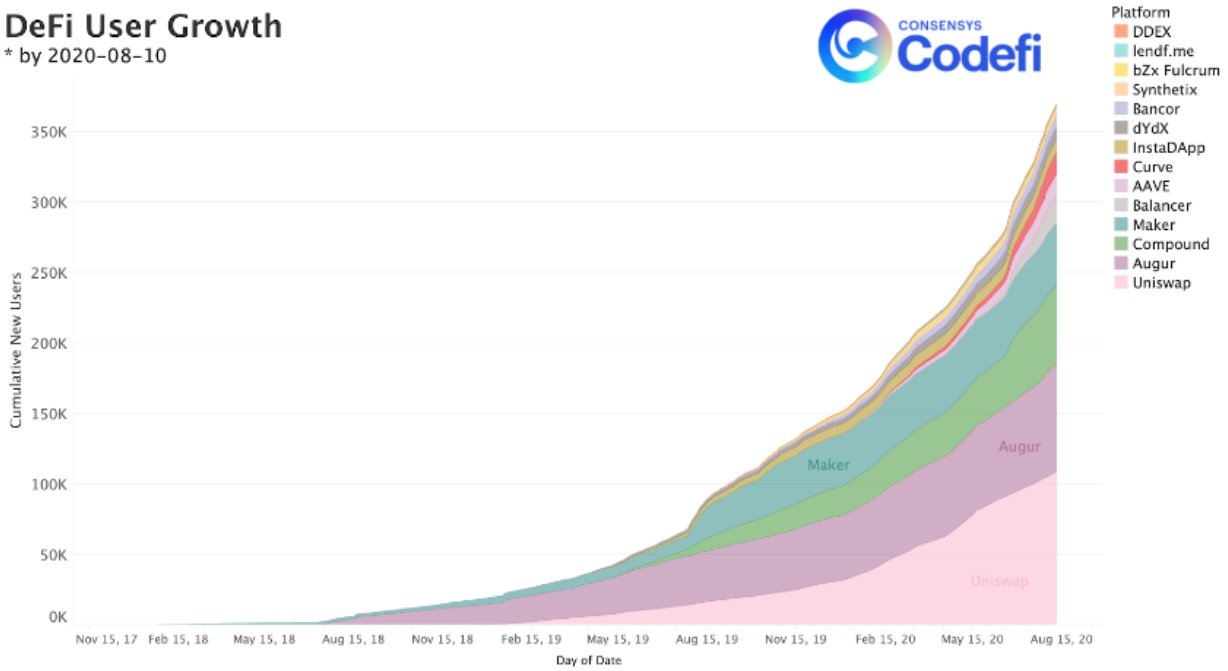


DeFi market size

In terms of user base, a good metric to follow is the amount of monthly active users of DeFi (non-custodial) wallets such as MetaMask. MetaMask has seen astounding growth figures of 1800% between July 2020 and August 2021, recently hitting the milestone of 10 million active users.

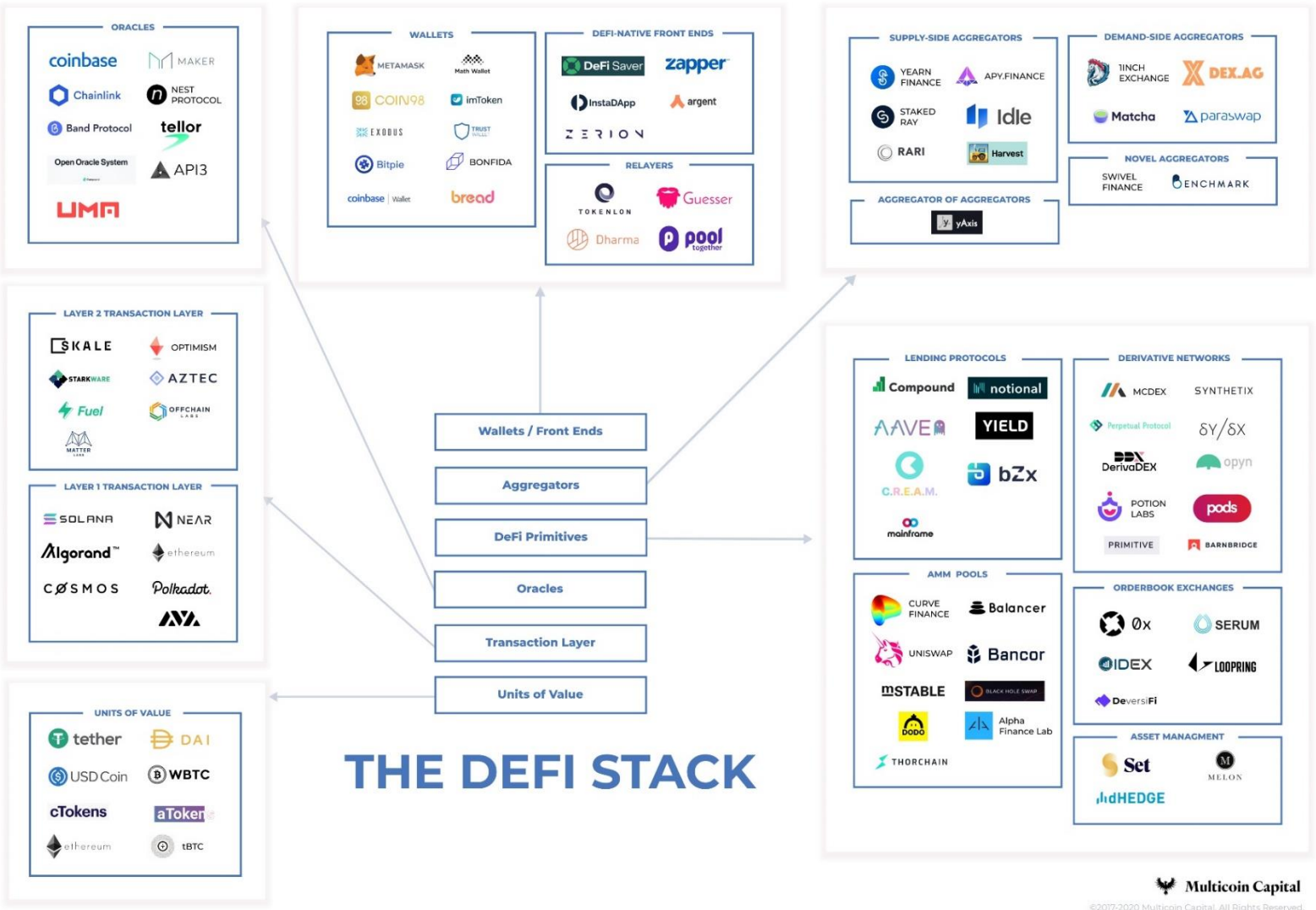
The chart to the right also shows the explosive growth in the summer of 2020.

It is worth noting that it all metrics about user growth don't measure unique users, as there is no easy way to determine this (due to the permissionless nature of DeFi)



Source: Consensys

Ecosystem



Source: Multicoin

Session 1: Fundamentals of DeFi

4. Conclusions

Conclusions

In this session, you have learned about the history of Finance, its size and importance, and the contrast between TradFi and DeFi. You have also seen the benefits which DeFi promises along with the risks associated with being active in that space in these early days.

In the remainder of this course you will learn about concepts such as:

- Stablecoins (cryptocurrencies with a stable value peg to an external reference, such as US$).
- (Decentral) Lending and Borrowing, and even insurance
- Decentralised Exchanges (DEXes)
- NFTs (Non Fungible Tokens)
- Synthetic Assets
- Tokenomics is the topic of understanding the supply and demand characteristics of cryptocurrency.
- **Oracles,** being third-party services that allow smart contracts within blockchains to receive external data from outside of their ecosystem
- Algorithmic Governance / DAO

Session 1: Fundamentals of DeFi

5. Further Reading

Further Reading

Mapping the future of DeFi:

- https://www.realvision.com/shows/the-interview-crypto/videos/mapping-the-future-of-defi

A beginner's guide to DeFi

- https://blog.coinbase.com/a-beginners-guide-to-decentralized-finance-defi-574c68ff43c4

Adventures in DeFi land

- https://www.economist.com/briefing/2021/09/18/adventures-in-defi-land

DeFi infrastructure 101 – Overview and market landscape (June 2021)

- https://medium.com/racecapital/defi-infrastructure-101-overview-market-landscape-78e096a85834

The DeFi list:

- https://defipulse.com/defi-list/

Building blocks and Risk analysis framework of DeFi

- LinkedIn article

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Questions?

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