Decentralized Monetary Policy

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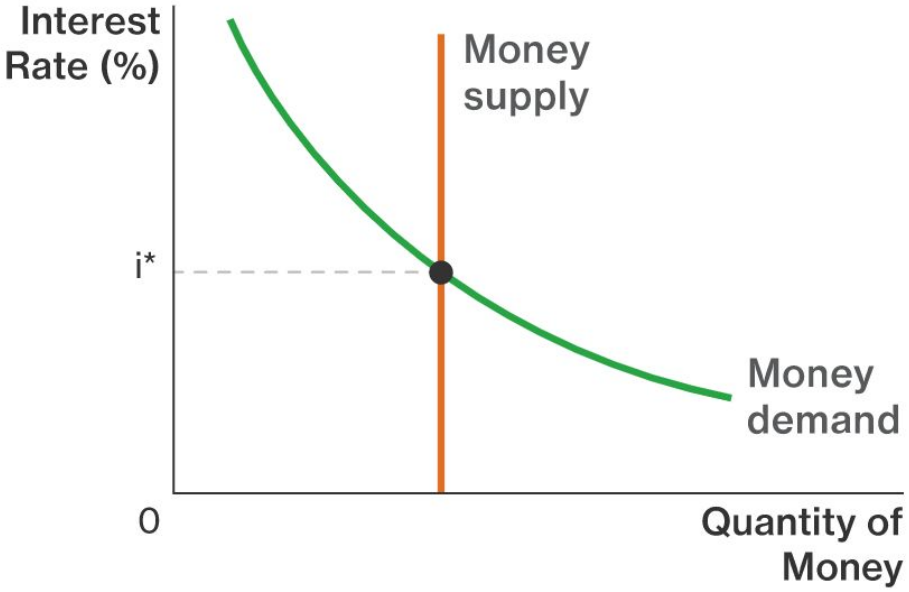
Outline

- Traditional monetary policy
  - Conventional monetary policy
  - Unconventional monetary policy
  - Challenges
- Decentralized monetary policy
  - Blockchain and smart contract
  - Decentralized Finance
  - Monetary policy on the blockchain

Section 1: Traditional monetary policy

Conventional Monetary Policy



Interest rate

Inflation
(-)

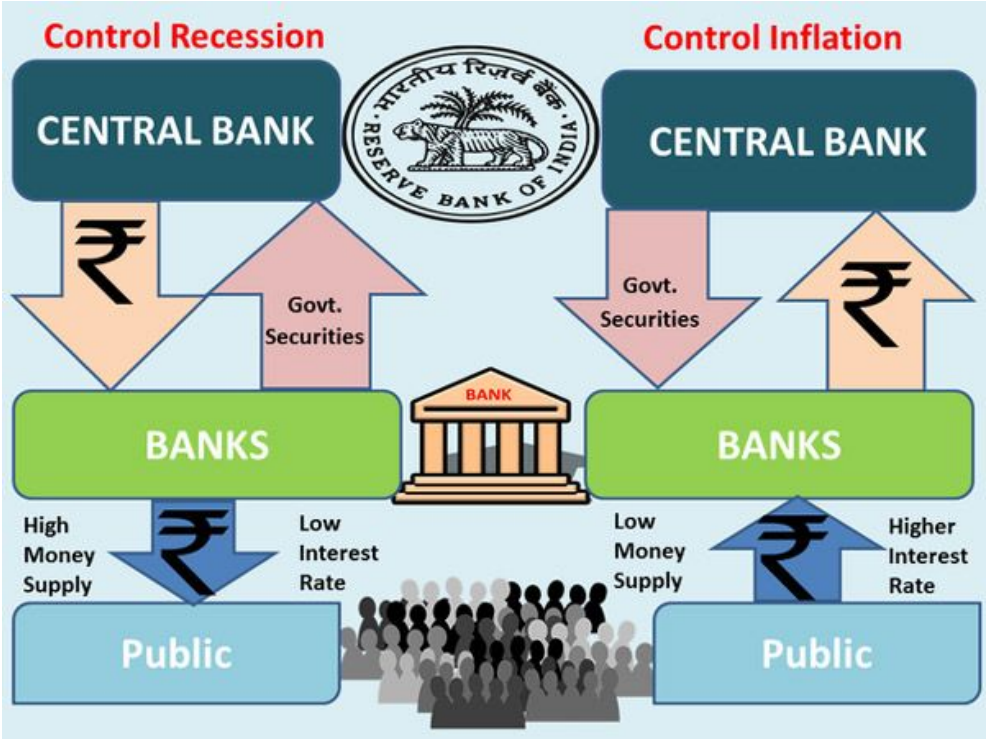
Unemployment
(+)

Other Factors
e.g. financial markets

Open Market Operations

Open market operations is how central banks usually alter money supply

- Buy bonds, inject money, MS increases
- Sell bonds, withdraw money, MS decreases.



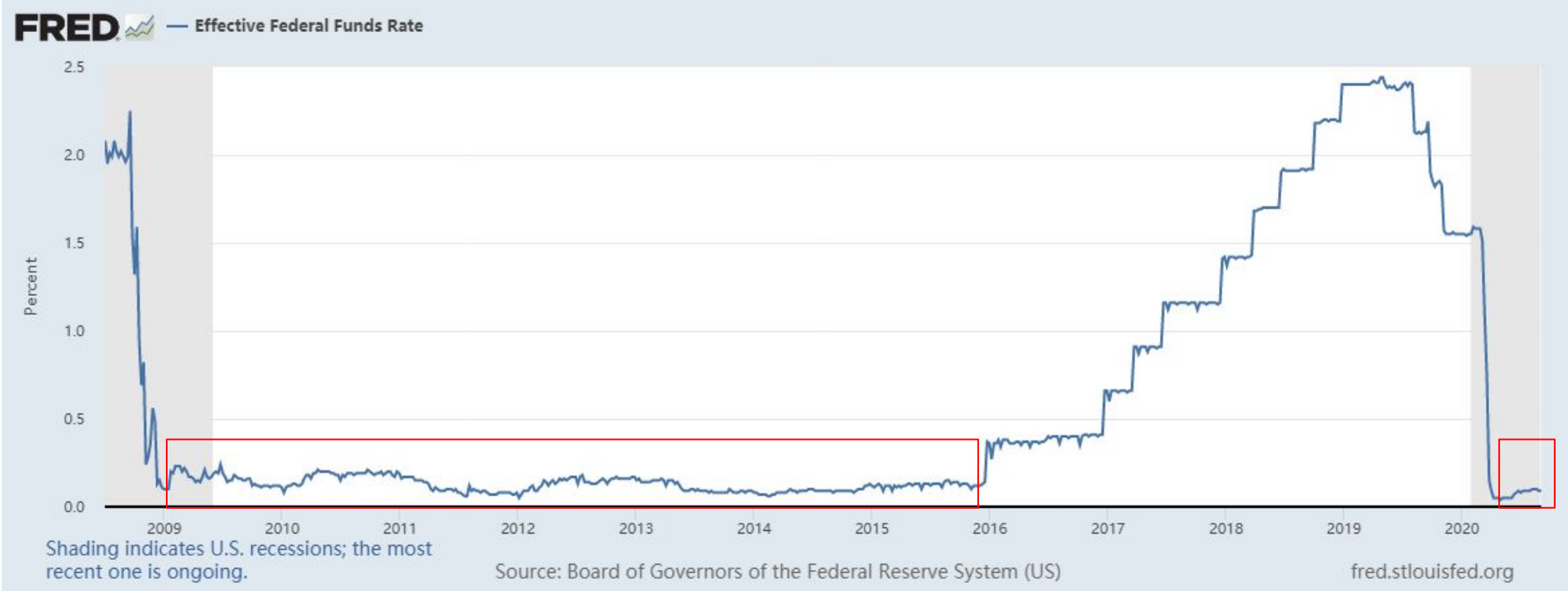
https://www.vskills.in/certification/blog/open-market-operations-central-bank-tools-to-stabalize-the-economy/

Fed targets Federal Funds Rate

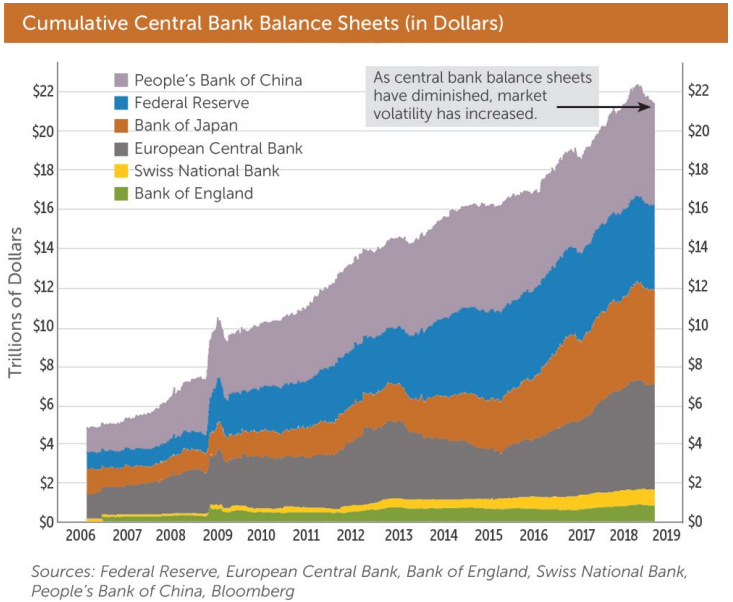
- **Federal Funds Rate** is the interest rate at which depository institutions lend to each other overnight.

- Federal Funds Target Rate ≈ Effective Federal Funds Rate

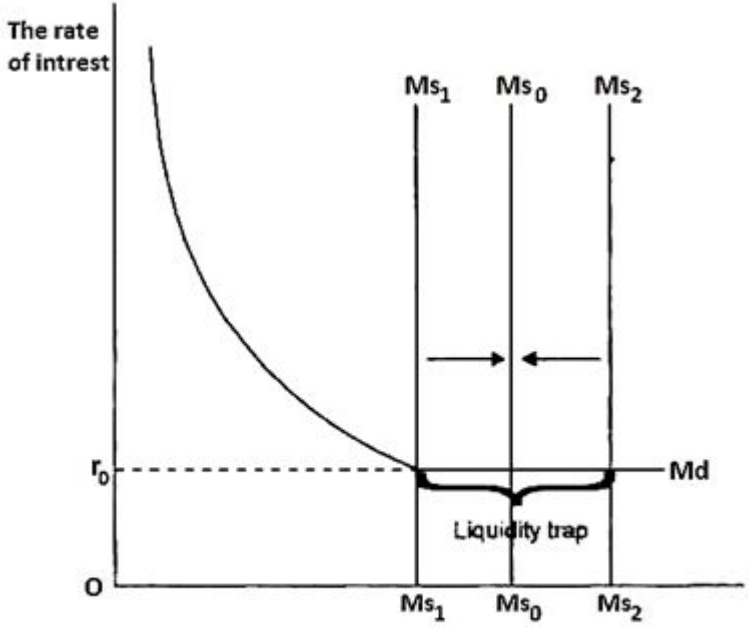
Unconventional Monetary Policy

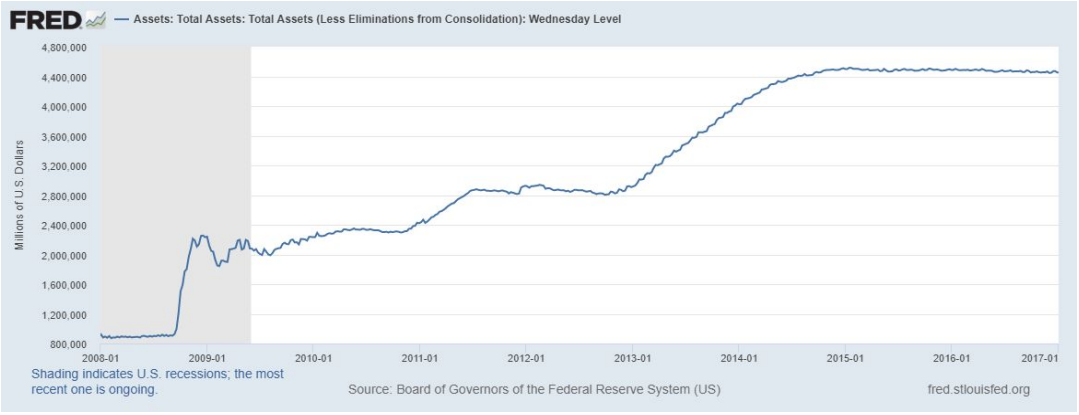


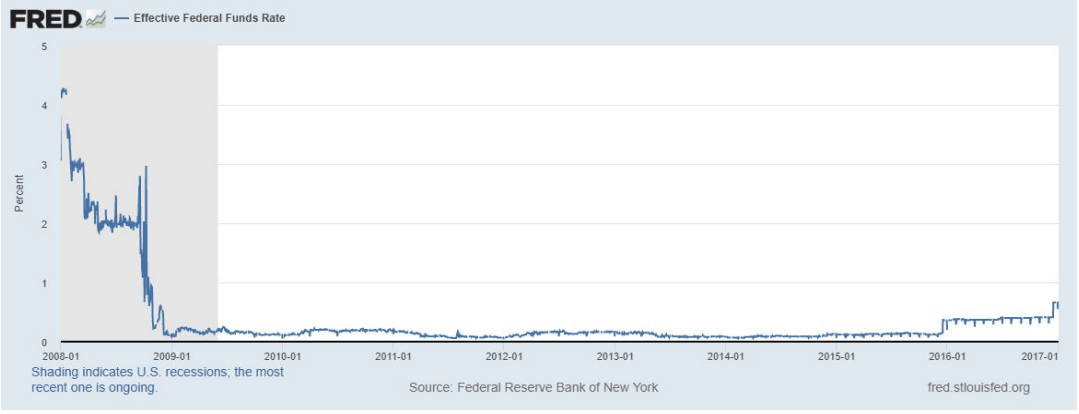
Quantitative Easing



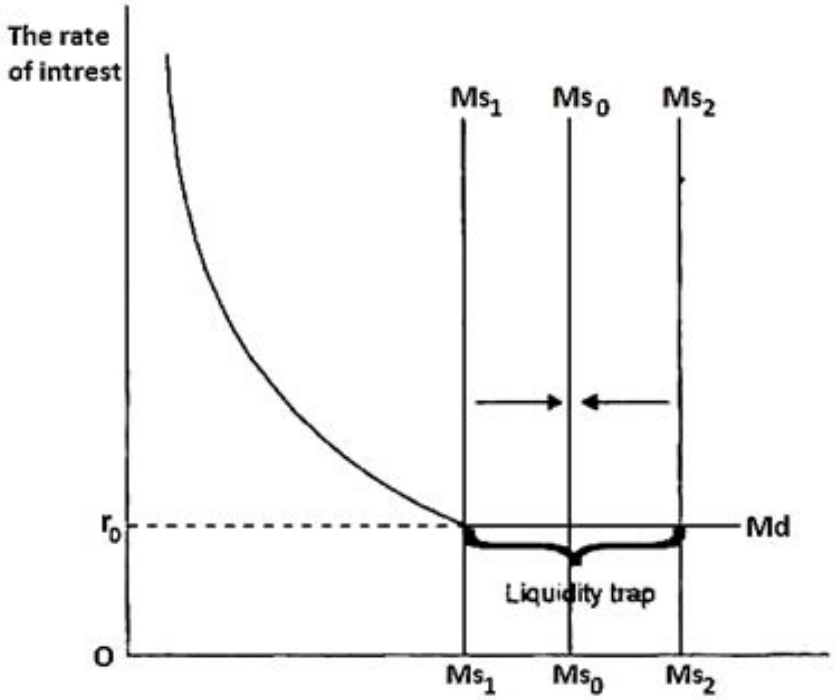
Liquidity Trap







Effective Zero Lower Bound



Interest rate

Inflation

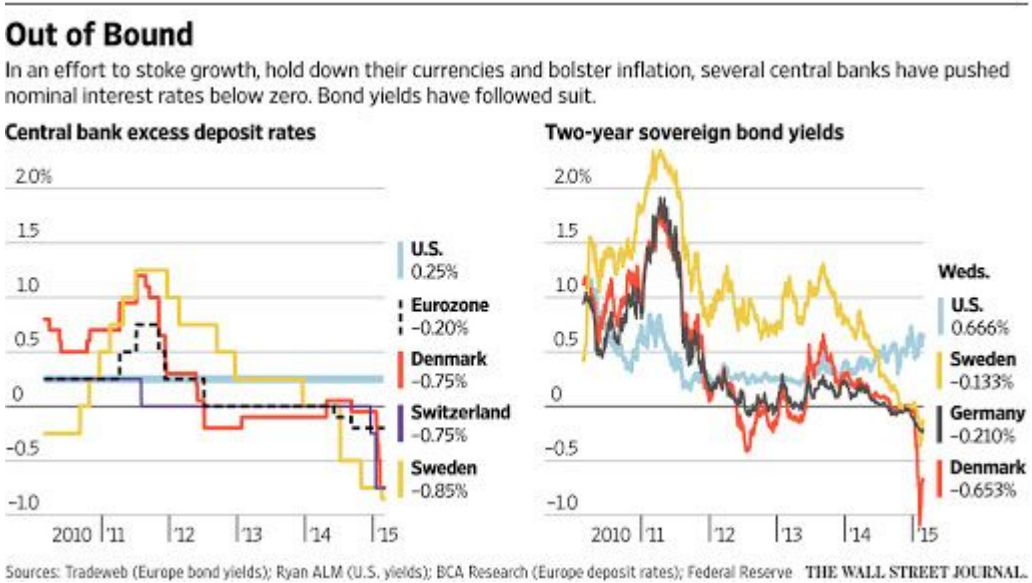
Unemployment

Other Factors

Negative Interest Rate - in theory

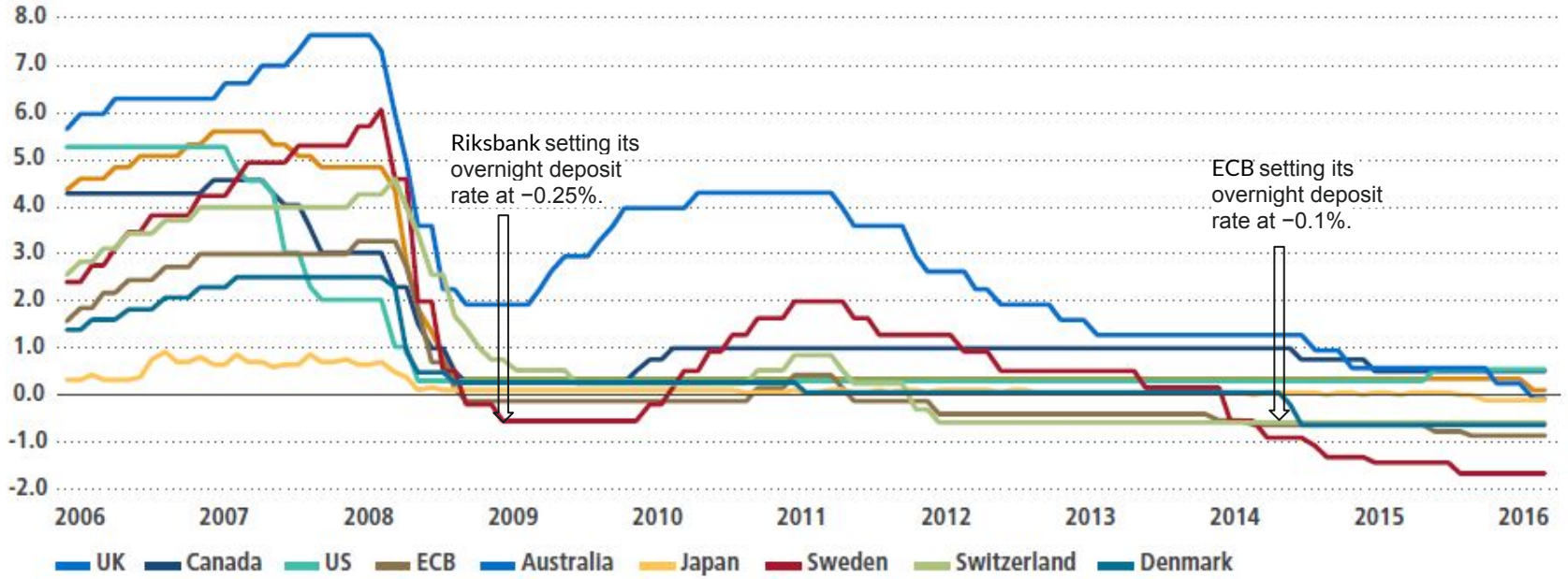
- “Tax on holding money”
- Central banks can charge banks of their excess reserves, which may carry over to deposits and bonds.

- Risk: deposit holders withdraw money from the banking system.



Negative Interest Rate - in practice

FIGURE 1: GLOBAL CENTRAL BANK RATES

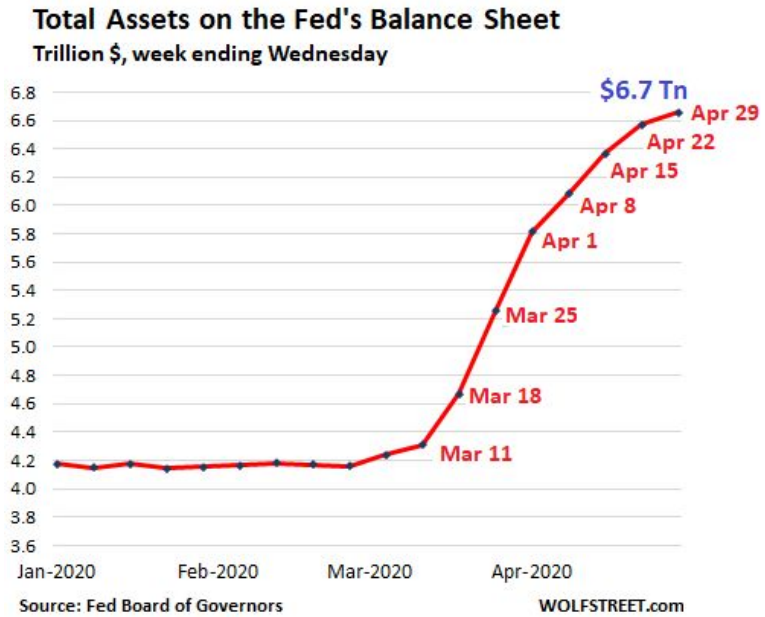


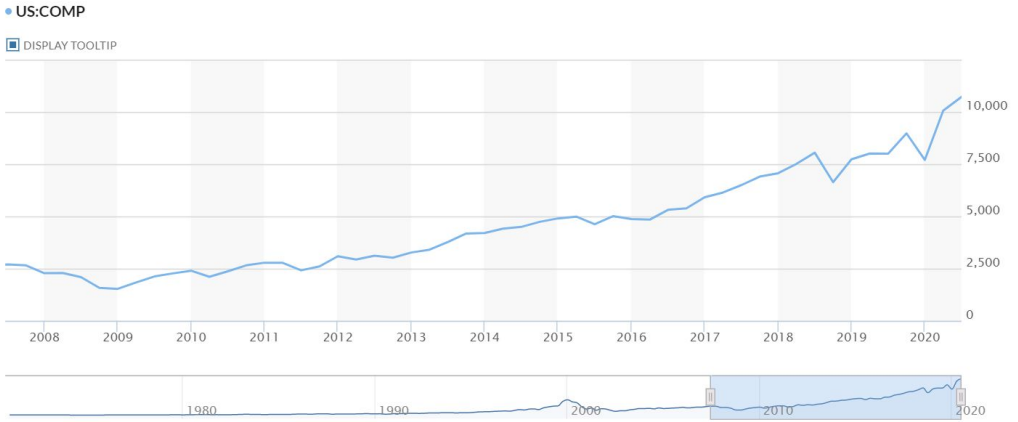
Source: Bloomberg as of 17 October 2016

CB Actions during COVID-19 recession

Central Bank	Action
Federal Reserve	Targeted Federal Funds Rate at 0%-0.25%; unlimited QE.
European Central Bank	Deposit Facility Rate at -0.50%; Pandemic Emergency Purchase Program: €1350 billion purchases of assets.
Bank of Japan	COVID-19 lending programme of $1.02 trillion; overnight interest rate at -0.1%, 10-year-bond yield at about 0%.
Swiss National Bank	Overnight deposit rate at -0.75%, the lowest in the world; increase foreign currency purchase to depreciate the currency.
People's Bank of China	two special loan programs worth a combined 800 billion yuan; reduce reserve rate by 0.5-1%.

Insight: Covid-19 accelerates the speed of QE





Challenges: Inflation

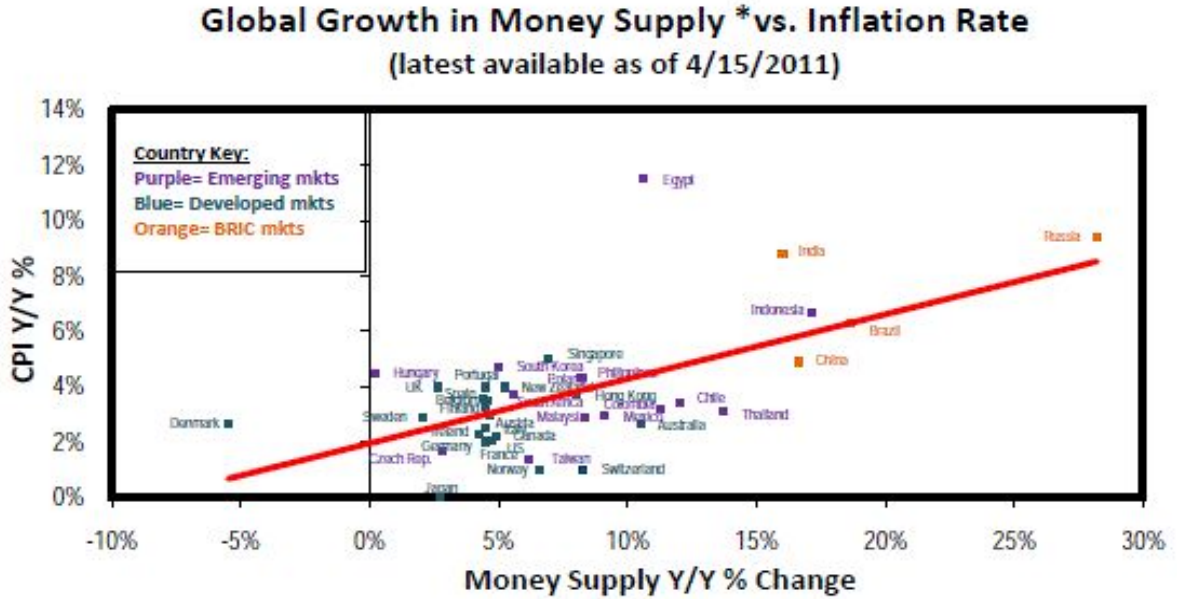
Quantity Theory of Money: MV=PQ

M = nominal quantity of money,

V = velocity of money,

P = general price level,

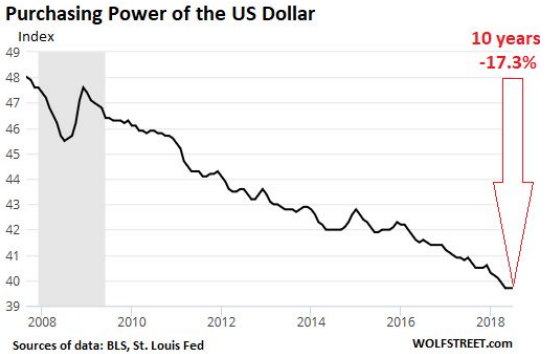
Q = real value of final expenditures.



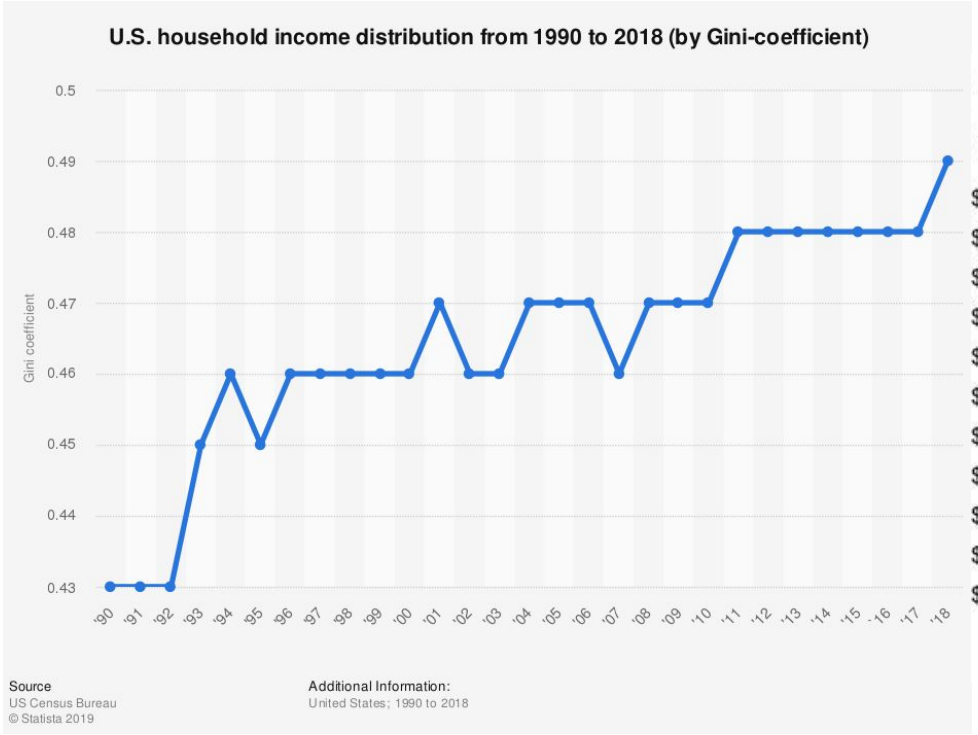
Source: Richard Bernstein Advisors LLC, The Economist, Bloomberg

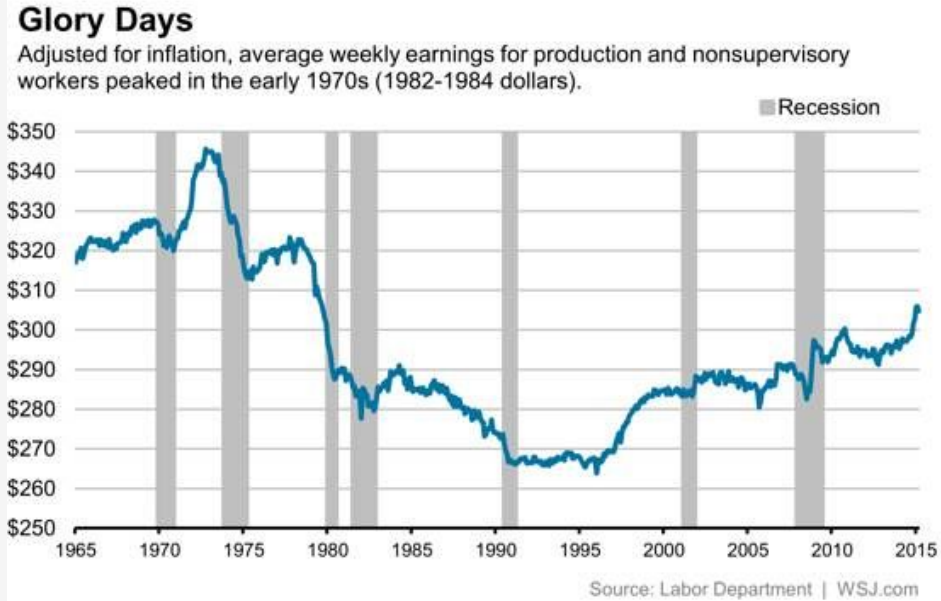
*Money Supply defined as M2 (or M3, if M2 not available, or IMF Currency Issued Monetary Authority in National Currency, for EMU countries).

Insight: Money is losing value & Trickle down economics



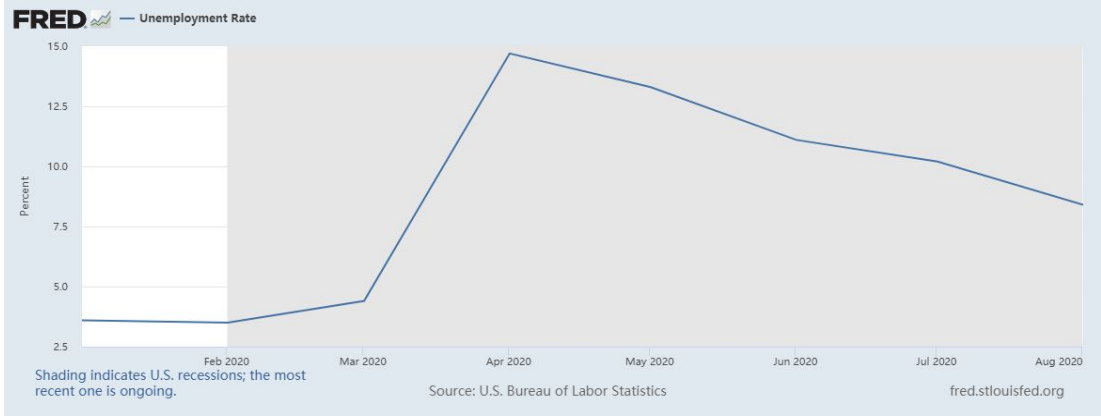
Challenges: Wealth Inequality





Challenge: Wealth Inequality

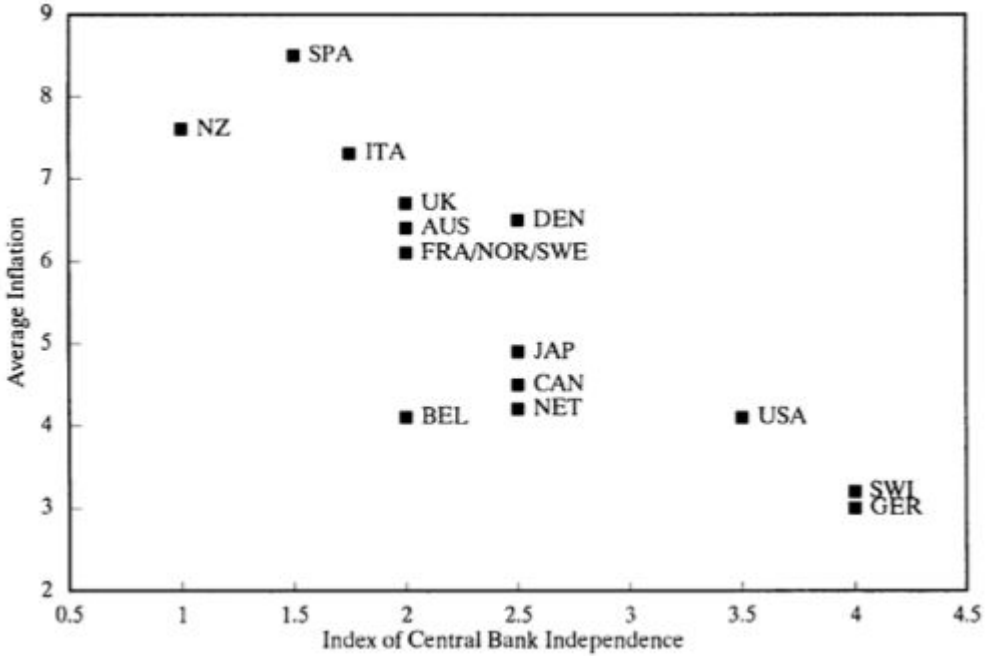
- During COVID-19, people became unemployed, but the stock market continued to grow.
- Only rich people can invest in the stock market and benefit from the growth.



Challenges: Central Bank Independence

"It is critical to preserve the Federal Reserve's ability to make decisions based on the best interests of the nation, not the interests of a small group of politicians."

--- *America Needs an Independent Fed*, signed by Former Fed chairs Volcker, Greenspan, Bernanke and Yellen, Wall Street Journal, Aug. 5th, 2019.



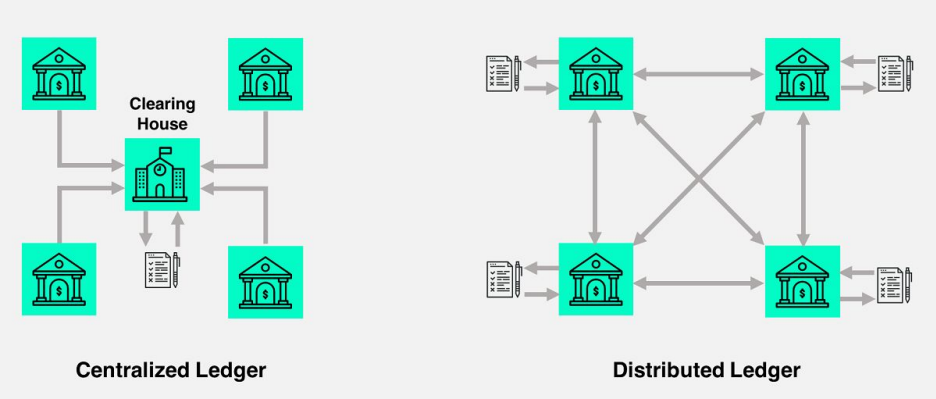
- Conventional monetary policy is ineffective after the 2008 global financial crisis and unconventional monetary policy, e.g. QE, has become the new normal.
- Three major problems of the unconventional monetary policy
  - Money is losing purchasing power at a fast pace.
  - Money will eventually flow to the financial markets with higher returns⇒Wealth inequality has been exacerbated.
  - Central banks lose independence.

Take home messages

Section 2: Decentralized monetary policy

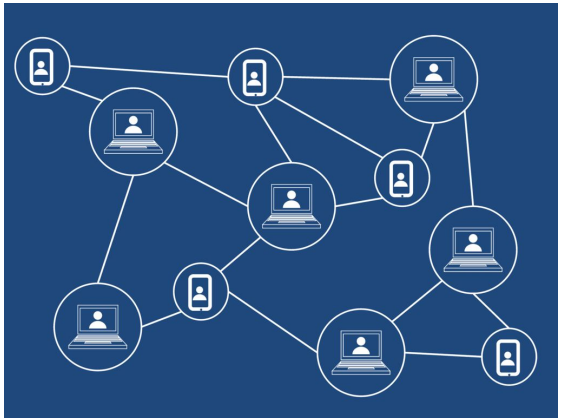
- 2.1: Blockchain and smart contract

Distributed Ledger Technology

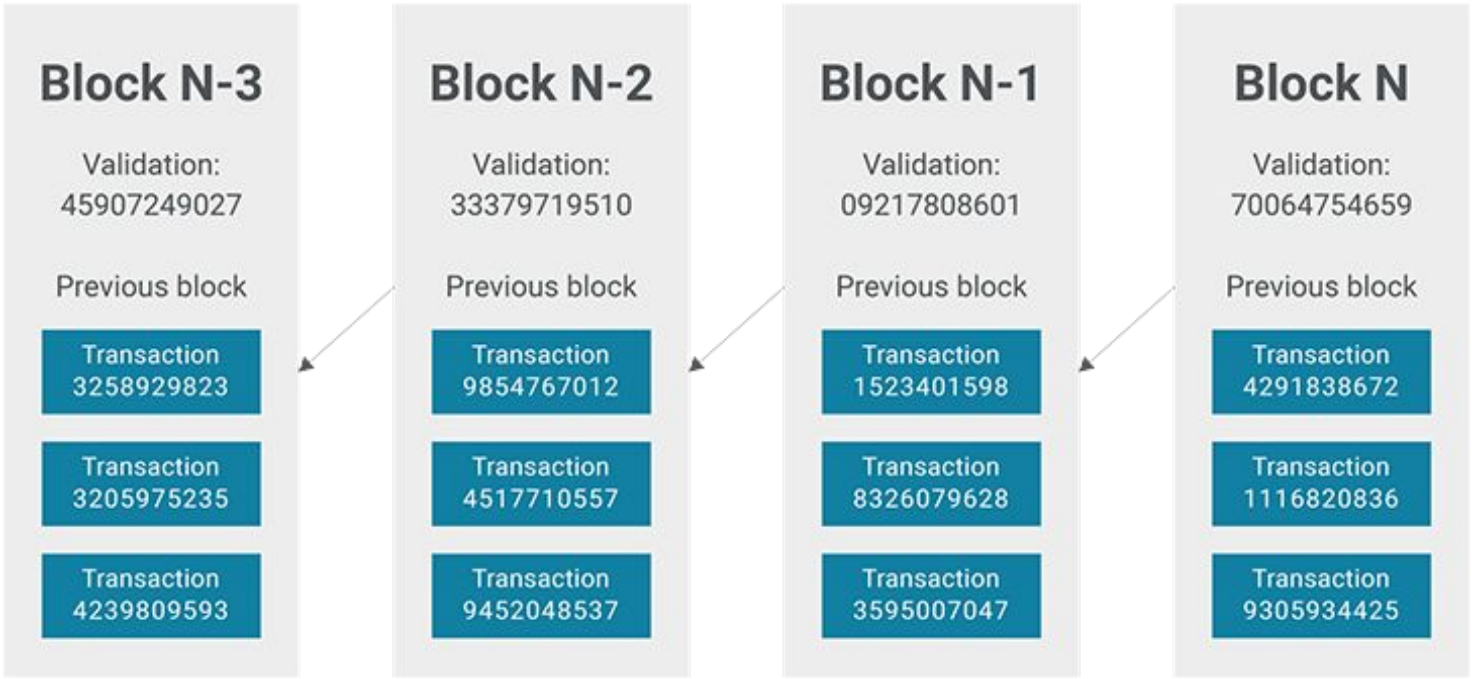


- Decentralized
- Transparent
- Immutable
- Secure

1. Randomly select one entity, as the bookkeeper, to record all transactions for a certain period, e.g. 1 day
2. The bookkeeper collects all transactions during that period and records them in a page of his account book
3. The bookkeeper shows the account book to his neighbors/supervisors
4. His neighbors check its authenticity. If yes, then copy it and show it to their neighbors
5. By doing so, the account book is copied by all peers
6. The new period starts, a new bookkeeper is selected and repeats the procedures above



Blockchain


Block N-3
Validation:
45907249027
Previous block
Transaction
3258929823
Transaction
3205975235
Transaction
4239809593
Block N-2
Validation:
33379719510
Previous block
Transaction
9854767012
Transaction
4517710557
Transaction
9452048537
Block N-1
Validation:
09217808601
Previous block
Transaction
1523401598
Transaction
8326079628
Transaction
3595007047
Block N
Validation:
70064754659
Previous block
Transaction
4291838672
Transaction
1116820836
Transaction
9305934425

Rank	Name	Market Cap	Price	Volume (24h)	Circulating Supply	Change (24h)	Price Graph (7d)
1	Bitcoin	$176,753,490,601	$9,585.16	$19,016,746,568	18,440,325 BTC	2.37%	
2	Ethereum	$30,681,131,023	$274.23	$11,195,257,638	111,879,656 ETH	12.06%	
3	Tether	$9,991,123,039	$0.999290	$26,941,860,088	9,998,221,723 USDT *	-0.12%	
4	XRP	$9,294,048,553	$0.207400	$1,271,761,635	44,812,133,482 XRP *	3.80%	
5	Bitcoin Cash	$4,414,143,226	$238.99	$1,483,235,054	18,470,050 BCH	2.99%	
6	Bitcoin SV	$3,428,863,768	$185.66	$1,423,503,659	18,468,490 BSV	5.33%	
7	Cardano	$3,211,853,068	$0.123880	$200,092,701	25,927,070,538 ADA	2.05%	
8	Litecoin	$2,933,001,652	$45.06	$1,856,649,812	65,094,354 LTC	3.26%	
9	Chainlink	$2,737,848,921	$7.82	$703,724,311	350,000,000 LINK *	5.98%	
10	Crypto.com Coin	$2,690,768,203	$0.146583	$69,305,230	18,356,621,005 CRO *	1.37%	
11	Binance Coin	$2,662,521,296	$18.44	$235,885,913	144,406,560 BNB *	4.04%	
12	EOS	$2,481,215,915	$2.65	$1,532,396,692	934,575,355 EOS *	2.15%	
13	Tezos	$2,333,233,408	$3.16	$141,150,606	737,319,673 XTZ *	6.48%	
14	Stellar	$1,996,651,628	$0.097641	$221,265,215	20,448,833,688 XLM *	0.71%	
15	Monero	$1,295,268,850	$73.42	$79,089,723	17,641,185 XMR	5.25%	
16	TRON	$1,194,864,910	$0.017919	$357,593,994	66,682,072,191 TRX *	2.46%	

Cryptocurrency Taxonomy

<u>Payment system</u>
Bitcoin, Bitcoin Cash, Bitcoin SV, Litecoin, Stellar, Monero

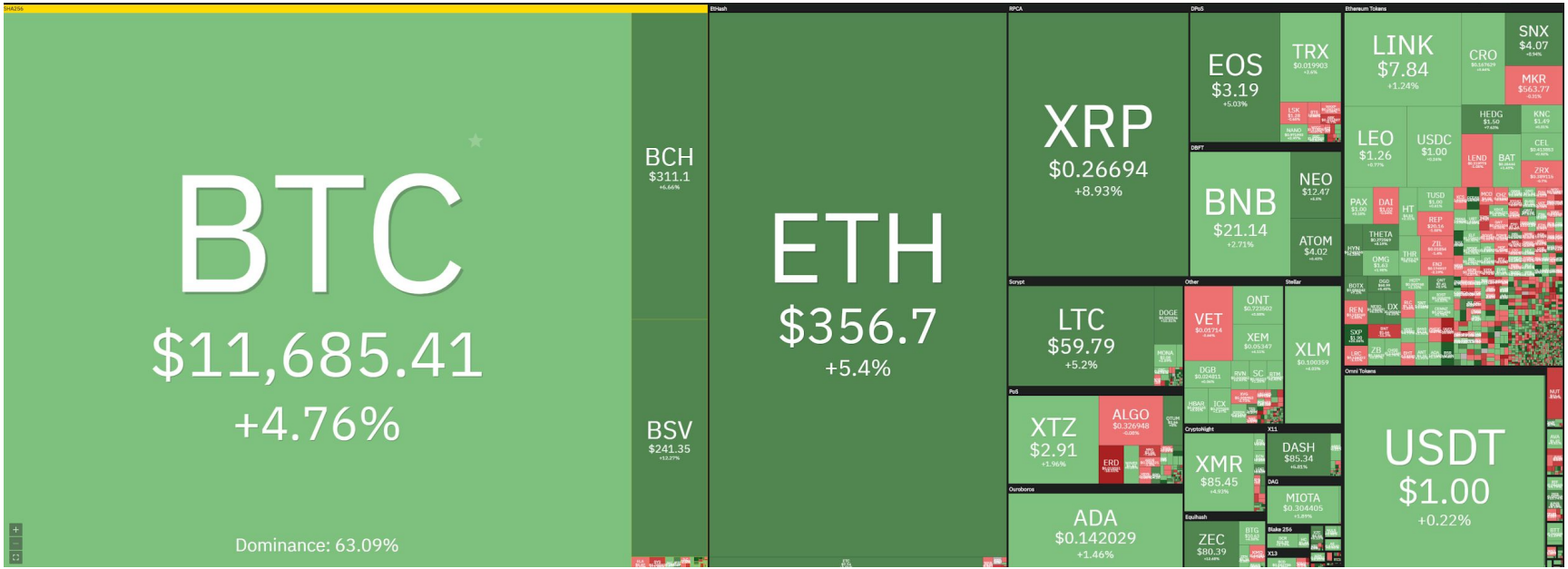
<u>Smart contract platform</u>
Ethereum, Cardano, EOS, Tezos, TRON, Cosmos, Neo, Ethereum Classic

<u>Decentralized Finance</u>
--Stable coin
Tether, USDC, Paxos, Dai, Binance USD, HUSD

--Decentralized banks
Aave, Compound

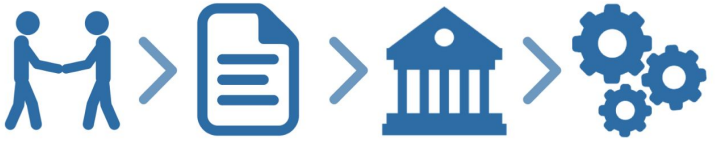
--Decentralized Exchange
Uniswap, Sushiswap, Bancor, Kyber

Cryptocurrency market share



Date: 1st August 2020
Source: https://coin360.com/

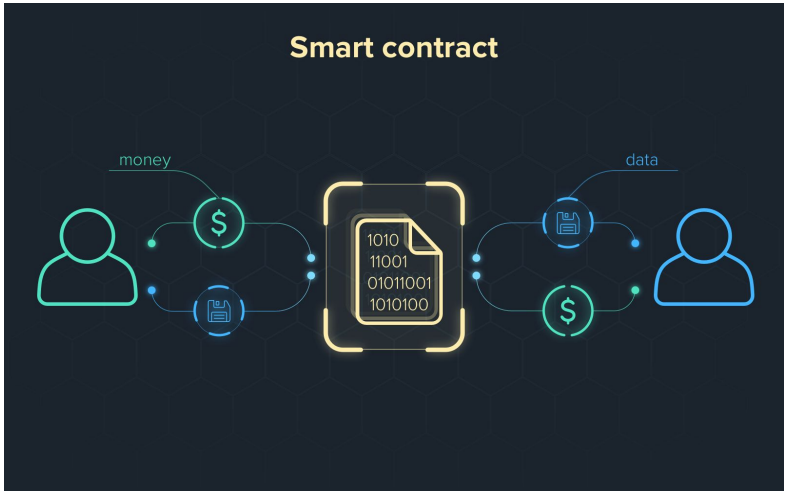
TRADITIONAL CONTRACT



PARTIES CONTRACT 3RD PARTY EXECUTION

SMART CONTRACT

PARTIES SMART CONTRACT EXECUTION

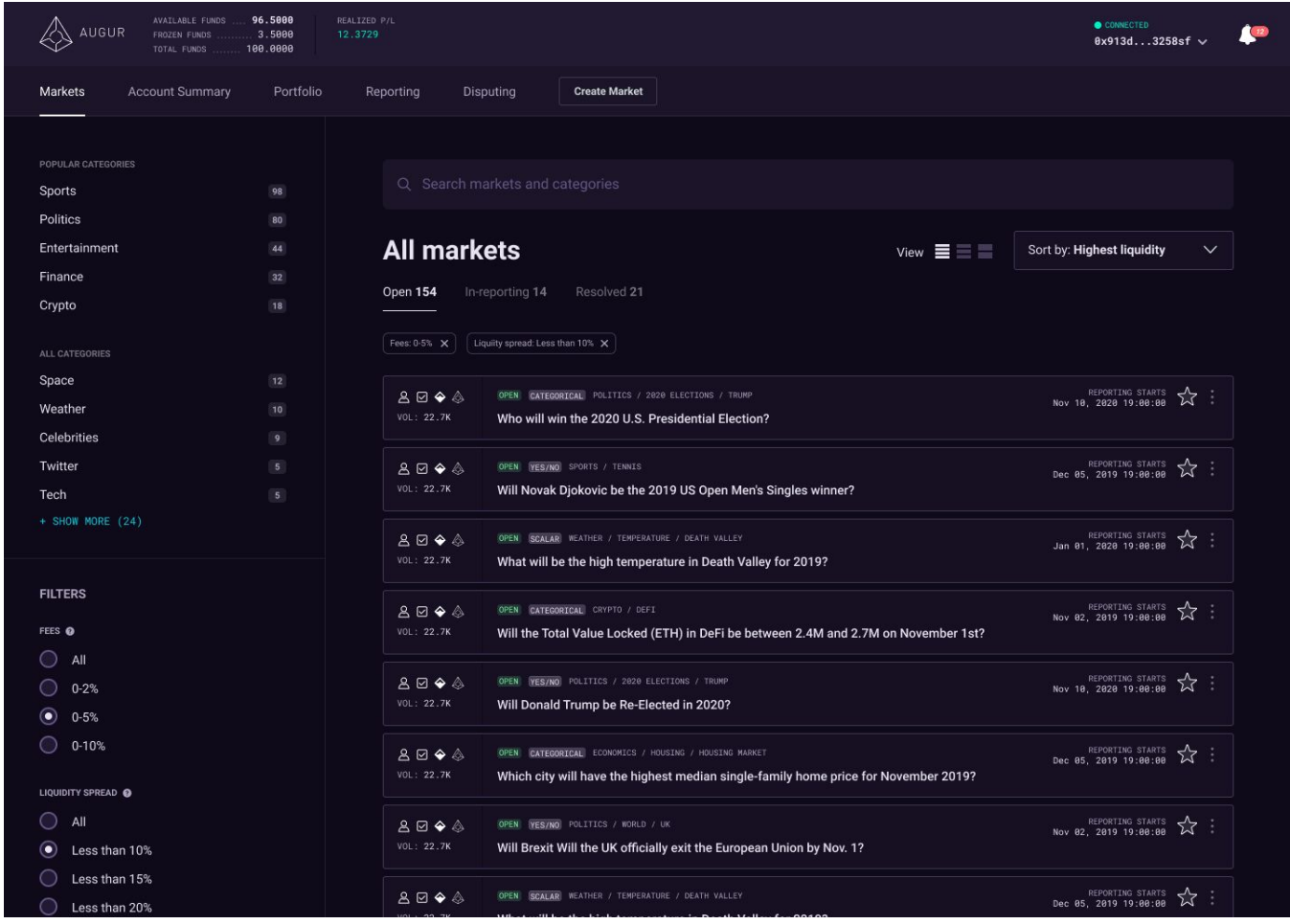


Smart contract

- Smart contract
  - Storing business rules
  - Verifying rules
  - Self execution
- Computer codes: automatically executed (If A, then B)
- No need for a central authority, legal system, middle man or external enforcement mechanism
- Properties
  - publicly verifiable
  - low costs
  - high speed
  - transparent
  - immutable

```
contract MyContract {
    event MyLog(string, uint256);

    function supplyErc20ToCompound(
        address _erc20Contract,
        address _cErc20Contract,
        uint256 _numTokensToSupply
    ) public returns (uint) {
        // Create a reference to the underlying asset contract, like DAI.
        Erc20 underlying = Erc20(_erc20Contract);

        // Create a reference to the corresponding cToken contract, like cDAI
        CErc20 cToken = CErc20(_cErc20Contract);

        // Amount of current exchange rate from cToken to underlying
        uint256 exchangeRateMantissa = cToken.exchangeRateCurrent();
        emit MyLog("Exchange Rate (scaled up by 1e18): ", exchangeRateMantissa);

        // Amount added to you supply balance this block
        uint256 supplyRateMantissa = cToken.supplyRatePerBlock();
        emit MyLog("Supply Rate: (scaled up by 1e18)", supplyRateMantissa);

        // Approve transfer on the ERC20 contract
        underlying.approve(_cErc20Contract, _numTokensToSupply);

        // Mint cTokens
        uint mintResult = cToken.mint(_numTokensToSupply);
        return mintResult;
    }
```

Use case: Prediction market



- Smart contracts are deployed on decentralized operation systems (not centralized system like Windows, IOS, Android)
- Ethereum = distributed ledger + smart contracts
- Ethereum is a decentralized world computer!

Take home messages

Section 2: Decentralized monetary policy

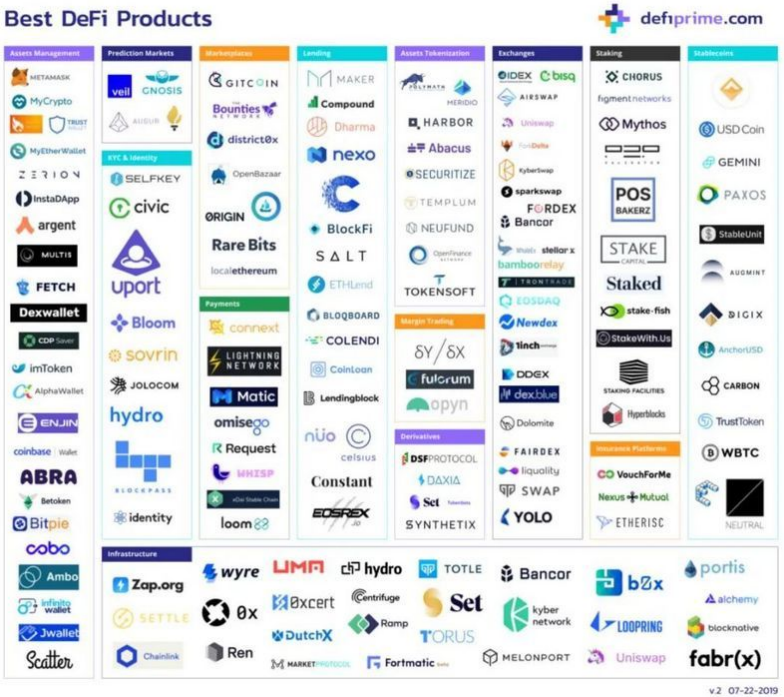
- 2.1: Blockchain and smart contract
- 2.2: Decentralized Finance

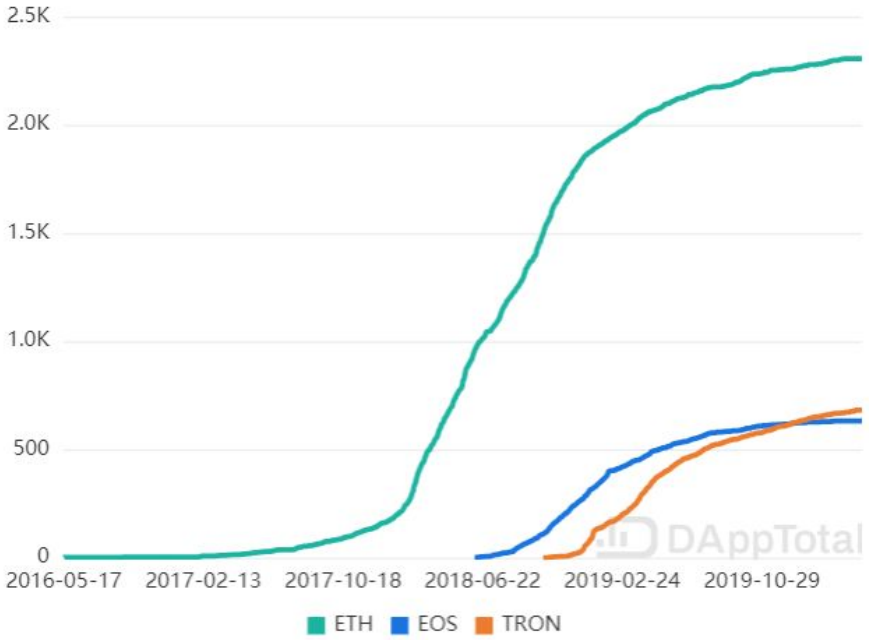
What is Decentralized Finance

Decentralize Finance — or Open Finance — refers to the paradigm shift from today's closed financial system towards an open financial economy based on open protocols that are interoperable, programmable, and composable. DeFi is not about creating a new system from scratch, it's about democratizing the existing system and making it more equitable using open protocols and transparent data.

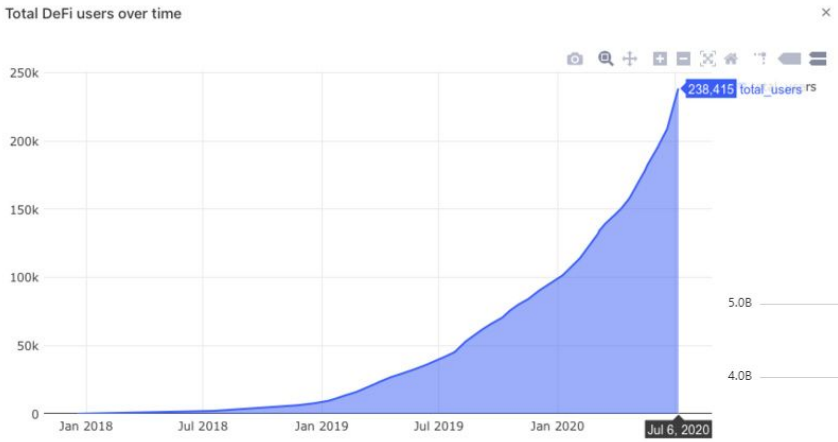
- No middleman/third party, trustless
- No custodian, control of your own asset
- 24/7 accessible
- Open source
- Transparent

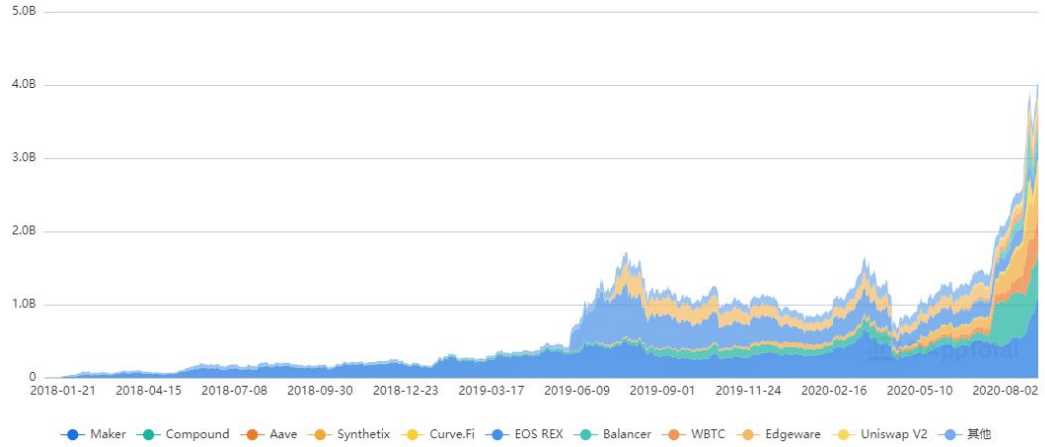
Growth of the DeFi ecosystem





DeFi users & staked value in USD

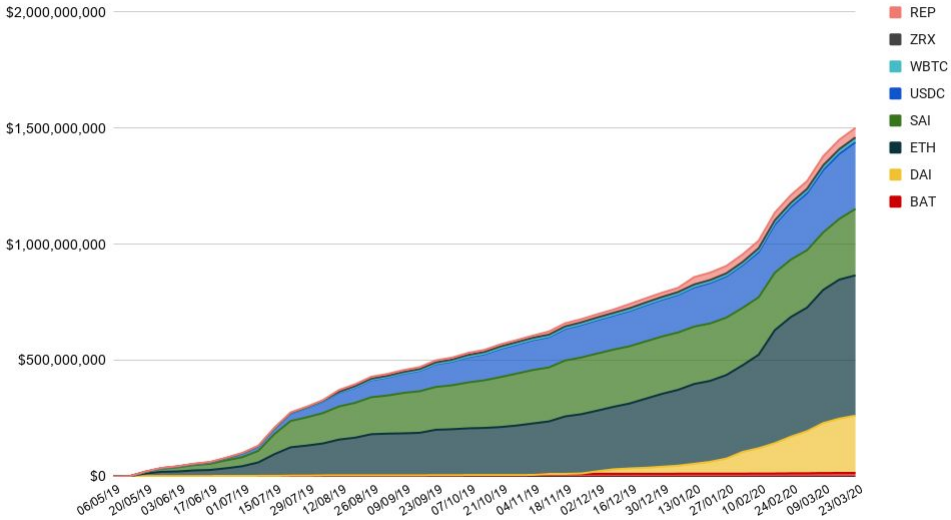




https://dapptotal.com/defi

Decentralized Bank

Compound Total Value Deposited (USD)



Total Supply

$114,663,924.23 +0.73%

Top 3 Markets

ETH	46.81%
USDC	29.04%
DAI	18.66%

24H Supply Volume: $826,898.74

Suppliers: 18359

Total Borrow

$25,651,684.48 +1.55%

Top 3 Markets

DAI	76.94%
USDC	20.03%
ETH	1.47%

24H Borrow Volume: $391,431.36

Borrowers: 1762

All Markets

Market	Gross Supply	Supply APY	Gross Borrow	Borrow APY
Ether ETH	$53.67M +1.05%	0.01% –	$377k -15.51%	2.09% -0.01
USD Coin USDC	$33.30M -0.25%	0.52% –	$5.13M -0.13%	3.60% –
Dai DAI	$21.39M +1.73%	2.44% +0.67	$19.73M +2.41%	2.79% +0.75
Augur REP	$3.13M –	0.04% –	$56k +1.81%	2.57% +0.01
Wrapped BTC WBTC	$1.06M -1.18%	0.33% +0.01	$88k -0.02%	4.58% +0.03
0x ZRX	$764k +0.58%	0.04% –	$13k +7.08%	2.57% +0.03
Basic Attention Token BAT	$725k -0.03%	0.15% –	$34k +0.01%	3.49% –
Sai (Legacy DAI) SAI	$596k -0.95%	2.98% +0.04	$205k +0.02%	9.37% +0.04

Crypto-backed Stable Coin

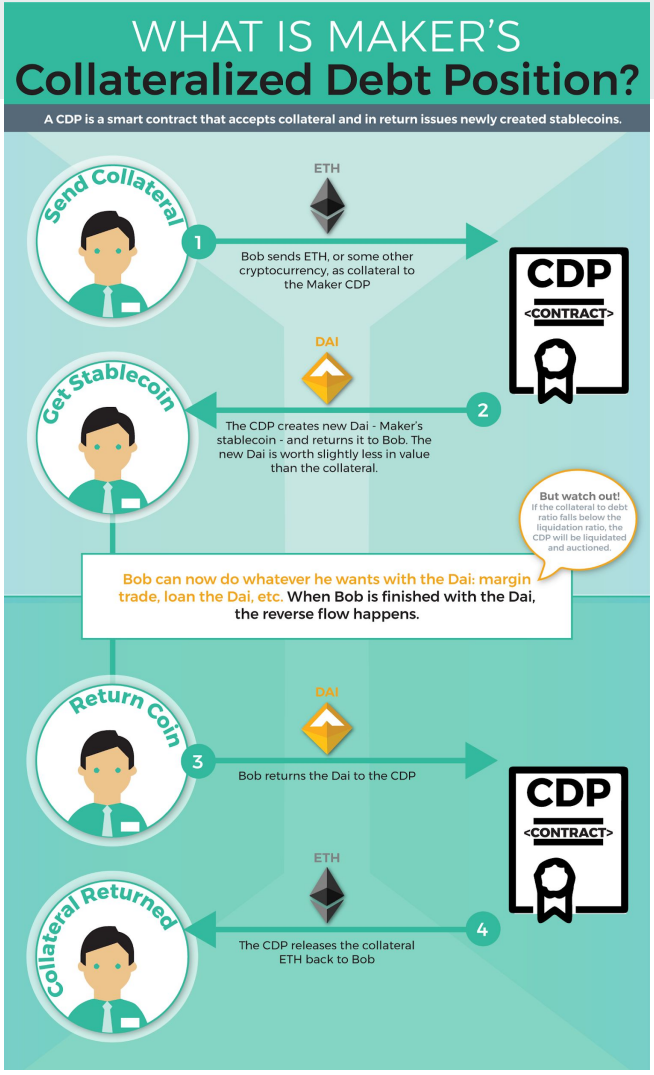
- Users could pledge their crypto assets as collateral in a smart contract, i.e. autonomous bank on the blockchain
- The smart contract automatically generates stable coins (i.e. loan in crypto fiat) against the collateral to the user
- Because the value of the crypto collateral is volatile, the stable coin is over-collateralized to buffer the price swing of the crypto collateral

Merits

- Users get liquidity without giving up ownership of their Ether collaterals
- Users could do leverage by exchanging Dai for Ethers and opening CDP again
- Simplified procedure & 24/7
- Decentralized, transparent and traceable
- The liquidation of crypto-backed stable coin is instant

Deficiencies

- volatile value of the underlying collaterals
- relatively complicated stability mechanism



Chanllenges

User friendliness: One of the challenges DeFi has to overcome before it will reach mainstream adoption is making DeFi much more user friendly.

Security: DeFi composability is awesome, but it also opens up the ecosystem to new threats if one of the components isn’t secure, so measures to alleviate the risks found in DeFi are extremely important.

- DeFi products democratize the centralized traditional finance sector
- DeFi brings transparency, automation, openness and the spirit of cutting off middleman
- It has new challenges such as security and user adoption

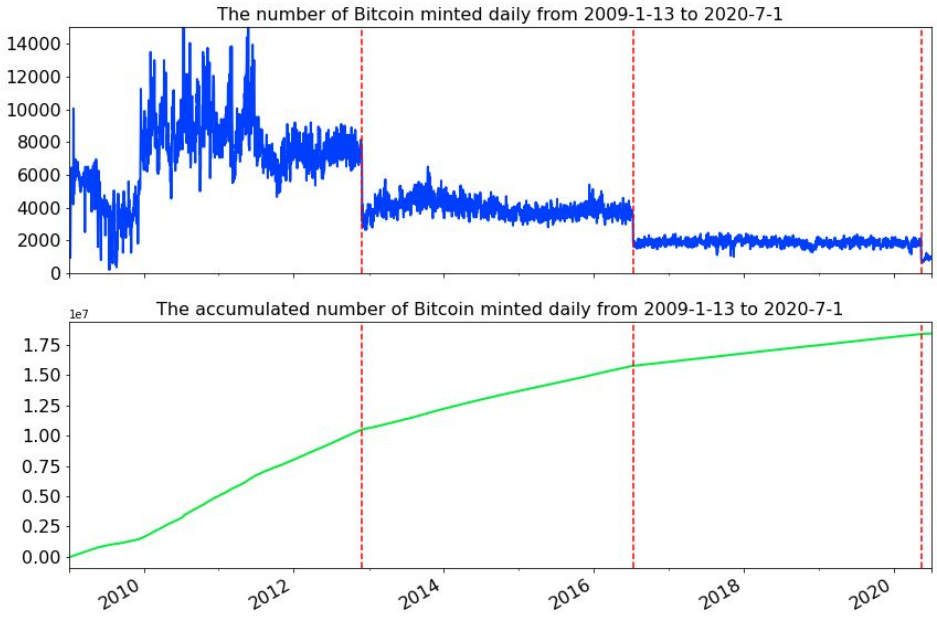
“DeFi is a new stack of financial services built on top of blockchains that embraces the core values of the open internet, including 1) open access to anyone in the world; 2) commitment to open source code; 3) permissionless extensibility by third-party developers; 4) minimal-to-no fees; and 5) encryption-backed security and privacy.” – a16z Crypto

Take home messages

Section 2: Decentralized monetary policy

- 2.1: Blockchain and smart contract
- 2.2: Decentralized Finance
- 2.3: Monetary policy on the blockchain

Bitcoin's monetary policy



Cryptocurrency Valuation and Machine Learning, Liu and Zhang (2020)

- The Bitcoin system generates new bitcoins at a predefined issuance rate
- Initially, each block consists of 50 BTC as block rewards to miners
- The issuance is set to decay in half every four years (dubbed halving)
    - November 28, 2012 ⇒ 25 BTC/block
    - July 9, 2016 ⇒ 12.5 BTC/block
    - May 11, 2020 ⇒ 6.25 BTC/block
- BTC has a capped total supply of 21 million
- The seigniorage is awarded to Bitcoin miners for maintaining the network

Ether issuance under PoW

~4.5 million ether per year as block rewards

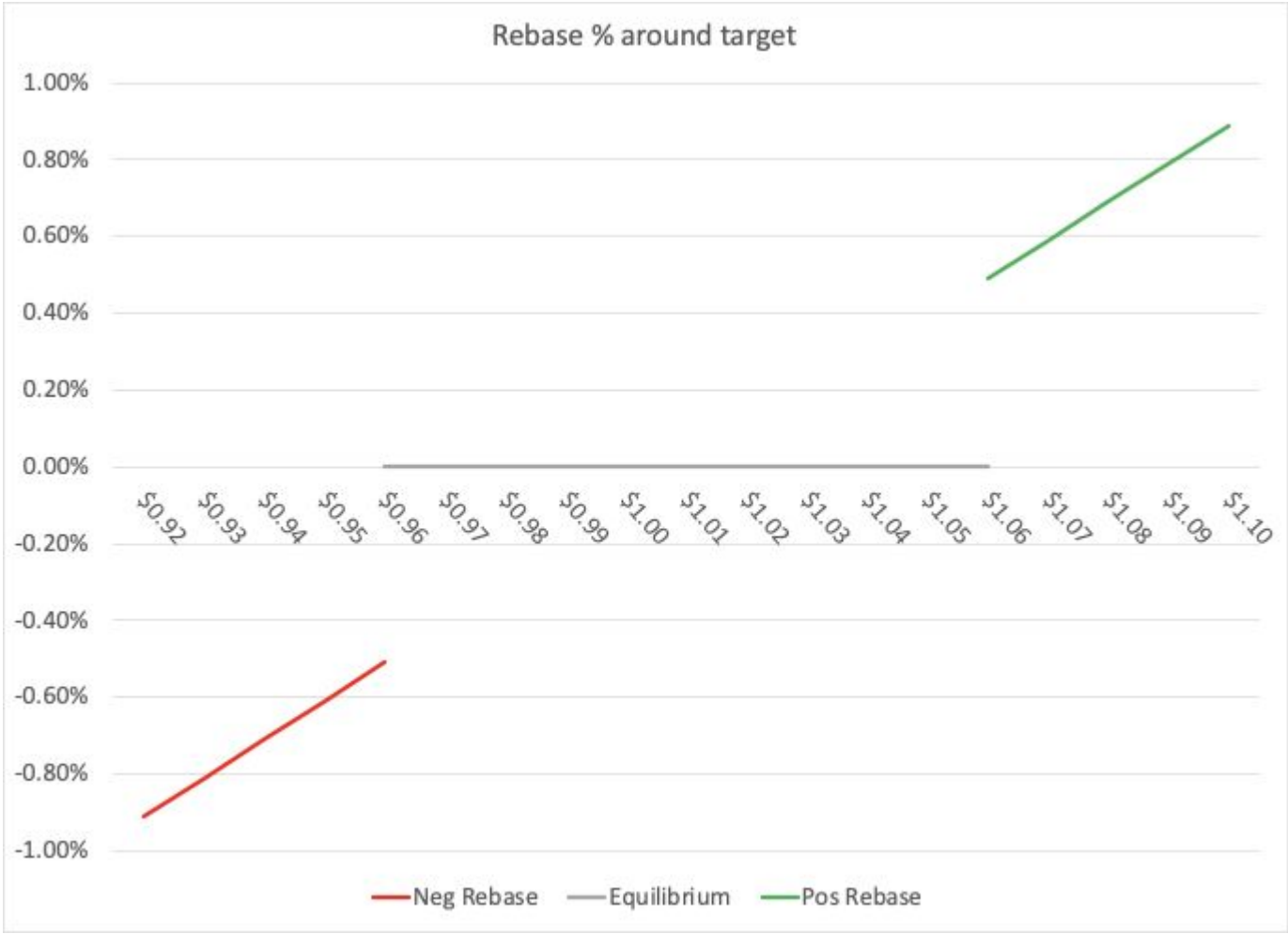
- 2 ether per block
- ~14s block time

Decentralized monetary policy (1)

- The monetary protocol automatically adjusts the supply of AMPL across all user wallets based on price, i.e. the number of AMPL you own changes based on market conditions
- Given a price target, P_t and price threshold, δ:
  - *if* the exchange rate is $> P_t + \delta$, the protocol responds by expanding to coin holders proportionally
  - *if* the exchange rate is $< P_t - \delta$, the protocol responds by contracting from coin holders proportionally
- This supply adjustment operation happens every night at 7:00pm (Pacific) and is called a rebase
- This daily rebase operation is applied universally and proportionally across every wallet's balance
  - non-dilutive: if you own 1% of the overall network you will always own 1% unless you actively make a transfer
  - In comparison: Quantitative Easing directs money to the wealthy people and financial markets first and then trickles down

Decentralized monetary policy (2)

- The target price is a 2019 dollar
  - Due to inflation, the target is $1.011 in 2020
  - The equilibrium band is $0.96 to $1.06 (+/- 5%)
- Smoothen the supply adjustment: To avoid unnecessary overcorrection, the protocol grades supply changes as though they will distribute evenly over the course of 10 days
  - *E.g. if* the exchange rate is $1.5 per Ample, the protocol will increase wallet quantities by **+50% / 10** on the first day
- The supply change is recomputed and executed no more than once every 24 hours
  - This operation is stateless, meaning each day the protocol recomputes a supply target based on the latest price difference, and executes *as though* the change will occur evenly over the next 10 days without any memory of the previous day's supply change
  - Following the previous example, if after the adjustment, the exchange rate is $1.2 per Ample in the second day, then the protocol will increase wallet quantities by **+20% / 10** instead of **+50% / 10**
  - By construction, negative rebases are capped at about 10%, positive rebases are uncapped


Rebase % around target
1.00%
0.80%
0.60%
0.40%
0.20%
0.00%
-0.20%
-0.40%
-0.60%
-0.80%
-1.00%
$0.92
$0.93
$0.94
$0.95
$0.96
$0.97
$0.98
$0.99
$1.00
$1.01
$1.02
$1.03
$1.04
$1.05
$1.06
$1.07
$1.08
$1.09
$1.10
Neg Rebase
Equilibrium
Pos Rebase


Ampleforth Chart
From
Jun 29, 2019
To
Aug 16, 2020
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
CoinGecko
Jul '19
Sep '19
Nov '19
Jan '20
Mar '20
May '20
Jul '20

- Bitcoin and Ethereum have a predefined and rigid monetary policy
- Ampleforth has a rule-based & flexible money supply
- We are in the dawn of a new era: algorithmic & decentralized economics

Take home messages

Reference

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