Beyond the Hype: Stablecoins and DeFi

Ganesh Viswanath-Natraj

Warwick Hodl

March 16, 2022

References: Stablecoins and CBDCs

- Stablecoin Trilemma
- Stablecoin Arbitrage
- Why Libra/Diem Global Stablecoin Failed
- CBDC Design: Retail and Wholesale
- China's CBDC Design
- China's CBDC Security/Trust
- Stablecoin and CBDCs: Policy Challenges

References: Blockchains and DeFi

- Blockchain and DeFi Summary
- Proof of Work
- Math Behind proof of Work
- Proof of Work vs Proof of Stake
- BTC Lightning Network
- Ethereum Rollups explained
- Ethereum Layer 2 Solutions:Polygon Matic
- Decentralised Finance Lecture Notes: Cam Harvey Duke
- Decentralised Finance Lecture Notes: Berkeley
- DAI Stablecoin
- Decentralised Exchanges

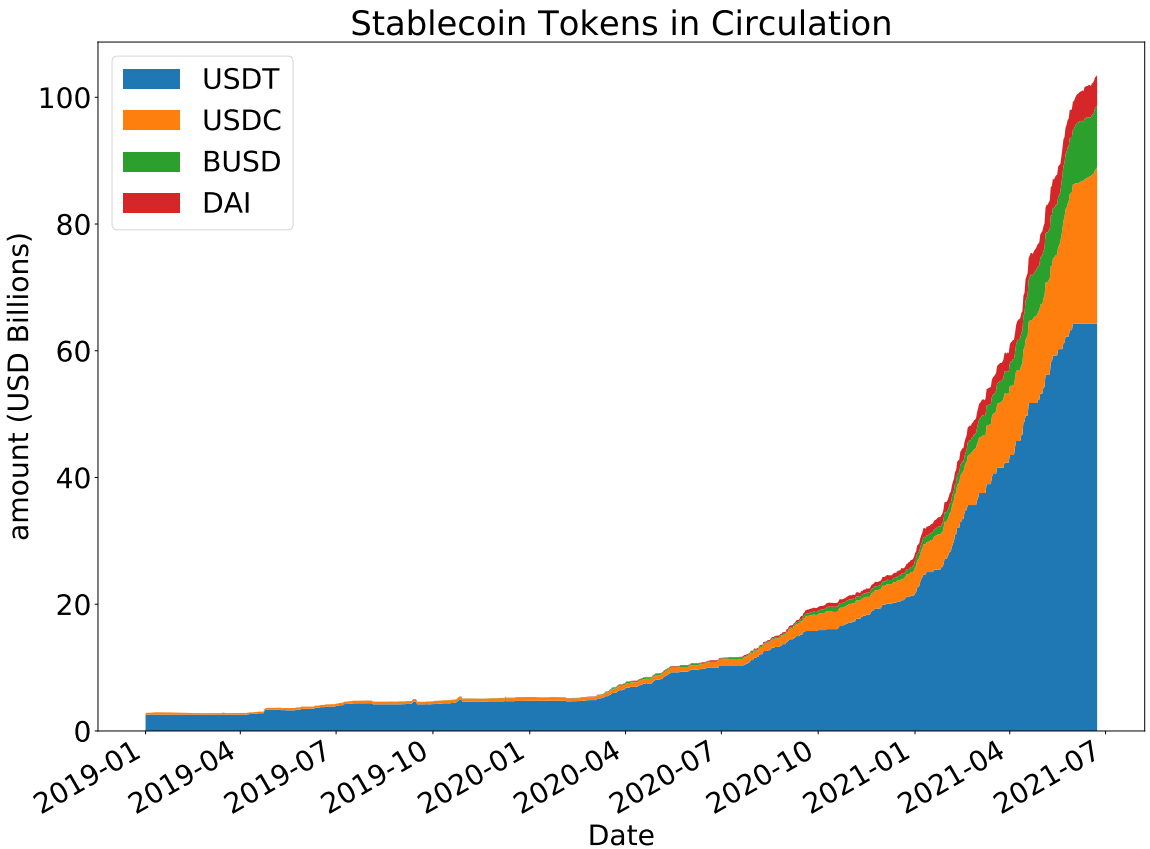
Roadmap of Talk

1. Stablecoins and Central Bank Digital Currencies (CBDCs)
   - Design
   - Policy challenges
   - Comparison of Stablecoins and CBDCs
2. Blockchain and DeFi applications
   - Economics of the Blockchain
   - Blockchain solutions
   - DeFi stablecoins, exchanges and lending protocols
   - Comparison to traditional financial markets

Stablecoin systems and properties

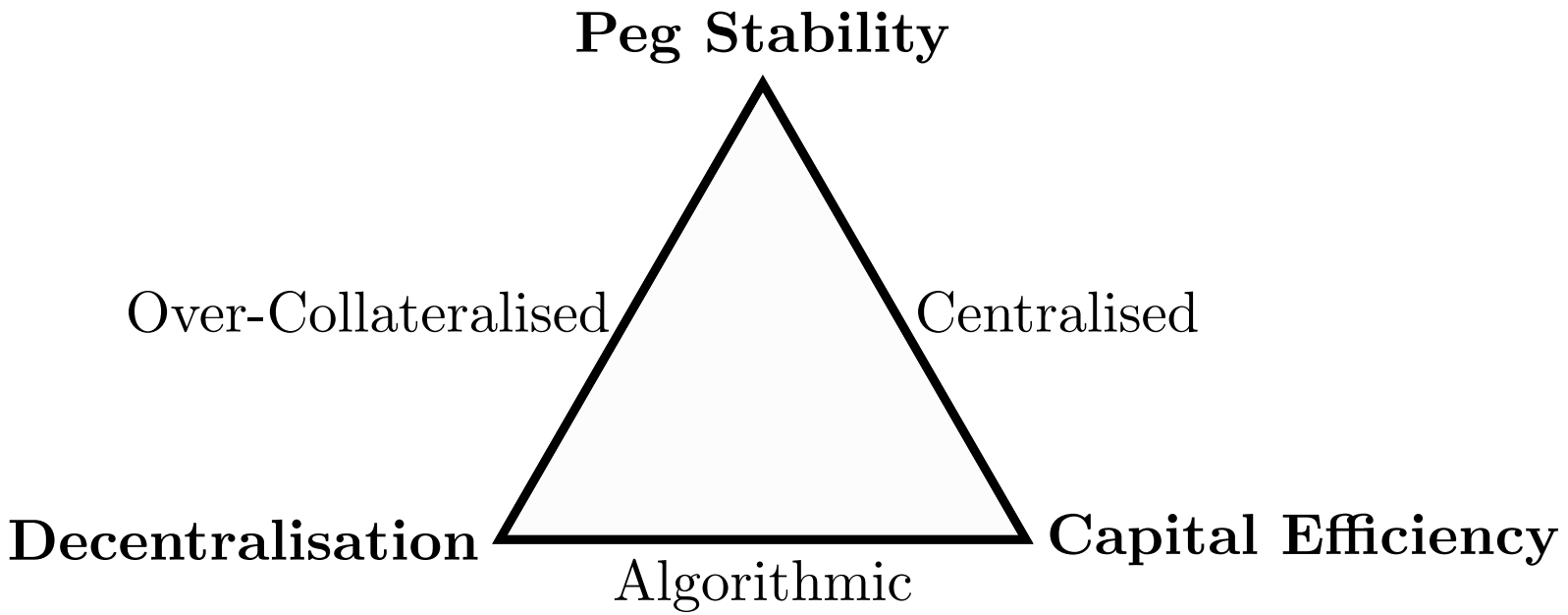
- Stablecoins operate on the blockchain and are pegged at parity to the US dollar.
- Two systems of collateral: **National-Currency backed** or **Cryptocurrency backed**, with the former predominating.
- **Vehicle currency**: They serve as vehicle currencies for trading crypto assets generally due to a reduction in intermediation costs by operating on the blockchain
- **Use in DeFi applications**: Stablecoins used as vehicle on Uniswap (DEX) and DeFI lending protocols to earn high savings rates (eg. Compound)
- **Alternative payments**: Remittance and cross-border payments. Residents in developing countries may use stablecoins to evade capital controls/high inflation.

Stablecoin Ecosystem



Stablecoin Trilemma

Stablecoin designs typically meet two of the following three objectives.

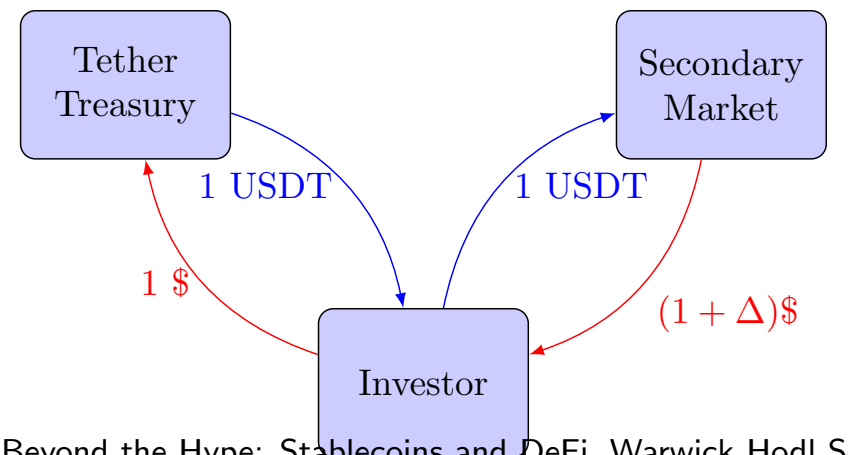


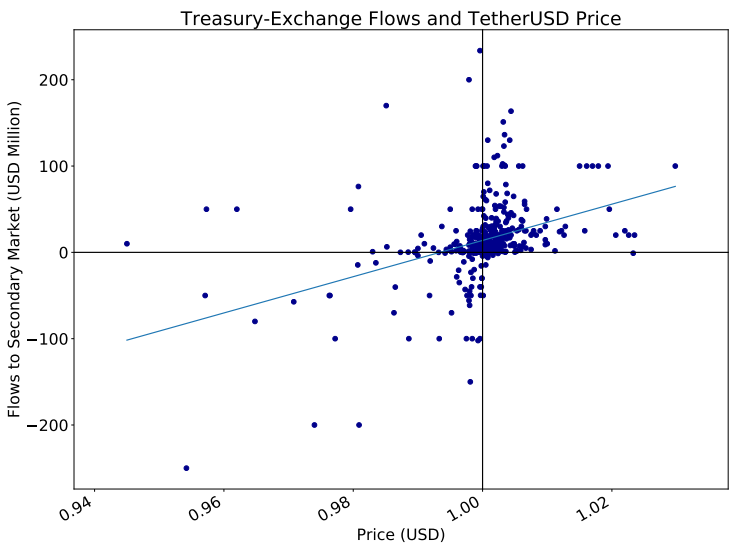
Stablecoin Designs

1. **Centralised**:
   - Most common stablecoin type, lead by Tether. Typically backed by dollar reserves, although not all dollar reserves are cash or cash-equivalent.
   - Tether's balance sheet includes commercial paper and less liquid assets.
2. **Decentralised (over-collateralised)**:
   - Lead by MakerDAO's DAI. Allows individuals to issue DAI tokens through over-collateralised positions in which they deposit cryptocurrency collateral (typically ETH).
   - Drawback is that it is less capital efficient.
3. **Algorithmic**:
   - Stablecoins that typically have zero collateral.
   - While it is capital efficient, it has the drawback that it is prone to speculative attacks and can trade at large discounts.

Research Findings: Arbitrage Design

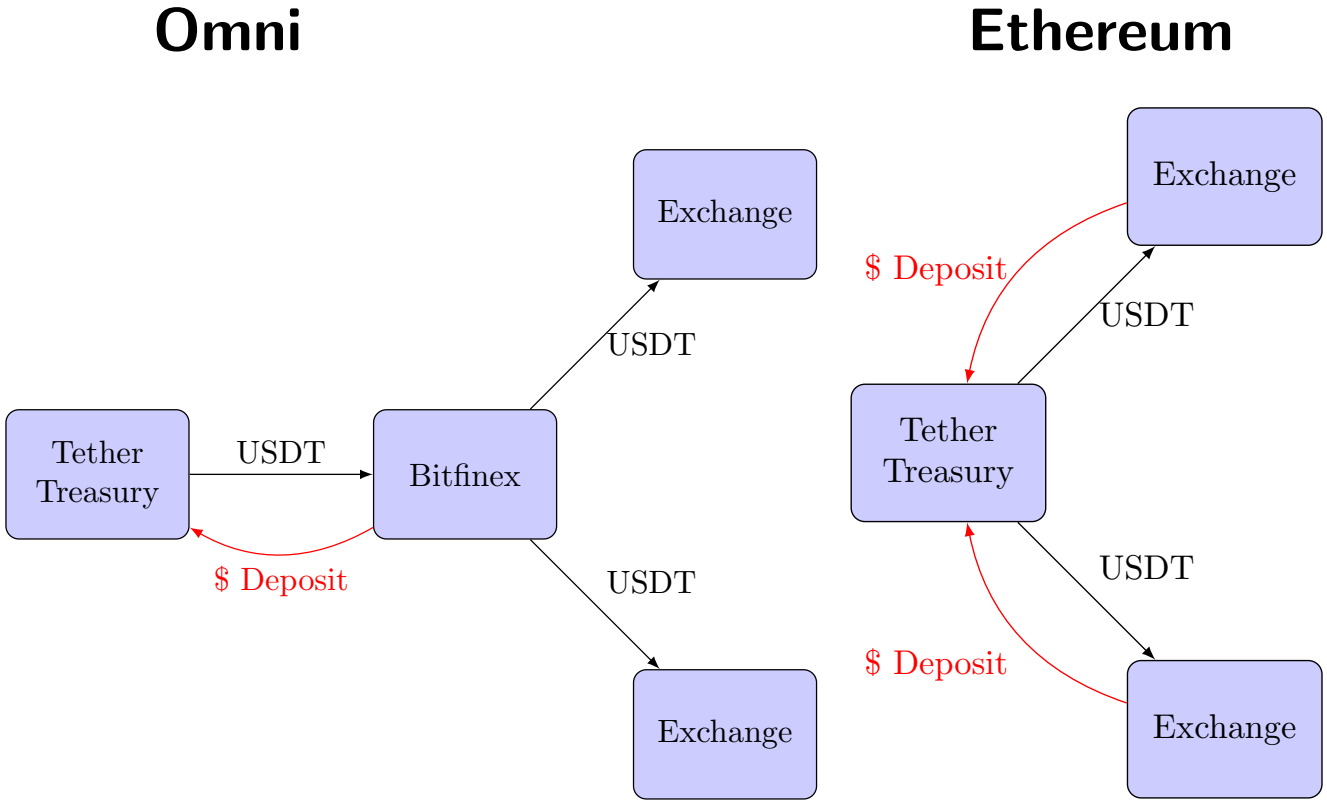
- **Arbitrage mechanism**: Stability of the Tether peg is maintained through arbitrageurs that exploit differences between the primary and secondary market price.
- If the secondary market price of Tether is above one dollar, an investor can buy Tether from the Treasury at a one-for-one rate, and sell Tether at the prevailing market rate to profit, resulting in a flow of Tether from the Treasury to the secondary market.





Research Findings: Arbitrage Design

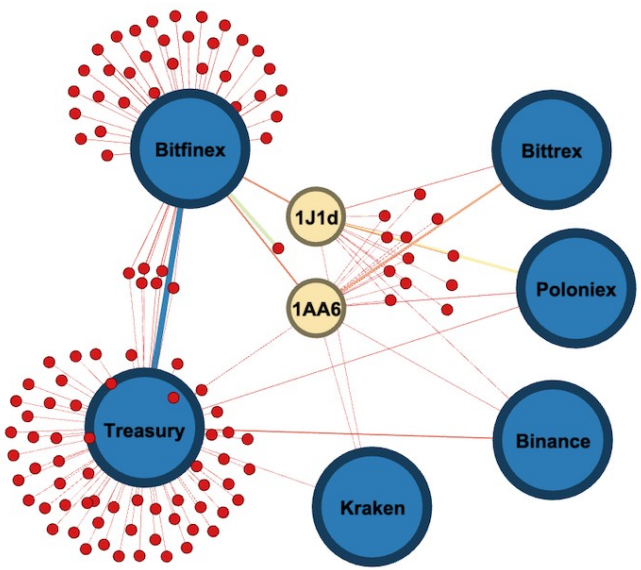
- Decentralisation of issuance is critical to the arbitrage design.
- Initially, Bitfinex has monopoly creation of Tether: issuing 1 dollar deposit and receiving 1 Tether token in return.
- Migration to Ethereum Blockchain led to increased investor access



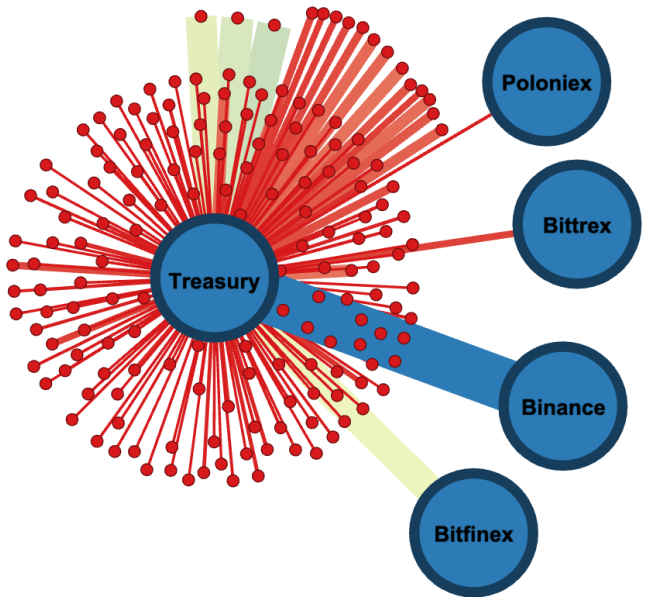
Research Findings: Arbitrage Design

Introduction of Tether to Ethereum Blockchain in April 2019 greatly increased access of investors to directly deposit dollars with the Treasury. Increased investor access $\Longrightarrow$ increase in peg efficiency.

Omni

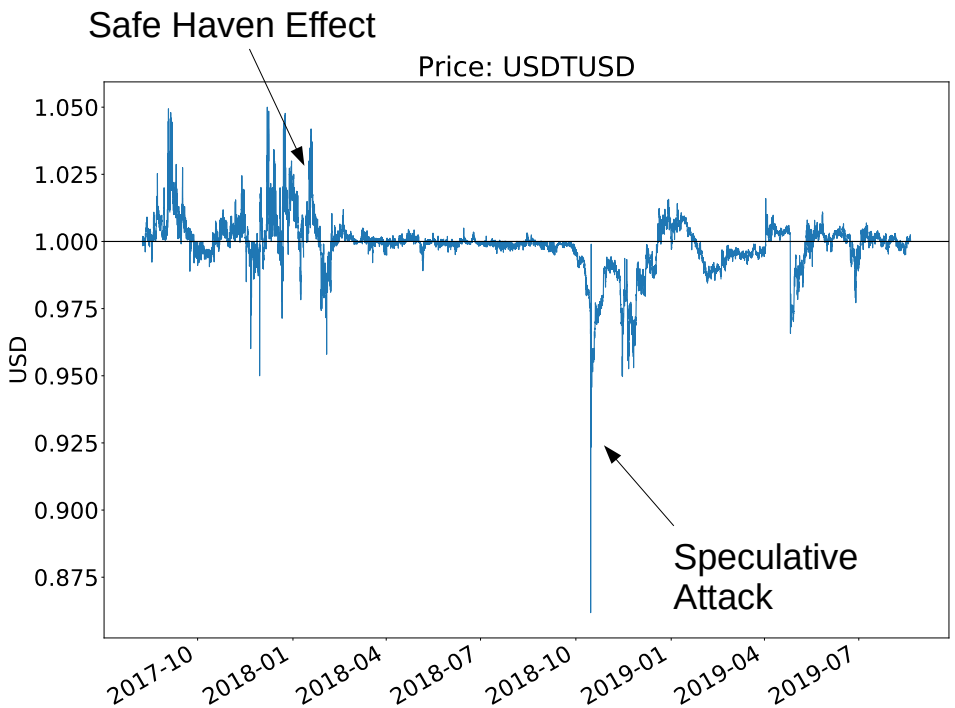


Ethereum



Research Findings: Two-Sided Distribution

- Empirically, we observe a two-sided distribution, stablecoins trade at a premium as well as a discount.
- **Speculative attack**: investors price discounts due to insufficient collateral or custodial and run-risk concerns.
- **Safety premium**: investors liquidating from BTC to stablecoins in a crypto downturn



Policy Challenges

Custodial and run-risk

- **Custodial Risk**: Absconding with funds leading to un-backed Tether tokens
- **Run-risk**: Classic bank run, withdrawals that exceed liquid cash reserves can trigger a speculative attack and mass withdrawals.

Regulation

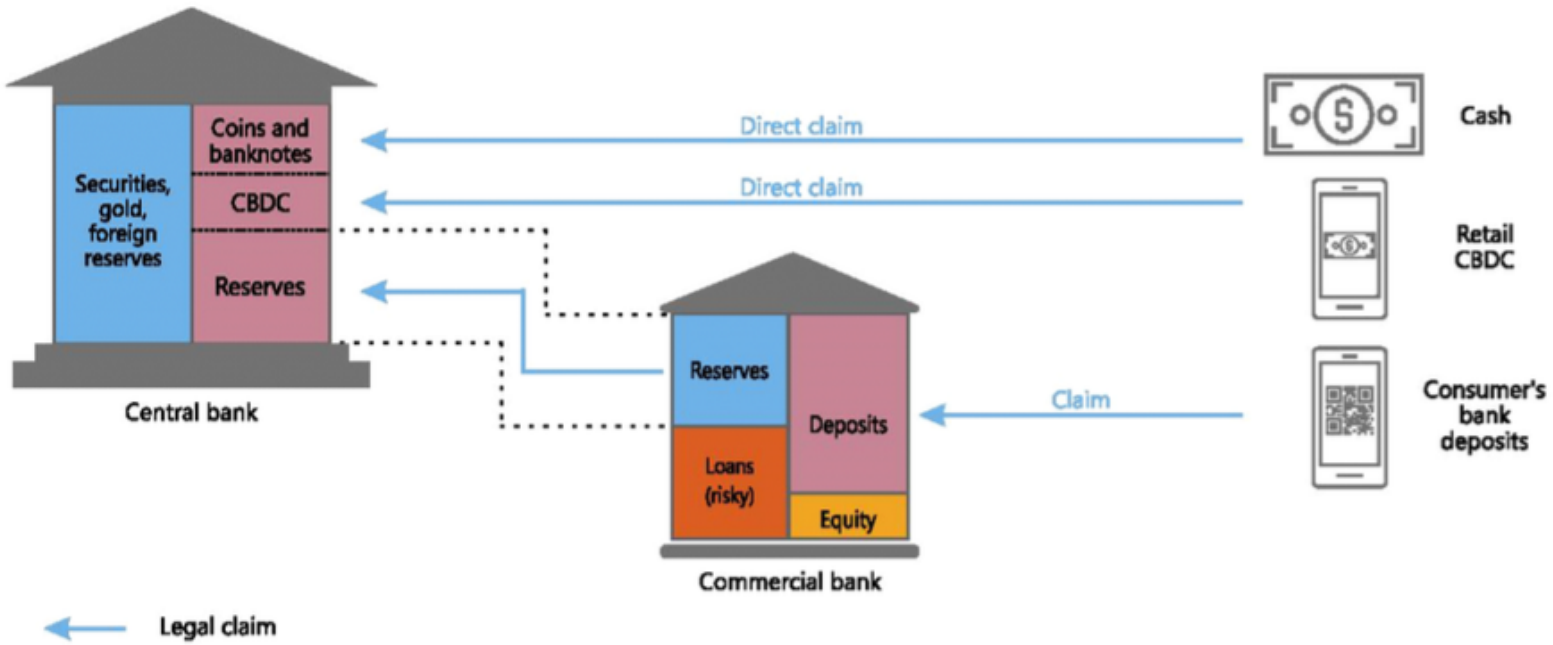
- Recent work by central banks such as the Bank of England suggests run-risk can be mitigated by:
  1. Capital requirements to insure full collateralisation
  2. A backstop to compensate depositors through a deposit guarantee scheme
  3. Liquidity support by the central bank to enable the bank to meet redemptions of deposits in most circumstances.

Central Bank Digital Currency

- Central bank digital currencies are digital tokens, similar to a cryptocurrency, issued by a central bank.
- They are pegged to the value of that country's fiat currency–a public stablecoin.
- CBDC Features
  1. Retail or Wholesale
  2. Token-based or account based (usually the former)
  3. Interest rate (adjustable or fixed)
  4. Private or Public Blockchain
- Pilot projects: Sweden's E-Krona and China's Digital Currency Electronic Payment (DCEP).

CBDC vs Cash vs Deposit

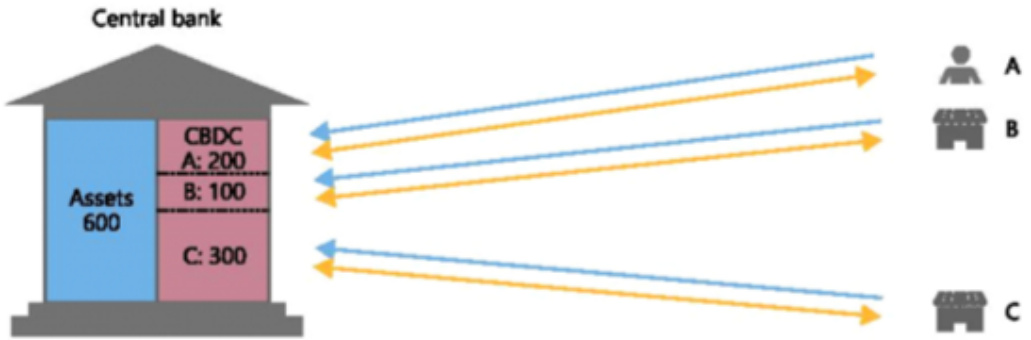
- Retail CBDC is a direct claim on the central bank, similar to cash with an adjustable interest rate.



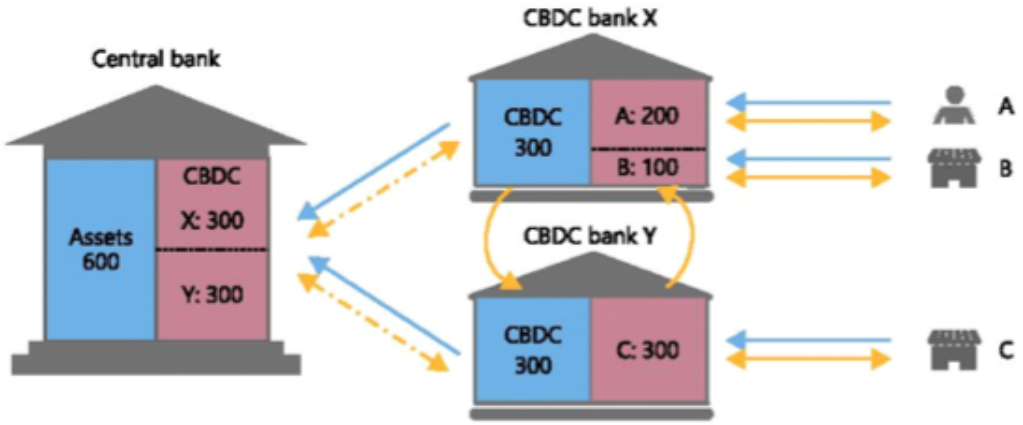
Source: BIS Report

Direct or Indirect Retail CBDC

Direct Retail: Direct claim on central bank



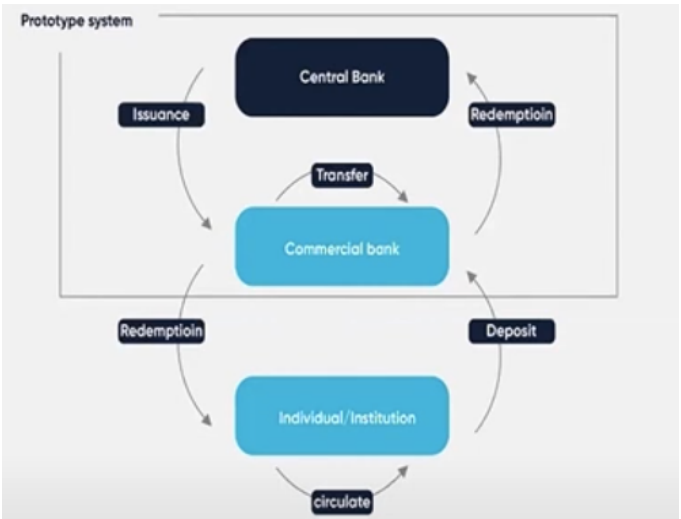
Indirect Retail: Indirect claim on central bank through banks.



Source: BIS Report

China's DCEP Project

- Two-tier system: Central Banks distribute currency to Commercial Bank, which then issues DCEP to retail users.
- Each CBDC token is 100 % backed by reserves.
- The DCEP features *controllable anonymity* on a centralised blockchain. China's government has the ability to freeze and close accounts.



Source: Wanxiang Blockchain

Policy Challenges

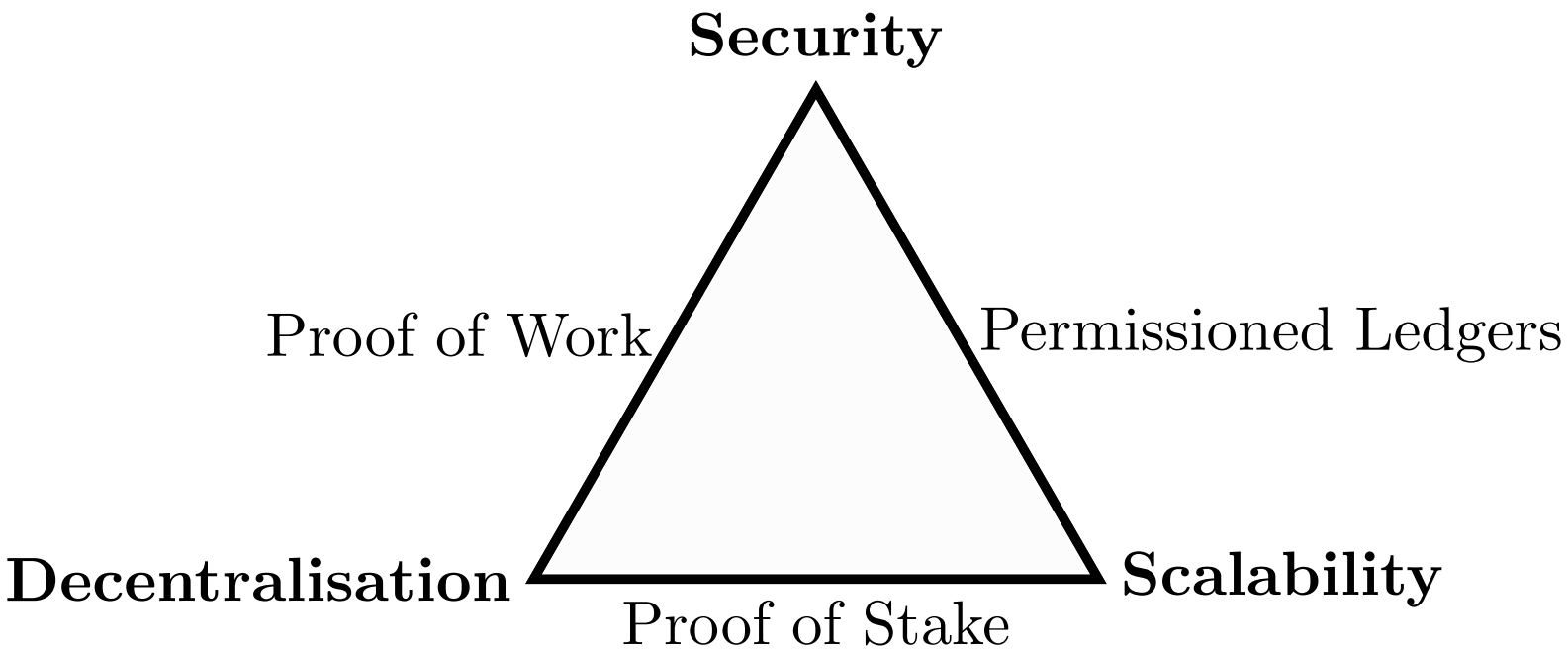
1. **Retail or Wholesale**: Retail is more useful to address financial inclusion for the unbanked in emerging markets. Wholesale can reduce transaction costs in advanced economies.
2. **Token or Account-based**: Tokens increase liquidity and allow for payment services to link between central bank and consumer. Account-based requires central bank to handle all retail payments.
3. **Blockchain or no Blockchain**: A CBDC does not have to use a blockchain. Issues regarding security, permissioning of blockchain and trust/privacy.
4. **Cross-border flows**: Issues in interoperability of digital currencies across borders. Does a digital dollar on Federal Reserve's blockchain transfer to a BoE blockchain for USD/GBP trades?

Digital Currency Battle: Stablecoins vs CBDCs

- **Stablecoins and Financial disintermediation**: Stablecoins can disintermediate the financial sector by reducing deposits and scaling down bank balance sheets.
- **Stablecoins and emerging markets**: Stablecoins have a strong use case in emerging markets with high inflation and weak macroeconomic fundamentals. It can also address financial inclusion by providing a savings vehicle for the unbanked.
- **CBDCs and reserve currency**: China's DCEP is partly motivated by increasing its share of currency use in global transactions.
- **CBDCs in Advanced economies**: Unclear if CBDC is net benefit to UK/US. Financial inclusion and Visa/Mastercard fees $\downarrow$ benefits are low, and it needs to be weighed against costs, eg. blockchain and interoperability concerns.

Blockchain Trilemma

- Blockchains are a peer-to-peer immutable public distributed ledger of transactions.
- The validation of transactions requires authentication through a consensus by validators, typically called miners.



Blockchain

There are three predominant types of validating blockchains

1. **Proof of work**: Most common and is system adopted by Bitcoin and most cryptocurrencies. Miners solve complex mathematical puzzle to authenticate next block of transactions and receive a reward.
2. **Proof of stake**: Less computationally intensive. Miners stake tokens to determine which miner authenticates block. Increases scalability but is less secure.
3. **Permissioned**: Restricts number of validators and achieves consensus through a super-majority (eg. two thirds) to authenticate a block.

Proof of Work

Ethereum Blockchain

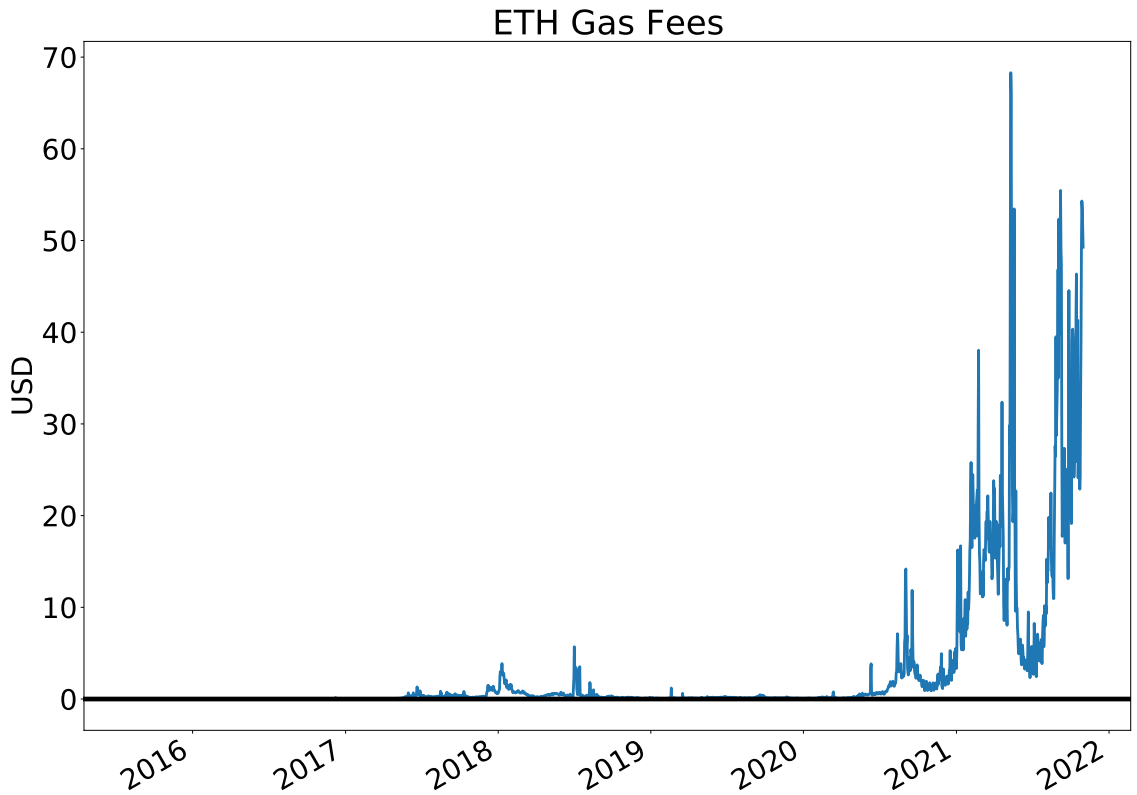
- Ethereum is a decentralized, open source, and distributed computing platform that enables the creation of smart contracts and decentralized applications.
- Smart contracts is a set of instructions, written in computer code, that defines the conditions of the contract for each counterparty under different scenarios (default etc).
- Example 1:**ERC-20 tokens**: A standard which provides functions including the transfer of tokens from one account to another, getting the current token balance of an account and the total supply of the token available on the network.
- Example 2: **Liquidation**. A smart contract can be written to auto-execute when your position is leveraged above the limit, by liquidating user collateral and extracting penalty fees.

Blockchain Scalability

- Biggest concern with blockchain is scalability: How can it be an effective medium of exchange if execution is slow?
- **Bitcoin Blockchain**:
  - Block of transactions is approximately 10 minutes and processes 7 transactions per second. Execution time is much slower than regular payments systems such as Mastercard that process up to 24,000 transactions per second.
  - Annual power consumption of authenticating Bitcoin's blockchain is greater than that of a medium-sized country like Argentina.
- **Ethereum Blockchain**:
  - ETH blockchain is more scalable with 15 transactions per second and blocks are authenticated every 15 seconds.
  - However, the surge in Decentralised Finance applications has led to a surge in **gas fees**.

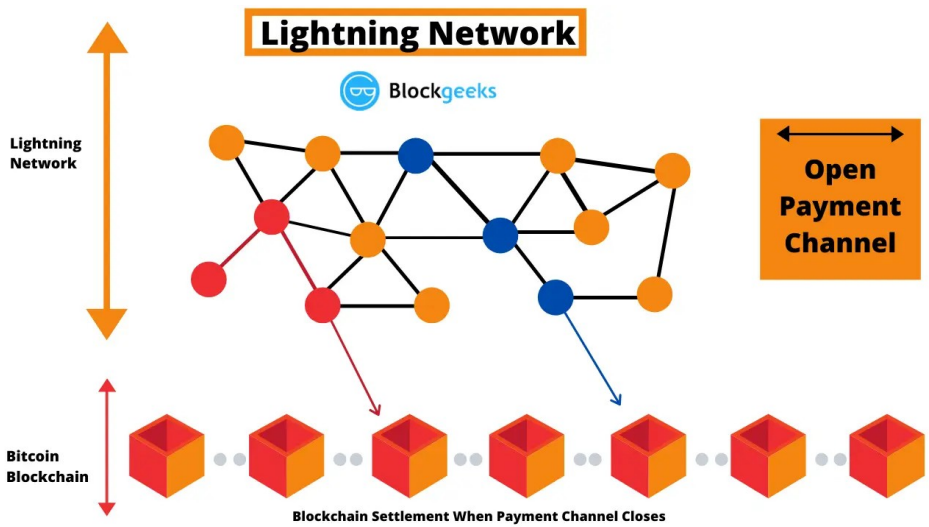
Ethereum Blockchain Gas Fees

Gas is a measure of the amount of ether (ETH) a user pays to perform a given activity and are paid to the miners who authenticate the transactions on the Ethereum blockchain.



Scalability Solution

- **Bitcoin**: Lightning network allows batches of transactions between two counterparties to be completed in an off-chain channel.
- **Ethereum**: Current solutions such as Polygon are a Layer-2 blockchain that builds on Ethereum, but uses proof of stake to validate transactions reducing gas fees.

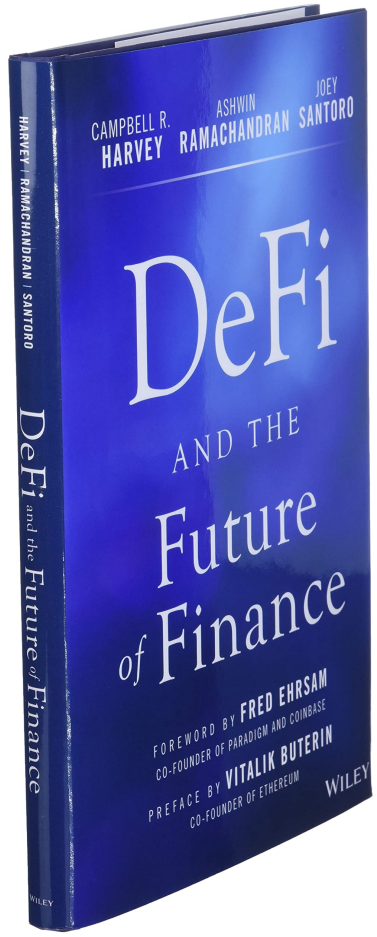


Future of Blockchains

- **Supply chain**:
  - Increases transparency of downstream (producer $\rightarrow$ wholesaler $\rightarrow$ retailer) by documenting all information on goods exchange on public blockchain.
  - Can generalise to any application which benefits from a public archive (eg. Medical/Insurance records).
- **Central bank digital currency**:
  - Potential benefit of reducing illicit (money laundering) activity.
  - Costs are security of blockchain and trust in government.
- **Decentralised Finance**:
  - In my view, the biggest net benefit of blockchains is in reducing the role of intermediation in financial markets.
  - This is through system of smart contracts, which through programming code allow prices to be algorithmically determined, and regulate system parameters.

Decentralised Finance

DeFi is a blockchain based form of finance that removes the need for intermediation. Applications include algorithmic exchanges, algorithmic lending, decentralized stablecoins and Non Fungible Tokens

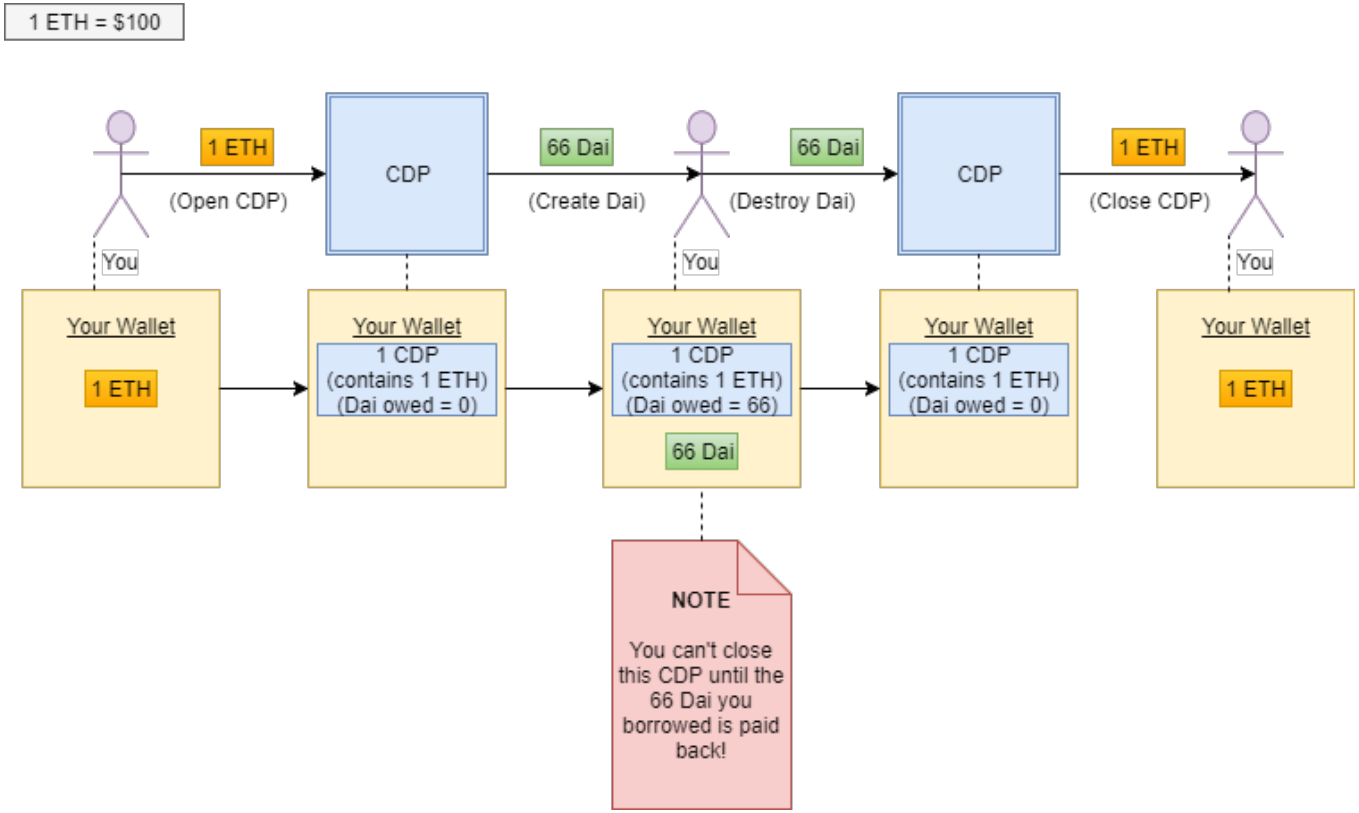


Decentralised Finance

1. **Decentralised Stablecoins: DAI**
   - Over-collateralisation in cryptocurrencies, typically ETH.
   - Collateral risk is a source of peg instability.
2. **Decentralised Lending Protocols: Compound**
   - Multiple asset version of DAI, users can borrow and lend multiple assets.
   - Algorithmic interest rates and over-collaterisation in contrast to credit ratings.
3. **Decentralised Exchanges: Uniswap**
   - Algorithmic prices, in contrast to limit order books that execute trades based on bid and ask quotes.

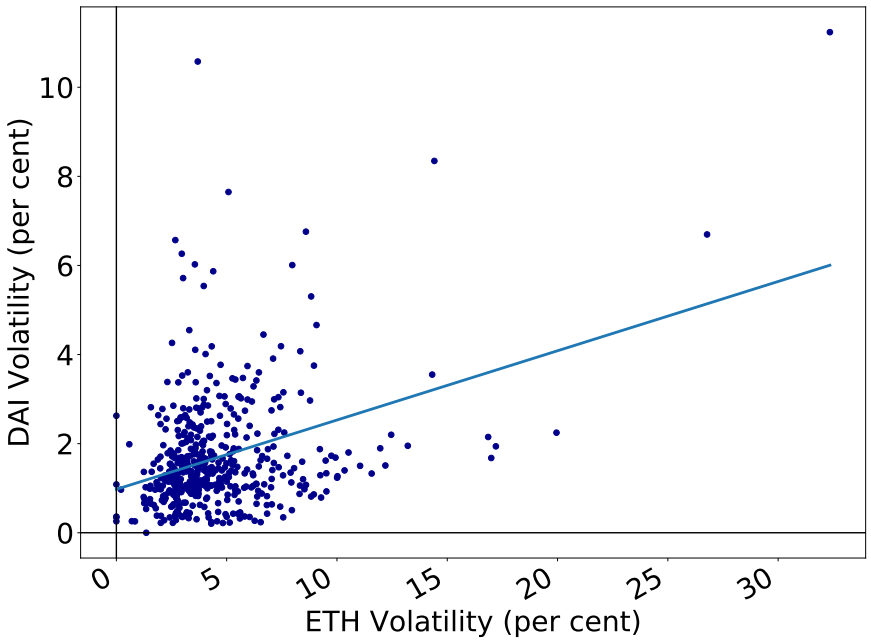
DAI Stablecoin

- Users generate Dai by depositing collateral assets (eg. ETH) into Maker Vaults within the Maker Protocol.
- User positions are over-collateralised. All system parameters are enforced through smart contracts.



Source: Maker for Dummies: A Plain English Explanation of the Dai Stablecoin (G. DiPrisco)

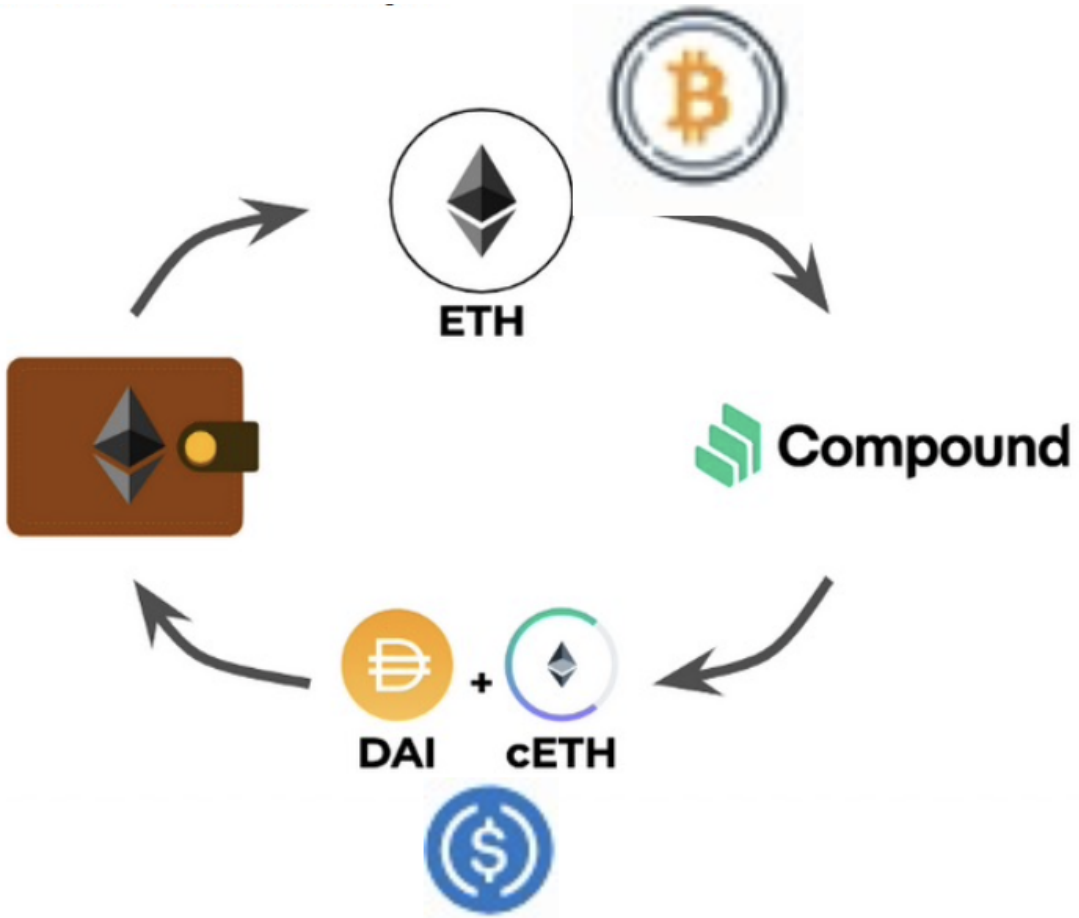
Research Findings



- risky collateral acts as a **limit to arbitrage**
- stable collateral increases ability of arbitrageurs to stabilize the peg.

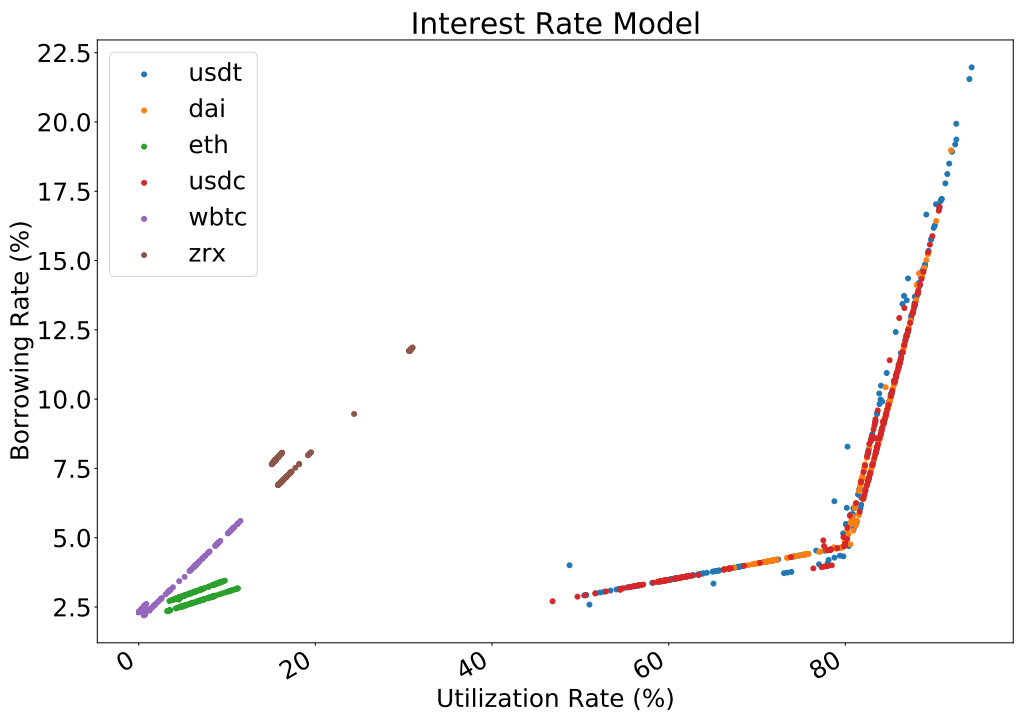
Lending Protocols

- Multi-dimensional version of DAI. Users can lend and borrow multiple assets through system of collateralised lending.
- User can deposit BTC and ETH as collateral, and borrow DAI and USDC.



Lending Protocols- Interest Rates

- Interest rates are determined through algorithms, and are based on utilisation, which measures the fraction of currency deposits that is borrowed.
- Higher utilisation $\implies$ higher interest rates.



Long or Short Leveraged Positions

Long Leveraged Position

- Suppose an investor is bullish about the price of ETH.
  1. Deposit ETH and use as collateral to borrow DAI.
  2. Sell DAI for more of ETH.
  3. If the price of ETH increases, investors use some of the ETH to purchase (cheaply) DAI to repay the debt.

Short Leveraged Position

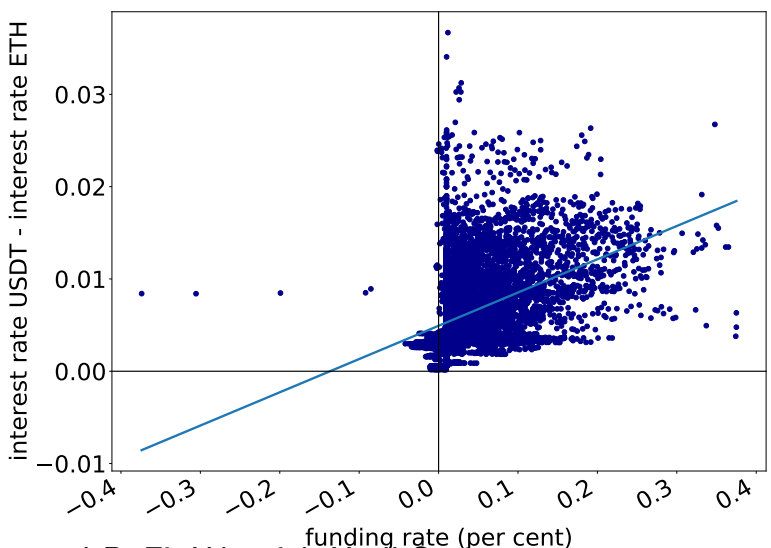
- Suppose an investor is bearish about the price of ETH.
  1. Deposit a stablecoin, such as DAI, and use as collateral to borrow ETH.
  2. Sell ETH for more of the stablecoin.
  3. If the price of ETH falls, investors use some of the DAI to purchase (cheaply) ETH to repay the debt.

DeFi vs Traditional Markets

- Can DeFi lending protocols challenge traditional financing as we know it?
- Banks typically lend to customers based on **credit score**.
- Banks are more capital efficient, for example to lend a mortgage a customer only requires to post a deposit that is 15% of the mortgage loan.
- In contrast, DeFi lending protocols require over-collateralisation to insure against default. Smart contracts enforce automatic liquidation of debt when collaterisation falls below a threshold.
- Trade-off between **over-collateralisation** and **scalability** of DeFi lending protocols. This is a limiting factor in banks adopting over-collateralised lending!

Research Findings

- We observe a strong correlation between the interest rate difference of ETH and USDT stablecoin and the funding rate in ETH/USDT perpetual futures.
- Funding rate: payment by speculators taking long positions to speculators taking short positions in ETH/USDT futures market.
- Equilibrium interest rates are connected to futures! Direct outcome of speculative trading.

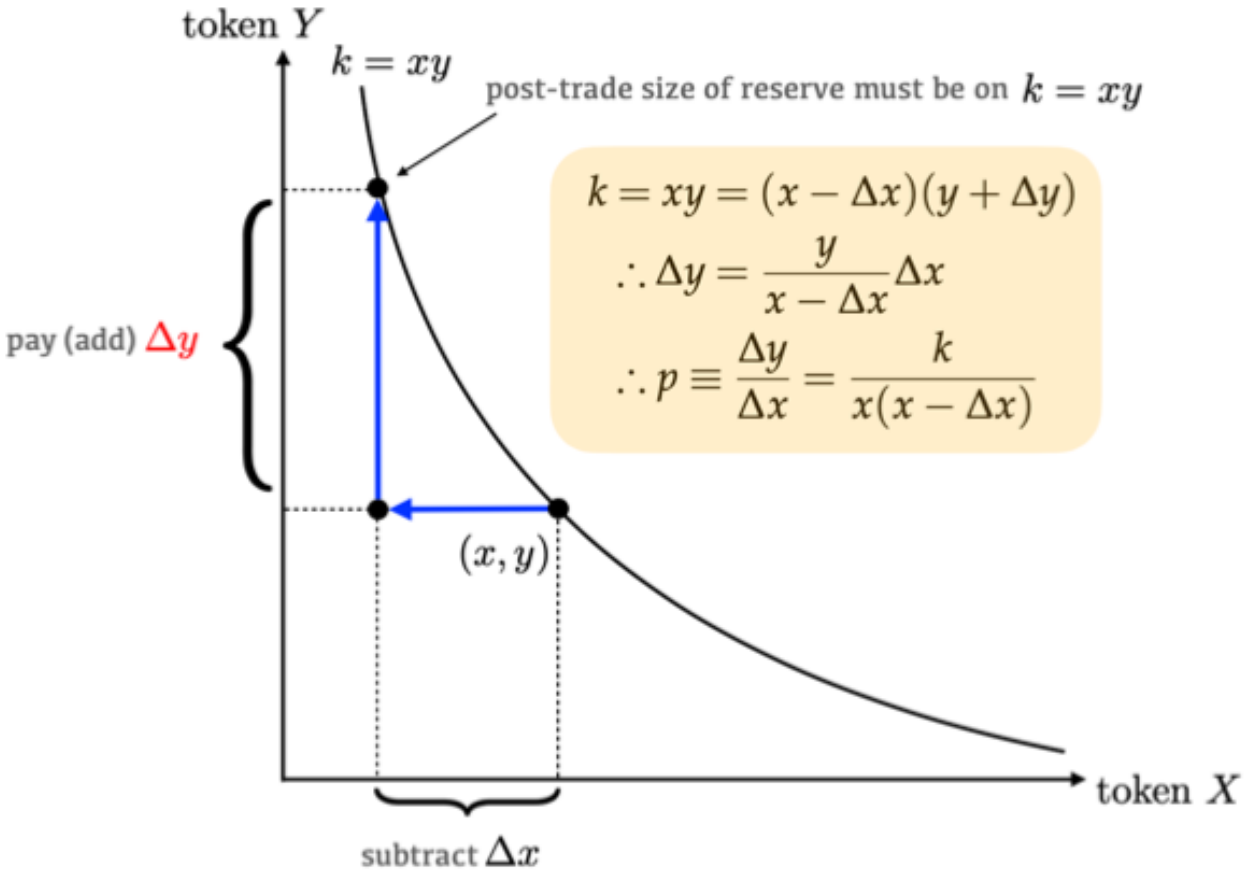


Decentralized Exchanges

- Exchanges typically have a centralised structure, for example with a market-maker that supplies liquidity and typically charge transaction costs (bid-ask spreads) in matching buyers to sellers.
- Decentralised exchanges (DEX) such as Uniswap allow investors to buy and sell tokens in a liquidity pool at an algorithmically determined price.
- Advantages of DEX:
  1. DEX do not have to rely on the service of professional market makers, individual investors can supply liquidity in DEX market.
  2. In order to trade in CEX you have to transfer your tokens to your account at CEX and it is exposed to counterparty risk of the exchange.
  3. On CEX you can only exchange tokens that are "listed". In DEX there is more possibilities to exchange across different tokens.

Automated Market Maker Algorithm

Price of token Y in terms of X is derived via a constant product algorithm $k = xy$



DeFi vs Traditional Markets

- Traditional markets (eg. New York Stock Exchange) and centralised cryptocurrency exchanges (eg. Binance) use a **limit order book**.
- Limit orders specify the price at which the trader is prepared to buy (bid) or sell (ask) the security. Market orders are executed at the best bid or ask.

Research Findings

- We test the relative market efficiency of DEX and CEX for liquid trading pairs, eg. ETH/USDC, ETH/DAI.
- If an investor has information on the future fundamentals of ETH, do they trade on Uniswap or Binance?
- Using a measure of information on each exchange, our findings suggest centralised exchanges lead the price discovery process, contributing on the order of 90% to price discovery.
- Why do Centralised (limit order book) exchanges dominate?
  1. Trades are executed at a higher-frequency in limit-order books.
  2. Gas fees and congestion on the Ethereum blockchain make **front-running** possible.
- Blockchain scaling and speed of payments will drive competitiveness of DEX!

Questions

Thank You!