

CURVE FINANCE

This month we look at Curve Finance, one of the most popular and widely used decentralized exchanges (or DEX) on the Ethereum blockchain.

Launched in January 2020 Curve has quickly become one of the central protocols within the DeFi ecosystem, offering users the ability to earn decent returns on their crypto assets. Curve is a DEX designed to trade stable coins efficiently through an AMM (Automated Market Maker) algorithm. Its main goal is to allow users to trade their stable coins at low cost and low slippage (or arbitrage). The main stable coins traded on Curve Finance are those pegged to the dollar, such as USDC USDT or DAI.

Curve Finance is the brainchild of Michael Egorov, founder of NuCypher and PhD in physics, who towards the end of 2019 noticed a big problem in the world of DeFi. Stable coins, a fundamental part of the whole ecosystem, are based on the concept of price stability and anchoring to a particular currency, very often the dollar. In many protocols the price anchor, also called a peg, was anything but stable and, indeed, prices fluctuated so abruptly that many open positions were liquidated. The success of DeFi depends on three key elements:

- peg stability,
- oracle data security,
- scalability of the Ethereum Blockchain.

To help with the first, an AMM algorithm was developed to provide a mechanism for arbitrage of the various stable coins to stabilize their pegs as much as possible.

CEX, DEX, LP's and AMMs

Before we go any further it will be instructive to gain an understanding of CEX, DEX, AMMs and Liquidity pools and their role in crypto and DeFi in particular.

CEX is a centralised exchange operated by a company which has ownership and control over the operation which allow parties to transfer ownership of assets through their hosted infrastructure. They stand in the middle of a trades.

DEX is a platform for exchanging assets on a blockchain. The rules of exchange are determined by computer programs written to operate on that blockchain. These are commonly referred to as smart contracts on the Ethereum blockchain.

Common examples of CEX's are stock exchanges such as the New York Stock Exchange (NYSE), NASDAQ and notably in the past week, the London Metals Exchange (LME). Well known centralised crypto exchanges include Coinbase and Binance.

Advantages of CEX's include relative ease of use (in crypto they manage wallets and private keys), a wider variety of trading options and the use of order books which provide fair and transparent pricing.

Disadvantages of CEX's include KYC requirements, users trust of the CEX holding their assets, fees are often higher than on a DEX and during times of volatility, CEX's have been suspected of cutting user access to prevent them (the exchange) incurring losses at the expense of their customers.

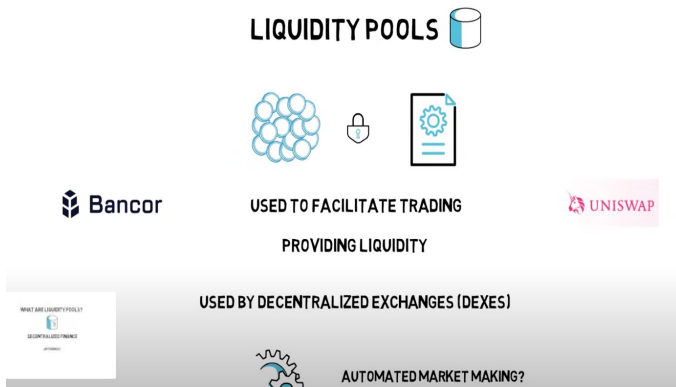
DEX's advantages are no KYC, users retain ownership of their assets, fees and commissions are lower as there are no middlemen to pay, and their uptime is close to 100%.

The primary disadvantage of a DEX is that on a blockchain it's not economically feasible to run a traditional order book. This was a challenge which DeFi had to overcome in order become competitive with CEX's.



Source: Finematics July 2020

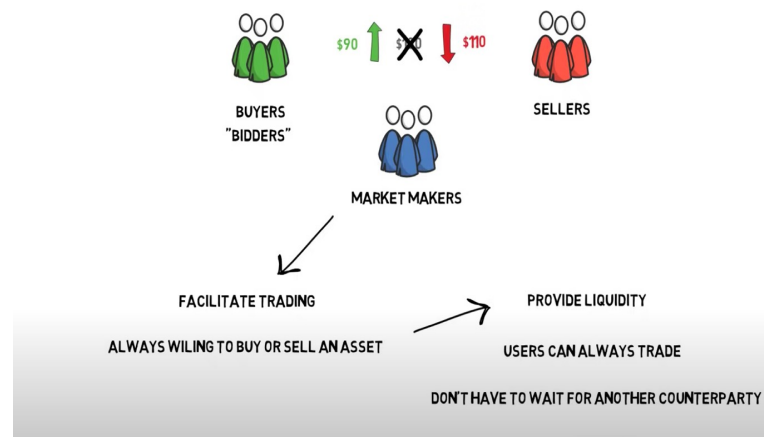
What are Liquidity Pools?



Source: Finematics July 2020

Liquidity pools are pools of tokens locked in smart contracts. They are used to facilitate trading by providing liquidity. They were wildly popularised by the Uniswap protocol.

CEX's are based on the order book model where a Market Maker is always willing to provide a price to facilitate trading.



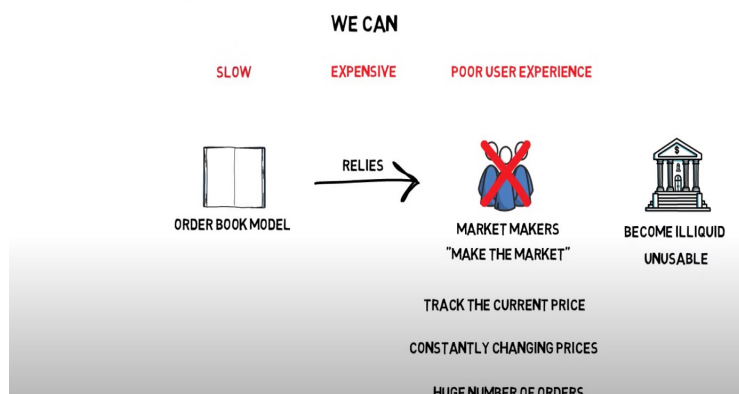
Source: Finematics July 2020

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This ensures users can always trade without having to wait for a counterparty to show them a price.

With Ethereum's current throughput of 12-15 transactions per second and 10-19 seconds block time, it is not viable for an orderbook style exchange.

WHY CAN'T WE JUST REPRODUCE THIS IN DEFI?



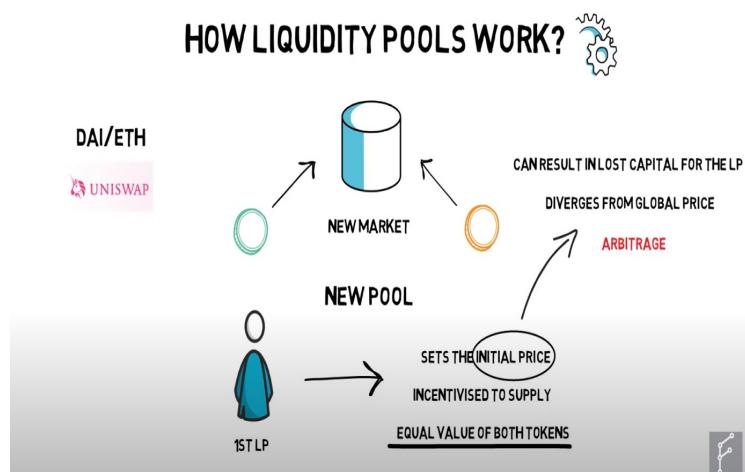
Source: Finematics July 2020

Without market makers, an exchange becomes illiquid and unusable for normal users.

However, market makers need to constantly update their prices to track current markets which results in a huge number of orders being sent to the exchange

Every interaction with the smart contract incurs a gas fee which would bankrupt a market maker by simply updating their prices.

HOW LIQUIDITY POOLS WORK?

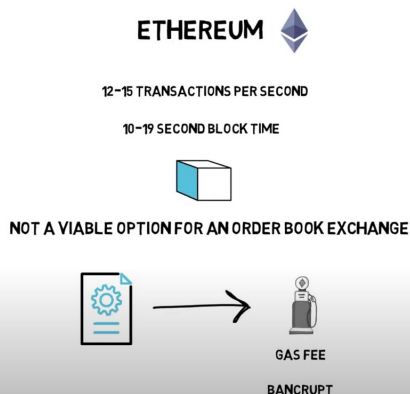


Source: Finematics July 2020

In its most basic form, a single liquidity pool holds two tokens. Each pool creates a new market for that particular pair of tokens. They are used to facilitate trading on DEX's.

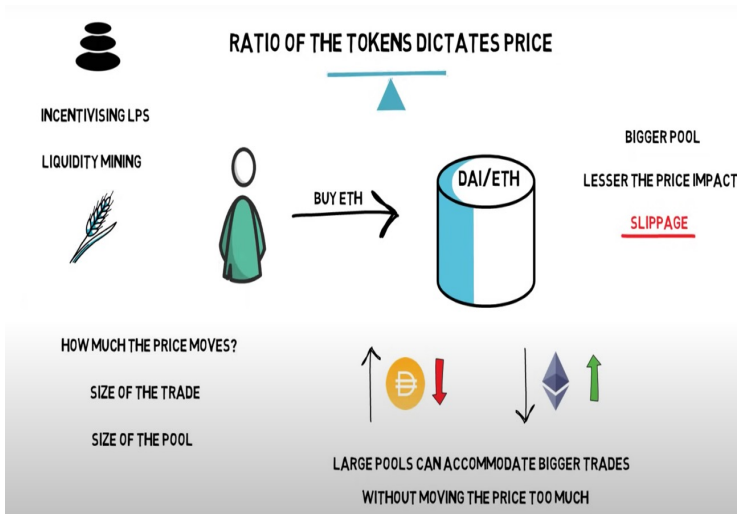
When a new pool is created, the first LP is the one that sets the price of the assets in the pool. Arbitrage constraints ensure liquidity is provided in the correct proportions to ensure the price doesn't deviate from the global price for that asset pair.

Liquidity providers receive a fee for providing liquidity to a pool. On Uniswap, when a trade is facilitated by the pool, the liquidity provider receives a fee of 0.3% of the value exchanged.



Source: Finematics July 2020

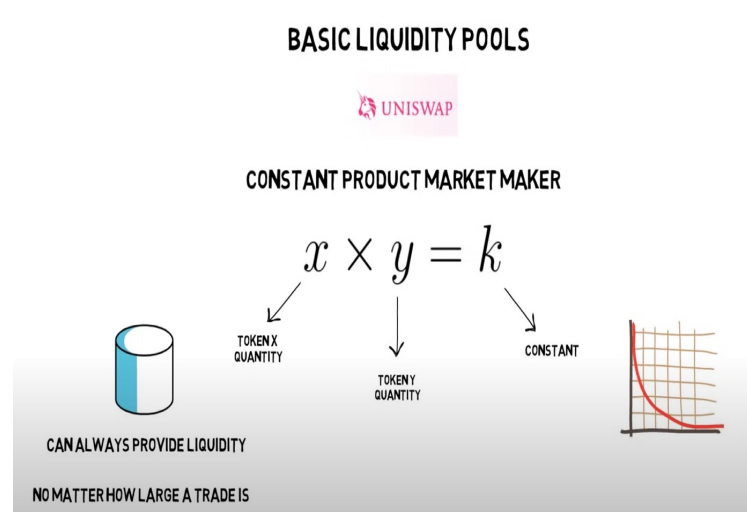
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Source: Finematics July 2020

How much the price moves depends on the size of the trade in proportion to the size of the pool. The bigger the pool, the lesser the price impact (slippage) of any one trade and the better the user experience.

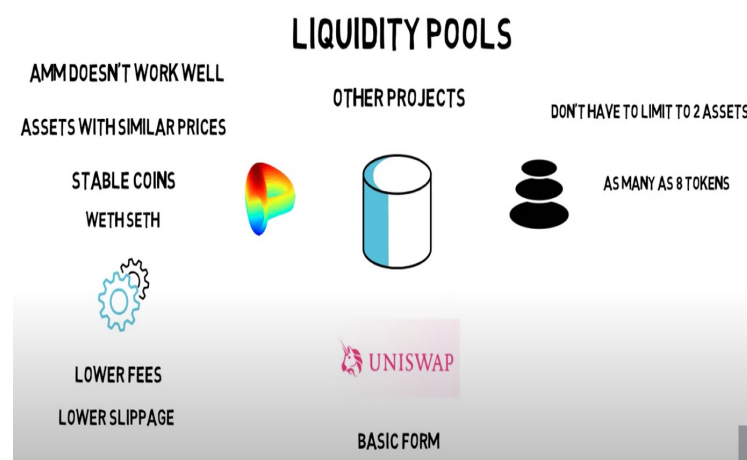
Protocols such as Balancer began incentivising LPs with extra tokens for providing liquidity to certain pools. This is what became known as yield farming or liquidity mining as those tokens became an additional source of yield for liquidity providers in addition to the fees received from trading.



Source: Finematics July 2020

The mechanism adopted by DEX's such as Uniswap to facilitate these liquidity pools was a deterministic algorithm known as a Constant Product Marker Maker. More generically, they are referred to as Automated Market Makers.

Uniswap's version ensures that the product of the value of the tokens supplied always remains the same. This ensures the pool can always provide liquidity no matter how large the trade is.



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Liquidity pools are a relatively simple but powerful concept in DeFi.

While Uniswap adopted the Constant Product Market Maker function for pairs of assets, protocols such as Balancer realised the concept could be extended beyond two assets and now allow as many as eight tokens in a pool.

Returning to Curve Finance

Curve realised that the constant product function doesn't work well for assets with similar prices such as stable coins or different variants of the same coin.

Without getting into the mathematics (follow this link if you'd like to know more, <https://curve.fi/files/stableswap-paper.pdf>) Curve introduced what they call the Stable Swap Invariant which allowed the protocol to concentrate liquidity around a specific price and greatly minimize slippage which significantly reduces trading costs.

According to defillama.com, Curve is the largest DeFi protocol in terms of Total Value Locked (TVL) holding almost \$18bn of the \$198bn locked in DeFi. <https://defillama.com/>

Liquidity – attracting it and keeping it

For any exchange to be successful, CEX or DEX, it must attract liquidity. Exchanges with the largest liquidity attract the most trading activity which generates more revenue for market makers and provides more returns to investors in those exchanges. Exchanges which don't have liquidity

There are essentially three types of participants in the Curve ecosystem: traders (the users that swap between assets), liquidity providers (market facilitators) and CRV token stakers (the owners).

Traders are incentivized to trade where costs are lowest. This is usually where liquidity is greatest as this reduces slippage. Larger trading volumes enable a protocol to charge lower fees while still being profitable.

Liquidity providers are incentivized to add liquidity to the Curve as they receive a 50% share of the trading fees (paid in Curve's native CRV token).

CRV token stakers are incentivized to own CRV tokens as they share the other 50% of trading fees as well as receiving up to an additional 2.5 times the number of CRV tokens they can earn for their own liquidity provision. And finally, CRV stakers have voting rights in the Curve DAO.

As with most DeFi protocols, the native token is used to pay incentives. The CRV token has an inflationary schedule with the last token being issued in just under 300 years from today. The token price acts like a share price and token owners would like the price to increase but liquidity providers are often more inclined to sell their tokens as they earn them, particularly when the inflationary nature of the emission schedule has a downward influence on the token price.

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The challenge for DeFi protocols is to incentivise token holders not to sell their tokens and Curve has come up with an innovative solution.

Incentive Design

“Crypto is a giant game of incentive design, with billions of dollars on the line.

Projects who design their incentives intelligently win massive power and wealth. Projects with poorly designed incentives see their tokens go to zero.

Most incentive design in DeFi is focused on solving two problems:

1. Discouraging people from selling your tokens
2. Encouraging people to make your token more liquid”

Almanack, Field Guide to the Curve Wars: DeFi Fight for Liquidity Curve, Convex, Llamas, Butterflies, Token Reactors, and a Big Bag of Stable coins

For CRV token stakers to earn the maximum 2.5 times the yield on their provided liquidity, they need to lock their tokens for 4 years. These tokens are known as veCRV or Vote Escrowed Curve. In addition to earning the boosted yield, veCRV stakers can vote on which liquidity pools Curve allocates its CRV rewards to. The more votes a liquidity pool gets, the more CRV liquidity providers will receive, and so theoretically more people will stake in that pool. For individual investors this is nice, but the real benefit is for

other DeFi protocols which want to attract liquidity to their own protocol. We are seeing new variations of stable coins being launched with increasing regularity.

To attract liquidity, a new stable coin protocol can add millions of dollars to a liquidity pool on Curve so that their coin can easily be traded with other liquid coins such as USDC and Dai. However, a more capital efficient way of achieving this is for the protocol to acquire veCRV directly and use it to vote for CRV rewards to be directed to their own pool which encourages others to provide their millions in liquidity instead.

These veCRV votes have become a very powerful force in DeFi and Curve has become the most influential protocol in attracting liquidity and driving revenues to its platform.

Curve has found a way to consistently emit tokens while incentivising users not to sell them. It’s what is commonly described as a flywheel effect.

The benefits of the veToken model have not gone unnoticed in DeFi and new protocols have emerged to try to capitalise on it in what has become known as “The Curve Wars” in DeFi.

A topic we will explore in a future research note.

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