



# Crypto Insights

## #2. Decentralised Exchanges & Automated Market Makers - Innovations, Challenges & Prospects

October 2021



# Foreword: The rise of Decentralised Exchanges

We encourage any readers new to Decentralised Finance (DeFi) to read [part one of our Crypto series](#), which introduces core Crypto and DeFi concepts with which this paper assumes readers are familiar.

DeFi is disrupting traditional markets by building applications on blockchain that disintermediate custodians, depository institutions, transfer agents, and trading activities that are typically performed by securities companies and exchanges.

Crypto projects run on tokens, which have utility that may include: governance rights, reserve currency status, unit of value for digital assets within their ecosystem, etc. Trading tokens is a core element in DeFi, allowing liquidity to flow into the most productive and in-demand protocols.

In this second report on DeFi, we look at the Decentralised Exchanges (DEXs) that enable token trading. The most valuable organisations in the centralised crypto industry are exchanges, and as may be expected, the most popular DeFi application by DAO token market cap is also an exchange. The largest DEXs are starting to rival some of the largest Centralised Exchanges (CEXs) by trading volume.

Initially DEXs deployed market-making order books similar to Traditional Finance (TradFi) and Centralised Finance (CeFi) exchanges. However, a key challenge for early DEXs was liquidity. For less well traded pairs, low liquidity resulted in slow execution, stale order books and significant bid-offer spreads.

These problems have by and large been solved by an innovation called 'Automated Market Makers' (AMM). AMM-based DEXs replace order books with a 'liquidity pool'. The liquidity pool is funded by 'liquidity providers', which are typically incentivised by shares of trading fees and issuance of tokens by the DEX. AMMs provide pricing based on an algorithm, allowing instant quotes regardless of the depth of the liquidity pool.

We are now starting to see AMM models being adopted by CEX and TradFi organisations. However, AMMs have drawbacks, including 'slippage' and 'divergence loss' for liquidity providers.

In this report on DEXs we discuss the competitive landscape, the AMM innovation and mechanics, advantages and challenges of AMMs, and the future of DEXs.

This paper pulls together KPMG's in-market insights from working with regulators, financial investors, and crypto exchanges, and sets out the background of DEXs and what we see as the key elements to understand when discussing DEXs. We hope you find this first report on DEXs useful.

# Who this report is for?

Party	Relevant insights in this report:
<p><b>Investors with appetite for crypto-exposure via holding tokens</b></p>	<p><b>Direct DeFi exposure:</b> Purchasing DeFi tokens, or investment in fiat-denominated investment funds holding DeFi tokens (public or private)  <b>Indirect DeFi exposure ('DeFi spillover')</b>: Investors in base blockchain 'Layer 1' network tokens (Ethereum, Solana, Avalanche, etc). Price and trading volume of these tokens is largely driven by demand for defi platforms built on their networks.</p>
<p><b>Investors with appetite for crypto-exposure without holding tokens</b></p>	<p><b>Private markets:</b> Investments in teams building DeFi protocols  <b>Public markets:</b> Investment into adjacent services (e.g. public crypto mining firms, a large share of Ethereum mining is driven by DeFi activity)</p>
<p><b>DeFi builders</b></p>	<p><b>The future:</b> Insights into what the future of Decentralised Exchanges may look like can drive protocol development  <b>The challenges:</b> See which major challenges &amp; risks to consider in order to maximise potential opportunities</p>
<p><b>Non-DeFi builders</b></p>	<p><b>New competition:</b> Money on traditional platforms will be targeted by a large number of tech-savvy competitors from an open innovation ecosystem</p>
<p><b>A 'traditional' financial services player</b></p>	<p><b>Innovation:</b> Centralised crypto exchanges are starting to leverage AMMs (e.g. Bullish), the innovation powering DeFi exchanges. DeFi innovation cycles are fast and may provide inspiration to non-crypto financial services as well</p>

# KPMG Point-of-View on the Future of Decentralised Exchanges & Automated Market Makers

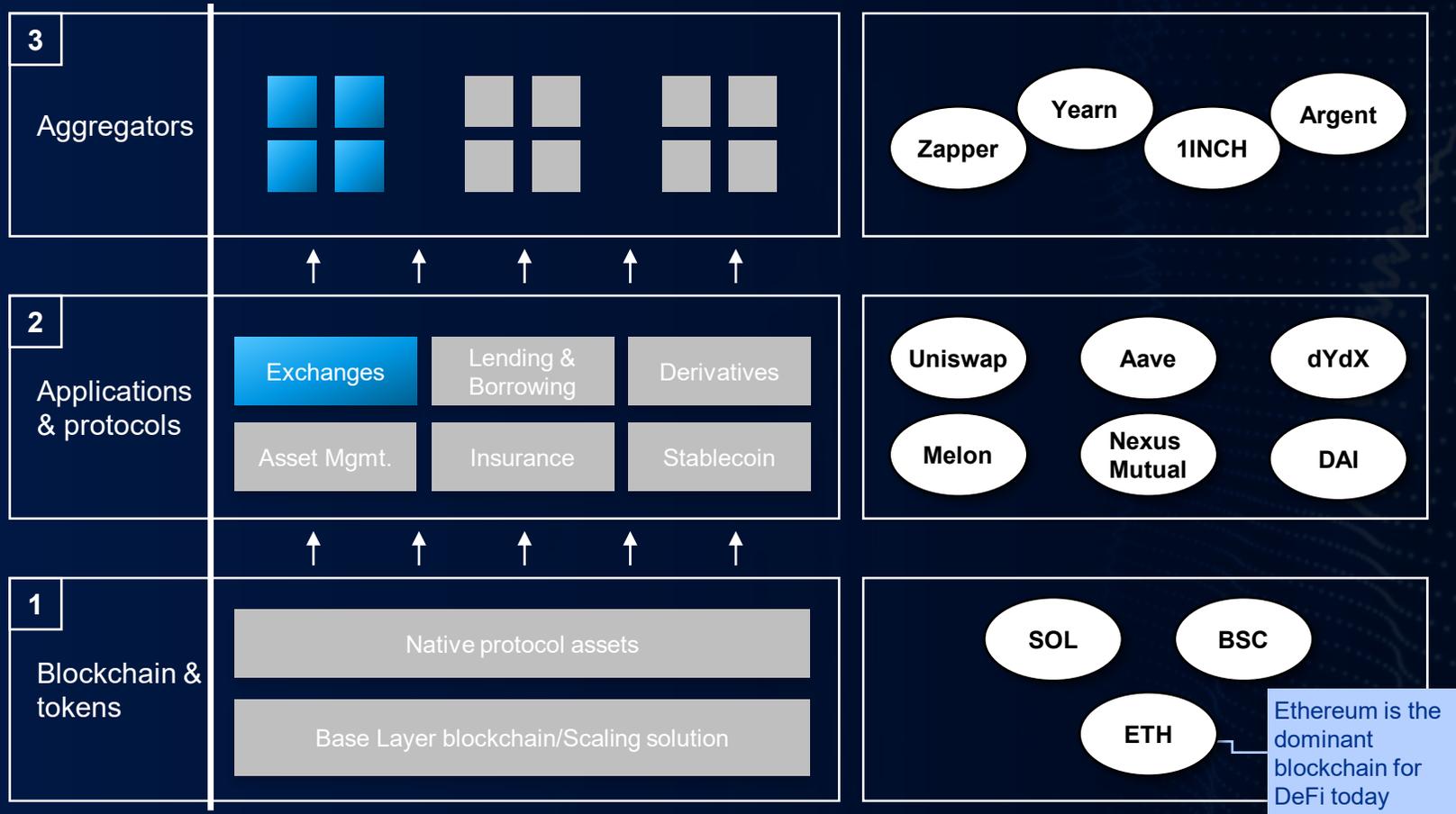
<p><b>Automated Market Makers will continue to drive value for both DeFi and CeFi platforms</b></p>	<ul style="list-style-type: none"> <li>— Automated Market Makers leveraging liquidity pools have their strength in correlated currency pairs due to their high operational efficiency. Over time, we will continue to see efficiency enhancements.</li> <li>— Blockchain efficiency will improve while order-book based exchange models with more professional market makers that manage adverse selection will resurface for non-correlated pairs (e.g. Serum on Solana)</li> <li>— AMM's potential depends on future innovation - if impermanent/divergence loss can be mitigated and capital efficiency increased, we believe they can remain competitive to traditional order-books, especially for large trades</li> </ul>
<p><b>Aggregators may become the 'de-facto' trading venues</b></p>	<ul style="list-style-type: none"> <li>— Aggregators allow traders to access total liquidity in an ecosystem – rather than just one protocol</li> <li>— This will enable a stronger liquidity proposition for aggregators, with lower fees as blockchain efficiency increases</li> <li>— DEXs can retain liquidity if they introduce value-added features, build loyalty, increase trade efficiency and maintain high relative trading volumes in a way that minimises execution costs</li> </ul>
<p><b>DEX volume is a function of overall DeFi scale. Regulation, use case development and long-term DeFi interest are key unknowns</b></p>	<ul style="list-style-type: none"> <li>— Regulatory transparency and solutions to AML concerns could be the catalyst for unlocking DeFi to institutional capital</li> <li>— Harsh regulation could lead to a 'schism' in DeFi ecosystems and fragment liquidity, hampering its potential</li> <li>— Development of use cases for DeFi to more smoothly integrate with the non-digital economy, reduce fraud, and increase blockchain efficiency will likely drive growth</li> </ul>
<p><b>DeFi will remain an innovation hub for the foreseeable future – but openness is under threat</b></p>	<ul style="list-style-type: none"> <li>— DeFi draws its innovative power from open source code, open access, and interoperability principles and architecture</li> <li>— We expect this to remain prevalent for the foreseeable future, as investor capital flows into individual projects</li> <li>— The innovations of DeFi will be replicated by CeFi and TradFi. Fintechs will likely be the first movers</li> <li>— Threat of imitation may lead to divergence from open source philosophies</li> </ul>

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# DEXs are distributed applications (Dapps) that operate through smart contracts hosted on blockchains. Certain aggregator applications integrate multiple DEXs

## The DeFi tech stack



**LAYER 3: Aggregation layer:** On top of the dApp layer, another layer of applications can exist and integrate with dApps. For example, Yearn Finance aggregates protocols to provide competitive liquidity offers across applications. This is possible due to the composability (like bricks, but for DeFi) enabled through shared interoperability standards.

**LAYER 2: Applications & protocols:** Protocols are autonomous programs that run on the underlying blockchain. Applications are the interfaces through which users interact with these protocols.

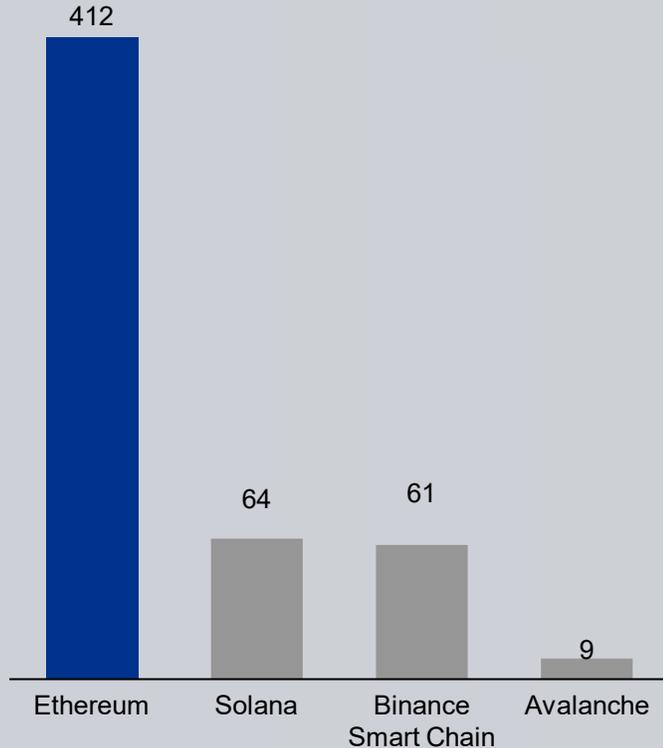
**LAYER 1: Blockchain & tokens:** Each network's base layer. Ethereum is the most commonly used blockchain in DeFi. Alternative chains in this layer include Solana, Binance Smart Chain, Ethereum scaling solutions environments (e.g. Arbitrum, Optimism, Polygon, and other sidechains). These base layers have native tokens used to pay for operations performed on-chain, and usually have the ability to create and transfer other tokens, fungible or non-fungible.

Source: Based on Schaer, 2021, "Decentralized Finance: on Blockchain- and Smart Contract-based Financial Markets"

# Total DEX volumes are low compared to centralised exchanges, but individual DEXs are noteworthy

## Ethereum is the dominant DeFi blockchain

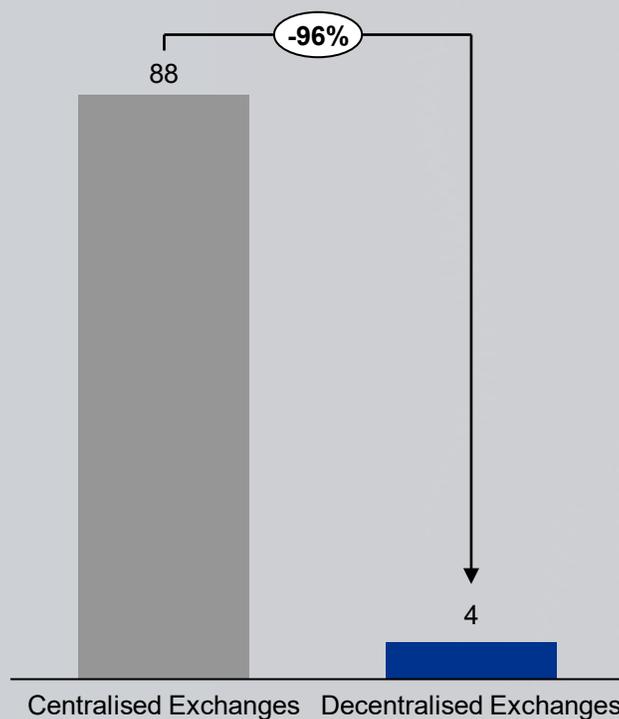
Market capitalisation of native tokens with DeFi activity (USD B, 09/21)



Source: CoinMarketCap and Hecoinfo  
 Notes: Market capitalisation as of 09/2021

## Centralised Exchanges (CEX) still dominate

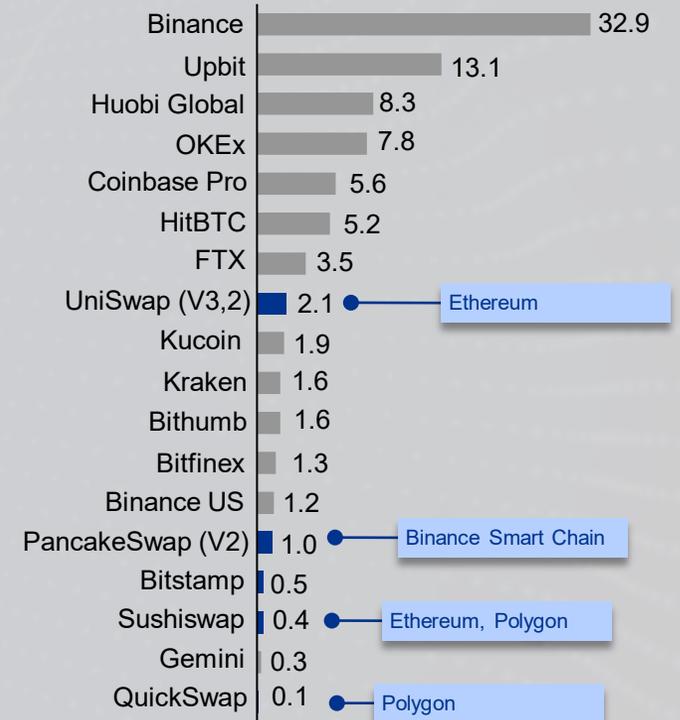
Average daily spot trading volume on exchanges (USD B, 09/21)



Source: Coingecko  
 Notes: 7-days average trading volume of week of 1 Sept – 7 Sept. Spot volume only for CEX.

## Top global exchanges & DEX blockchains

Average daily spot trading volume on exchanges USD B, 09/21

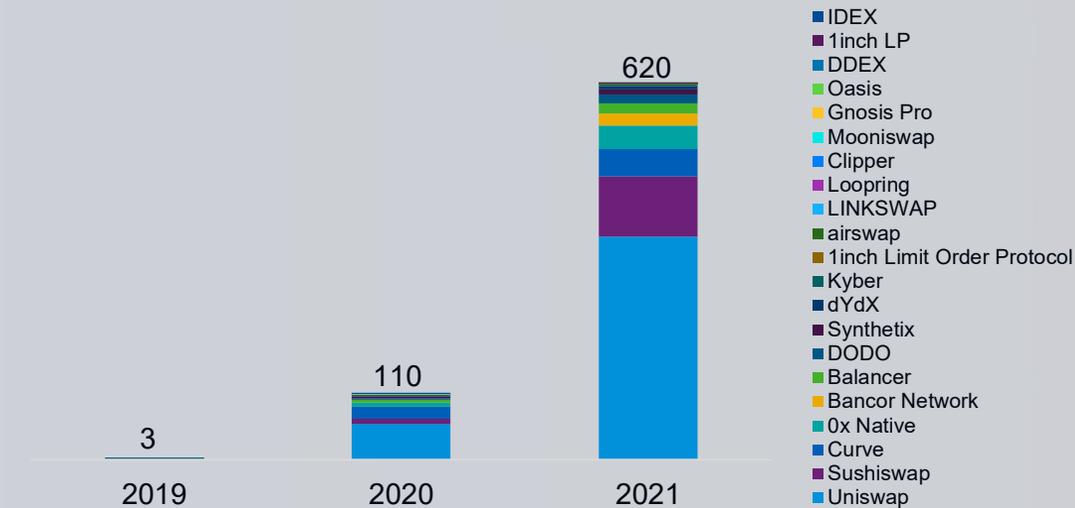


Source: Coingecko  
 Notes: 7-days average trading volume of week of 1 Sept – 7 Sept. Spot volume only for CEX.

# Uniswap is the largest Ethereum DEX with >50% market share, 3x the size of the runner-up

## Exchanges

Total trading volume of major DEXs running on Ethereum blockchain  
USD B, 2019-09/21



### Comments

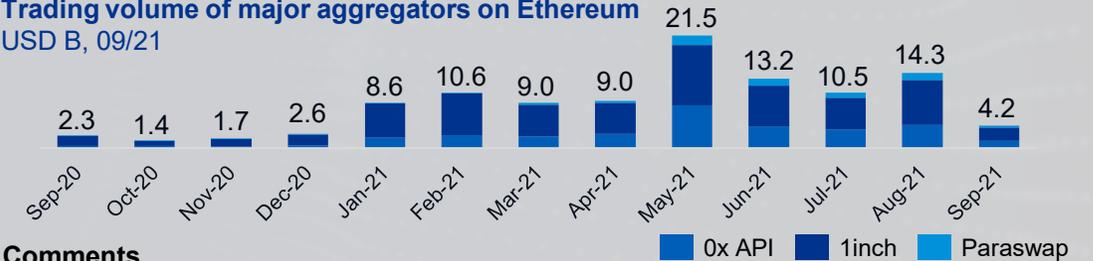
- Uniswap, hosted on Ethereum, was by far the biggest spot DEX as of September 2021
- Sushiswap forked (copied the open source code of) Uniswap in 2020. Sushiswap created and incentivised Uniswap’s liquidity providers with tokens (SUSHI) to migrate liquidity to Sushiswap. This ‘vampire attack’ did not harm Uniswap volumes long-term.
- As gas costs rise, DeFi volume is moving to other chains. DEXs on both Huobi Eco Chain and Binance Smart Chain (MDEX and Pancakeswap) have gained scale, offering average transaction gas fees at 1% of the ETH cost\*

## Aggregators (trading-side)

Trading volume of major aggregators on Ethereum blockchain  
%, 09/21



Trading volume of major aggregators on Ethereum  
USD B, 09/21



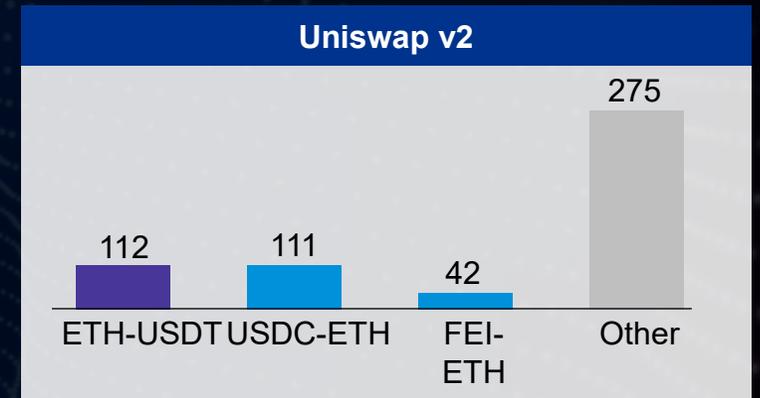
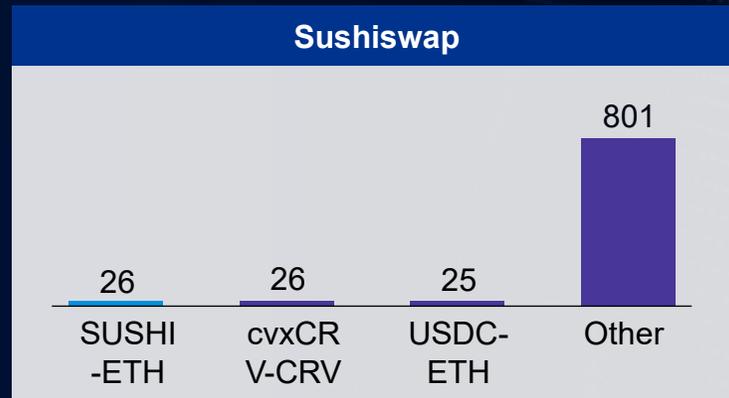
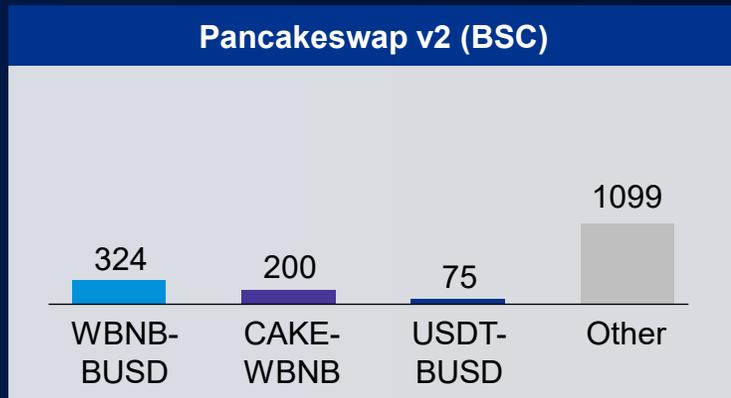
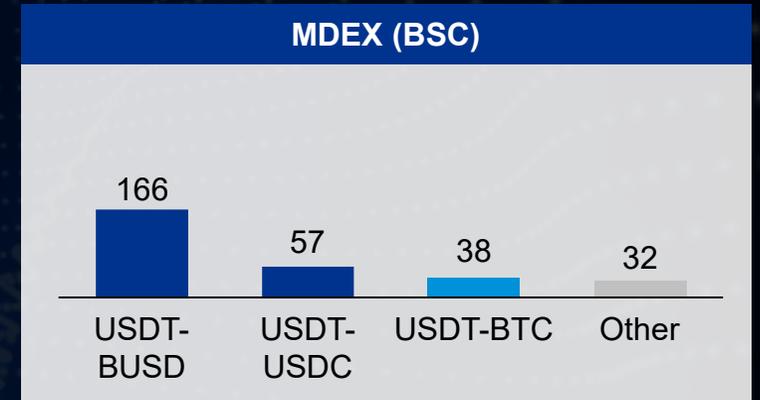
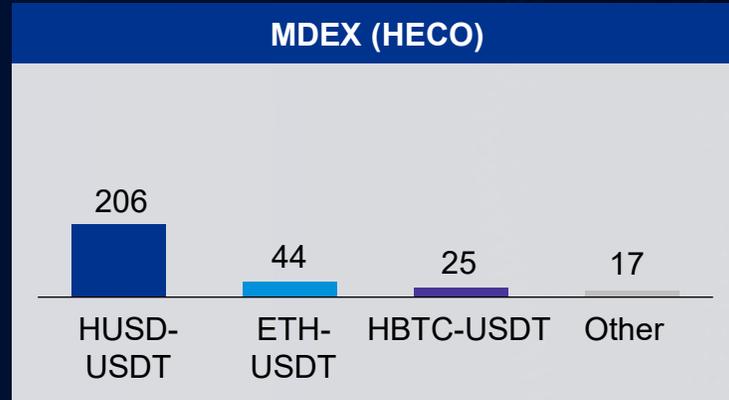
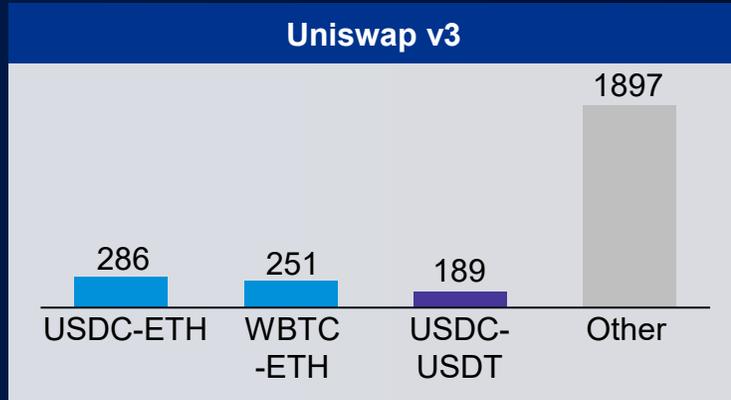
### Comments

- DEX aggregators route transactions to the DEXs with the lowest projected total execution cost (transaction fees, slippage, gas cost). Some aggregators like 1inch also bundle transactions, reducing chances of failed transactions
- They do not only need to include DEXs, but can potentially include features like OTC trading, interfacing with dApps, or providing liquidity
- Major aggregators today exist across blockchains

Source: Dune Analytics 09/21, \*The Defiant.io, June 21

# Concentration on major pairs differs significantly between exchanges – most prominent pairs however include at least one stablecoin

Daily trading volume of largest DEX by currency pair  
USD M, 07/09/2021



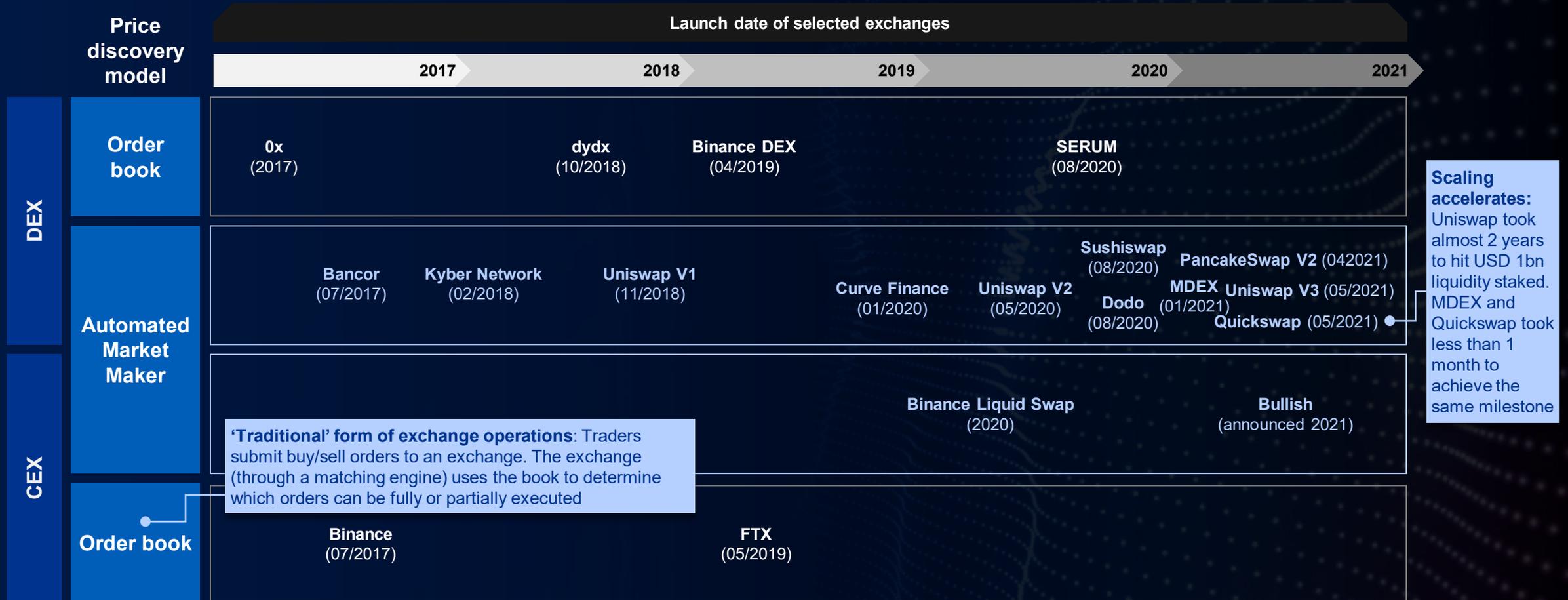
- Deep liquidity in pairs associated with the protocol or team related to the DEX
- Most prominent pairs include at least one stablecoin

Source: Project info pages, Coinmarketcap. Snapshot view of 24h trading volume on 07/09/2021

# Content

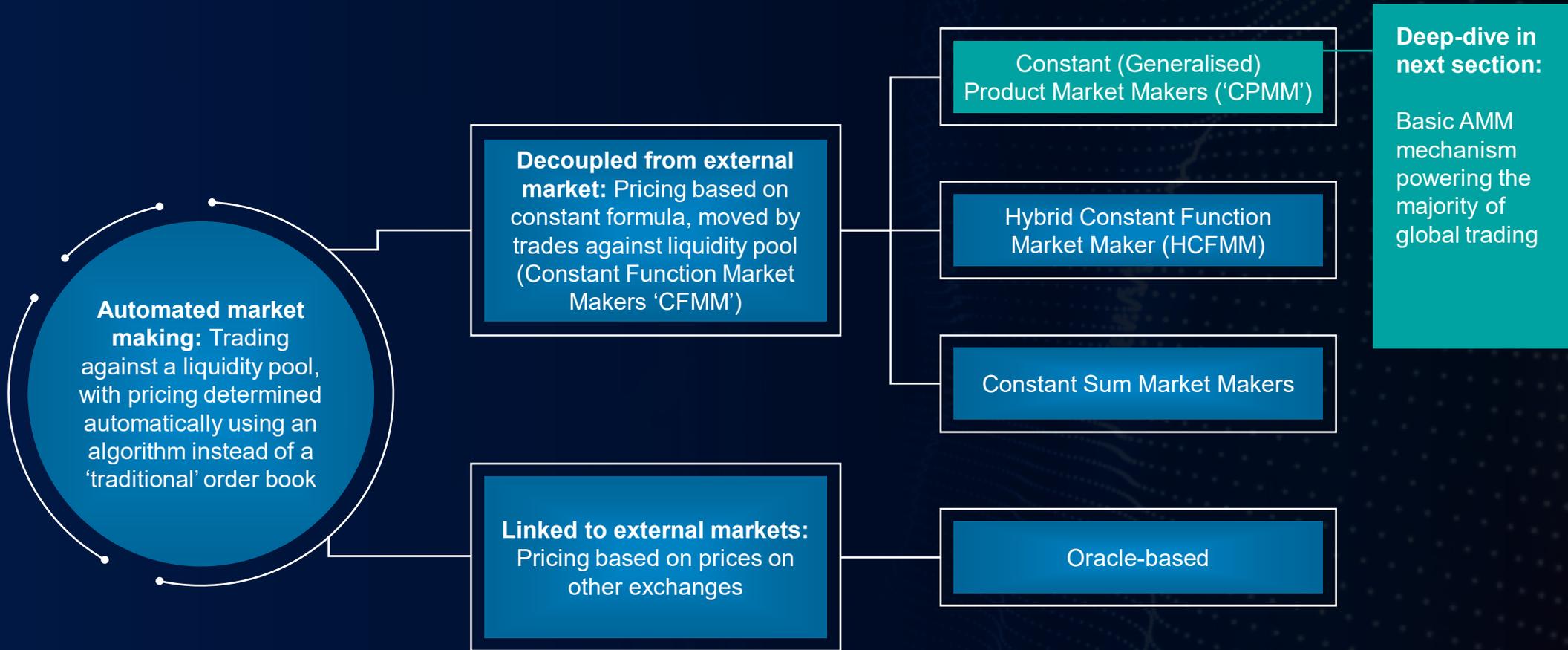
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# Most recent DEX (and some CEX) launches use Automated Market Makers - an alternative to 'traditional' exchange models that run on order books, with traders submitting buy- and sell-orders

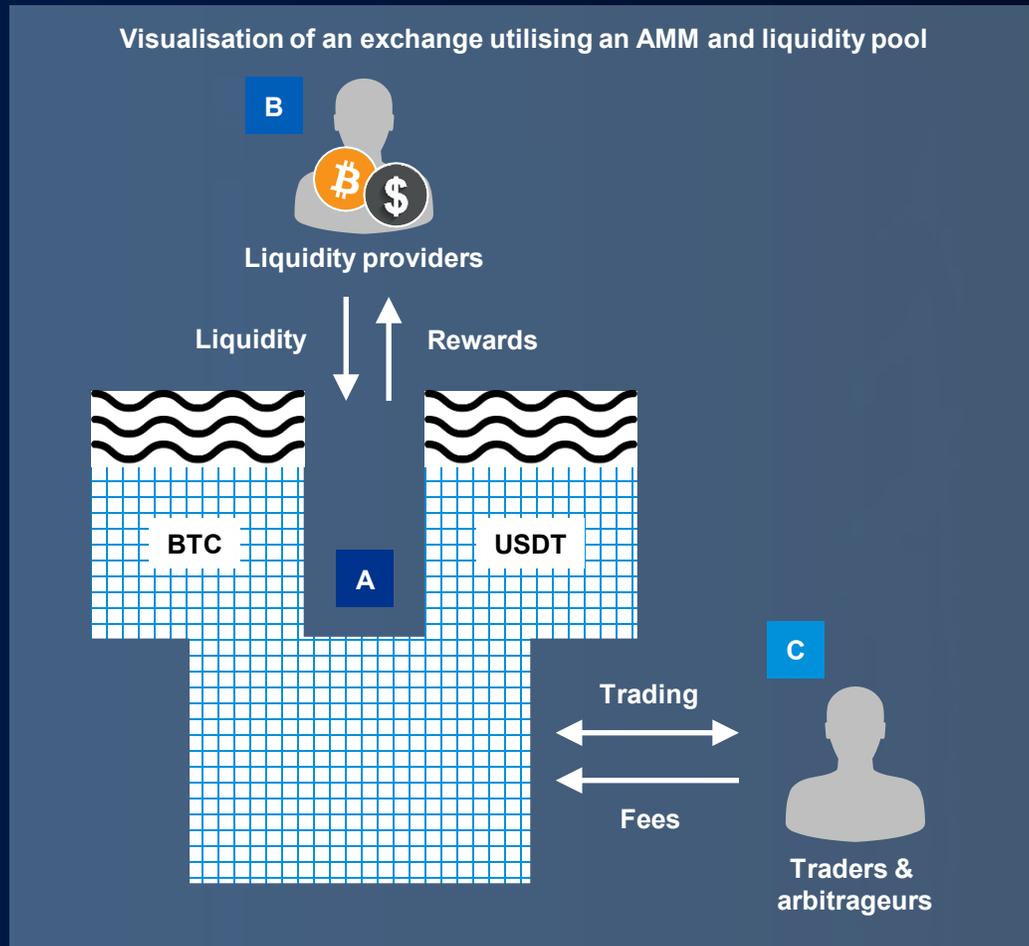


**Scaling accelerates:** Uniswap took almost 2 years to hit USD 1bn liquidity staked. MDEX and Quickswap took less than 1 month to achieve the same milestone

# We know that AMMs have taken over the DEX space - but what are they?



The largest AMMs to date have been 'Constant Function Market Makers', which set prices based on a balance of tokens in a user-provided liquidity pool, reflecting supply and demand



Party	Motivation	Activity
<b>A</b> The Exchange Protocol	<ul style="list-style-type: none"> <li>— Minimise execution costs while maximising availability for liquidity providers</li> <li>— Variable, depending on setup of governance and holders of governance tokens</li> </ul>	<ul style="list-style-type: none"> <li>— Develop and deploy AMM mechanism &amp; function</li> <li>— AMM: Calculate price offered based on token balance and AMM function</li> <li>— Collect transaction fees, mint tokens to distribute to liquidity providers as reward</li> </ul>
<b>B</b> Liquidity Providers	<ul style="list-style-type: none"> <li>— Maximise rewards generated from liquidity provided</li> </ul>	<ul style="list-style-type: none"> <li>— Provide tokens into liquidity pools</li> <li>— Earn a share of trading fees and reward tokens</li> <li>— Move funds between different liquidity pools in search of highest yields ('yield farming')</li> </ul>
<b>C</b> Traders & arbitrageurs	<ul style="list-style-type: none"> <li>— Minimise trading cost</li> <li>— Execute arbitrage opportunities</li> </ul>	<ul style="list-style-type: none"> <li>— Pay a transaction fee on every trade</li> <li>— 'Regular' traders: Trade against price offered by AMM</li> <li>— Arbitrage traders: Discover arbitrage opportunities between external markets and AMM prices, execute to bring prices in line with market</li> </ul>

# AMMs have become the dominating innovation for Decentralised Exchanges

Price discovery mechanism options	The dominant tech	Primary reasons for the success of AMMs/ CFMMs**																				
<table border="1"> <tr> <td data-bbox="155 515 336 729"><b>Automated Market Makers</b></td> <td data-bbox="336 515 626 729">Trading against a liquidity pool, with pricing determined mathematically</td> </tr> <tr> <td data-bbox="155 768 336 982"><b>Order-book based exchanges</b></td> <td data-bbox="336 768 626 982">'Traditional' market making through orders. Can be on-chain or off-chain</td> </tr> <tr> <td data-bbox="155 1021 336 1235"><b>Dutch auction model</b></td> <td data-bbox="336 1021 626 1235">All buyers submit bids, contract clears on highest bid on each block</td> </tr> </table>	<b>Automated Market Makers</b>	Trading against a liquidity pool, with pricing determined mathematically	<b>Order-book based exchanges</b>	'Traditional' market making through orders. Can be on-chain or off-chain	<b>Dutch auction model</b>	All buyers submit bids, contract clears on highest bid on each block	<p><b>Daily trading volume of top 3 DEXs employing AMMs*</b></p> <p>USD M, 09/2021</p> <table border="1"> <tr> <td>Automated Market Makers</td> <td>5006</td> </tr> <tr> <td>Order-book based exchanges</td> <td>57</td> </tr> <tr> <td>Dutch auction model</td> <td>N/A</td> </tr> </table>	Automated Market Makers	5006	Order-book based exchanges	57	Dutch auction model	N/A	<table border="1"> <tr> <td data-bbox="1243 475 1409 646"><b>Ethereum limitations</b></td> <td data-bbox="1409 475 2374 646"> <ul style="list-style-type: none"> <li>— High gas fees incentivise minimum number of transactions and complexity of transactions. On-chain order book updates incur gas fees.</li> <li>— Updating an order book is hence prohibitively costly</li> <li>— AMM's pricing is automated, liquidity providers only transact once</li> </ul> </td> </tr> <tr> <td data-bbox="1243 658 1409 858"><b>High rates of DeFi innovation</b></td> <td data-bbox="1409 658 2374 858"> <ul style="list-style-type: none"> <li>— New projects with associated tokens are launched almost daily</li> <li>— Raising funds used to require book building &amp; pricing in ICO's, and building an associated order book to build liquidity requires attracting makers. AMMs enable Initial DEX Offerings (IDOs): New projects can easily set up liquidity pools for their tokens without intermediaries to raise funds, enable trading at low cost</li> </ul> </td> </tr> <tr> <td data-bbox="1243 869 1409 1041"><b>Lack of regulation</b></td> <td data-bbox="1409 869 2374 1041"> <ul style="list-style-type: none"> <li>— Market making is hard and done by large institutional firms in TradFi. Lack of regulation means institutional makers are not active in DeFi</li> <li>— Retail investors hence need to make markets/ provide liquidity for DeFi. AMMs make this easy, as they automate pricing and accept any amount of liquidity</li> </ul> </td> </tr> <tr> <td data-bbox="1243 1052 1409 1223"><b>Novelty of AMMs &amp; DeFi</b></td> <td data-bbox="1409 1052 2374 1223"> <ul style="list-style-type: none"> <li>— Higher trading cost of AMM's compared to 'traditional' exchanges is accepted as volatility is very high for DeFi tokens</li> <li>— Divergence loss ('impermanent loss') not immediately understood in the wider liquidity provider community</li> </ul> </td> </tr> </table>	<b>Ethereum limitations</b>	<ul style="list-style-type: none"> <li>— High gas fees incentivise minimum number of transactions and complexity of transactions. On-chain order book updates incur gas fees.</li> <li>— Updating an order book is hence prohibitively costly</li> <li>— AMM's pricing is automated, liquidity providers only transact once</li> </ul>	<b>High rates of DeFi innovation</b>	<ul style="list-style-type: none"> <li>— New projects with associated tokens are launched almost daily</li> <li>— Raising funds used to require book building &amp; pricing in ICO's, and building an associated order book to build liquidity requires attracting makers. AMMs enable Initial DEX Offerings (IDOs): New projects can easily set up liquidity pools for their tokens without intermediaries to raise funds, enable trading at low cost</li> </ul>	<b>Lack of regulation</b>	<ul style="list-style-type: none"> <li>— Market making is hard and done by large institutional firms in TradFi. Lack of regulation means institutional makers are not active in DeFi</li> <li>— Retail investors hence need to make markets/ provide liquidity for DeFi. AMMs make this easy, as they automate pricing and accept any amount of liquidity</li> </ul>	<b>Novelty of AMMs &amp; DeFi</b>	<ul style="list-style-type: none"> <li>— Higher trading cost of AMM's compared to 'traditional' exchanges is accepted as volatility is very high for DeFi tokens</li> <li>— Divergence loss ('impermanent loss') not immediately understood in the wider liquidity provider community</li> </ul>
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Source: \*CoinMarketCap

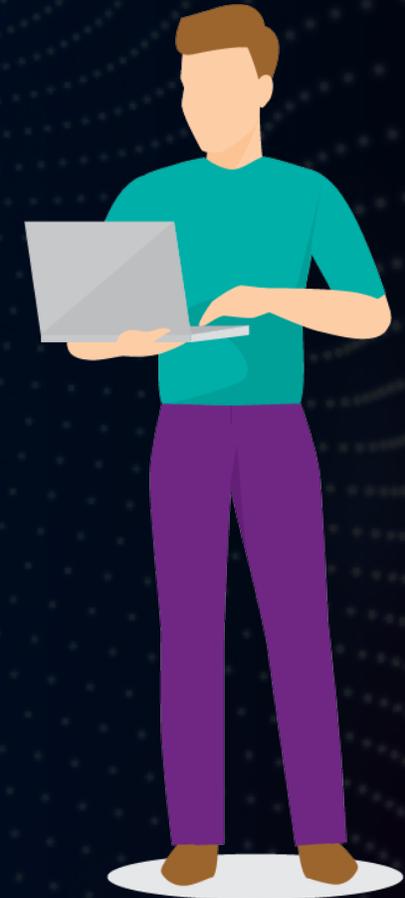
Notes: \*Average daily trading volume for week of 7th of June ; \*\*CFMM = Constant Function Market Maker, a specific variation of AMM

## A The original AMMs based on 'constant product market makers' were envisioned in 2017 by Ethereum founder Vitalik Buterin

*"My proposed solution is to use the style of "on-chain automated market maker" [...] I would add a simplification suggested by Martin Koppelman.*

*The mechanism would be a smart contract that holds A tokens of type T1, and B tokens of type T2, and maintains the invariant that  $A * B = k$  for some constant k (in the version where people can invest, k can change, but only during investment/withdrawal transactions, NOT trades).*

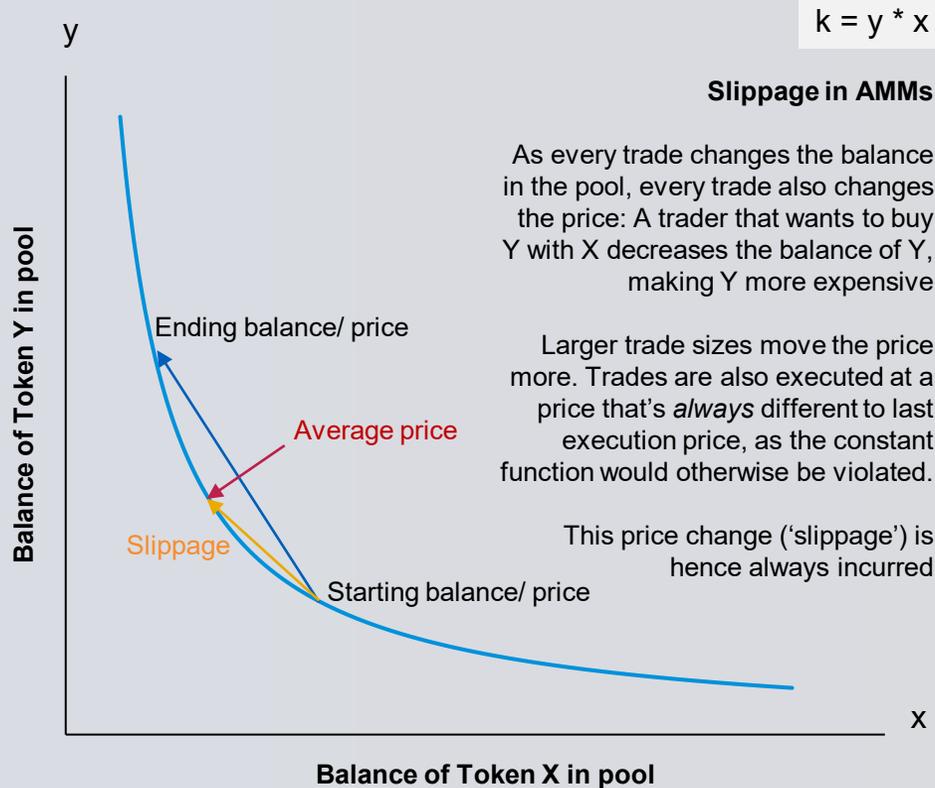
*Anyone can buy or sell by selecting a new point on the  $xy=k$  curve, and supplying the missing A tokens and in exchange receiving the extra B tokens (or vice versa). The "marginal price" is simply the implicit derivative of the curve  $xy=k$ , or  $y/x$ ."\**



Source: \*Reddit, post titled "Let's run on-chain decentralized exchanges the way we run prediction markets"

**A** Price discovery mechanism: Trades against the pool change token prices by altering the token balance. Arbitrageurs/ traders are hence required to bring price in line with wider market

Price discovery mechanism based on token balance in a pool made up of tokens X and Y for an exemplary trade



**Constant Function Market Makers (CFMM)**

- Prices are purely determined mathematically: The balance of tokens in the liquidity pool must remain constant, and the price for trading against the pool is based on the ratio of the two tokens to each other
- CFMMs are, in the base configuration, decoupled from markets. They therefore depend on arbitrage traders to bring them in line with other markets: As prices change in the wider market, this will be reflected in AMMs as traders buy tokens on other platforms to sell them on AMMs for a better price, altering the balance of tokens in the AMM pool so as to create a price that matches the market
- This also means that pricing is 'deterministic': As the AMM always maintains its constant balance, i.e. it never sells tokens at a price that would violate its formula, traders can predict at which prices a certain quantity of tokens will be sold. This is especially valuable for large trades

**Price discovery mechanism**

- The most well known formula to arrive at prices based on liquidity pools is the one popularised by Uniswap, namely  $k = Y * X$  (a Constant Product Market Maker, CPMM)
- X and Y here denote liquidity volumes of a currency pair consisting of currencies X and Y with k denoting a constant. Traders can only add X or Y from the pool in exchange for Y or X as long as it does not violate the above function
- This formula allows for liquidity at infinitely high or low prices of each asset, as neither asset can ever be fully depleted (a '0' for either X or Y would violate the formula)
- This infinite liquidity however comes at a price: Very high slippage once prices move into the more extreme ends of the curve, where minor changes in balance of one asset lead to dramatic changes in the other asset, implying increasing slippage

# B Liquidity providers are rewarded with transaction fees and tokens



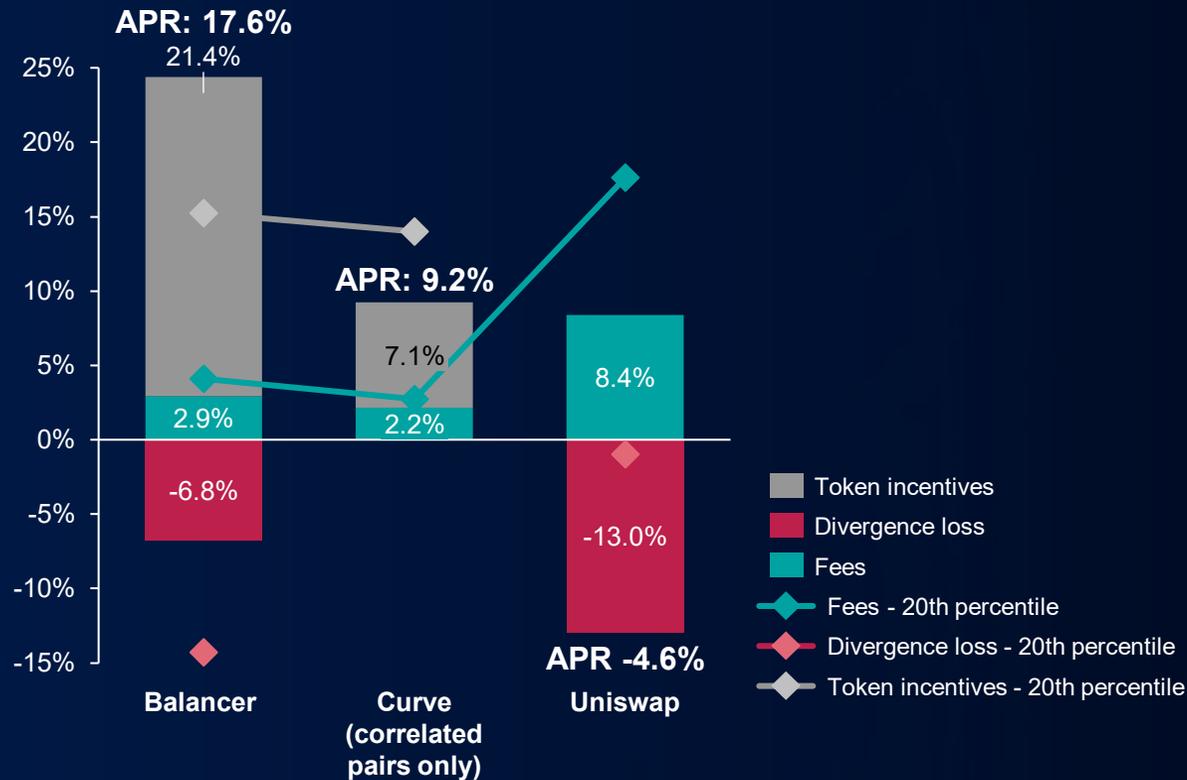
**Note:** \*Some protocols penalize providers for withdrawing liquidity before a certain period. This is to stabilize liquidity and mitigate undue volatility

# B Status quo of Liquidity Provider (LP) Rewards

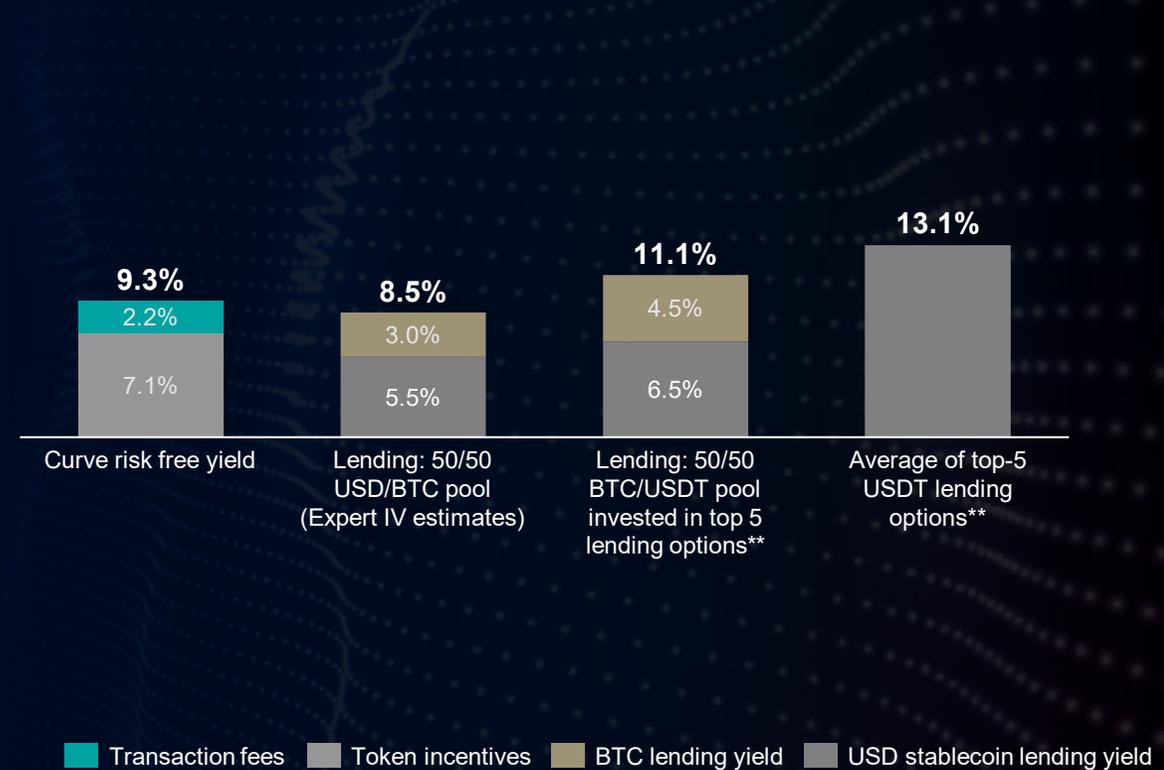
On average, liquidity pools currently do not produce positive yields if token incentives are not included. Selected pools, however, offer high yields

Compared to other crypto (DeFi and CeFi) market opportunities with different risk profiles, liquidity pools are currently only somewhat competitive

Average liquidity provider returns of different DEX & 20th percentile of pools\*  
%, 06/21



Average liquidity provider returns “fixed-income-style” opportunities\*\*  
(%, 05/21 and 06/21)



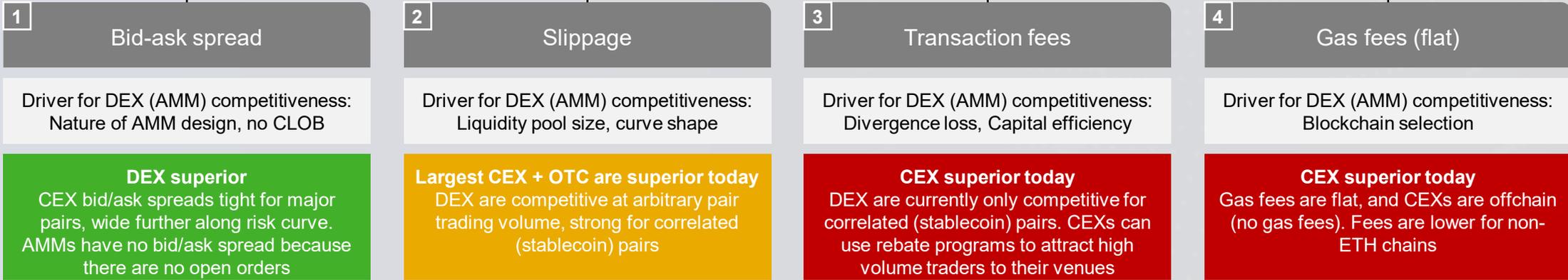
Source: \*LiquidityFolio, extracted on 17/06/2021 \*\*Coinmarketcap in May 2021, KPMG expert interviews

Note: \*Returns are forecast based on 30-day historical data. This data was based on a period of high volatility, leading to potentially high divergence loss forecasts.

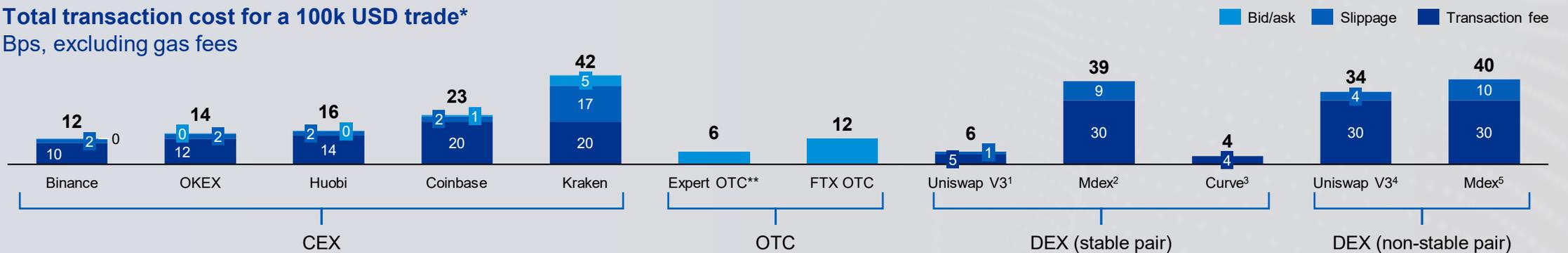
# c Execution cost to traders are competitive vs. centralised exchanges for stablecoins and large trades

See Appendix for details on 1-4

## Total transaction (execution) cost



**Total transaction cost for a 100k USD trade\***  
Bps, excluding gas fees



Source: \*Kaiko May Market Report, Protocol Websites accessed 16 June 2021, \*\*Expert Interviews conducted with two crypto hedge funds in May 2021, commenting on BTC-USD pairs.

Note: CEX pairs are the CEX's respective largest BTC pairs. DEX's pairs are chosen based on the largest liquidity pool size: (1) USDC-USDT; (2) HUSD-USDT; (3) USDC/sUSD; (4) USDC-ETH: This is a special case. While the pool on Uniswap v3 declares to charge a 30bps fee, when accessed on the 14<sup>th</sup> of July 21, the fee quoted was actually 5bps. This would make Uniswap v3 fees lower than Binance. For a USDC-WBTC pair, the application quoted 10bps in fees, with 20bps slippage; (5) ETH-HBTC. MDEX only refers to HECO

A

# Aggregators amplify liquidity in DeFi by routing trades and liquidity through various venues to minimise execution costs

B

C

## Aggregators: trading

Exemplary aggregator: 1inch



Aggregators route trades to minimise transaction fees

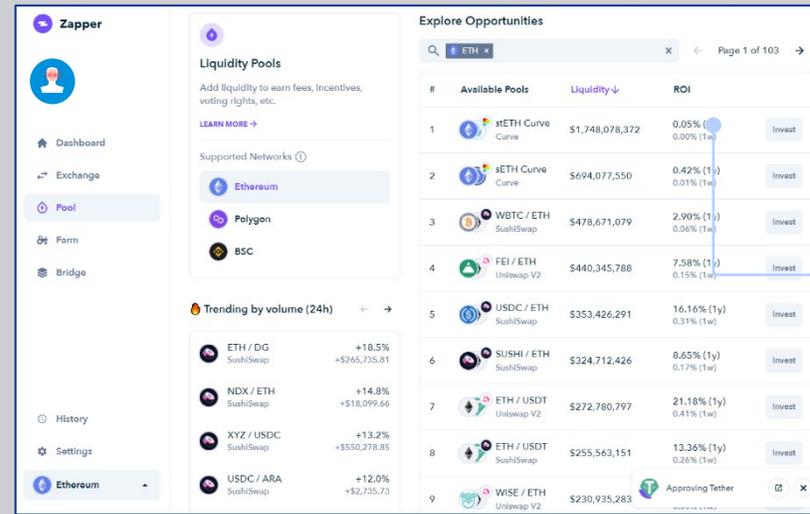
### Impact:

- Users visit aggregator site and funds are routed to the best priced pairs
- This means AMM DEX become a one stop in a multi-legged trade, instead of the sole venue, with aggregators facilitating execution
- Aggregator value proposition is strongest when liquidity is distributed among many pools and execution minimises slippage for retail and size traders

Source: 1Inch website, accessed 17/06/2021

## Aggregators: liquidity provider

Exemplary aggregator: Zapper



Aggregators allow users to identify pools with the highest yields, directly deploy funds

### Impact:

- Returns are equalised across liquidity pools as funds are directed into highest performing pools until returns drop
- Industry structure may be shaped similarly to the trading aggregator side: Users visit aggregators, not the DEX
- Aggregator value proposition is strongest when liquidity provider rewards differ strongly between protocols and reward calculations include factors like impermanent loss

Source: Zapper, accessed 17/06/2021

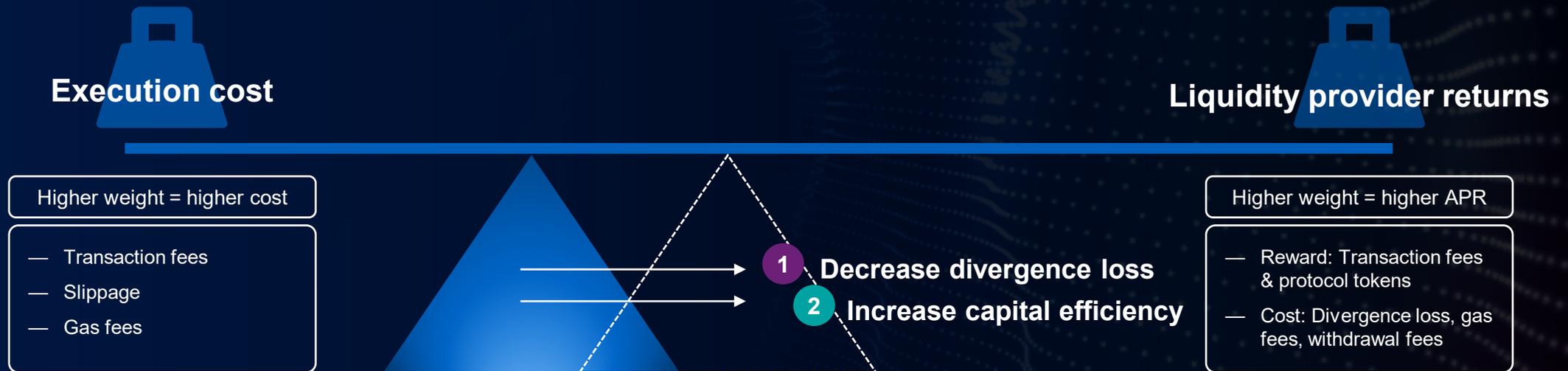
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# The core challenges: CPMMs need to reduce divergence loss and increase capital efficiency

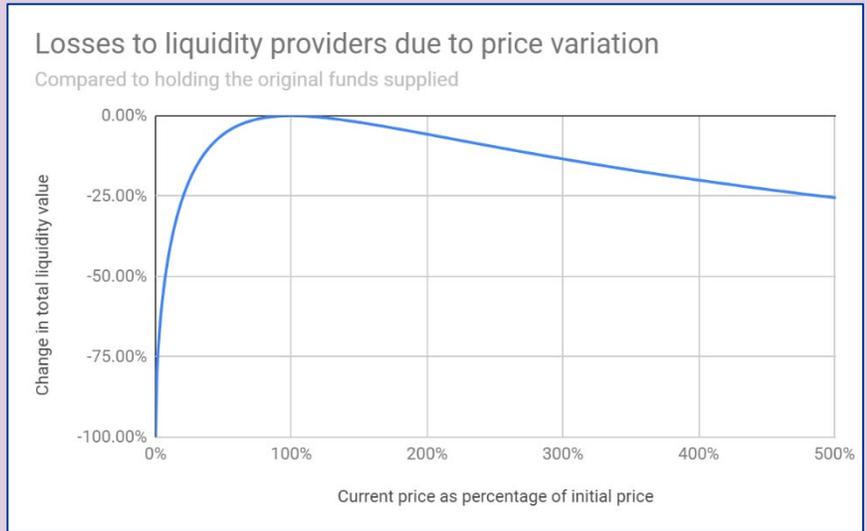
In order to maximise trading volume, AMMs have to strike the balance between maximising liquidity provider returns and minimising trading cost.

The major levers impacting liquidity provider returns are ‘divergence loss’ (impermanent loss) and ‘capital efficiency’ (velocity\*) of liquidity provided. The higher the divergence loss or lower the capital efficiency, the greater the transaction fee required to compensate liquidity providers\*\*. The major levers impacting execution costs are transaction fees, slippage and gas fees.



**Note:** \*Trading value (divided by) liquidity pool size. \*\*Other factors influencing transaction fee pricing also exist, e.g. attractiveness to attract arbitrageurs

# 1 Divergence loss occurs for any CPMM that is based on arbitrage for price discovery and its impact can be severe



**Divergence loss - a sample calculation**

Time	T+2	T+1	T-0	T+1	T+2
Token Y	22	14	10	10	8
Token X	447	707	1,000	1,049	1,225
Token balance x*y	10,000	10,000	10,000	10,000	10,000
Constant k	10,000	10,000	10,000	10,000	10,000
Price of Token Y	20	50	100	110	150
Price change of Token Y	20%	50%	100%	110%	150%
Value of 50/50 holding (H)	1,200	1,500	2,000	2,100	2,500
Value of liquidity pool (P)	894	1,414	2,000	2,098	2,449
<b>Divergence loss</b>	<b>306</b>	<b>86</b>	<b>0</b>	<b>2</b>	<b>51</b>
Divergence loss % of 50/50 holding	25.5%	5.7%	-	0.1%	2.0%

## Comments

- Divergence loss is an opportunity cost that liquidity providers can see as their staked token pair loses value compared to simply holding the tokens
- It is caused by the convex pricing curve of CPMMs, which leads the ratio of tokens in the pool to shift increasingly strongly towards the less valuable token as market participants buy the more valuable token. This also implies that arbitrageurs pick up the value lost by liquidity providers
- Divergence loss is also called ‘impermanent loss’ as losses may disappear once token prices (relative to each other) return to the level they were at when the stake in the pool was acquired
- Not all liquidity providers are concerned with divergence loss; some institutional investors are solely concerned with absolute returns, and provide liquidity with tokens that they specifically want exposure to (e.g. if a fund wanted exposure to UNI and ETH, they could add liquidity in a UNI/ETH pool)
- For a 50-50 CPMM pool (Uniswap v2, Sushiswap, Quickswap), see left for a sample calculation:
  - a 2x price change results in a 5.7% loss relative to simply holding tokens in a wallet
  - a 5x price change results in a 25.5% loss relative to simply holding tokens in a wallet

Drivers	Description	Impact on DL
Negative correlation of pool tokens	Divergence loss is caused by change in token price in terms of each other	●
Permanence of price changes	Divergence loss is eliminated if prices return to levels when liquidity was provided	●
Volatility	Larger price moves result in more extreme divergence loss	◐

# 1 Divergence loss can be managed, but not eliminated if a 'pure' CPMM is employed

Mitigation strategies of liquidity providers			AMM responses			
What?	How?	KPMG view	What?	Who?	How?	KPMG view
Hedging	<ul style="list-style-type: none"> <li>— Divergence loss (DL) can be hedged well through derivatives (e.g. a long straddle)</li> <li>— This removes the DL risk component from the equation. Now only transaction fee risk needs to be managed</li> <li>— Issue: Options markets are underdeveloped in DeFi.</li> </ul>		Liquidity mining	— All	<ul style="list-style-type: none"> <li>— LP's are rewarded with exchange tokens to improve returns. Has proven successful in attracting LP's</li> <li>— <b>Issues:</b> Token inflation risk</li> </ul>	
Stablecoin focus	<ul style="list-style-type: none"> <li>— Providing liquidity to only stablecoin pools (e.g. USDT-USDC) eliminates divergence loss as these pairs are mean reverting</li> </ul>		Oracles	<ul style="list-style-type: none"> <li>— DODO</li> <li>— Bancor v2</li> </ul>	<ul style="list-style-type: none"> <li>— Instead of using arbitrageurs to move price, external market price info is fed into the DEX</li> <li>— Can limit DL, requires some pool &amp; curve engineering</li> <li>— <b>Issue:</b> Potential for Oracle manipulation</li> </ul>	
Portfolio Management	<ul style="list-style-type: none"> <li>— Invest across pools to achieve an overall correlated exposure</li> <li>— Issue: Forecasting correlation is challenging, requires significant capital to make entry into several pools profitable given gas fees</li> </ul>		Dynamic fees	<ul style="list-style-type: none"> <li>— Balancer</li> <li>— Uniswap v3</li> </ul>	<ul style="list-style-type: none"> <li>— Fees can be designed to be flexible, covering divergence loss where it (likely) arises</li> <li>— Either a) flat fees differ between pairs based on historical correlation or b) dynamic based on volatility</li> </ul>	
			Flexible pool ratios	— Balancer	<ul style="list-style-type: none"> <li>— Allows traders to take more directional bets and exposure to tokens they prefer</li> <li>— <b>Issue:</b> Slippage is stronger for the pair with lower representation</li> </ul>	
			Insurance	— Bancor v2.1	<ul style="list-style-type: none"> <li>— Bancor collects a share of fees to reimburse traders by routing all trading against protocol token</li> <li>— <b>Issues:</b> Double fees, TVL limited by protocol token. Insurance/ hedging at scale does not reduce DL burden, just shifts it to "underwriters"</li> </ul>	
			Improve user management of risk	— Uniswap v3.0	<ul style="list-style-type: none"> <li>— Enable traders to specify price range LPs wish to add liquidity; traders can visualise risk and provide more options, tools (e.g. hedges) to manage risk</li> <li>— Attract professional LP's with risk management skills</li> <li>— <b>Issue:</b> Only indirect reduction in fees</li> </ul>	

## 2 Low capital efficiency is a function of high execution cost, which can be attributed to the CPMM curve shape

### Capital efficiency

#### What is it?

- Capital efficiency (or 'velocity') refers to the trading volume that is executed against the liquidity provided
- The higher the capital efficiency, the higher the trading volume executed against the liquidity pool, and hence the higher the liquidity provider reward (all else equal)

#### Why is it a problem?

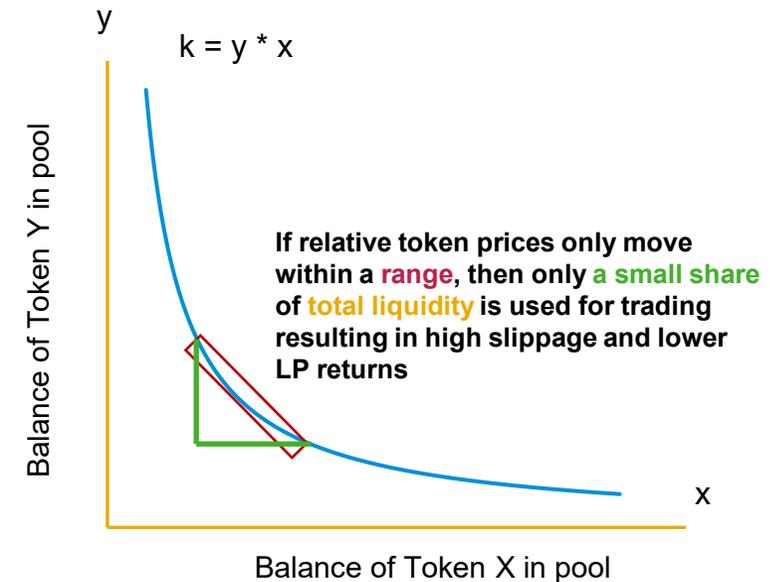
- Low capital efficiency means that only little trading is executed against capital provided by liquidity providers (i.e. trading volume / TVL)
- Low capital efficiency also implies high slippage given the TVL
- Low capital efficiency also implies transaction fees need to be increased, leading to a negative cycle

Drivers	Description	Impact on CE
Slippage of function of CPMM (Curve shape)	Curve shapes that enable lower slippage based on token balance lead to higher capital productivity	●
Liquidity pool size	Pool size should correlate with trading volume, moderated by arbitrage activity and LP returns. For short times, smaller pools may however be underfunded, resulting in higher turnover. Limiting pool size may drive up turnover as well	◐

### The challenge

#### Why does it occur?

- CPMMs in their base configuration provide **equal** amounts of liquidity along **every point of the curve**
- This means that, if prices move only within a certain segment of the curve, theoretically only a fraction of the tokens in the pool are ever traded
- This can mean that other tokens that could have been used to mitigate a sharp price increase/decrease are not utilised, decreasing LP rewards and resulting in prices moving in directions they otherwise may not have moved.



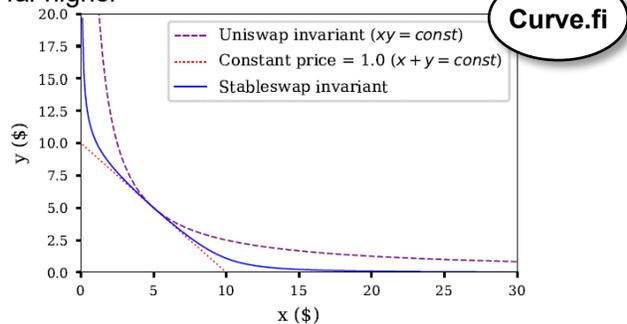
## 2 Significant innovation occurs around capital efficiency in the decentralised exchange space

### AMM innovation case studies: “Amplified liquidity”

**A core trade-off remains for ‘pure’ CPMM:** Improved slippage (i.e. more liquidity for certain price ranges) leads to higher slippage in other price ranges

#### Adjusted curve shape for correlated pairs

- A lower curvature allows stable prices at more token ratios than the traditional  $k=yx$ . This allows for larger trades at lower slippage
- This is highly beneficial when assets are highly correlated and mean-reverting, e.g. stablecoin pairs. Once prices move outside the range however, slippage is far higher

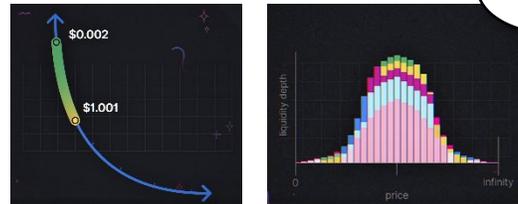


#### Impact

- Curve.fi could drop its transaction fees to attract significant trading volumes, outcompeting CEX, DEX, and OTC desks on stablecoin pairs.

#### Concentrated liquidity

- Uniswap v3 lets LPs pick price ranges in which they provide liquidity
- Hence each LP sets its own micro- $'k=yx'$  curve on the overall curve
- When prices move within the range, significantly higher fees are accrued, but none when prices move outside
- This moves closer to an order-book exchange and may require frequent order changes for tight price ranges

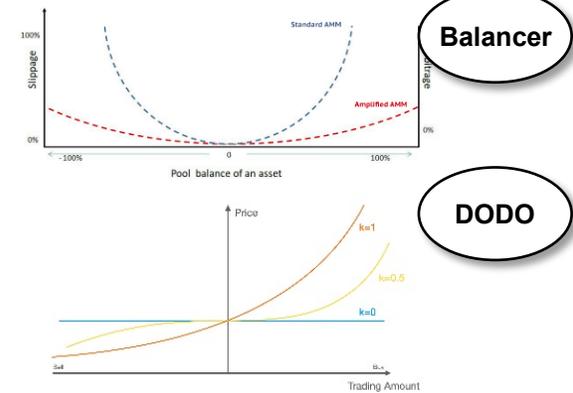


#### Impact

- Up to 4000x capital efficiency vs. v2
- We expect the higher complexity to attract larger, more professional market makers

#### Amplified liquidity through oracles

- Both Balancer and DODO have created price curves that use oracles
- Simply put, liquidity is concentrated around the current price as fed from a price oracle in the external market



#### Impact

- Up to 500x CE vs. Uniswap v2
- DODO Private pool aimed at professional market makers
- Large-scale market impact however still lacking

Source: Project websites, Medium

## Two fundamental questions for the future market structure of AMMs/CFMMs

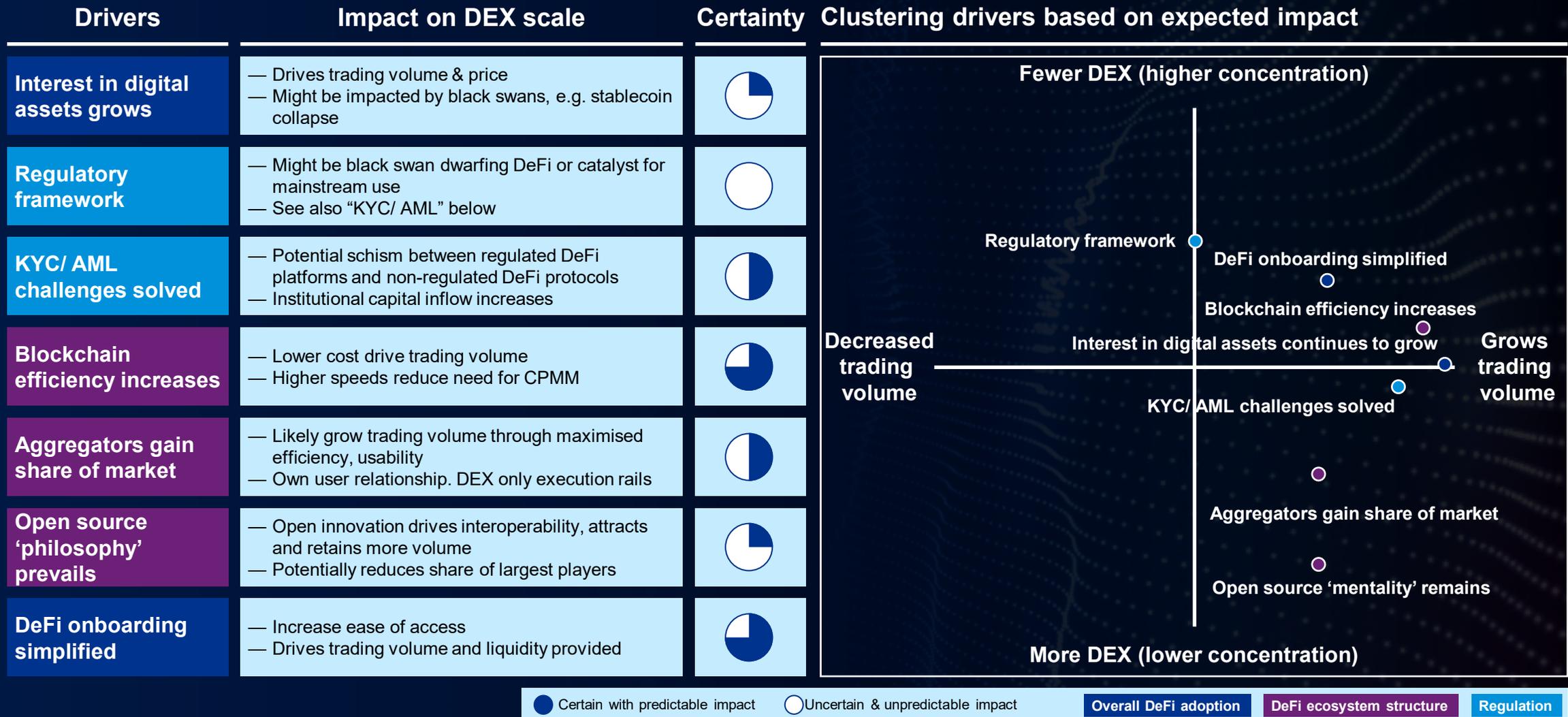
**Can a single market maker ever be more efficient than competing market makers (once blockchain limitations are removed)?**

**Can a 'blind' market maker serving every price provide fees as low as market makers that are aware of wider market prices?**

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# Major uncertainties shaping the future of DEX are regulatory action, overall DeFi adoption and degree of open innovation



# Factors likely to influence the development of decentralised exchanges

	What the future could look like	Impact				
		Description of impact	Trading volumes			Concentration (↑ = increased)
			Retail	Institu.	Total	
Interest in digital assets grows	A — Many new use cases in the DeFi space are discovered — Lasting fiat inflation period	— Institutional money flows into DeFi protocol tokens — Innovation is sustained — Protocol token prices and trading volume rise	↑	↑	↑	—
	B — Repeated fraud cases and volatility have caused lasting damage to cryptocurrencies/ DeFi	— Innovation slows as community becomes less active — Protocol token prices and trading volume drop — Regulation becomes more probable	↓	↓	↓	↑
Regulatory framework	A — Sandbox regulation followed by new regulatory framework that is truly fit for purpose in DeFi world	— Institutional investors can deploy their capital — Large loss from blockchain schism may be avoided	↑	↑	↑	—
	B — Heavy-handed regulation that e.g. introduces middlemen, deters experimentation and use of DeFi	— Costly (lost network effects) schism between regulated, non-regulated DeFi (below). Not only illicit funds stay on 'dark' side, but also legal funds that look for the benefits of 'free' DeFi. — Institutional investors can deploy capital, but usage drops	↓	↑	↓	↑
KYC/ AML challenges solved	— Regulators find ways to ensure that DEX do not operate without KYC — KYC/ AML DApps are developed	— Impact as for wider regulation: Potential schism between regulated and non-regulated DeFi, with institutional inflow increasing into regulated DEX, illicit funds flow into 'dark' DeFi	↑	↑	↑	↓
Blockchain efficiency increases	— Major issues are solved: Gas cost, front-running	— CPMs are used for IDO's and correlated pairs. They become OTC competitors for non-corelated pairs if pools grow, capital efficiency is increased. Revival of order-book based exchanges makes attracting liquidity more difficult, leads to fewer DEX	↑	↑	↑	↑

# Factors likely to influence the development of decentralised exchanges

	What the future could look like	Impact				
		Description of impact	Trading volumes			Concentration (↑ = increased)
			Retail	Institu.	Total	
Role of aggregators	<p><b>A</b></p> <ul style="list-style-type: none"> <li>Large share of trading/ liquidity provision runs through aggregators</li> <li>AMMs become market makers</li> <li>LP aggregators are able to aggregate altered AMM curves</li> </ul>	<ul style="list-style-type: none"> <li>Aggregators own user relationships, offer new features</li> <li>DEX can only attract trading/ liquidity through providing the best offers. Managing capital efficiency/ divergence loss is now key</li> <li>DEX concentration: Aggregators are more successful at lower concentration, but don't necessarily cause lower concentration</li> </ul>	↑	↑	↑	↓
	<p><b>B</b></p> <ul style="list-style-type: none"> <li>DEXs retain user relationship</li> <li>They achieve this either through making aggregation impossible (e.g. custom liquidity provision) or by building scale so quickly that aggregator proposition is diminished</li> </ul>	<ul style="list-style-type: none"> <li>Fewer, large DEXs exist</li> <li>DEXs focus on liquidity scale, value-added features to traders, and (as above) sophisticated liquidity provider features</li> <li>Impact on system liquidity depends on whether innovations making aggregation impossible outweigh the lost efficiency gains from lacking aggregation</li> </ul>	▬	▬	▬	↑
DeFi onboarding simplified	<ul style="list-style-type: none"> <li>DeFi access becomes easier</li> <li>Mobile applications for major protocols become ubiquitous</li> </ul>	<ul style="list-style-type: none"> <li>DeFi seeps into mainstream. This further stimulates usage and trading volume</li> <li>Regulation becomes more likely, likely increasing concentration</li> <li>Users are loyal to best UX – increasing concentration</li> </ul>	↑	▬	↑	↑
Open source culture	<ul style="list-style-type: none"> <li>Open-source culture remains</li> <li>Potentially only in less regulated spaces of DeFi</li> </ul>	<ul style="list-style-type: none"> <li>Open innovation: Winning approaches are rapidly copied across protocols. Aggregators are more likely to succeed</li> <li>VC/ IDO funding is spread across more protocols, less focused</li> </ul>	▬	▬	▬	↓
	<ul style="list-style-type: none"> <li>Protocols increasingly introduce barriers to open source culture (e.g. as new Uniswap v3 license)</li> </ul>	<ul style="list-style-type: none"> <li>Fewer, larger DEXs exist through economies of scale, higher barriers of entry, favoured capital access</li> <li>The lack of open innovation may hinder volume growth</li> </ul>	↓	▬	↓	↑

# The role of aggregators: Driven by openness in DeFi and feasibility of aggregation

**Scenario 1: Current DEXs remain key to DeFi**

**Description: Scenario outcome**

- Fewer, larger DEX dominate
- Traders/ LPs seek out best options or are loyal to few providers
- DEX retain user relationship

---

**Driver 1: Feasibility of integration**

**Scenario: Aggregation is not feasible**

- Aggregators will not succeed if technical reasons prohibit aggregation
- Liquidity provision aggregation: “Amplified liquidity” features may be difficult to aggregate. These features may however be necessary to increase exchange effectiveness, leading to less
- Feasibility is likely not an issue for trading aggregation

---

**Driver 2: Openness in DeFi**

**Scenario: Openness is reduced**

- Most projects in DeFi are open source under licenses allowing for direct copycats (e.g. Sushiswap and Uniswap v2)
- A winning DEX innovation licensed in a way to prevent copycats (e.g. UniSwap v3) could attract large shares of trading
- Larger DEXs make aggregators less used, as DEX execution costs may beat aggregators often enough to retain liquidity and mindshare

**Scenario 2: Aggregators take majority of users**

**Description: Scenario outcome**

- Large share of trading/ liquidity provision runs through aggregators
- Today’s AMM DEX effectively become market makers
- Aggregators own user relationship

---

**Scenario: Aggregation is feasible**

- Liquidity Provision: In this scenario, (some) DEX that allow for aggregation found a way to provide low fees and attract liquidity
- As DEX do not own user relationship, they can only grow by offering best execution cost/ rewards to LPs

---

**Scenario: Openness is maintained**

- DEXs borrow each others’ most valuable elements, leading to a distribution of liquidity that makes aggregation more valuable
- Aggregators also borrow features from one other, limiting centralisation should individual aggregators act in conflict with the wider community

# Potential strategies for today's DEXs and Aggregators

### Scenario 1: Current DEXs remain key to DeFi

- Fewer, larger DEXs dominate
- Traders/ LP's seek out best options or are loyal to few providers
- DEXs retain user relationship

**A potential strategy for today's DEX**

- Build loyalty of traders: Improve onboarding, usability, distribute tokens, introduce **value added features** earlier and better than aggregators to **grow relative market share of liquidity pools** vs. other DEX to unlock flywheel: Larger scale improves proposition and reduces value of aggregators
- Achieve growth by **focusing innovation on capital efficiency, divergence loss reduction and features to attract professional makers**
- If openness is not a core tenet – prevent copycats through **prohibitive licenses** or **community loyalty**
- **Be present on secure, relevant chains**, layer-2 environments
- Safely adapt market making approach to more efficient blockchains

What?

### Scenario 2: Aggregators take majority of users

- Large share of trading/ liquidity provision runs through aggregators
- Today's AMM DEX effectively become market makers
- Aggregators own user relationship

**A potential strategy for Aggregators**

- For trading aggregators – **build loyalty of traders** earlier and better than current DEXs (e.g. margin trading, limit orders, prime brokerage offering for institutional traders once feasible)
- For liquidity provision aggregators: Focus on **ability to aggregate across various platforms, create comparability**
- If openness is not a core tenet – prevent copycats through **prohibitive licenses** or **community loyalty**
- **Be present on secure, relevant chains**, layer-2 environments
- Safely adapt market making approach to more efficient blockchains

How to make it happen?

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# KPMG has experience across the full spectrum of crypto needs

Consulting						Deal Advisory
Planning	Onboarding		Service and Deliver			
 Strategy and revenue models	 Customer onboarding, KYC & investor qualification	 Asset provenance	 Order management, booking & settlement	 Anti-money laundering, counter terrorist financing & sanctions		 Financial, tech, operating, HR, tax, and commercial due diligence
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 Product management & pricing	 Custody operations and physical security		 Cyber threat defense	 Resiliency and disaster recovery		 Fund raise
	 Privacy	 Market Surveillance & Fraud Monitoring	 Third party risk management		 Blockchain network optimisation & risk management	
 Leadership & governance	 Regulatory compliance, integration, and reporting		 Proof of reserves	 Finance, P&L and Tax reporting	 Internal audit, external audit and attestation	 Deal strategy and equity value story development

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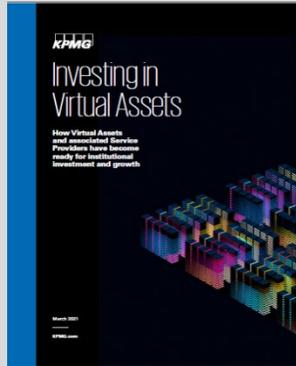
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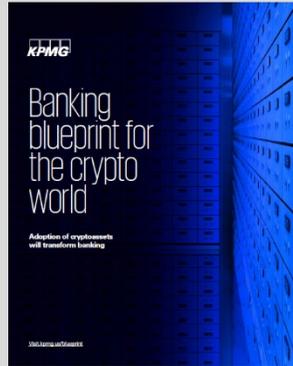


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Contributors

# KPMG regularly publishes thought leadership in the digital asset space



**Investing Virtual Assets  
2021**



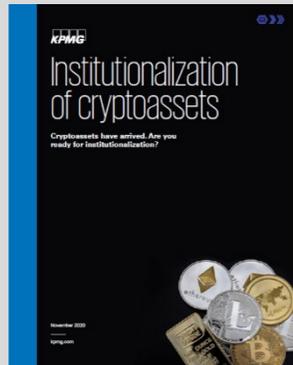
**Banking blueprint for  
the crypto world  
2021**



**Cracking crypto  
custody  
2020**



**Six blockchain and  
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**Institutionalization of  
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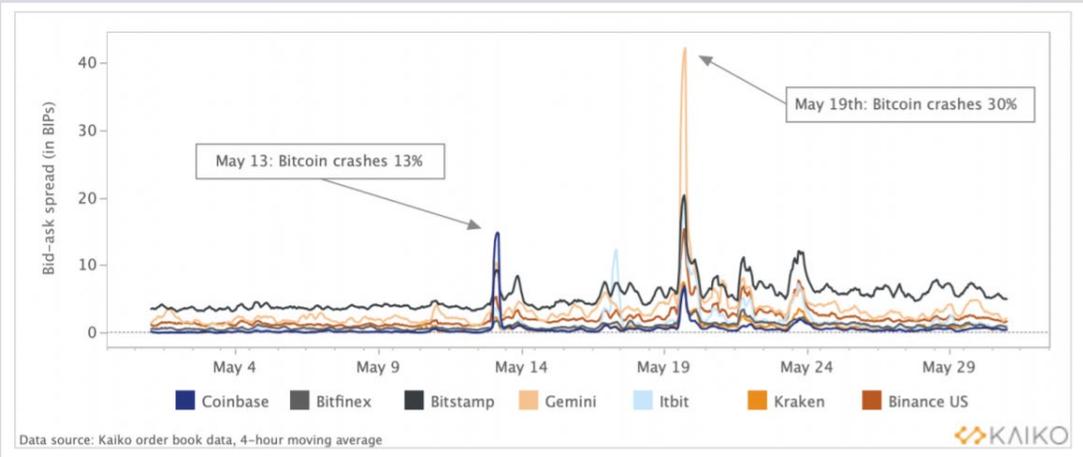
# Appendix



# Comparison of DEX and CEX: Execution costs to traders

## 1 Bid/ask spread only exists for CEX and are low for highly traded, less volatile pairs

Average spread at hourly intervals for BTC USD markets on top CEX  
Bps, 05/2021\*

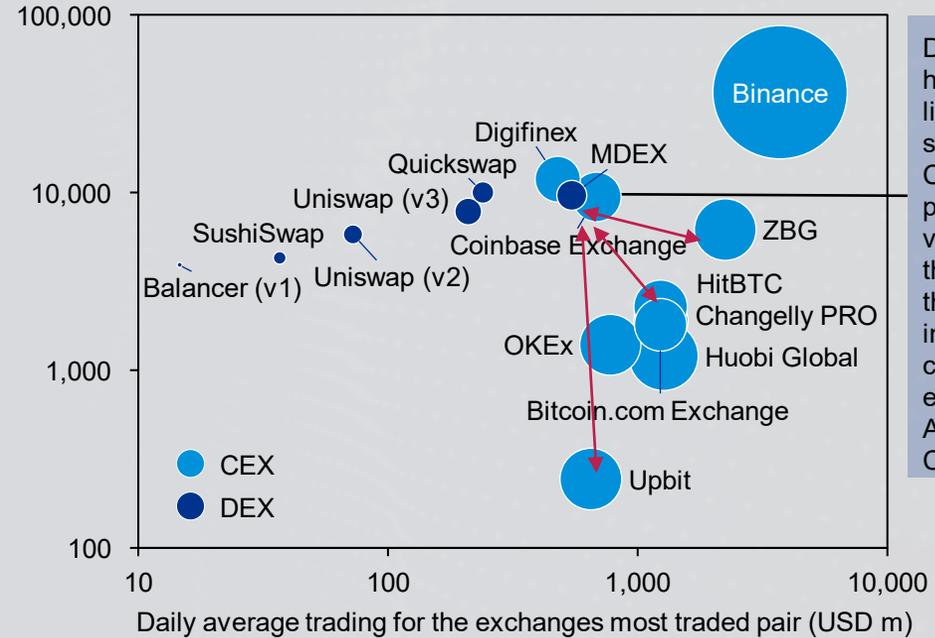


- Bid-ask spreads on CEX are tight for major trading pairs outside of high volatility hours
- Smaller trading pairs have higher bid/ask spreads
- AMM do not operate with bid-ask spreads but with flat transaction fees. They ensure that prices stay in line with external markets by presenting arbitrage opportunities

## 2 Slippage: DEX offer lower slippage than CEX at same trading volume – the most liquid exchange is however still a CEX (Binance)

Market depth of different exchanges for their most traded pairs\*\*  
USD, 06/2021

USD k required to move price of most traded pair 2% ('2% depth')



DEX offer higher liquidity/ lower slippage than CEX at equal pair trading volumes. On the flipside, this also implies lower capital efficiency of AMMs than CEX

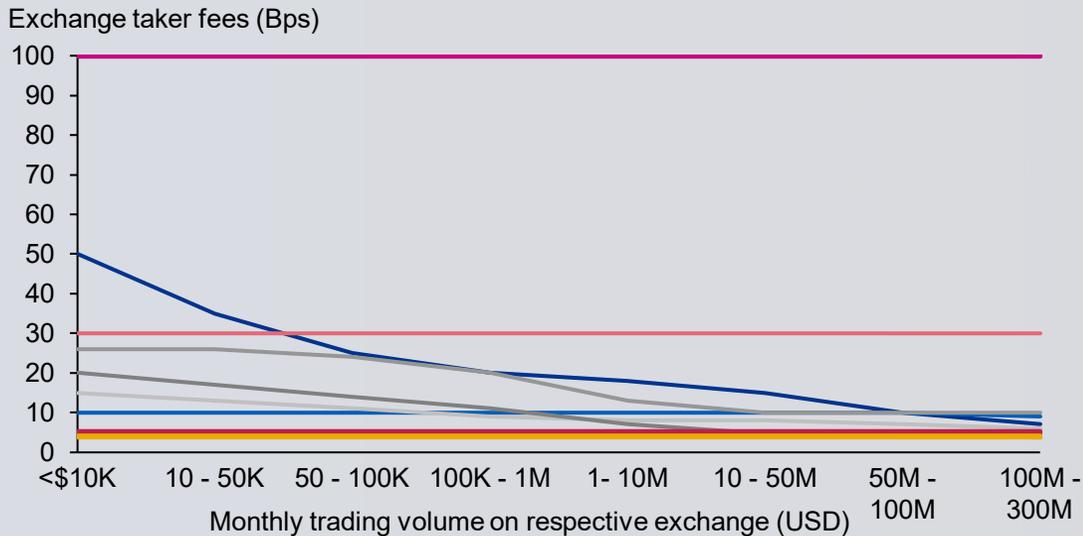
Bubble size = total daily trading on exchange

Source: \*Kaiko May Market Report \*\*Coingecko

# Comparison of DEX and CEX: Execution costs to traders

## 3 Transaction fees are significantly higher for non-stablecoin pairs on DEX than CEX

Exchange taker fees by monthly trading volume\*  
Bps & USD, 06/21



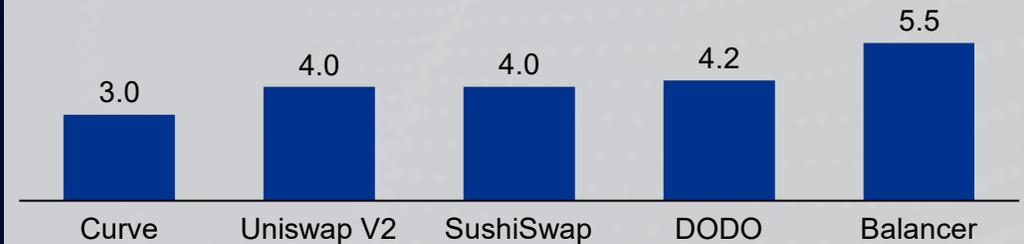
- Coinbase
- Binance
- OKEx
- Kraken
- Huobi
- Uniswap v2/ Sushiswap/ MDEX
- Uniswap v3 - correlated pairs
- Uniswap v3 - uncorrelated pairs
- Curve

Source: \*Exchange websites \*\*Crypto.com \*\*\*Bitquery

Note: \*All CEX also charge maker fees. Some CEX lower fees for holders of CEX token. \*\*Gas Fee are calculated based on the 7-days average starting the 14<sup>th</sup> of June for 'fast' transactions \*\*\*Based on 31 Ethereum DEX and four Binance DEX, covering data since inception until end-January 2021

## 4 Gas fees differ between Ethereum DEX but especially between chains

Average gas fee (transaction fee) on selected Ethereum DEX\*\*  
USD, 06/21



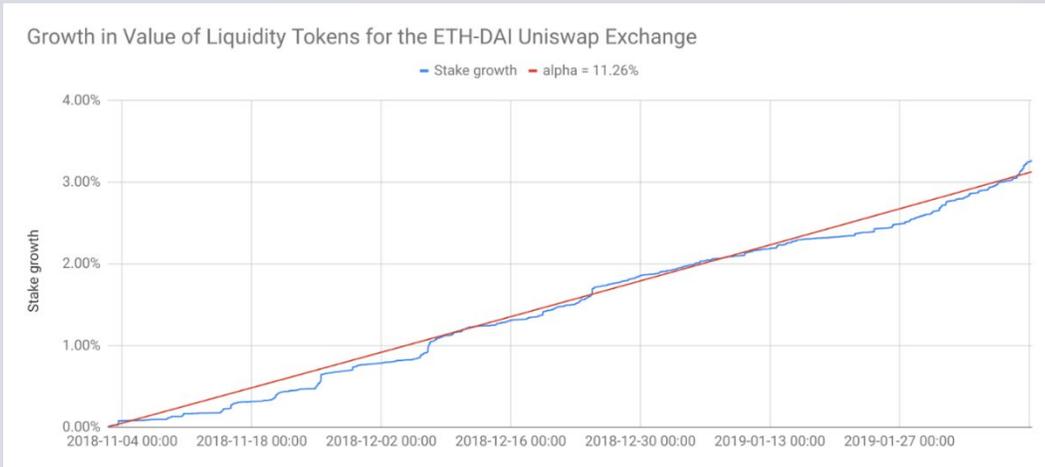
Comparison: Gas fees on Ethereum DEX vs. Binance Smart Chain \*\*\*  
USD, 2019-21



- Gas fees are charged on flat basis, regardless of transaction size
- Growing gas fees hence lead to growing transaction sizes – especially for less volatile pairs
- While fees have recently dropped, peaks in demand have historically lead to price spikes
- Layer-2 Ethereum, or the Binance/ Huobi blockchains boast gas fees of <0.5 USD

# The balance: Trading volume correlates with liquidity pool size. Net returns of liquidity pools, including divergence loss, balance around 0 (excluding token)

## Liquidity pool size and trading volume correlates



### Why?

- Larger liquidity pools require more arbitrage trading to move prices in line with market
- Slippage makes market more attractive, driving trader growth

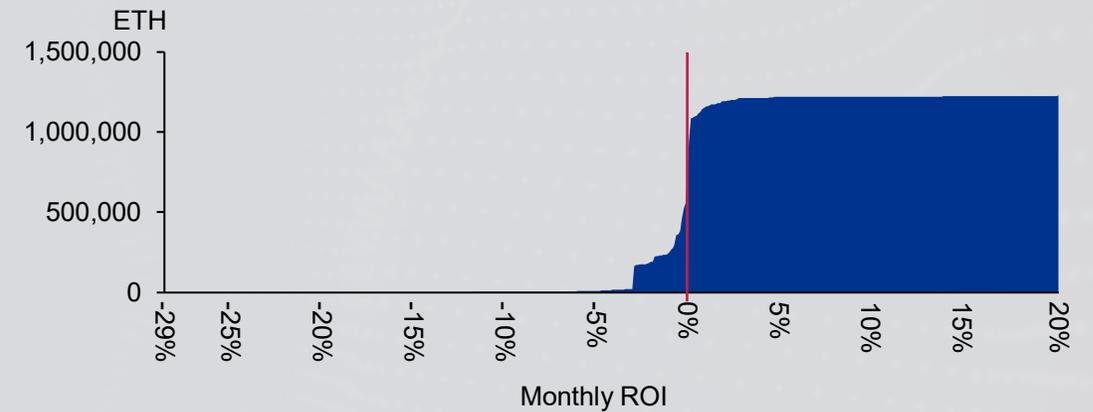
### Implication

- AMMs not including arbitrage may not grow trading volume as quickly

Source: Pintail, Medium

## Most liquidity pools are hardly profitable

### Monthly return forecast on liquidity provided\* ETH/ %, 06/21



### Why?

- Pools with high fees attract liquidity until fees become so low they are no longer attractive

### Implication

- Divergence loss mitigation matters

Note: This data was based on a period of high volatility, leading to high divergence loss

Source: Liquidityfolio: 30 day forecast of Uniswap v2 pool returns, including fee and divergence loss forecasts

# Glossary (1/4)

Term	Definition
<b>AML</b>	Anti-Money Laundering; processes and policies put in place to prevent and/or detect money laundering
<b>Aggregator</b>	Distributed applications/protocols which allow users to access to a wider range of liquidity pools via one single platform
<b>Automated Market Making (AMM)</b>	A DeFi protocol allowing digital assets to be traded in a permissionless and automatic way via Liquidity Pools rather than a traditional CLOB (Closed Limit Order Book)
<b>Blockchain</b>	A cryptographically secure digital ledger that maintains a record of all transactions that occur on the network and follows a consensus protocol for confirming new blocks to be added to the blockchain
<b>Centralised exchange (CEX)</b>	A type of cryptocurrency exchange that holds users' funds in custody
<b>CeFi</b>	Short for Centralised Finance; financial services organised through centralised corporations that hold users' funds in custody
<b>Constant Function Market Maker (CFMM)</b>	A type of Automated Market Maker where the price satisfies a constant formula; the price depends on the amount of two or more tokens and compel traders to trade against the liquidity pool. CPMMs and CSMM are types of CFMM
<b>Constant Product Market Makers (CPMM)</b>	A type of Constant Function Market Maker, which was first introduced by Uniswap, and satisfied the trading <i>function</i> ( $k = y * x$ ), where k acts as the constant balance of the tokens x and y in order to the determine the token's price
<b>Constant Sum Market Makers (CSMM)</b>	A type of Constant Function Market Maker, which satisfies the function of the <i>sum</i> of the reserves of each token equals to the constant
<b>Cryptocurrency (or crypto)</b>	Tokens on a cryptographically secured ledger, including Bitcoin and 'altcoins', (tokens launched after Bitcoin). This category of cryptoasset is designed to work as a medium of exchange, store of value, or to power applications, and typically excludes security tokens. "Crypto" is often used as a term for any cryptography-based market, system, application, or decentralised network
<b>Crypto asset (or 'token')</b>	Any digital asset built using blockchain technology, including cryptocurrencies, stablecoins, and security tokens

# Glossary (2/4)

Term	Definition
<b>Decentralised exchange (DEX)</b>	A type of cryptocurrency exchange which functions without a central intermediary party holding users' funds in custody
<b>DeFi</b>	Short for Decentralised Finance. Peer-to-peer software-based network of protocols that can be used to facilitate traditional financial services like borrowing, lending, trading derivatives, insurance, and more through smart contracts
<b>Ethereum (ETH)</b>	A decentralised global computing platform that supports smart contract transactions and peer-to-peer applications. The native crypto asset is called "Ether" (ETH)
<b>Fiat money/currency</b>	A type of currency which is government issued and is not backed by any physical commodity, such as gold and silver
<b>Fork</b>	A fundamental change to the software underlying a blockchain which results in two different blockchains.
<b>Gas</b>	A term used on the Ethereum blockchain, which refers to the required cost when making transactions on the blockchain
<b>Hodl</b>	Hold On for Dear Life; holding a crypto asset through ups, downs and times of volatility rather than selling it
<b>Hybrid Constant Function Market Maker</b>	A type of Constant Function Market Maker, which introduces more complex equations/ graphs to achieve liquidity, minimised volatility, and/or price exposure
<b>Impermanent/Divergent loss (DL)</b>	An opportunity cost incurred by liquidity providers of automated market makers; depositing in a CFMM means the market participant takes a non-market neutral position in the tokens used to post liquidity, the liquidity provider may see their initial balance of tokens change due to other market participants moving into and out of positions using the liquidity posted
<b>KYC</b>	Short for Know Your Client
<b>Miner</b>	Validators for Proof of Work; Individuals or entities who operate a computer or group of computers that add new transactions to blocks, and verify blocks created by other miners. Miners collect transaction fees and are rewarded with new tokens for their services

# Glossary (3/4)

Term	Definition
<b>Mining</b>	The process by which new blocks are created, and thus new transactions are added to the blockchain. This is done by 'miners'
<b>Oracle</b>	A service, entity, or smart contract that provides information outside of the context of a given smart contract. This can include data found on-chain (price feeds) and data found off-chain (weather, sports events). It queries, verifies, and authenticates external data sources via trusted APIs and then relays that information to other nodes in a network
<b>OTC</b>	Short for Over-The-Counter, referring to trading between market participants without an exchange
<b>Liquidity Pool</b>	A smart contract holding two or more tokens or cryptoassets for the purposes of facilitating transactions performed by market participants
<b>Liquidity Provider (LP)</b>	Users that provide tokens to a liquidity pool in exchange for a reward
<b>Protocol</b>	A type of algorithm or software that governs how a blockchain operates
<b>Proof of Stake (POS)</b>	A consensus mechanism/algorithms used by blockchain networks to prevent users from invalid transactions and provide a distributed consensus by giving miners voting rights depending on the share of tokens held
<b>Proof of Work (POW)</b>	A consensus mechanism/algorithms which demands a great amount of computational energy to verify and process transactions
<b>Sandwich attack</b>	A type of front-running technique in Decentralised Finance, which involves a predatory trader placing an order before the transaction by the victim
<b>Smart contract</b>	Software that digitally facilitates or enforces a rules-based agreement or terms between transacting parties
<b>Stablecoin</b>	Crypto assets designed to minimise price volatility. A stablecoin is designed to track the price of an underlying asset such as fiat money or an exchange-traded commodity (such as precious metals or industrial metals). Stablecoins can be backed by fiat money or other crypto assets

# Glossary (4/4)

Term	Definition
<b>Slippage</b>	A term refers to the difference between the expected (or pre-trade) price and the actual price at which a trade is executed
<b>Total Value Locked (TVL)</b>	The amount of assets in dollar value which are locked in smart contract at a given decentralised protocol
<b>TradFi</b>	Traditional, i.e. non-cryptocurrency finance. This mostly refers to finance based on fiat currency
<b>USD Coin (USDC)</b>	A USD stablecoin that is issued through the Centre Consortium (co-founded by Coinbase and Circle)
<b>USD Tether (USDT)</b>	A USD stablecoin that is issued through the Tether organisation (administrated by iFinex)
<b>Vampire Attack</b>	In a 'vampire attack' an actor forks another protocol, in efforts to incentivise users of the forked protocol to participate in the new protocol. For example, Sushiswap conducted a vampire attack of Uniswap in 2020
<b>Yield Farming</b>	Also known as liquidity mining; providing liquidity in order to receive rewards from a protocol or dApp. Yield farming especially refers to moving funds around between decentralised applications in the shorter term



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