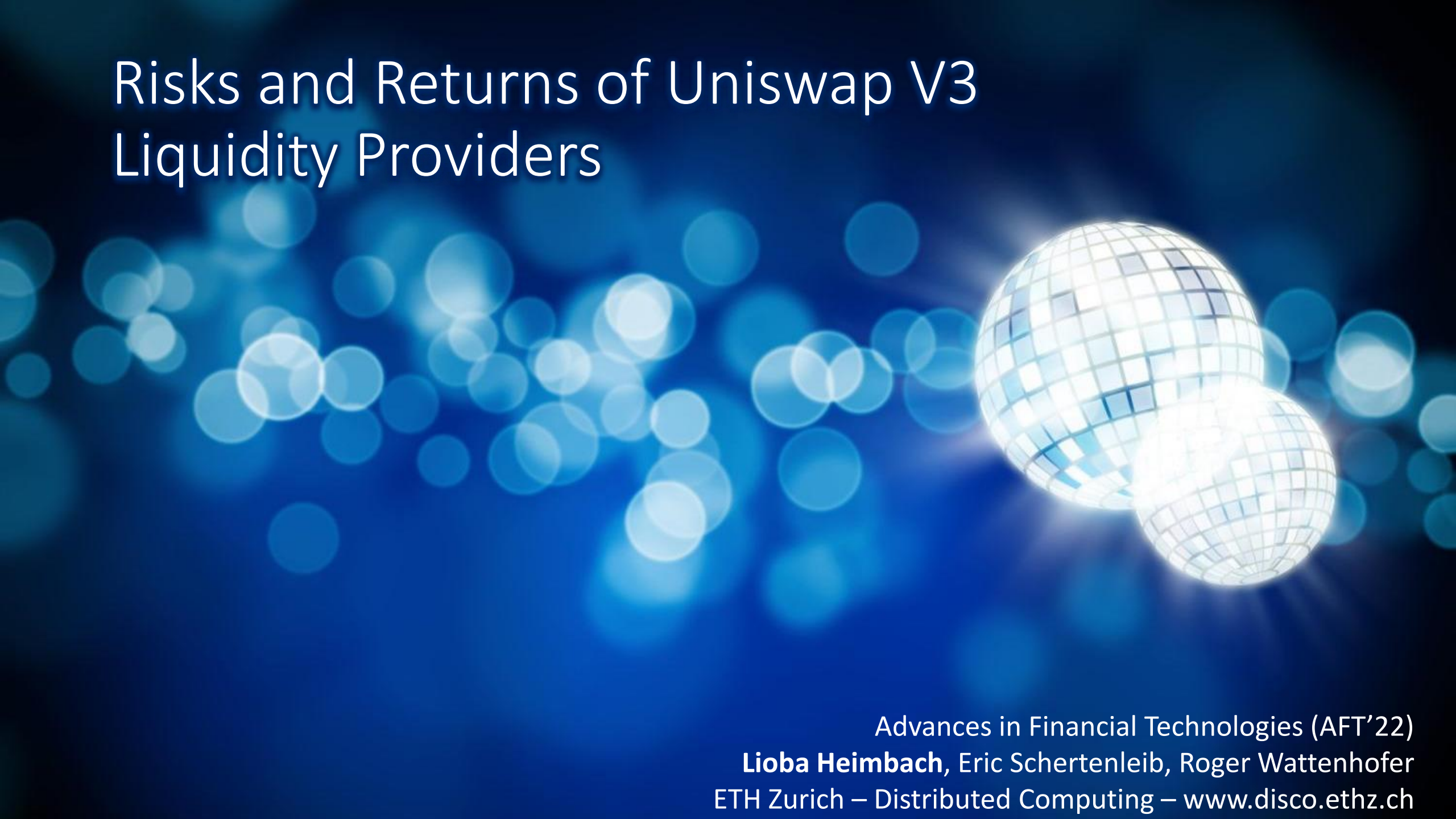
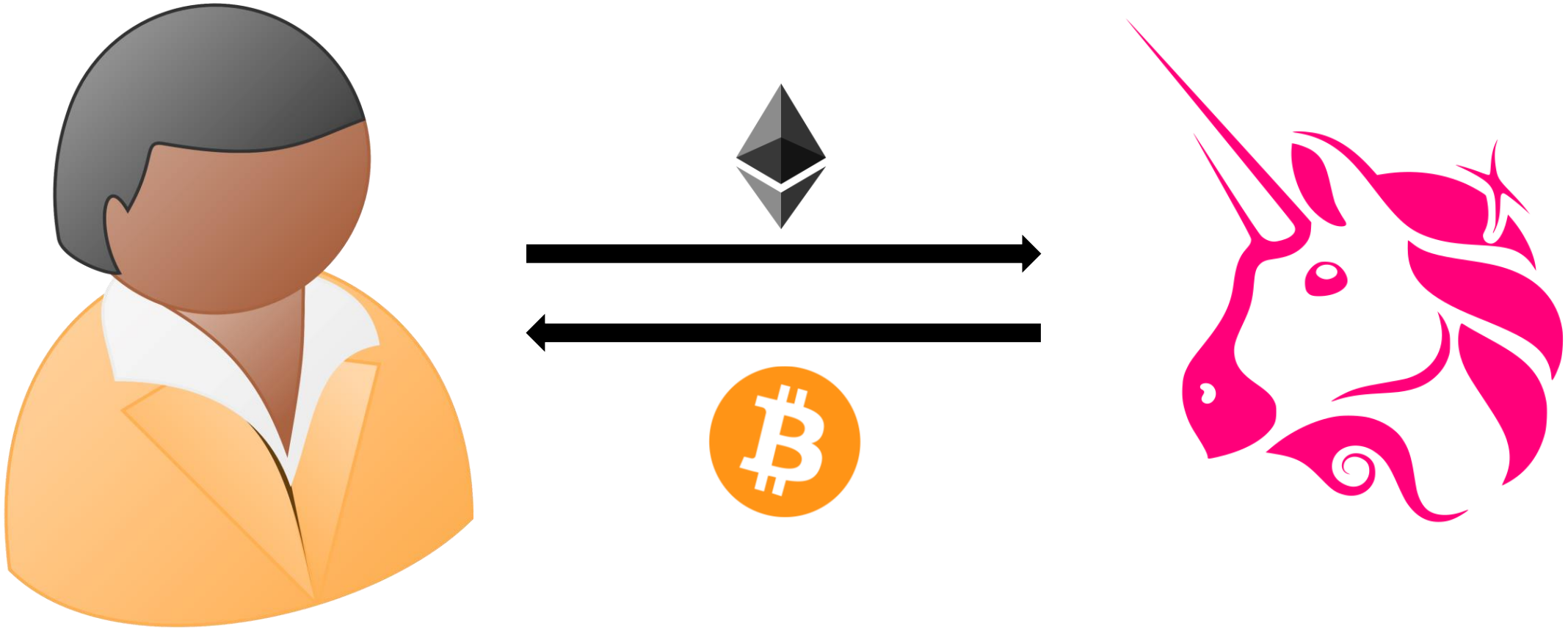
Risks and Returns of Uniswap V3 Liquidity Providers

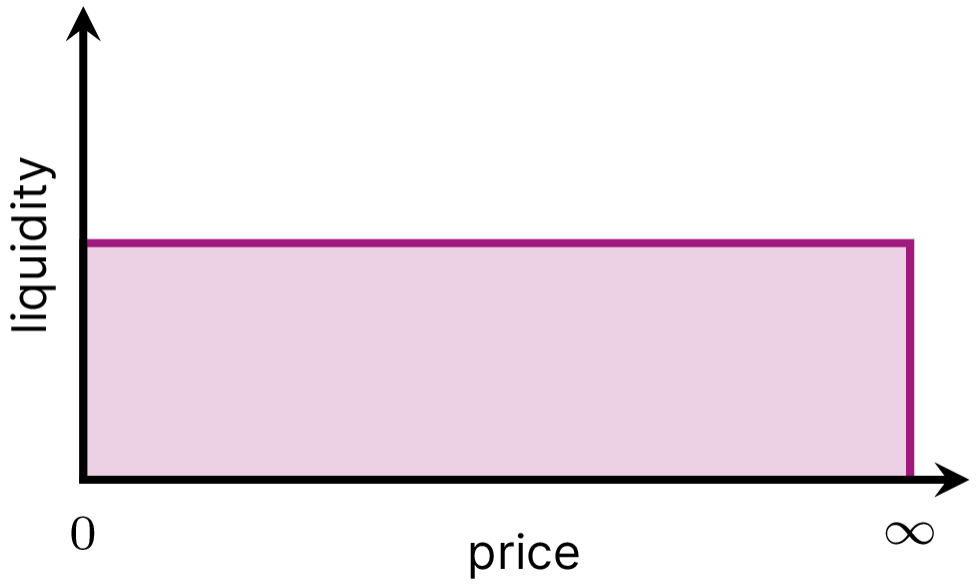


Advances in Financial Technologies (AFT'22)
Lioba Heimbach, Eric Schertenleib, Roger Wattenhofer
ETH Zurich – Distributed Computing – www.disco.ethz.ch

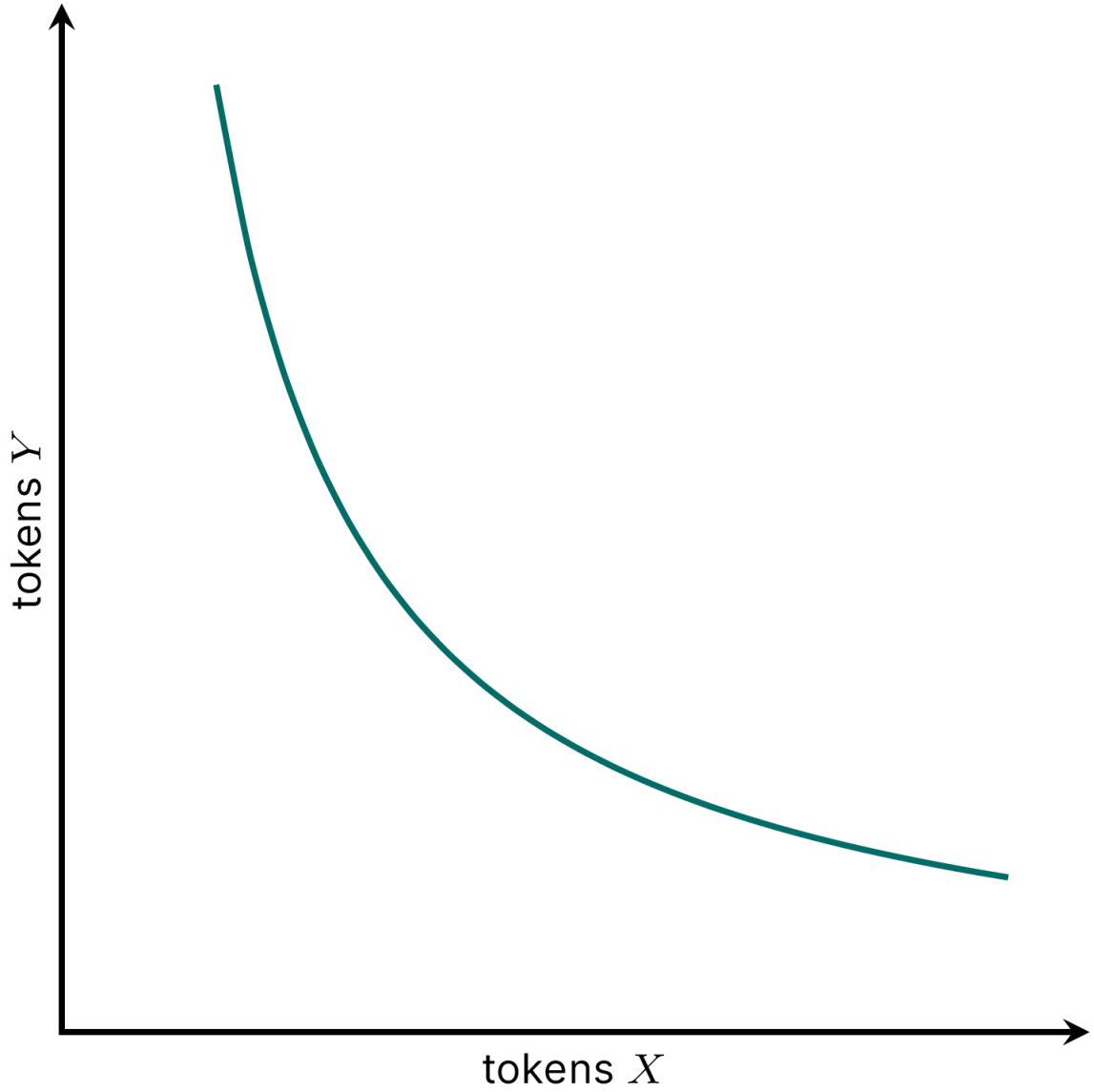
Decentralized exchanges (DEXes)



Constant product market makers (CPMMs)

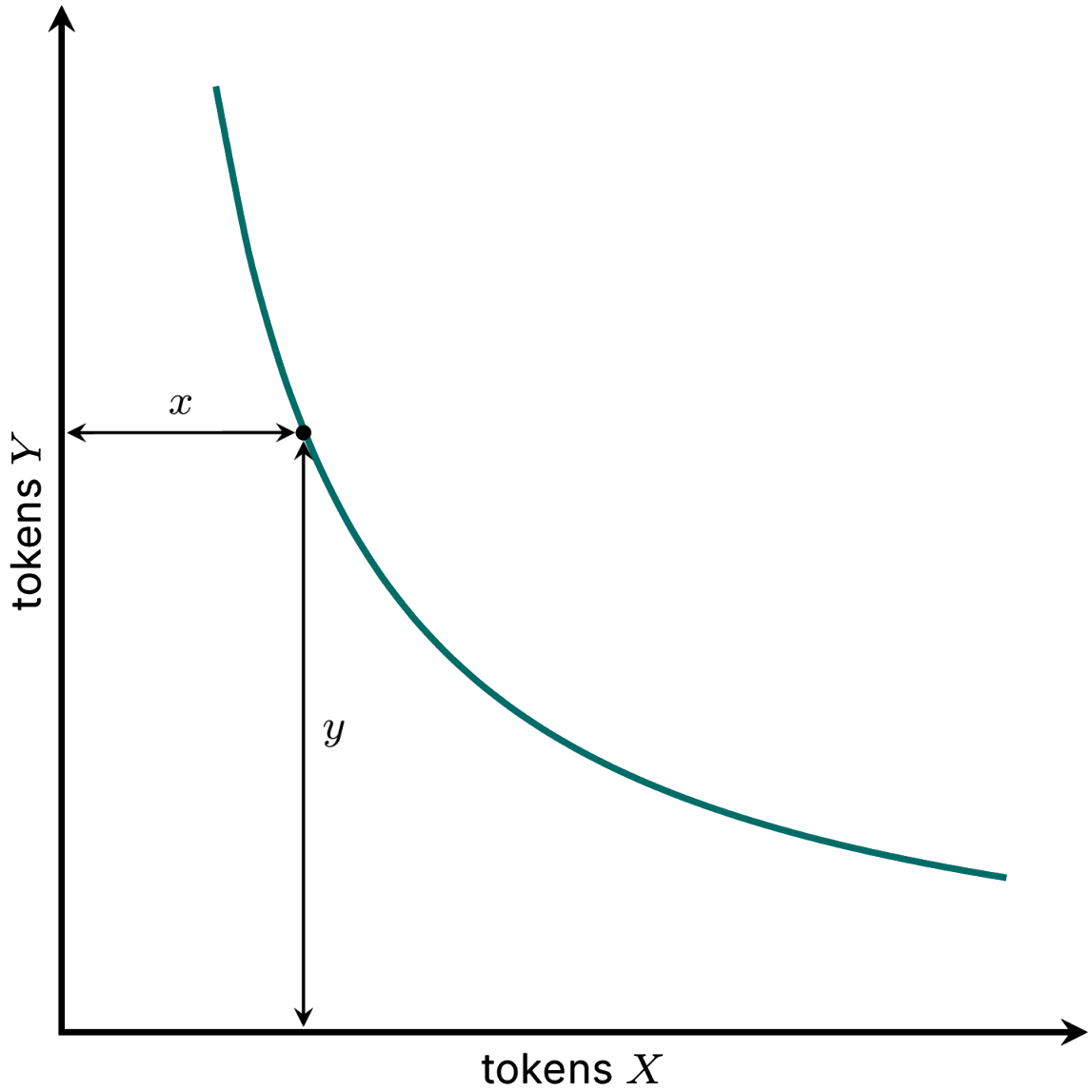


Constant product market makers (CPMMs)



trading along price curve

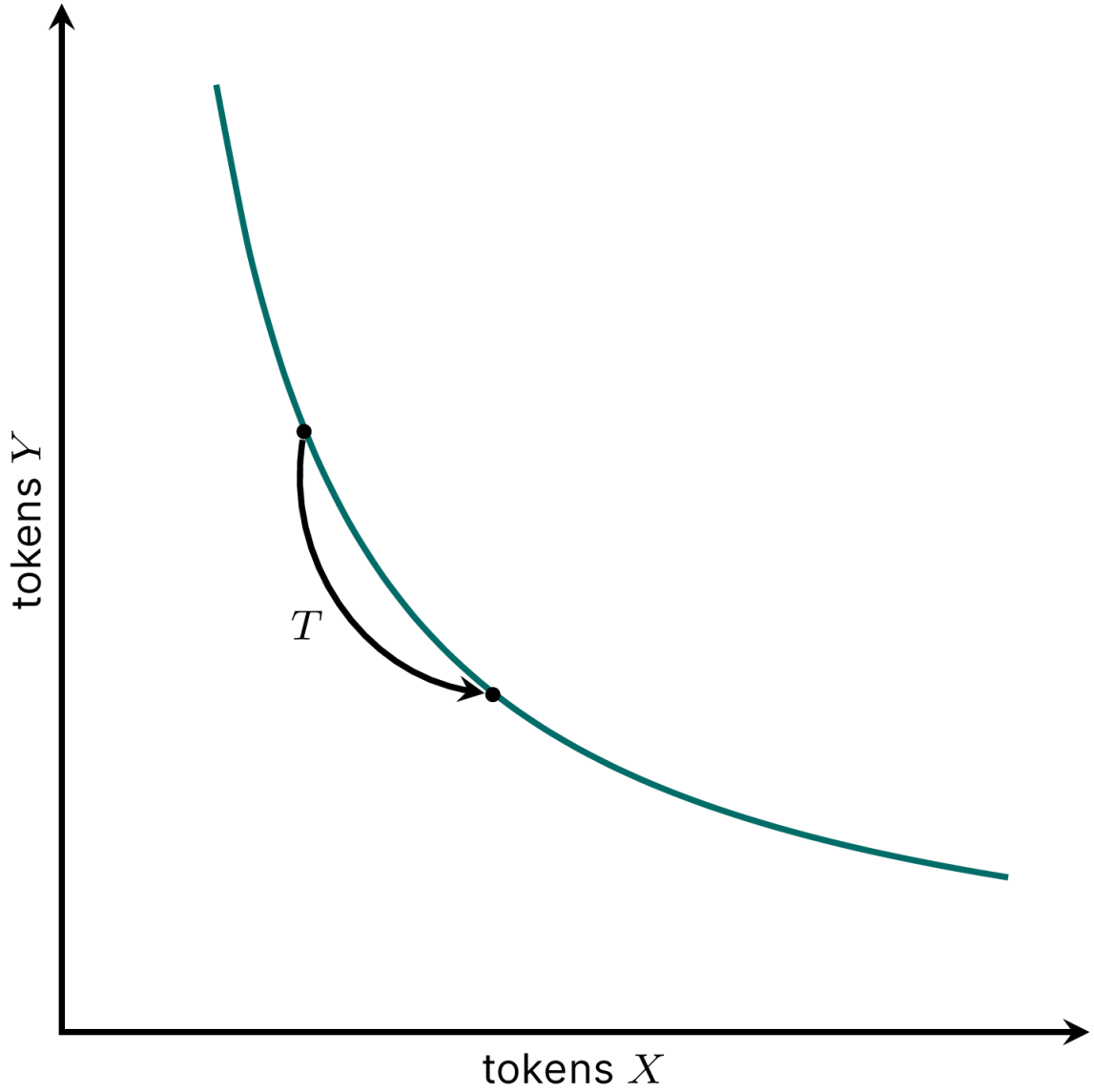
Constant product market makers (CPMMs)



trading along price curve

marginal price: S = y/x

Constant product market makers (CPMMs)

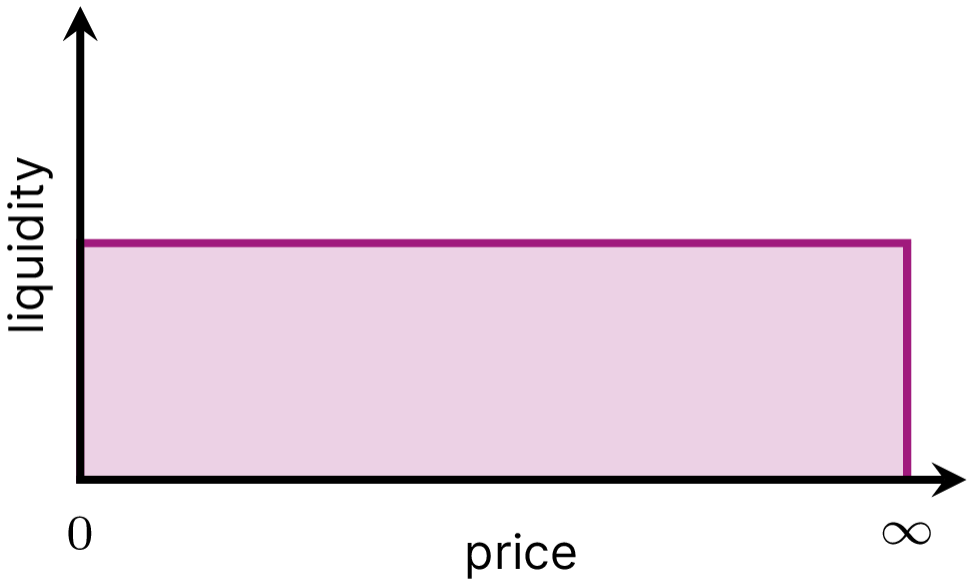


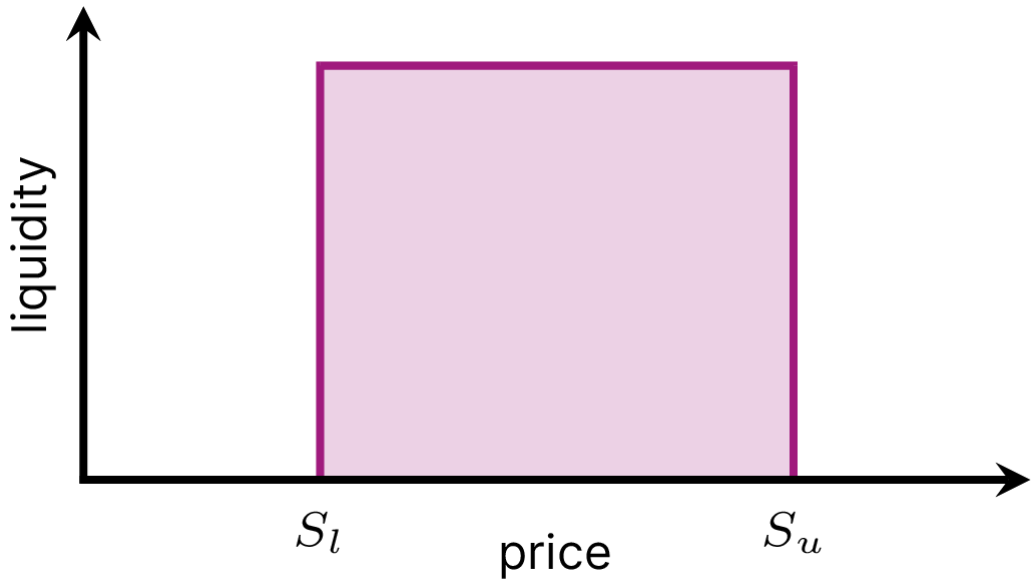
trading along price curve

marginal price: S = y/x

trade *T:* $X \rightarrow Y$

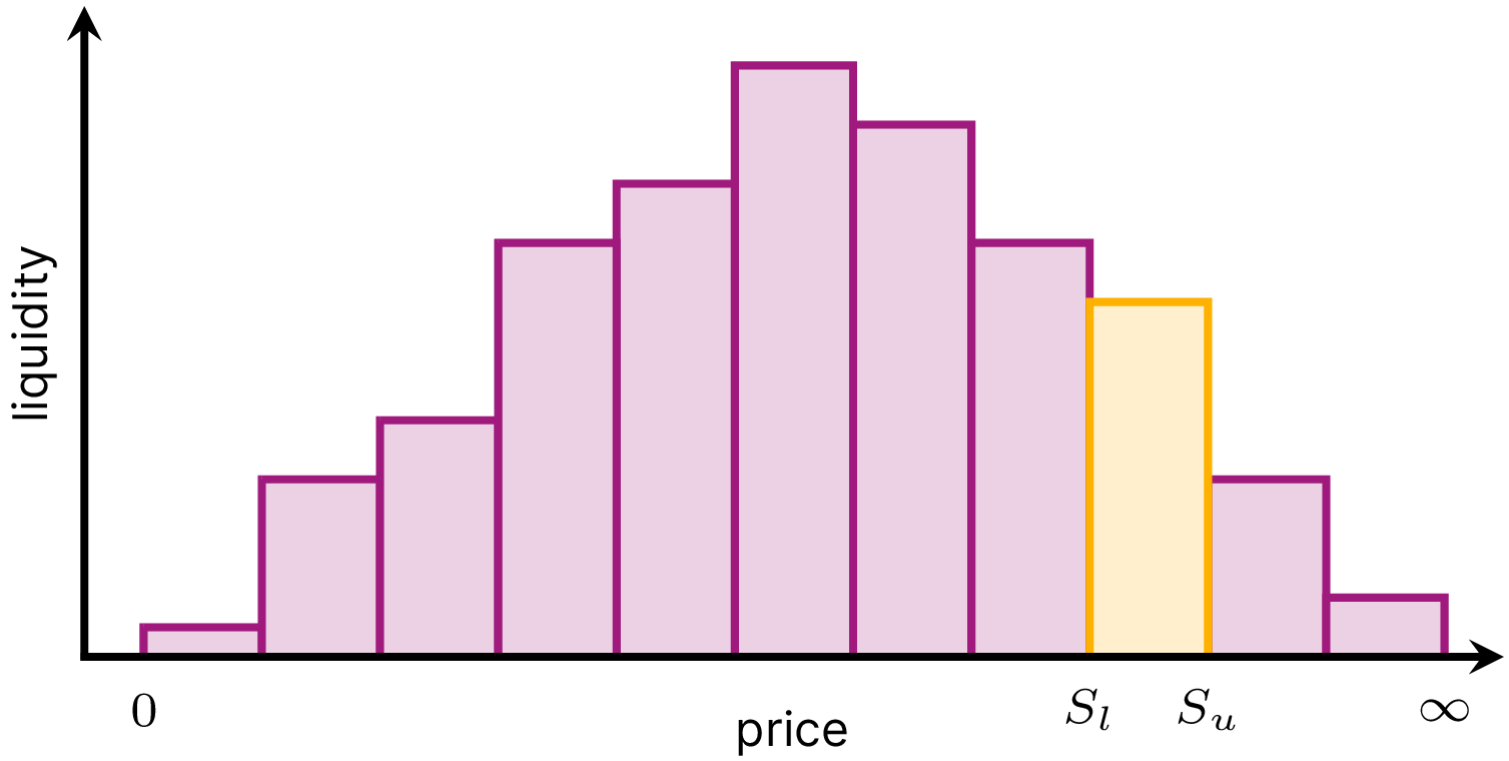
Concentrated liquidity CPMMs



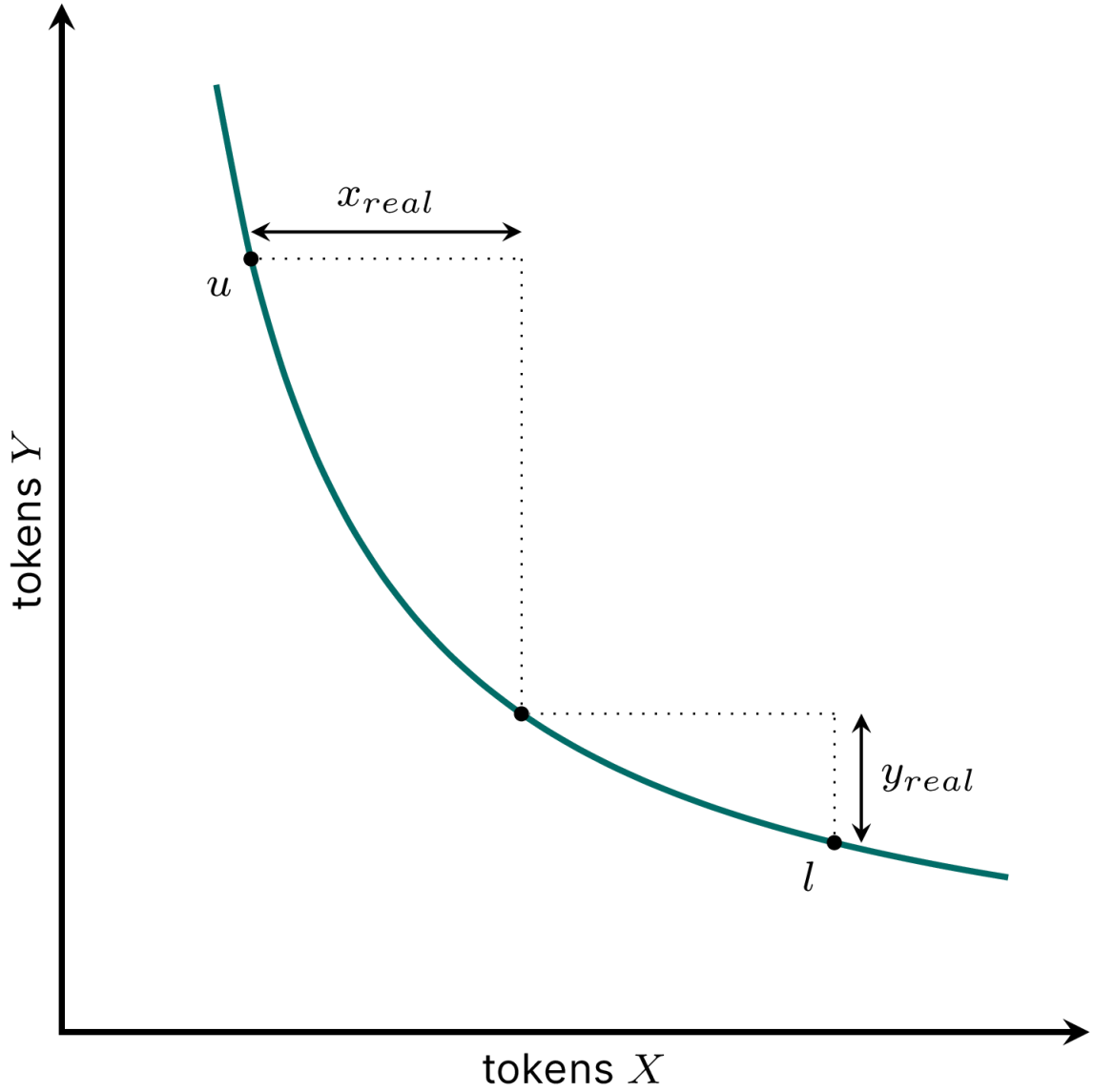


Concentrated liquidity CPMMs

Concentrated liquidity CPMMs

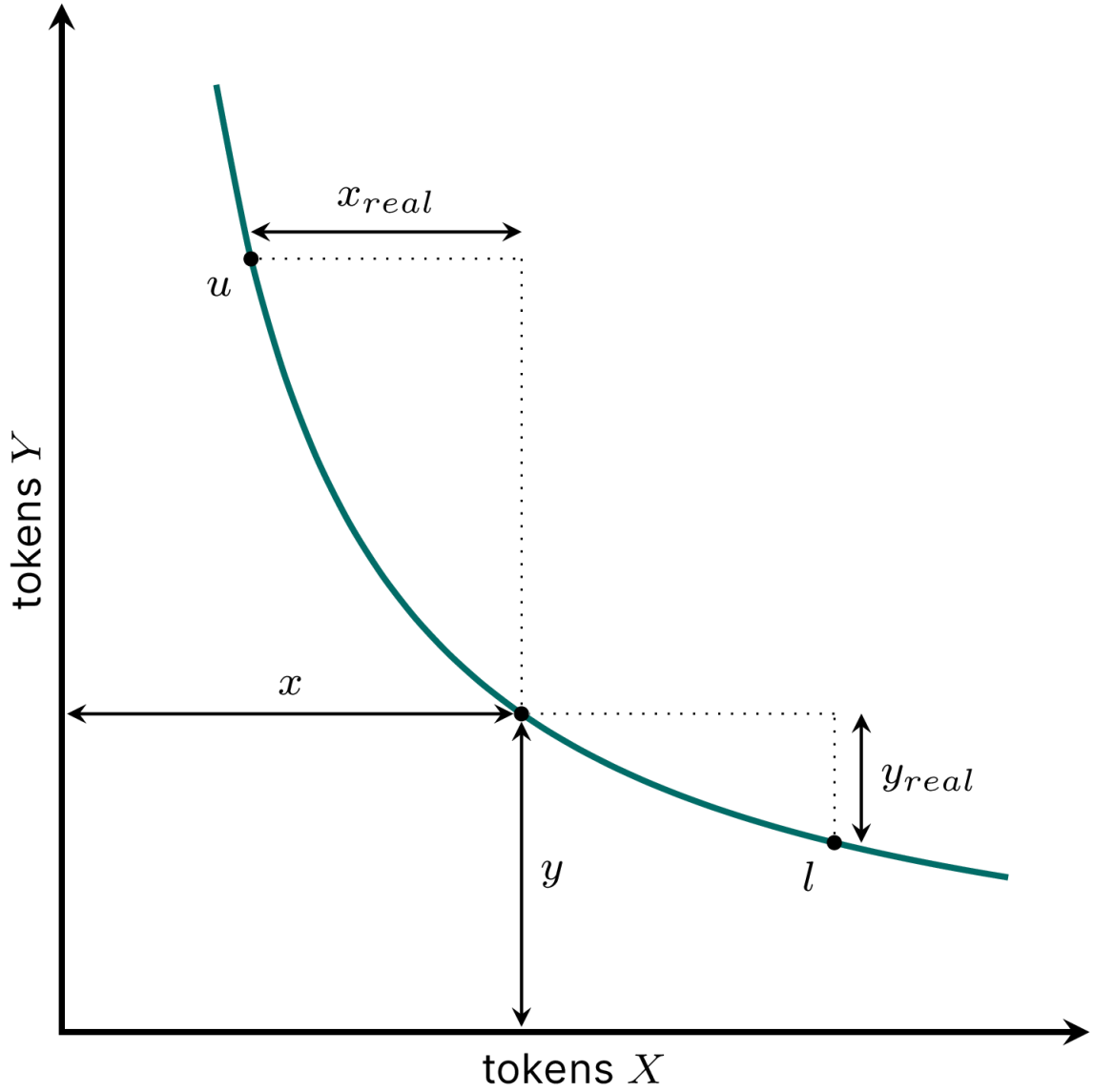


Concentrated liquidity CPMMs



real reserves support trading
up to price boundaries

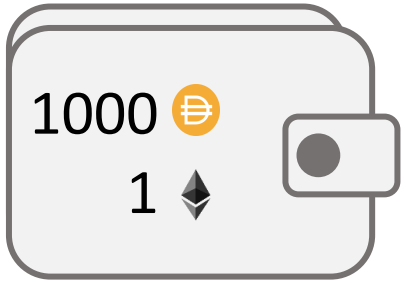
Concentrated liquidity CPMMs

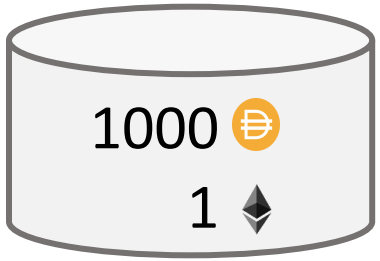


real reserves support trading
up to price boundaries

virtual reserves used
to simulate CPMM

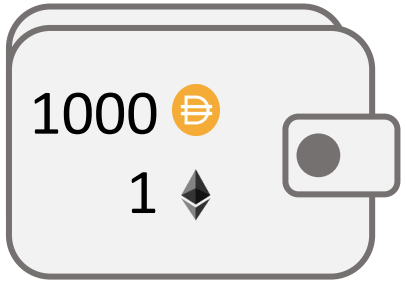
Returns and risks



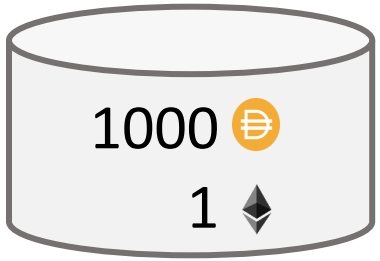


$p(\text{Ð})_{t_1} = 1$ $\quad$ $p(\text{Ξ})_{t_1} = 1000$

Returns and risks



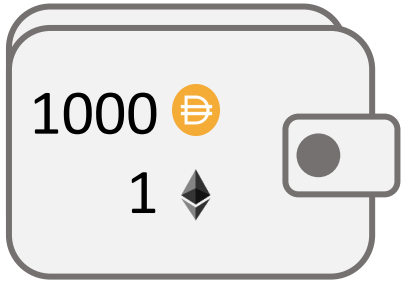
$2000



$2000

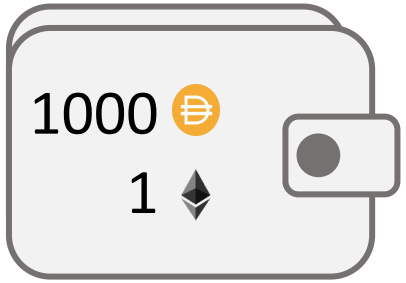
$p(\text{Ð})_{t_1} = 1$ $p(\text{Ξ})_{t_1} = 1000$

Returns and risks



$p(\text{Ð})_{t_2} = 1$ $\quad$ $p(\text{Ξ})_{t_2} = 2000$

Returns and risks



$3000

$2828

$p(\text{Ð})_{t_2} = 1$ $p(\text{Ξ})_{t_2} = 2000$

Impermanent loss

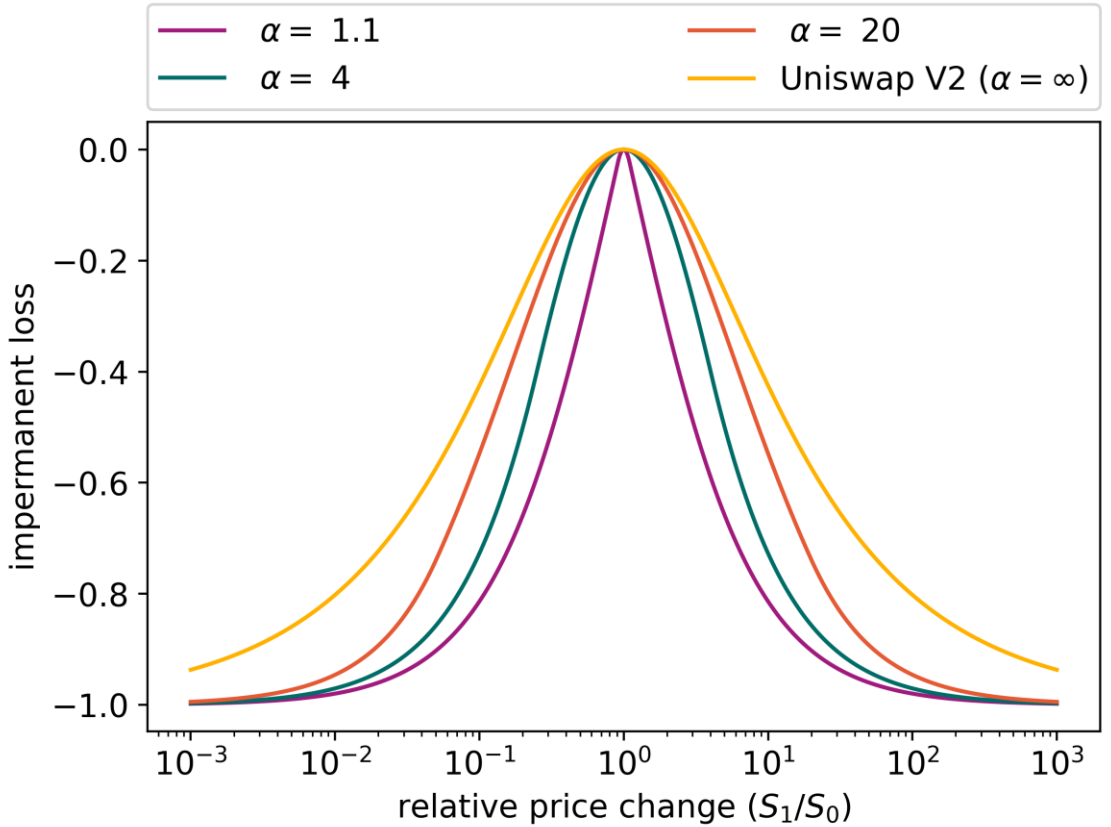
impermanent loss: describes the risk for liquidity providers of seeing the value of their reserved tokens decrease in comparison to holding the assets

Impermanent loss

$$\text{impermanent loss}_{t_1 \to t_2} \approx -6\%$$

Impermanent loss

Impermanent loss



Fees

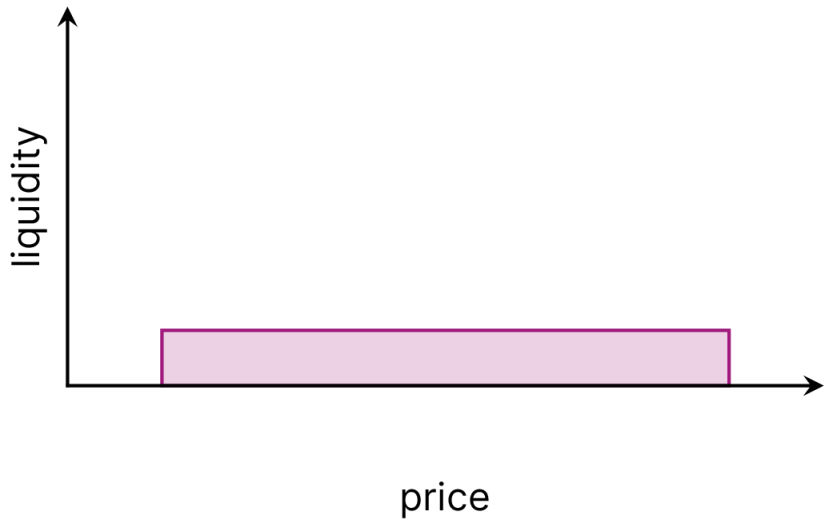
Fees

fees: received by liquidity providers for every trade in liquidity pool

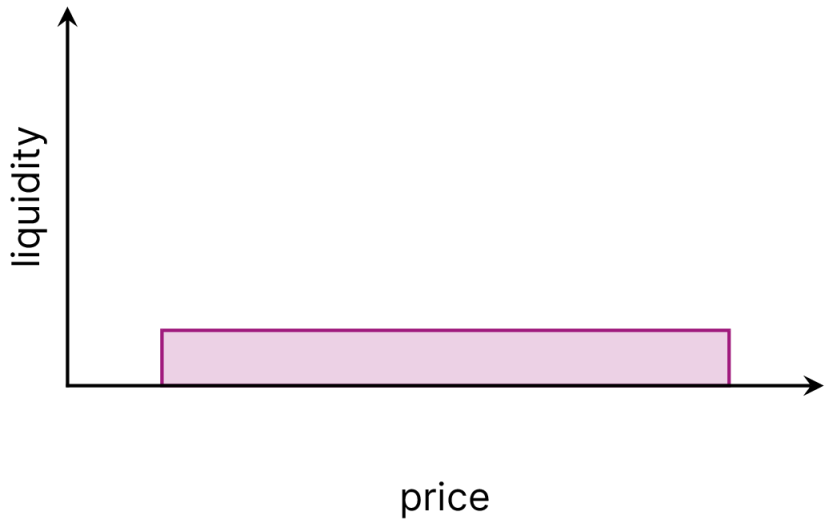
Return

return: compares the value of the liquidity to holding the assets from the initial injection

Liquidity position



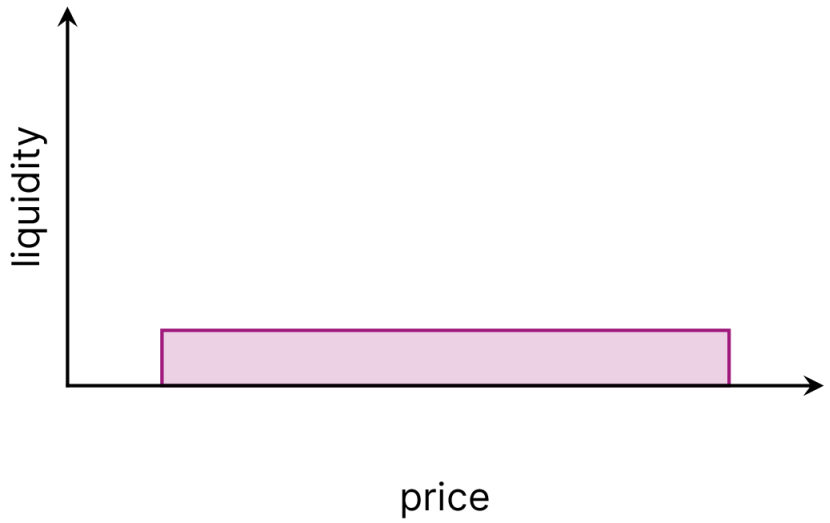
Liquidity position



↓ capital efficiency

↓ impermanent loss

Liquidity position



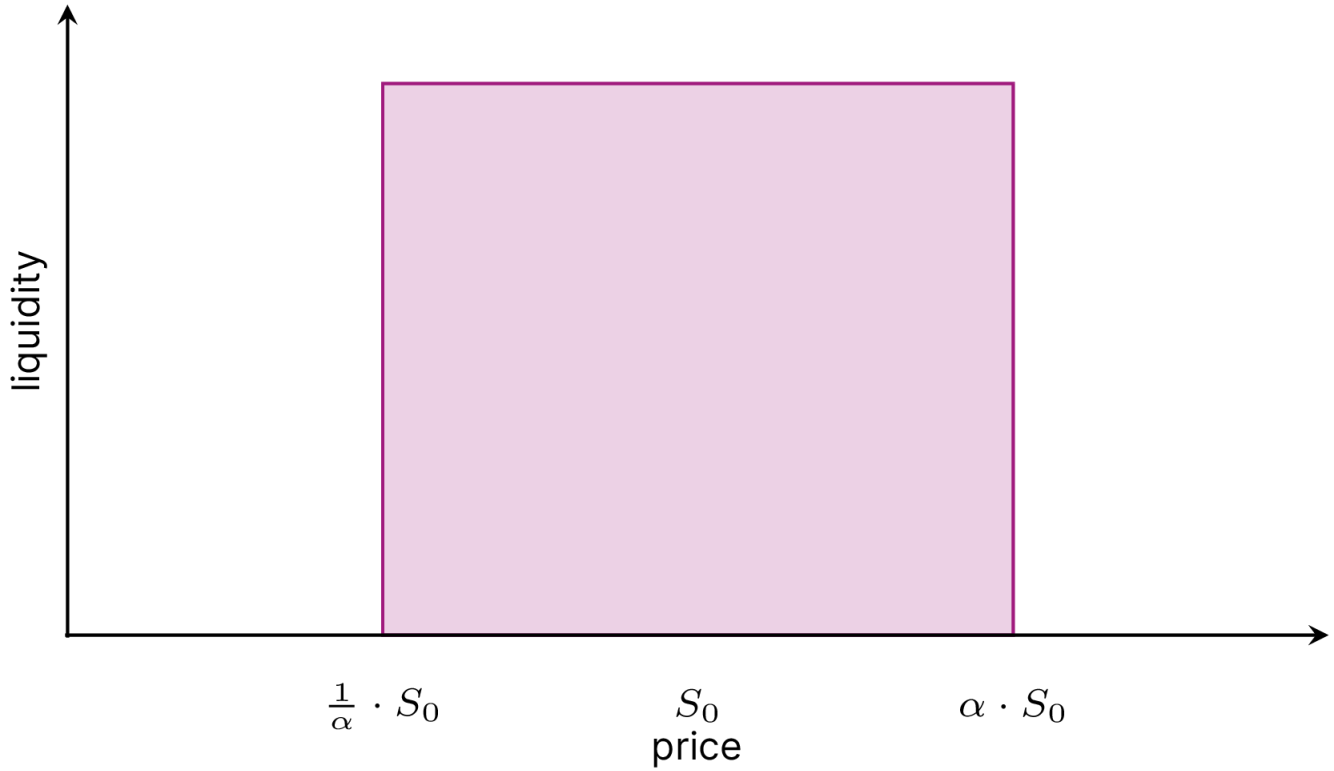
↓ capital efficiency

↓ impermanent loss

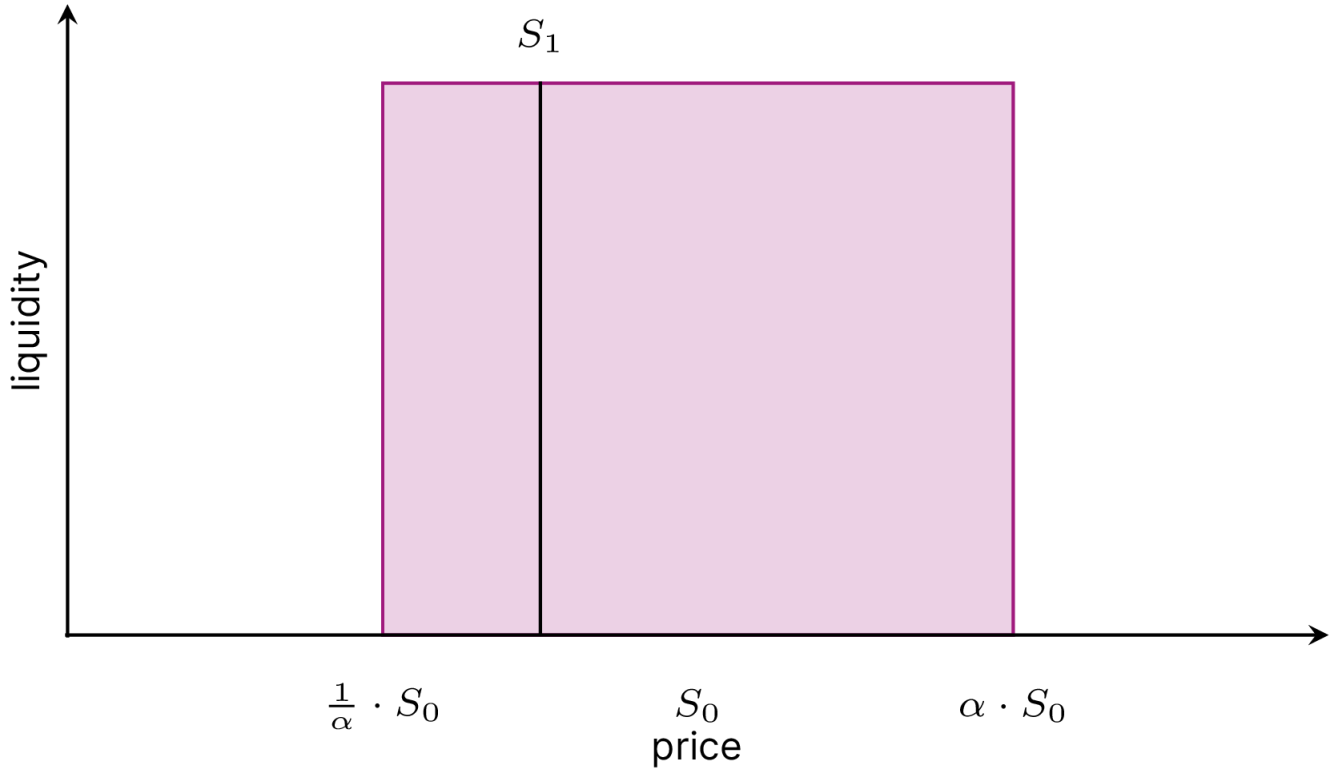
↑ capital efficiency

↑ impermanent loss

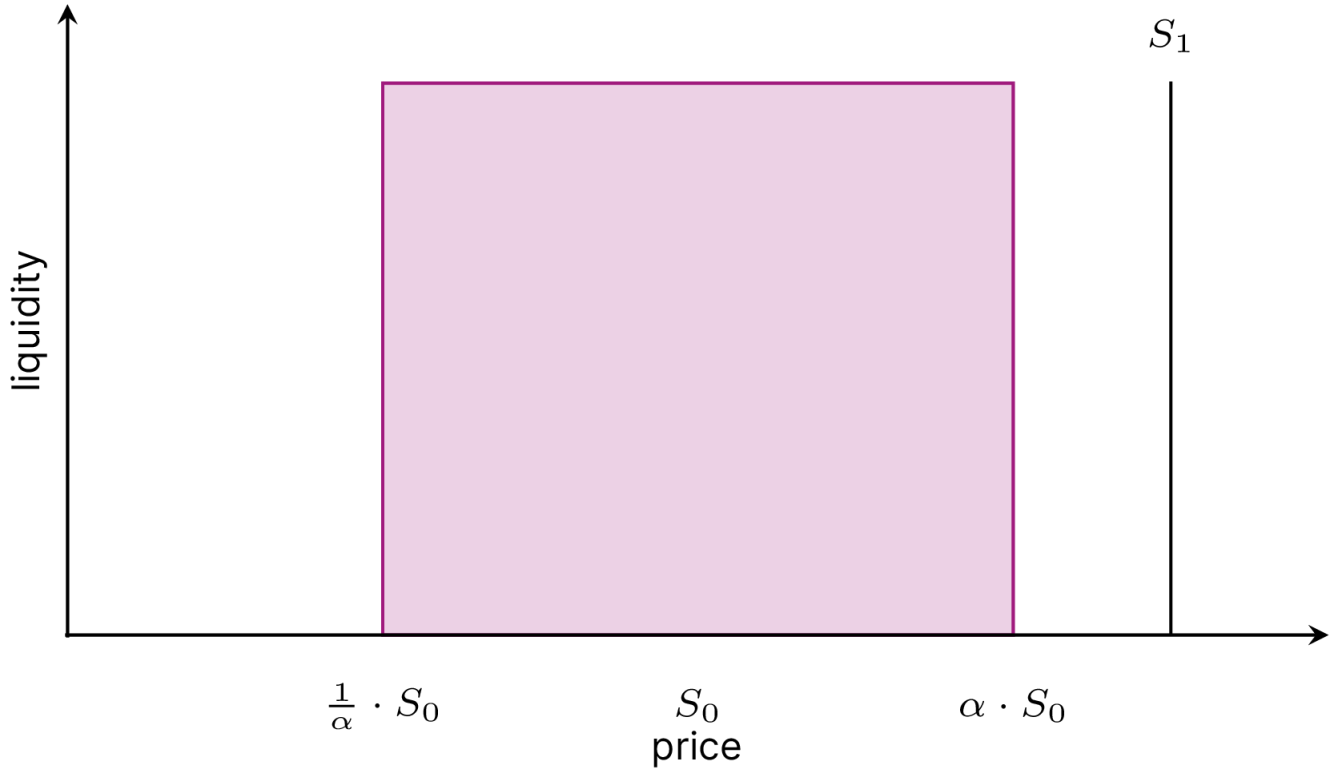
Liquidity position



Liquidity position



Liquidity position



Simulation of daily asset price

Black-Scholes market model

Simulation of daily asset price

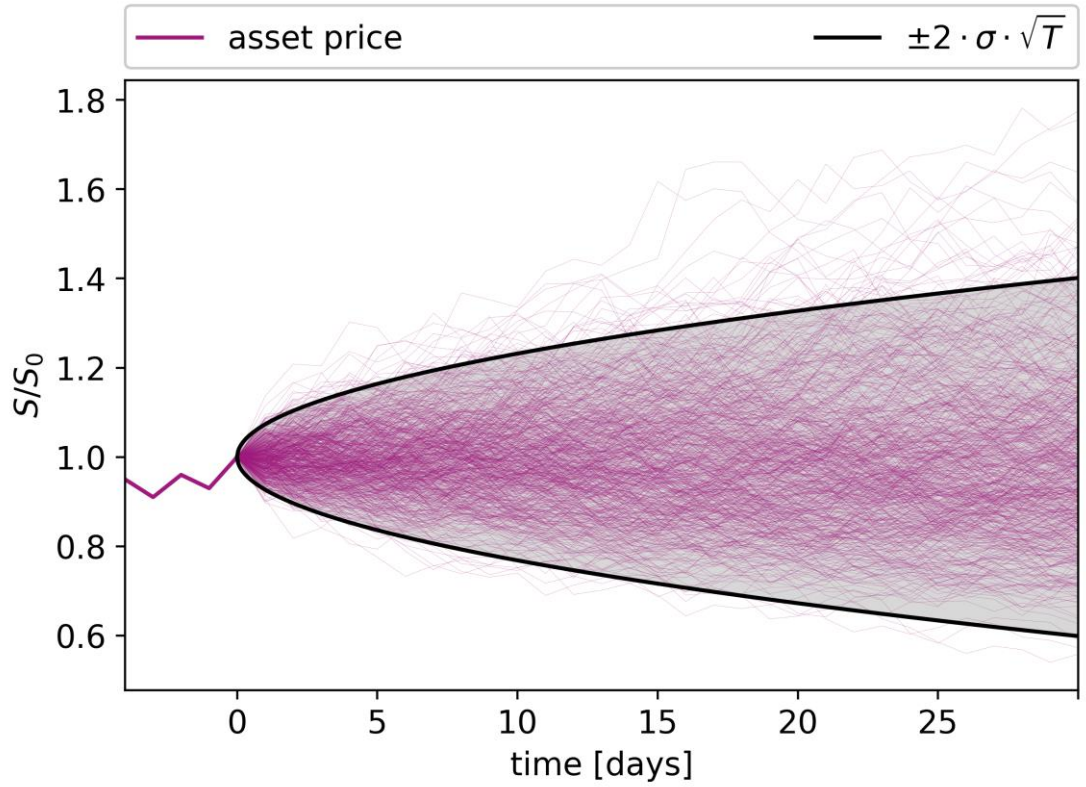
Black-Scholes market model

$$S(t) = S(0)\exp\left(\mu\, t - \frac{\sigma^2}{2} t + \sigma\, W(t)\right)$$

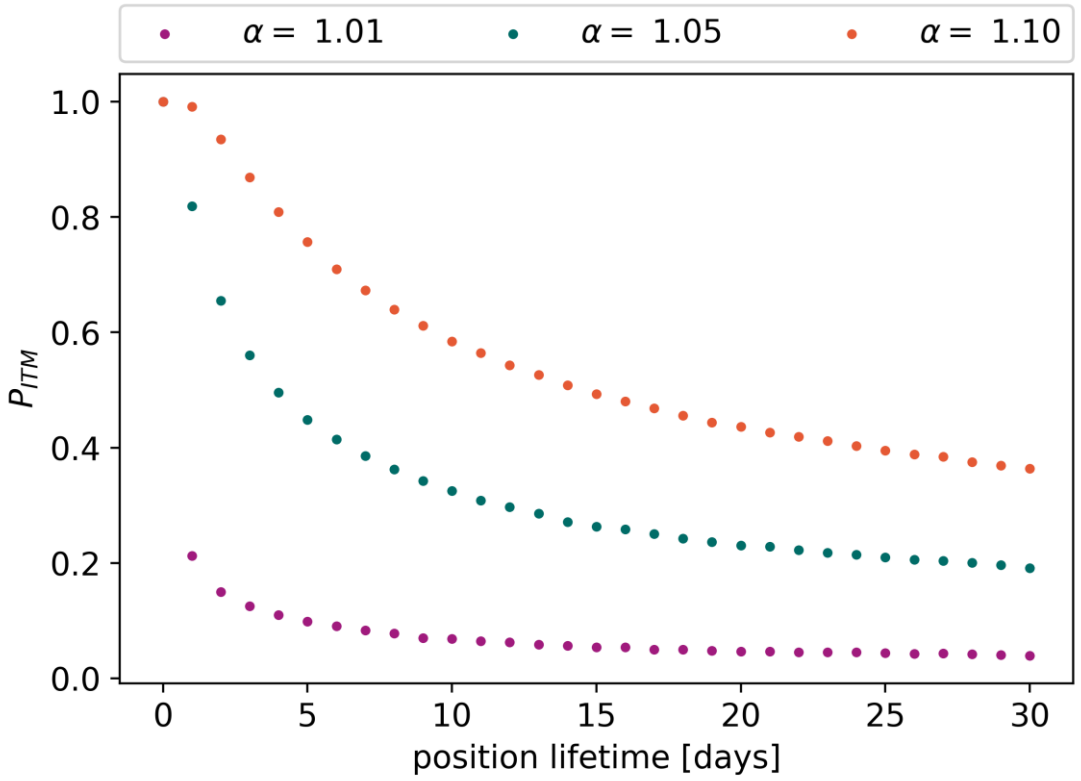
Simulation of daily asset price

Black-Scholes market model

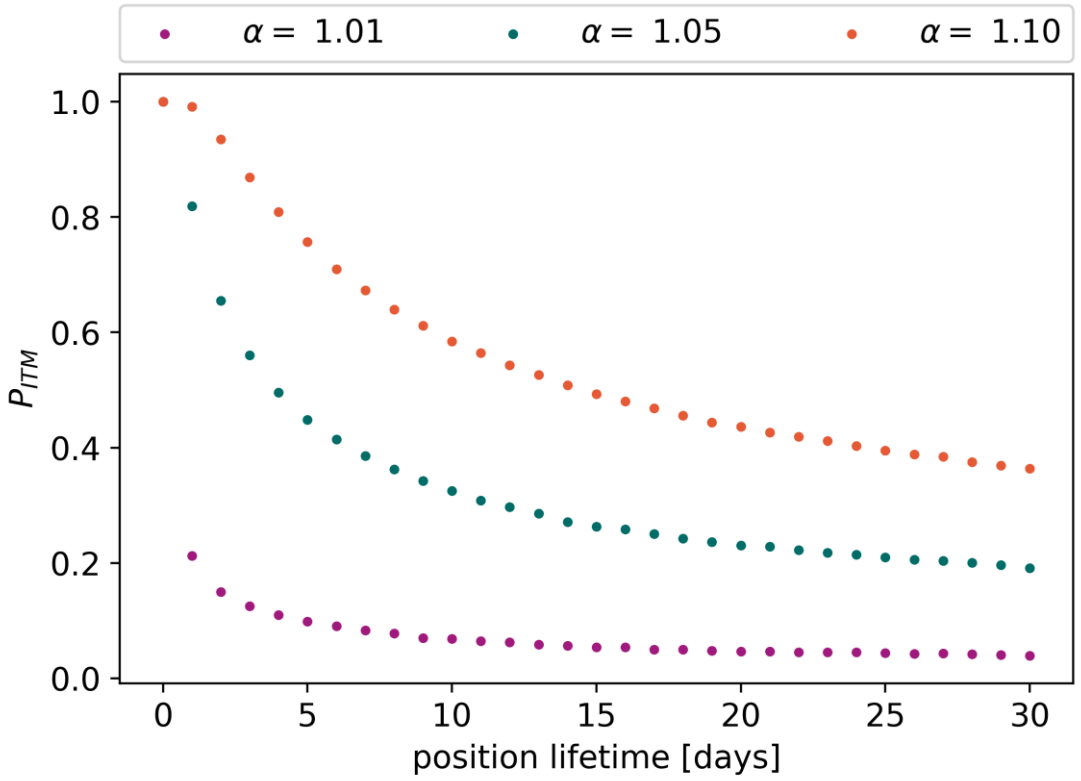
$$S(t) = S(0)\exp\left(\mu\, t - \frac{\sigma^2}{2} t + \sigma\, W(t)\right)$$

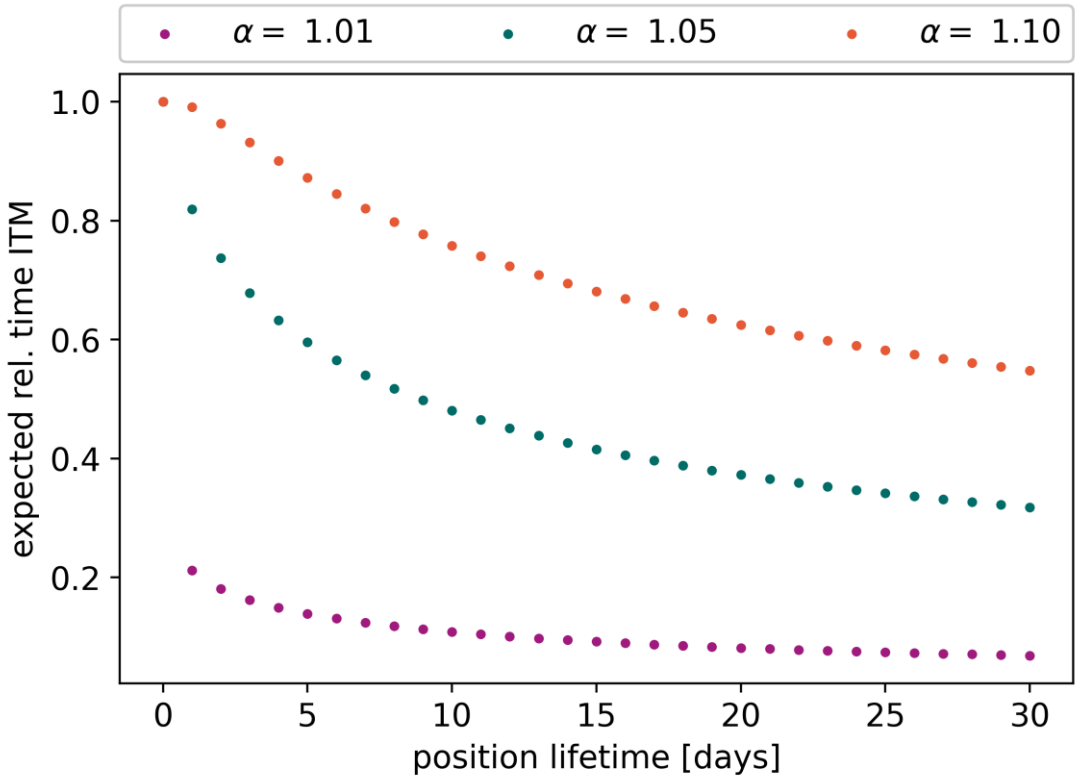


Probability and time in the money (ITM)



Probability and time in the money (ITM)



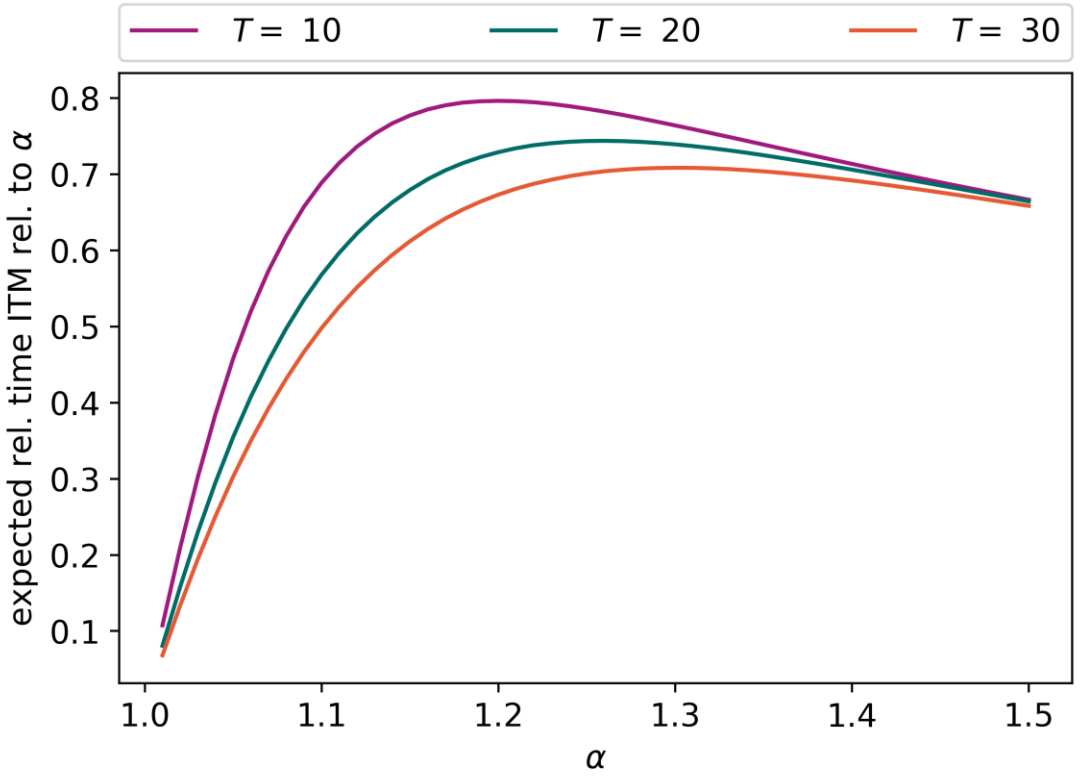


Optimal position width

$$F \propto \frac{T_{ITM}}{\alpha}$$

Optimal position width

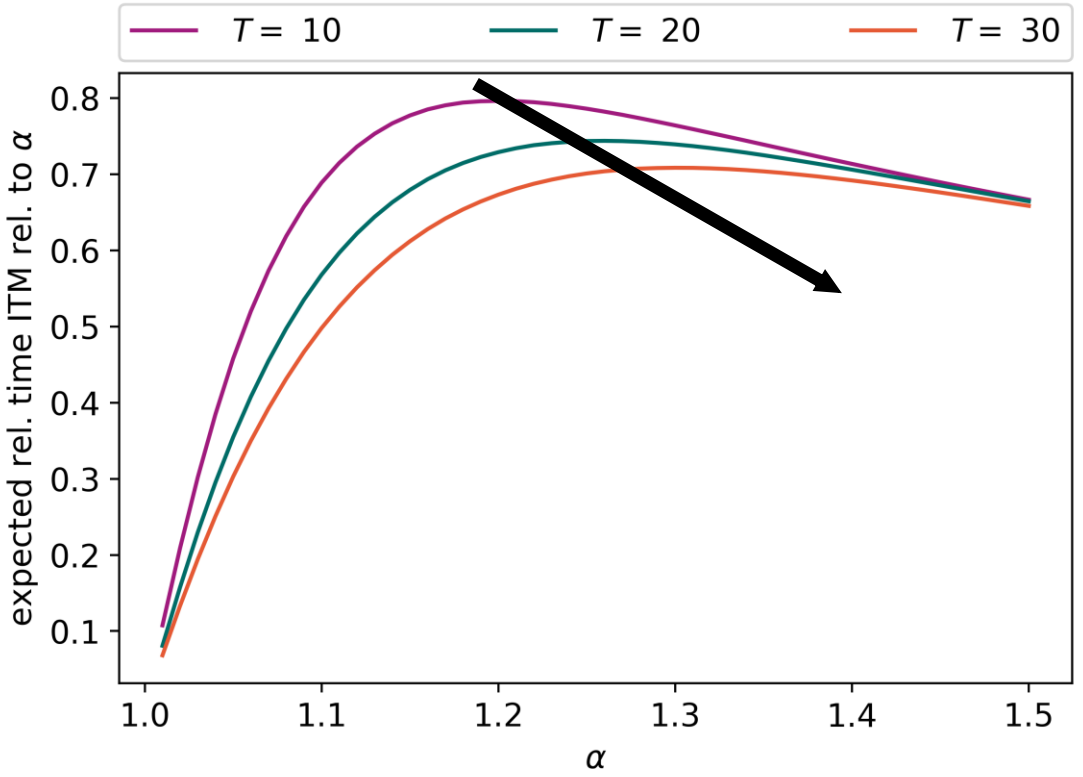
$$F \propto \frac{T_{ITM}}{\alpha}$$



Optimal position width

$$F \propto \frac{T_{ITM}}{\alpha}$$

optimal position width increases with position lifetime



Pair types

stable pair: both tokens traded in the pool are stable coins

Pair types

stable pair: both tokens traded in the pool are stable coins

DAI-USDC ($f \in \{0.01\%, 0.05\%\}$)

Pair types

stable pair: both tokens traded in the pool are stable coins

DAI-USDC ($f \in \{0.01\%, 0.05\%\}$)

normal pair: both cryptocurrencies traded in the pools are established currencies

Pair types

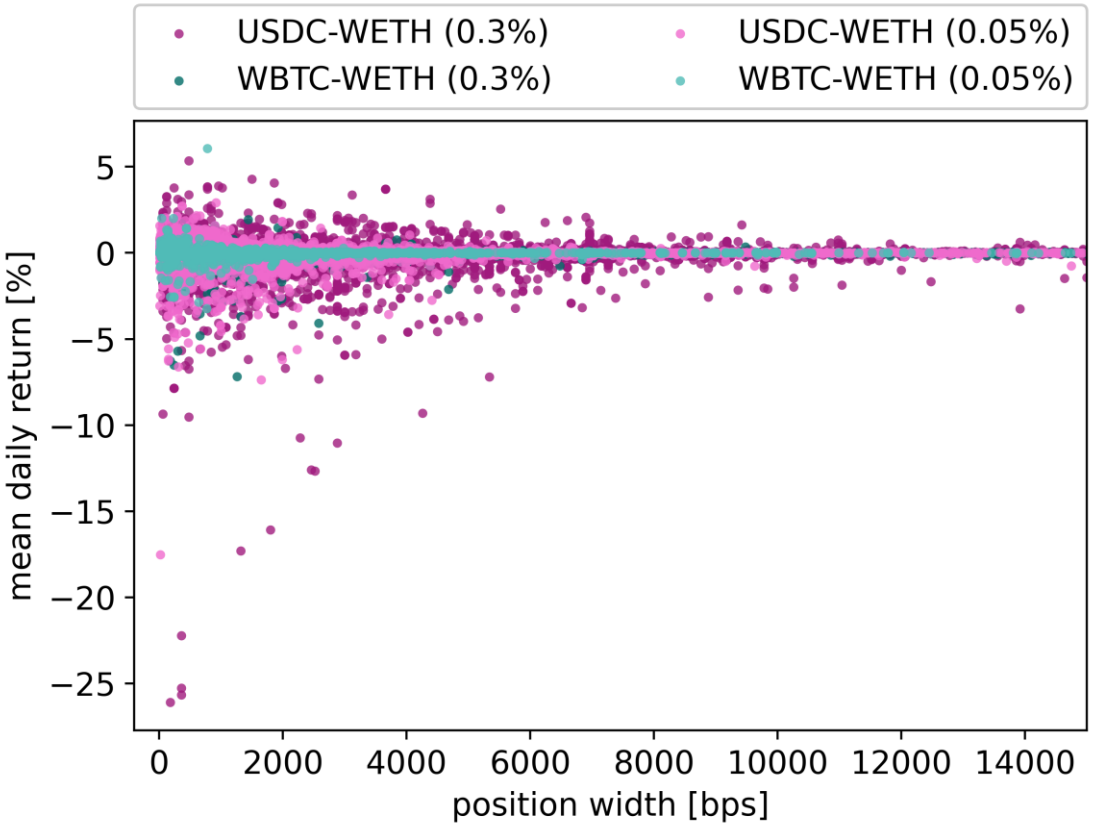
stable pair: both tokens traded in the pool are stable coins

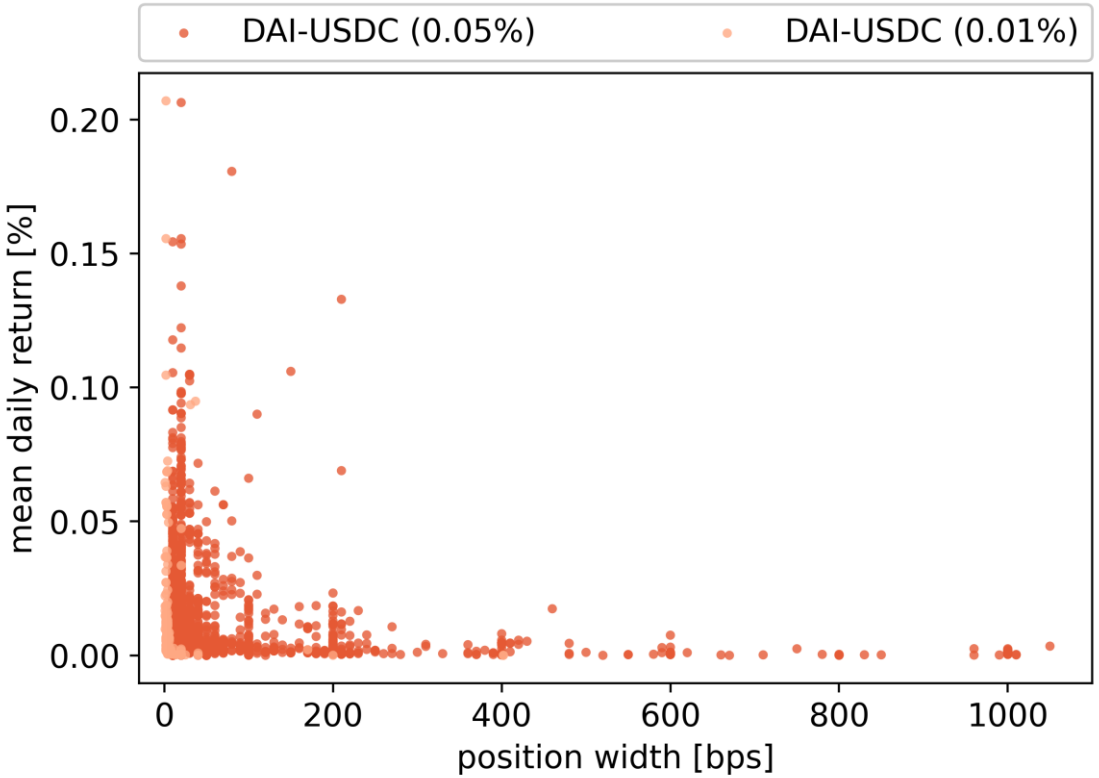
DAI-USDC ($f \in \{0.01\%, 0.05\%\}$)

normal pair: both cryptocurrencies traded in the pools are established currencies

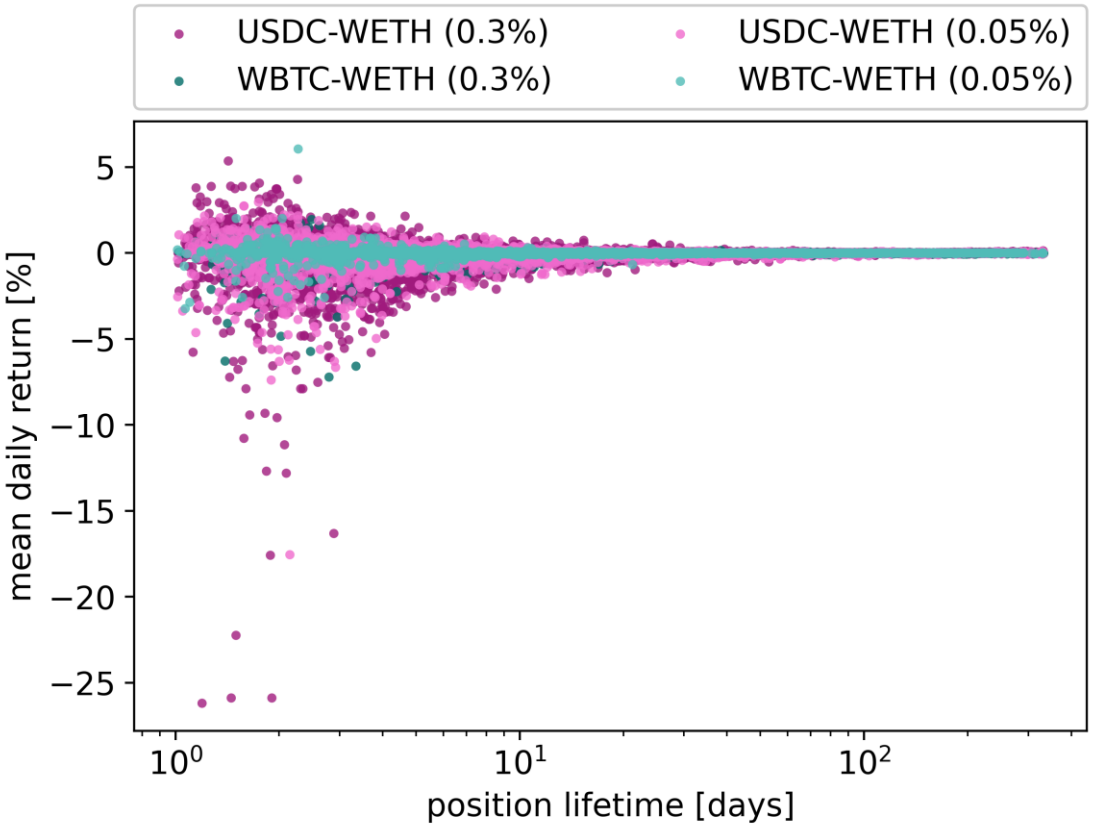
USDC-WETH ($f \in \{0.05\%, 0.3\%\}$)
WBTC-WETH ($f \in \{0.05\%, 0.3\%\}$)

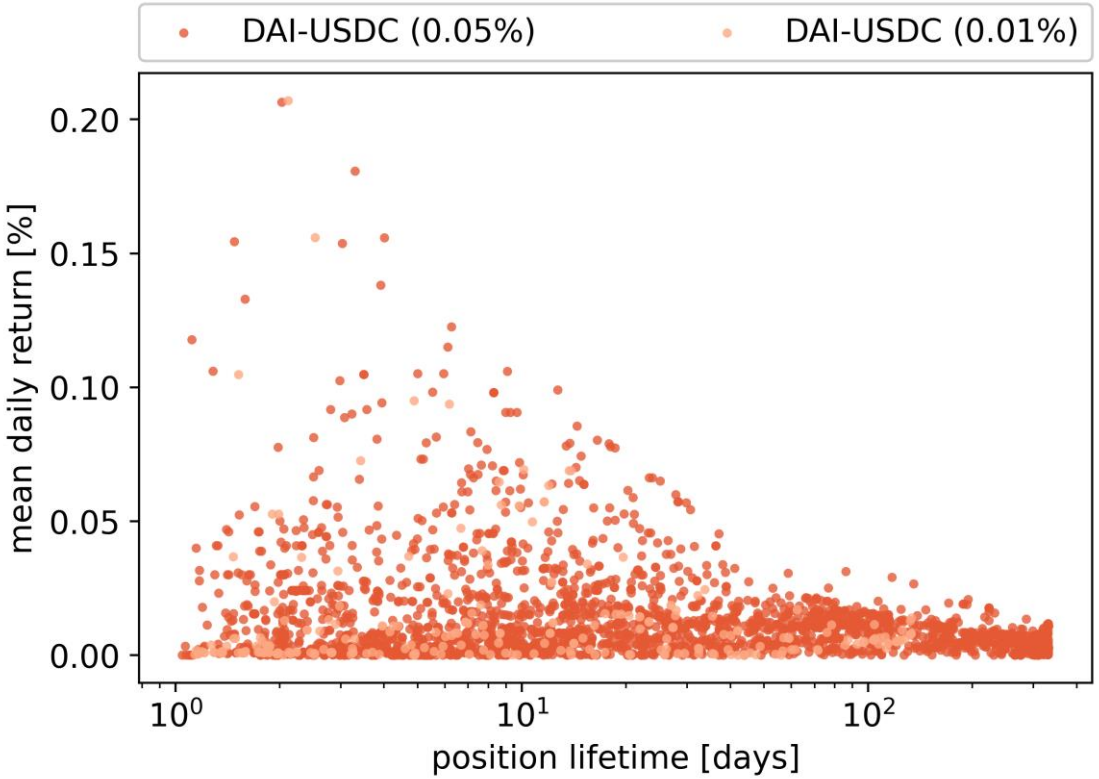
Position width



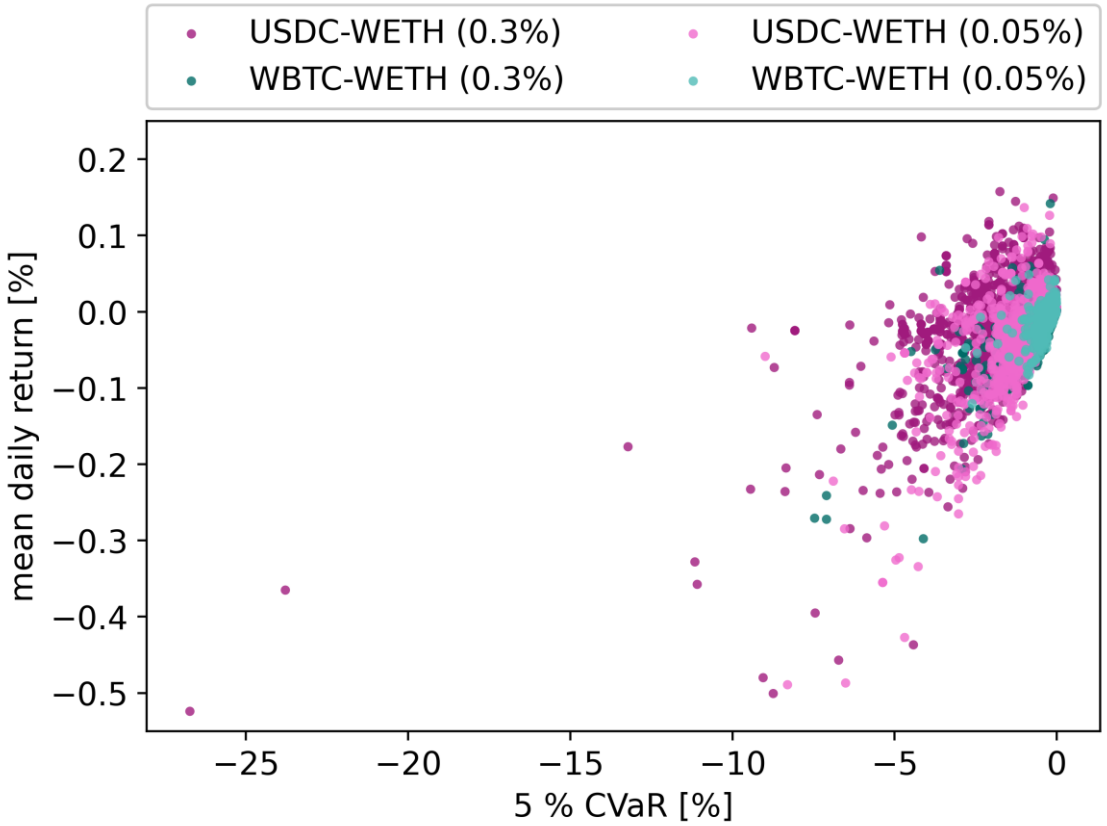


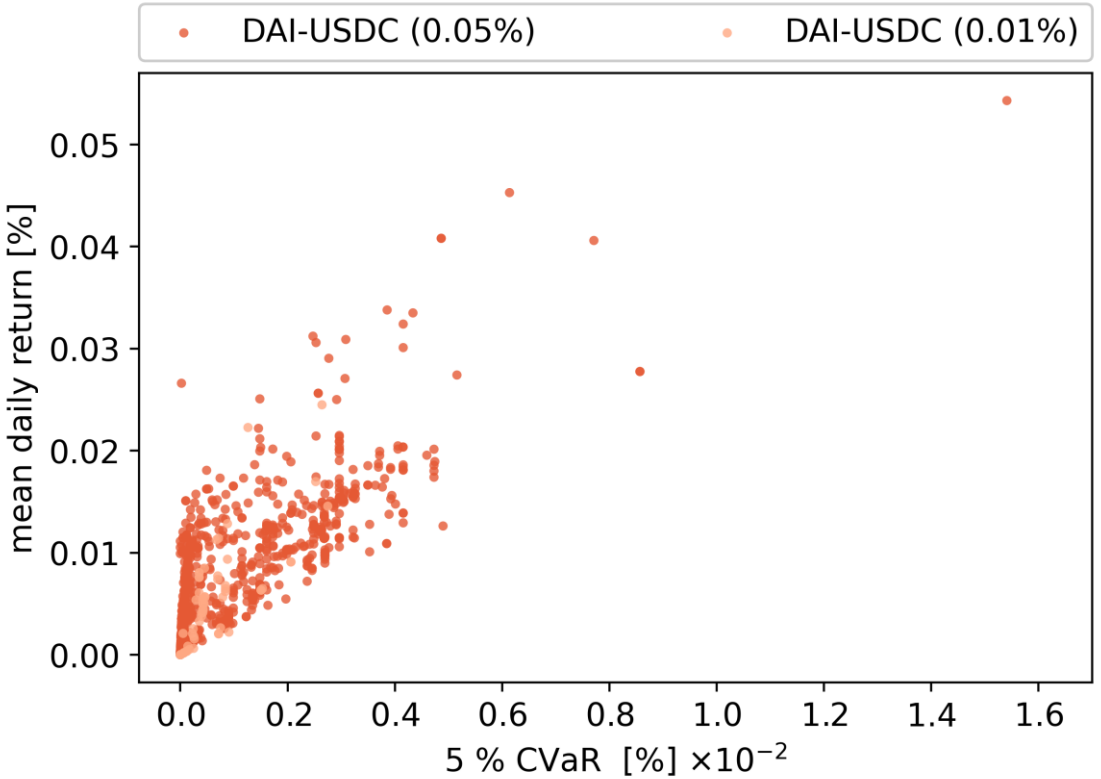
Position lifetime





Conditional value at risk (CVaR)



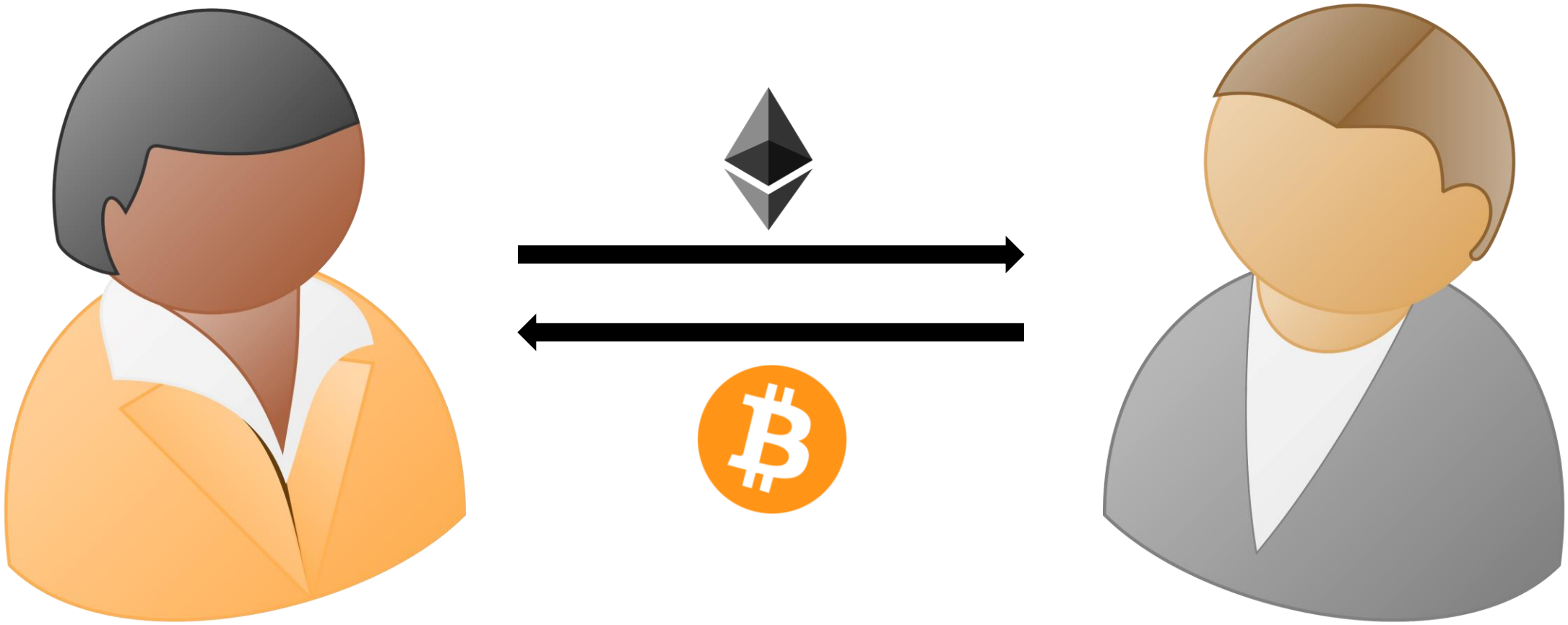


Thank You!

Questions & Comments?

Advances in Financial Technologies (AFT'22)
Lioba Heimbach, Eric Schertenleib, Roger Wattenhofer
ETH Zurich – Distributed Computing – www.disco.ethz.ch

Decentralized exchanges (DEXes)

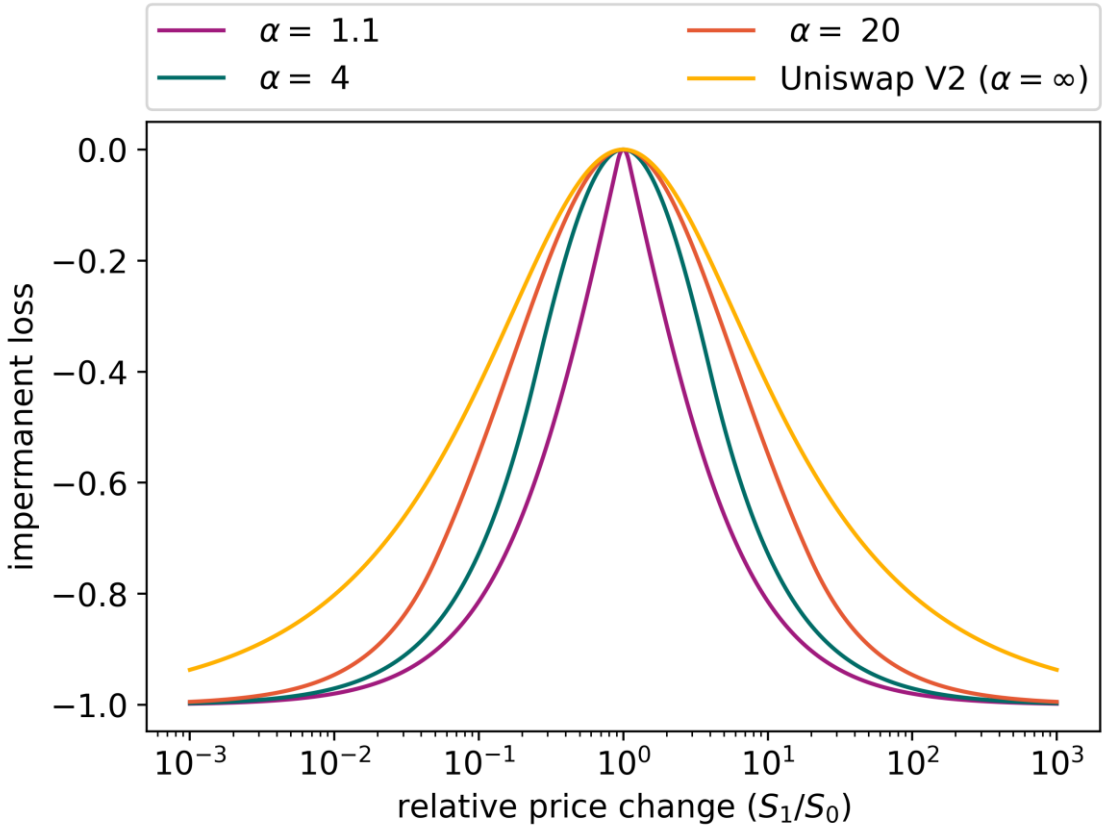


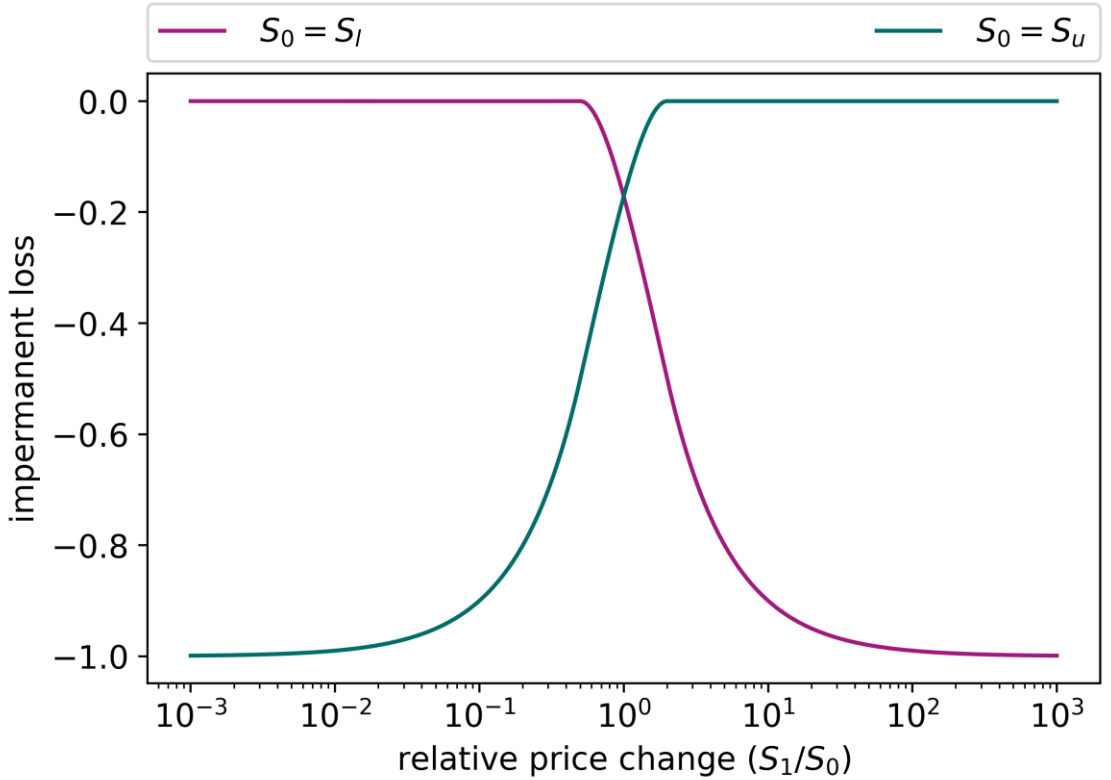
Return

return: compares the value of the liquidity to holding the assets from the initial injection

$$R(S_0, S_1, S_l, S_u, F) = \frac{V_{pos} + F - V_{hold}}{V_{hold}}$$

Impermanent loss





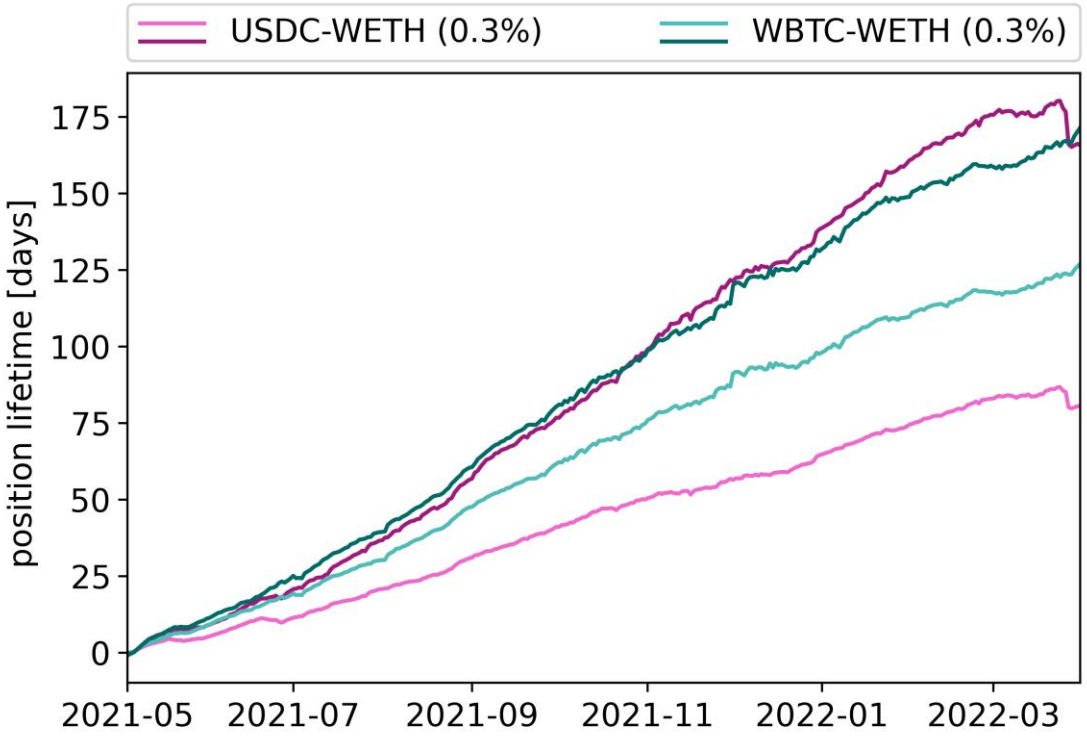
general liquidity
pool statistics

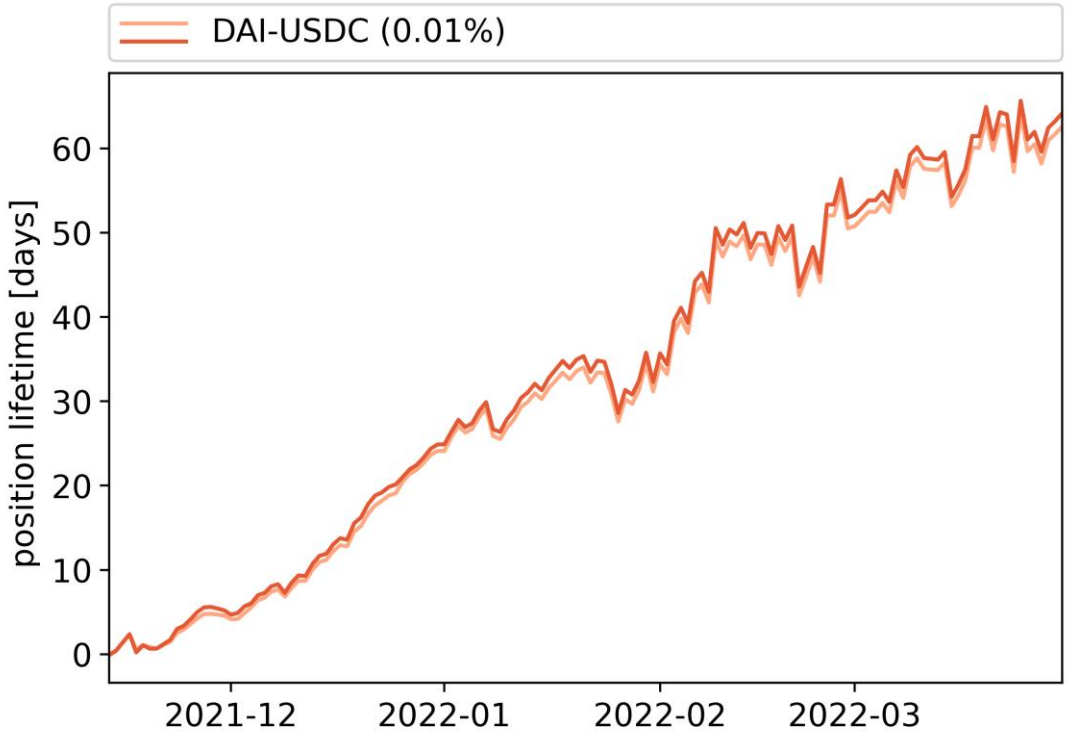
performance statistics
of liquidity positions

general liquidity
pool statistics

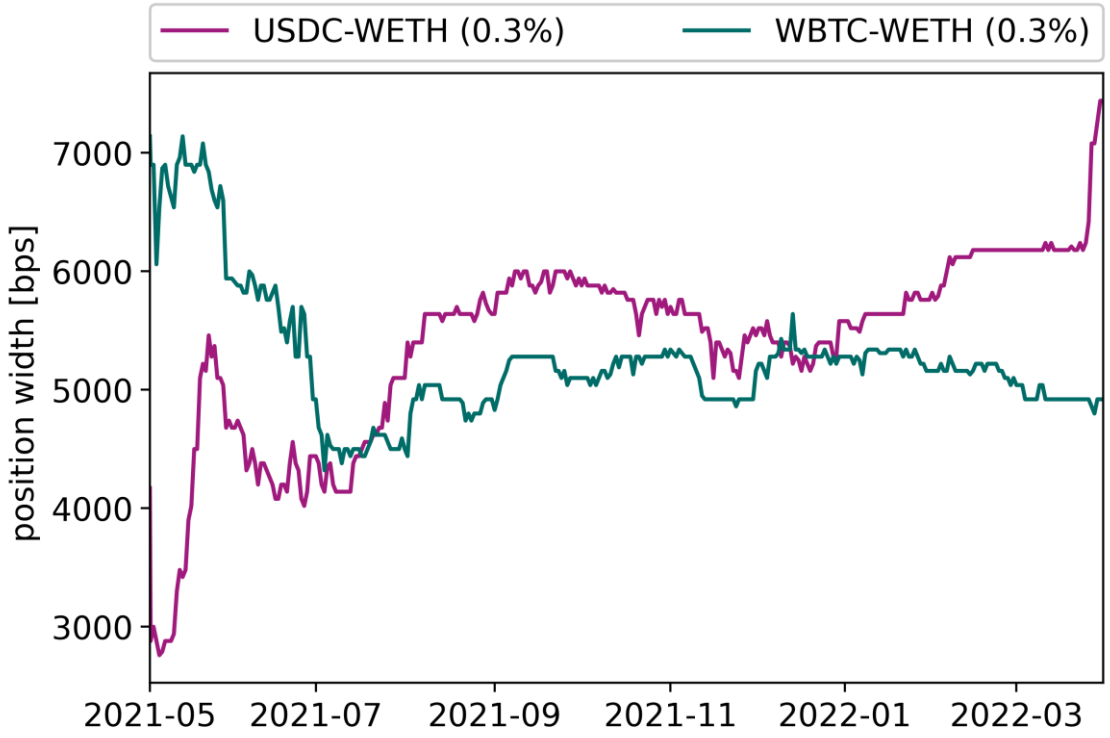
performance statistics
of liquidity positions

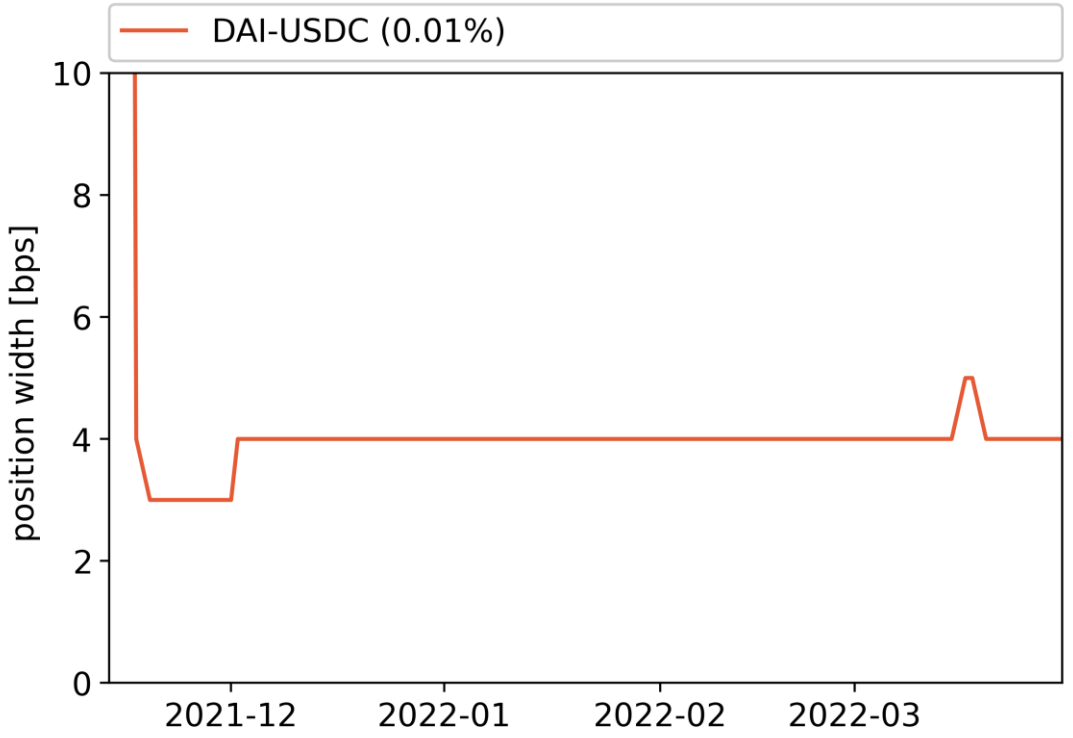
Position lifetime



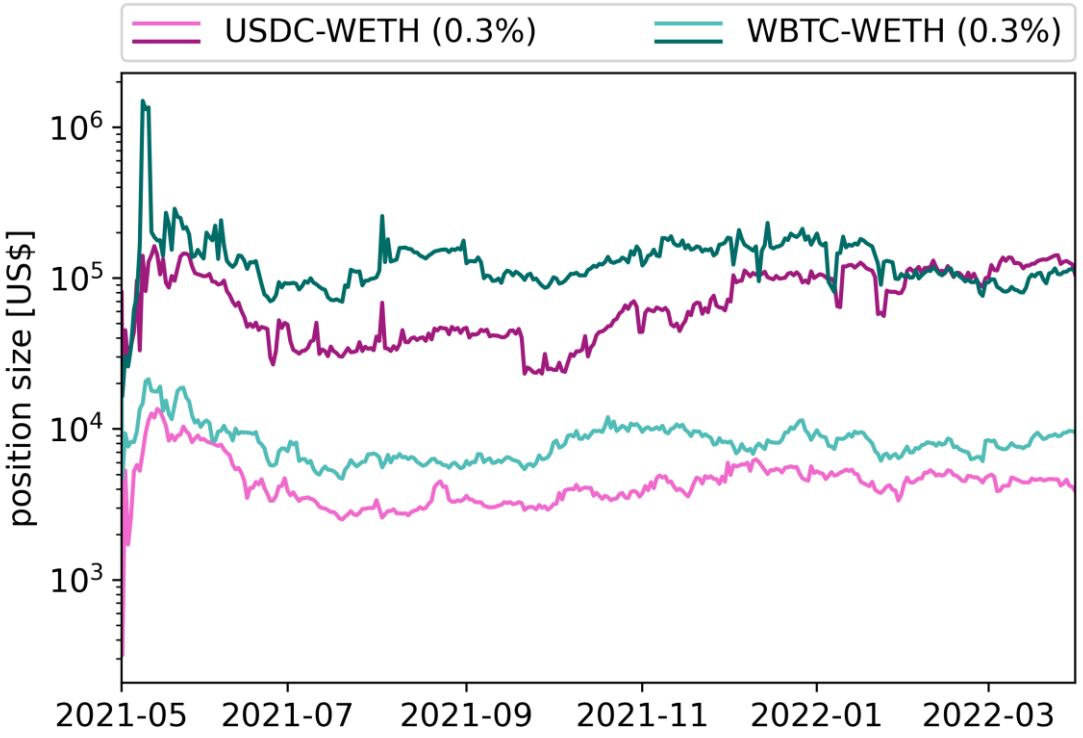


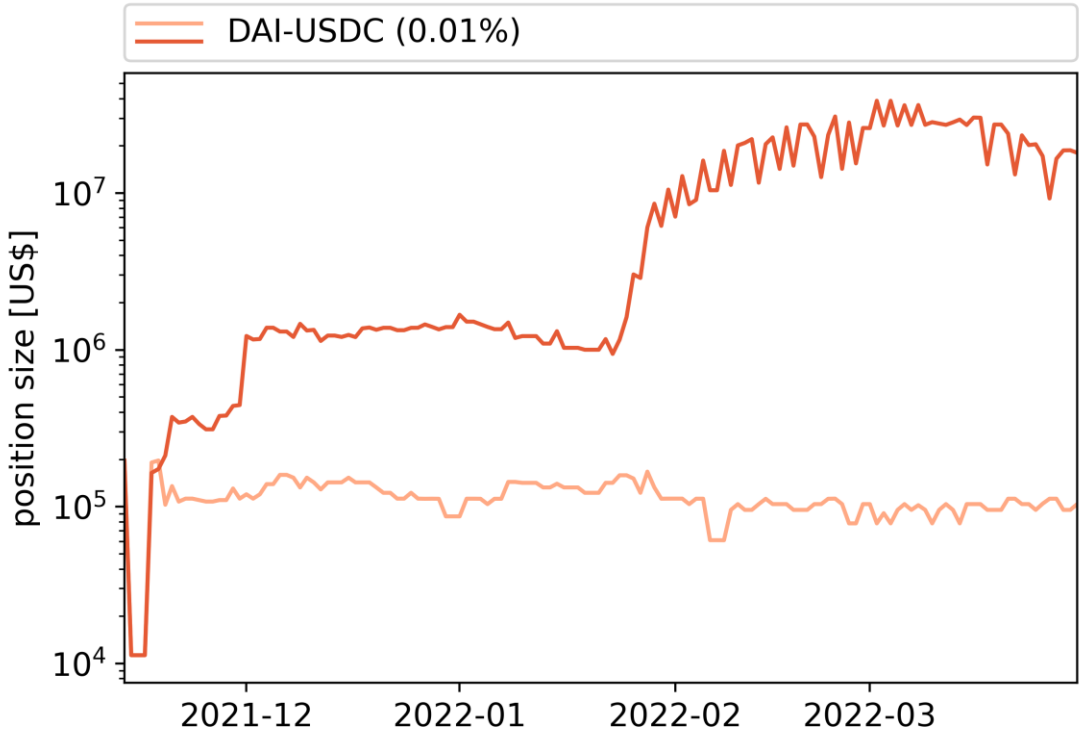
Position width



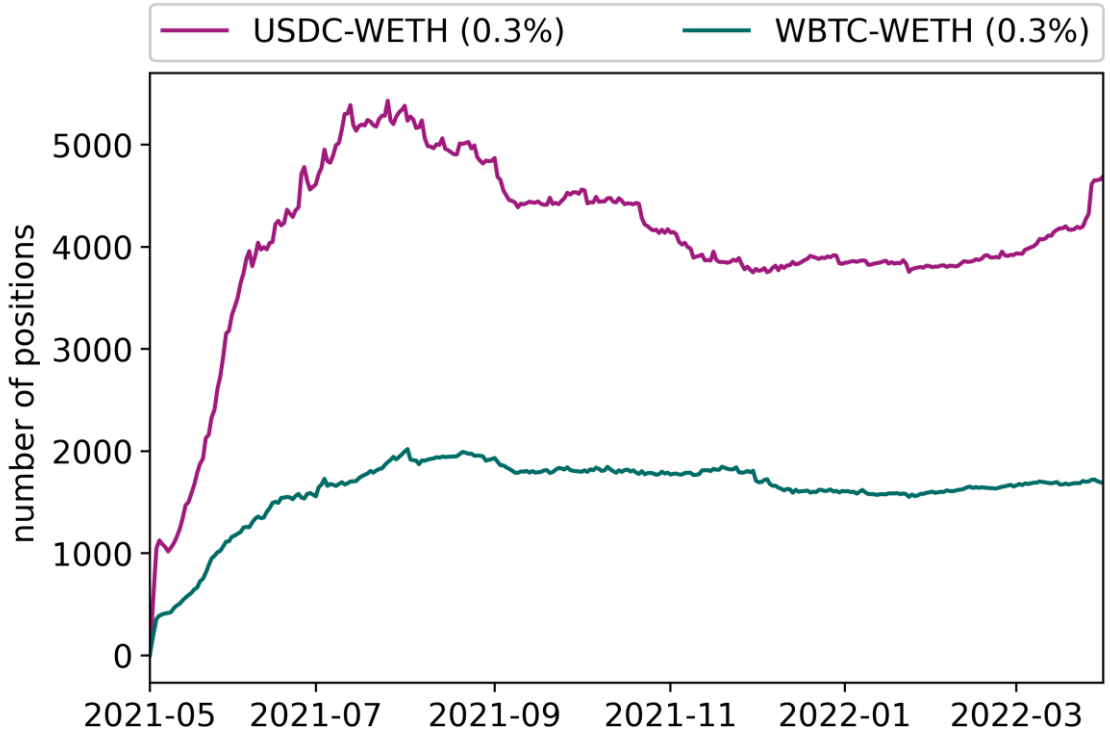


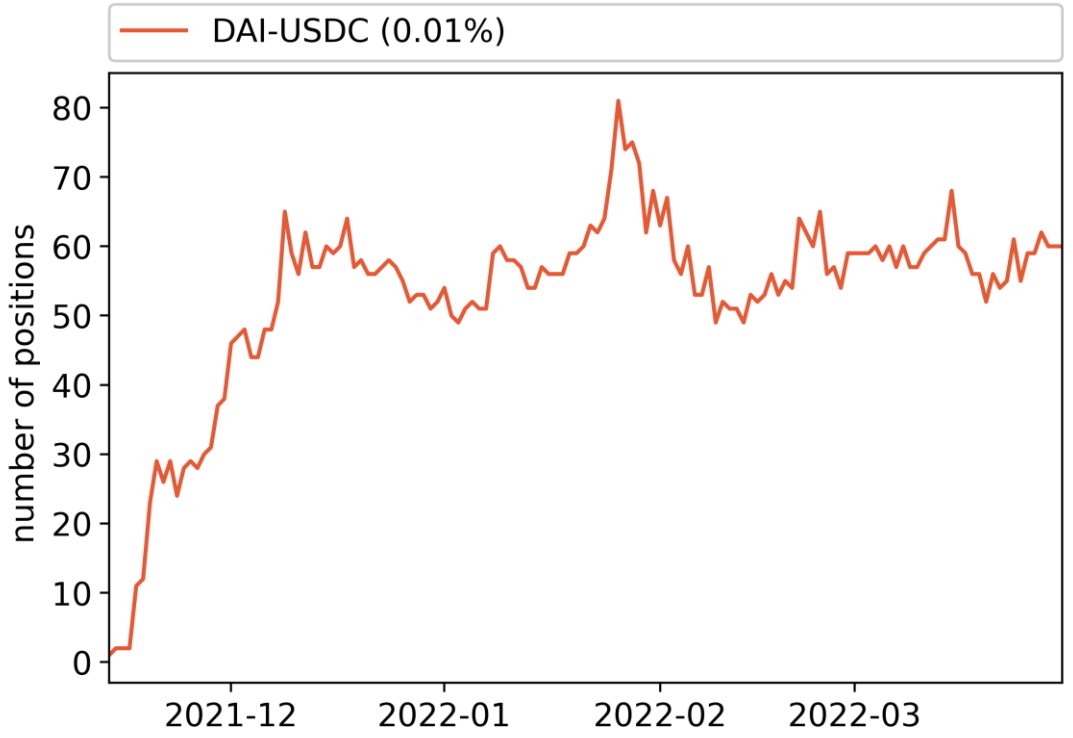
Position size



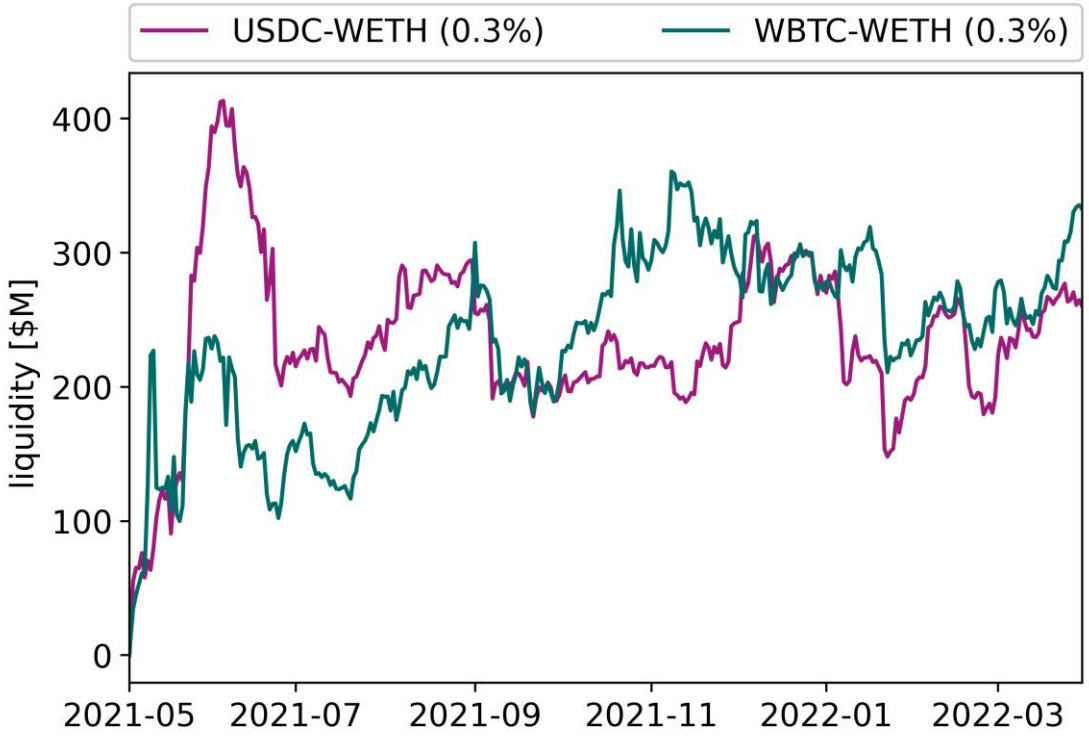


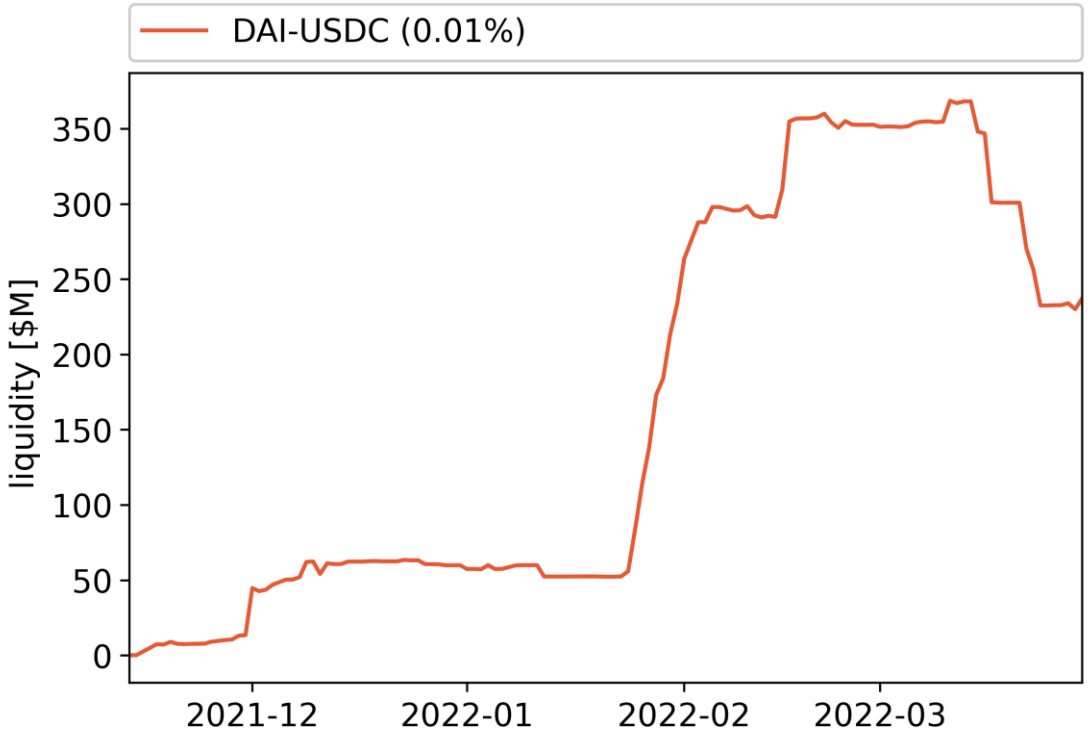
Number of position



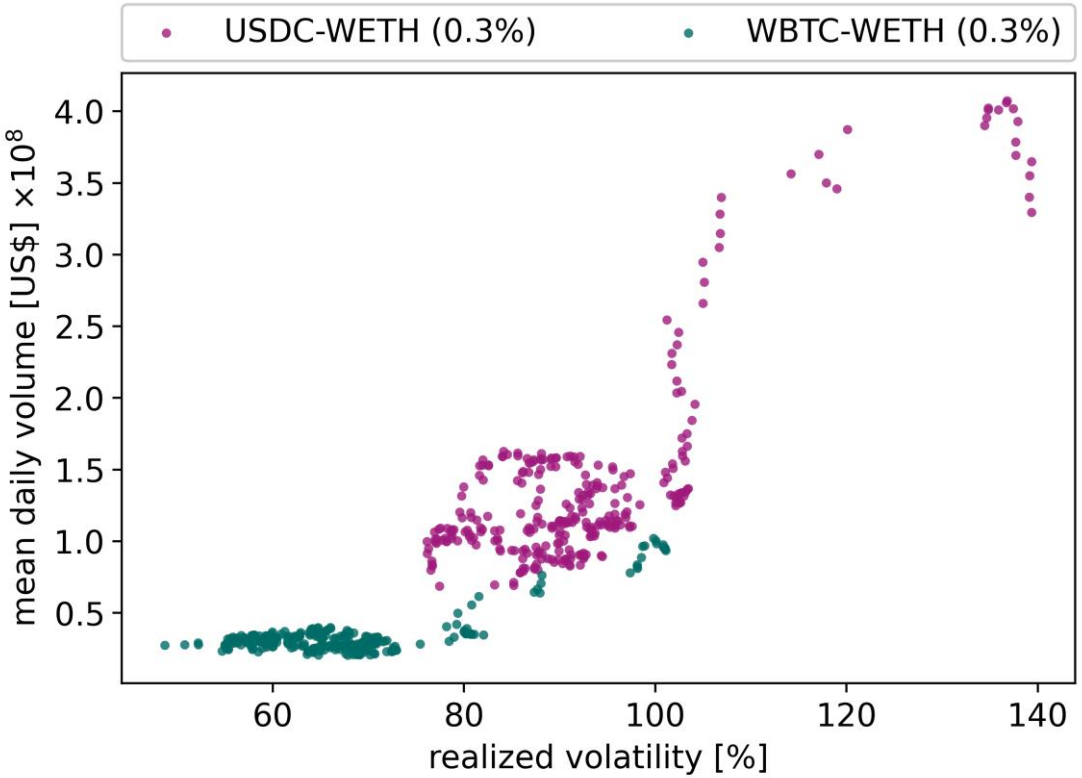


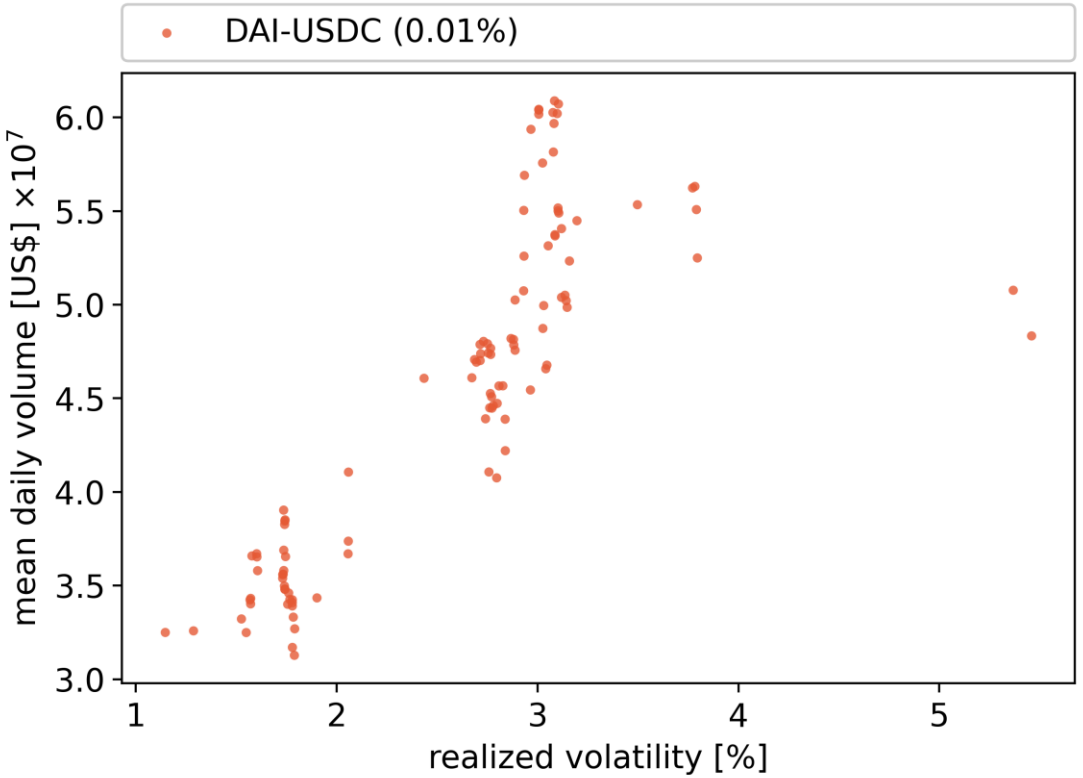
Pool liquidity





Volume vs. volatility





general liquidity
pool statistics

performance statistics
of liquidity positions

Volatility of returns