Risks and Returns of Uniswap V3 Liquidity Providers

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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: $S = \frac{y}{x}$
Constant product market makers (CPMMs)

trading along price curve

marginal price: $S = \frac{y}{x}$

trade $T$: $X \rightarrow Y$
Concentrated liquidity CPMMs
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![Graph showing concentrated liquidity CPMMs](image)
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

\[ p(\text{BTC})_{t_1} = 1 \quad p(\text{ETH})_{t_1} = 1000 \]
Returns and risks

\[ p(\text{Bitcoin})_{t_1} = 1 \quad p(\text{Ethereum})_{t_1} = 1000 \]
Returns and risks

\[ p(\text{฿})_{t_2} = 1 \quad p(\text{￥})_{t_2} = 2000 \]
Returns and risks

\[ p(\€)_{t_2} = 1 \quad p(\$)_{t_2} = 2000 \]
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

\[ \text{impermanent loss}_{t_1 \rightarrow t_2} \approx -6\% \]
Impermanent loss
Impermanent loss

\[ \frac{1}{\alpha} \cdot S_0 \quad S_0 \quad \alpha \cdot S_0 \]

price

\[ \text{liquidity} \]

\[ \text{impermanent loss} \]

\[ \alpha = 1.1 \quad \alpha = 4 \quad \alpha = 20 \quad \text{Uniswap V2 (}\alpha = \infty\text{)} \]

\[ \text{relative price change (}\frac{S_1}{S_0}\text{)} \]

\[ 10^{-3} \quad 10^{-2} \quad 10^{-1} \quad 10^0 \quad 10^1 \quad 10^2 \quad 10^3 \]
Fees

\[ 1000 \rightarrow \$3000 \]

\[ 1414 \rightarrow \$2828 + F \]
Fees

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

\[ \text{return: compares the value of the liquidity to holding the assets from the initial injection} \]
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

\[ S(t) = S(0)e^{\left(\mu t - \frac{\sigma^2}{2}t + \sigma W(t)\right)} \]
Probability and time in the money (ITM)

The diagram shows the probability $P_{ITM}$ as a function of the position lifetime in days for different values of $\alpha$: 1.01, 1.05, and 1.10.
Probability and time in the money (ITM)
Optimal position width

\[ F \propto \frac{T_{ITM}}{\alpha} \]
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\[ F \propto \frac{T_{ITM}}{\alpha} \]

optimal position width increases with position lifetime
Pair types

**stable pair:** both tokens traded in the pool are stable coins
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DAI-USDC \( (f \in \{0.01\%, 0.05\%\}) \)
Pair types

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

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

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

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

![Graph 1: Scatter plot showing mean daily return (%) against position width [bps] for various asset pairs.

Graph 2: Scatter plot showing mean daily return (%) against position width [bps] for DAI-USDC (0.05%) and DAI-USDC (0.01%).]
Position lifetime
Conditional value at risk (CVaR)
Decentralized exchanges (DEXes)
Return

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

**return:** compares the value of the liquidity to holding the assets from the initial injection
Impermanent loss
general liquidity pool statistics

performance statistics of liquidity positions
general liquidity pool statistics

performance statistics of liquidity positions
Position lifetime

- USDC-WETH (0.3%)
- WBTC-WETH (0.3%)
- DAI-USDC (0.01%)

Graphs showing the position lifetime for different pairs over time.
Position width
Position size

- USDC-WETH (0.3%)
- WBTC-WETH (0.3%)
- DAI-USDC (0.01%)

The charts show the position size [US$] against time for different asset pairs. The x-axis represents the time period from 2021-05 to 2022-03.
Number of position
Pool liquidity

![Graph showing liquidity changes over time for different pools such as USDC-WETH, WBTC-WETH, and DAI-USDC.](image)
Volume vs. volatility
general liquidity pool statistics

performance statistics of liquidity positions
Volatility of returns

![Graph showing the relation between daily volatility of returns and mean daily return for different assets.](image)