

Estimation of potential earnings from exclusive access arbitrage in DEX pools

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Abstract

In this study, we analyze the potential profits from arbitrage between decentralized exchanges (DEXs) and centralized exchanges (CEXs), specifically examining scenarios where an arbitrager possesses exclusive swap access to Uniswap V3 like pools ETH-USD and BTC-USD. We employ a straightforward strategy wherein the arbitrager conducts swaps at intervals of 1, 2, 15, and 60 seconds to align DEX prices with current Binance CEX prices. Our findings reveal that...

1 Introduction

Arbitrage opportunities are a fundamental and inextricable feature of decentralized exchanges (DEXs) such as Uniswap V3, due to the inherent design of these platforms. The asynchronous price updates between decentralized and centralized exchanges (CEXs) create discrepancies that can be exploited for profit. According to recent data from Glassnode, the trading volume attributed to arbitrageurs has reached levels comparable to that of human traders, underscoring the prominence and potential of arbitrage within the DEX landscape.

In this context, our research aims to quantify the potential earnings from arbitrage by assuming exclusive access to DEX pools, such as ETH-USDC and BTC-USDC on Uniswap V3. We simulate a scenario in which an arbitrageur aligns DEX prices with those of a major centralized exchange, Binance, at frequent intervals (1, 2, 15, and 60 seconds), to gauge the profitability of such operations.

This investigation serves as a fundamental analysis to measure the potential profits that can be consistently generated from structured arbitrage opportunities within DEX environments. By quantifying these earnings under a scenario of exclusive market access, we lay the groundwork for evaluating various models, including the Contract Special Access Leasing (CSAL) mechanism. This study provides essential data that could help determine whether implementing CSAL might truly enhance liquidity provider yields, thereby supporting more sustainable economic dynamics in decentralized finance.

2 Calculation Methods

The calculations were performed by simulating the Uniswap v2 liquidity pool model, using historical data from the Binance exchange. The methodology was structured around several key assumptions:

Input Data: Initial liquidity in the pool was assumed to be \$1,000,000 USD. The proportions of tokens in the pool were aligned to match the price from beginning of historical data.

Fee Parameter: The model incorporates the swap fee charged by the pool.

2.1 Strategy

The strategy for analyzing historical data and executing profitable trades involved a process outlined in the following steps:

Selection of Historical Data: A specific subset of historical data from the Binance exchange was selected, corresponding to various time intervals such as every second, every other second, every fifteenth second, and so forth.

Analysis of Data Points: At each data point, an analysis is conducted to determine whether there is an opportunity to execute arbitrage operations between DEX and CEX. This is achieved by comparing the token valuation at the given moment on Binance to the price determined by the token proportions in the pool, taking into account the fees charged by the pool.

Decision on Operations: Decisions to execute swaps were based on the profitability determined at each data point. Transactions were initiated only when a profitable opportunity was identified.

3 Uniswap V3 Pools

Uniswap v3 introduced concentrated liquidity, allowing LPs to define price ranges for their capital, optimizing capital efficiency. To estimate the potential arbitrage profits on real Uniswap V3 pools we need to be able to calculate how much more virtual liquidity the real pools have than simulation pool filled with \$1 million. This can be achieved using formulas (1) and (2) from Uniswap V3 whitepaper [3].

Currently, the largest v3 pool for ETH exchange with the stablecoin USD is the USDC/ETH pool [1], with a total value locked (TVL) of approximately \$200 million and around \$300,000 locked in each price range around current price. The price ranges in this pool are the powers of 1.001.

Similarly, the largest pool for BTC and stablecoin exchange is WBTC/USDT [2], with a TVL of about \$40 million and around \$60,000 locked in each price range around current price. The price ranges in this pool are the powers of 1.005.

Accounting for concentrated liquidity in the pools, the resulting arbitrage profits for these pools could be 1,000 times greater for ETH and 50 times greater for BTC than the one calculated with use of the above method.

4 Results

Below are the results obtained for the historical data from 01.01.2024 to 31.03.2024, for the ETH/USDT and BTC/USDT pairs. Calculations were conducted for the following parameters: fee = {0%, 0.01%, 0.05%, 0.3%}, and data selection intervals of {1s, 2s, 15s, 60s}.

| | 0% | 0.01% | 0.05% | 0.3% |
|-----|---------|---------|--------|--------|
| 1s | \$10313 | \$5689 | \$2302 | \$650 |
| 2s | \$11474 | \$6754 | \$2779 | \$804 |
| 15s | \$14247 | \$10821 | \$5402 | \$1779 |
| 60s | \$15344 | \$13296 | \$8428 | \$3191 |

Table 1: DEX-CEX ETH/USDT arbitrage profits of dif-

ferent strategies generated on simulation pools with different fees.

| | 0% | 0.01% | 0.05% | 0.3% |
|------------|---------|---------|--------|--------|
| 1s | \$9006 | \$5022 | \$2069 | \$618 |
| 2s | \$10028 | \$6009 | \$2556 | \$714 |
| 15s | \$12215 | \$9300 | \$4789 | \$1507 |
| 60s | \$12709 | \$10918 | \$6775 | \$2440 |

Table 2: DEX-CEX BTC/USDT arbitrage profits of different strategies generated on simulation pools with different fees.

4.1 Swap analysis

Transaction analysis was also conducted based on calculations for the ETH/USDT and BTC/USDT examples with fee equal to 0% and a data selection interval of 60 seconds.

Over the course of 3 months, the generated profit in the ETH pool amounted to \$15,344, while the total exchanged value of all transactions was \$21,394,146.

4.1.1 Generated Gain

The charts below illustrate the distribution of generated profit based on the size of swaps (grouped into baskets).

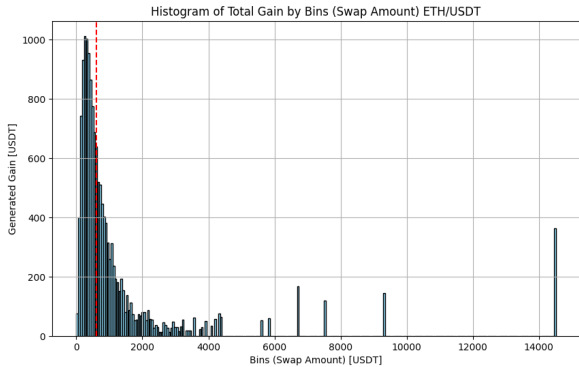


Figure 1: Histogram of Total Gain within Bins (Swap Amount) ETH/USDT. The red line indicates a median of distribution.

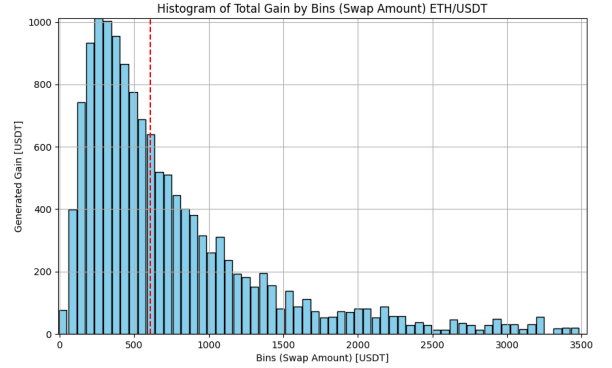


Figure 2: Histogram of Total Gain within Bins (Swap Amount) ETH/USDT. The red line indicates a median of distribution.

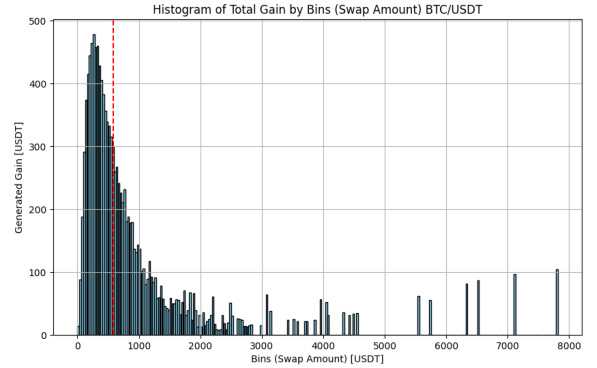


Figure 3: Histogram of Total Gain within Bins (Swap Amount) BTC/USDT. The red line indicates a median of distribution.

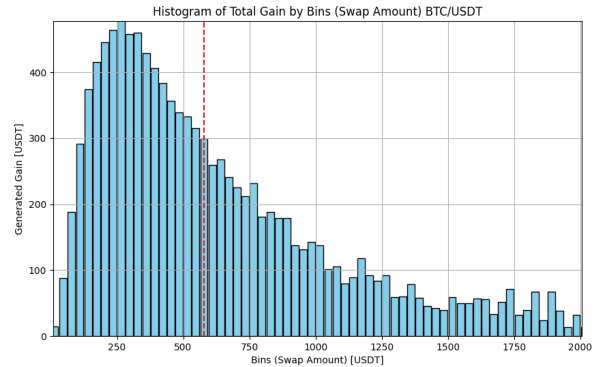


Figure 4: Histogram of Total Gain within Bins (Swap Amount) BTC/USDT. The red line indicates a median of distribution.

4.1.2 Swap Sizes

The charts below illustrate the distribution of swapped amounts based on their size.

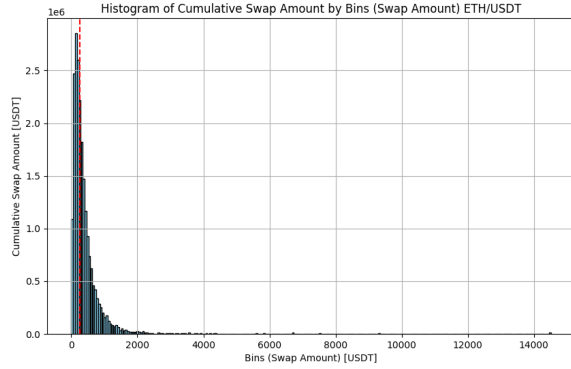


Figure 5: Histogram of Number of swaps within Bins (Swap Amount) ETH/USDT. The red line indicates a median of distribution.

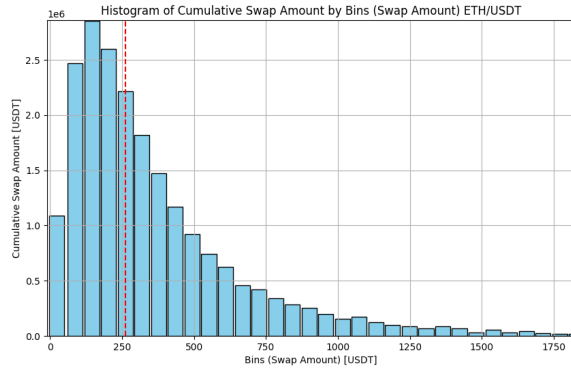


Figure 6: Histogram of Number of swaps within Bins

(Swap Amount) ETH/USDT. The red line indicates a median of distribution.

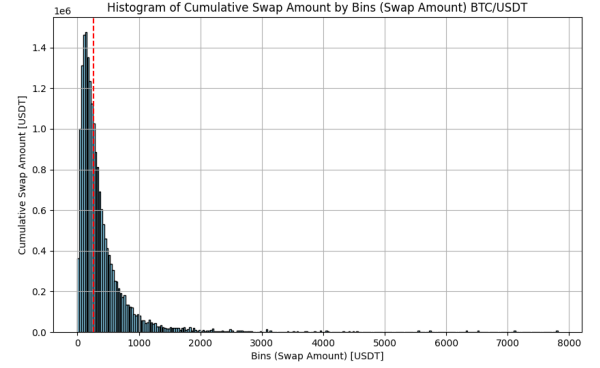


Figure 7: Histogram of Number of swaps within Bins (Swap Amount) BTC/USDT. The red line indicates a median of distribution.

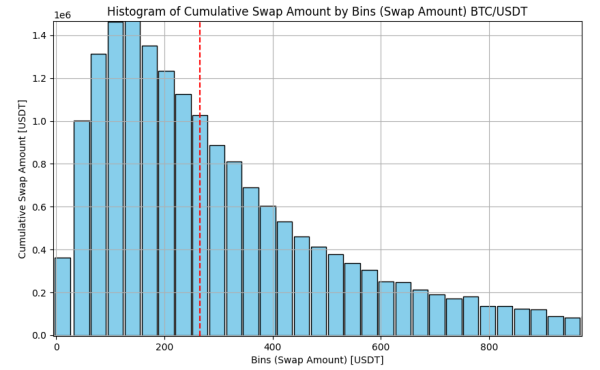


Figure 8: Histogram of Number of swaps within Bins (Swap Amount) BTC/USDT. The red line indicates a median of distribution.

References

- [1] [Uniswap V3 ETH-USDC 0.05% pool](#)
- [2] [Uniswap V3 BTC-USDT 0.3% pool](#)
- [3] [Uniswap V3 whitepaper](#)