

The Value of Uninformed Orderflow on the Uniswap Protocol

Max Holloway *
max@xenophonlabs.com

Elijah
elijah@duality.xyz

December 2022

Abstract

In this paper, we analyze how *uninformed orderflow* – orders that are not predictive of future price movements – affect the revenue earned by liquidity providers on the Uniswap Protocol. We also present an opinionated framework for how much the protocol should value liquidity. Finally, we conclude by providing a recommended upper bound on how much the protocol should pay for uninformed orderflow.

1 Introduction

The Uniswap protocol. The Uniswap protocol is a collection of smart contracts that enable liquidity providers (LPs) to passively make a market on pairs of fungible tokens. LPs deposit tokens into a pool, and traders can place orders against the liquidity in the pool. The price that traders receive is computed in smart contracts based on the state of the pool; importantly, LPs are not required to change their liquidity positions to facilitate trades on the pool. Instead of earning revenue by charging a bid-ask spread, Uniswap’s LPs earn a fee on each order that is proportional to the order’s volume.

Since the tokens traded on Uniswap have time-dependent demand, and the price quoted by an Uniswap pool does not utilize a time term, the prices quoted by the pool do not always align with those of external trading venues. In the case of Uniswap V2, the only way of changing the price quoted by a pool is to place an order on the pool [AZR20]. Although this is technically not the case in Uniswap V3, since LPs can set their liquidity positions with different price bounds, the cost of blockspace makes it impractical for LPs to affect price discovery by updating and cancelling liquidity positions [Ada+21]. This is in contrast to the prevailing orderbook-based centralized exchanges, where liquidity providers can remove limit orders to adjust the price, all without incurring cost when cancelling orders. In both Uniswap V2 and V3, price discovery is primarily driven by arbitrageurs.

Under most conditions, taking the other side of an arbitrageur’s trade is a very bad deal for LPs. The more general phenomenon of trading between parties with asymmetric information is known in game theory as *adverse selection*. Perhaps obviously, agents with more information about the “true” value of a financial product than their counterparty can use this information to place better trades. And since bilateral exchange of common-value assets is a zero-sum game, it follows that the agent who gets the better deal – typically the agent with better information – profits at the expense of their counterparty. This is relevant in the case of Uniswap, where LPs’ trading strategy is fixed by the automated market maker, and arbitrageurs make money at the expense of LPs.

Intuitively, LPs should earn more when they face non-arbitrage volume. To study this, we introduce the notion of orderflow information.

Orderflow information. We can formally define uninformed flow using price expectations. Let t_0 be the current time, let $h > 0$ be a fixed time interval that we choose, let P_t be the instantaneous pool price of token0 relative to token1 at a time t , let O be a random variable representing the next order in the pool,

*Disclosure: The authors do not own UNI token, nor are they affiliated with Uniswap Labs nor any of its affiliates. This research was funded by a grant from the Uniswap Foundation. Any opinions and results stated here are those of the authors, not of Uniswap Foundation nor any of its affiliates. Nothing in this paper should be construed as financial advice.

and let $x(O)$ be the number of token0 purchased in order O ($x(O)$ is negative if token0 is sold). We say that an order o is *informed* if the expected value of the change in pool price is in the same direction as the order:

$$\text{sign}(\mathbb{E}[P_{t_0+h} - P_{t_0} \mid O = o]) = \text{sign}(x). \quad (1)$$

In contrast, we say that an order o is *uninformed* if statement 1 is false.

Notice that this is a permissive characterization of orderflow information. For instance, if order o is executed at time t_0 , and the next order is executed at time $t_1 > t_0 + h$, then order o will necessarily be characterized as informed, since o pushes the pool price in the direction of x . This can be resolved by selecting a sufficiently large h parameter, for which we provide a methodology in Section 2.

Furthermore, this characterization considers orders informed even when $\text{sign}(\mathbb{E}[P_{t_0+h} - P_{t_0}]) = \text{sign}(x)$. That is, if the pool price is expected to move in the same direction as order o , even if o did not exist, we would still characterize o as informed. Put another way, an order o can be informed, even if it does not bring new information about price changes. Since an informed order *can* bring new information about price changes, we define uninformed orders with conditional expectation.

Related work. The profitability of Uniswap LPs is not a new topic of research. Angeris et al. provided analytic formulas for the profitability of Uniswap LPs between discrete points in time [Ang+19]. White demonstrated that Uniswap LPs with nearly-zero fees outperform those with higher fees under specific volatility and drift conditions. A number of reports have shed light on the historical profitability of Uniswap V3.

2 Value of Uninformed Orderflow for LPs

3 Value of LPs for the Protocol

4 Discussion

5 Conclusion

References

- [Ada+21] Hayden Adams et al. “Uniswap v3 Core”. In: *Tech. rep., Uniswap, Tech. Rep.* (2021).
- [Ang+19] Guillermo Angeris et al. “An analysis of Uniswap markets”. In: *arXiv preprint arXiv:1911.03380* (2019).
- [AZR20] Hayden Adams, Noah Zinsmeister, and Dan Robinson. “Uniswap v2 Core”. In: (2020).