Analysis of Maximal Extractable Value on the Algorand Blockchain

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Abstract

This research provides a first analysis of the Maximal Extractable Value (MEV) dynamics on the Algorand blockchain. While MEV has been extensively studied in dynamic gas-price blockchains like Ethereum, there is limited understanding of MEV in blockchains with fixed gas-price mechanisms. Our research involves analyzing theoretical arbitrage-related MEV as an upper-bound estimate that can potentially be exploited through decentralized exchange (DEX) to centralized exchange (CEX) arbitrage. We identify potential opportunities for profitable cross-DEX arbitrage transactions, thereby highlighting the presence of MEV. However, after analyzing arbitrage-related transactions of market participants in the Algorand decentralized finance (DeFi) ecosystem, we find no indication of systematic cross-DEX related MEV exploitation in the analyzed time-period.

Keywords: Algorand Blockchain, Maximal Extractable Value, Arbitrage, Decentralised Exchanges, Constant-Product Market Maker

Contents

1. Introduction

Decentralized blockchain-based networks, such as Ethereum and Algorand, have gained significant traction in the last couple of years as they try to replicate existing services from the traditional financial industry but at the same time aim to create entirely new types of financial applications, commonly called decentralized finance (DeFi). By leveraging smart contracts on platforms like Algorand, these services aim to reimagine traditional financial offerings in a simpler, more transparent, and streamlined manner. Decentralized exchanges, derivatives platforms, and lending protocols are just a few examples of such services. Over the last couple of years, the decentralized finance space has evolved from a small experimental niche technology into a multibillion-dollar ecosystem on a variety of different blockchain networks. A wide range of decentralized finance applications handle assets worth over 50 billion US dollars as of March 2023[1].

While the concept of decentralized finance and its applications promise a fair, decentralized, and transparent financial system that accrues value to its users, certain trends threaten this promise. One such trend is called Maximal Extractable Value (MEV), a concept that describes the highest attainable value from the block production process beyond the standard block reward by including, excluding and changing the order of transactions in a given block.

In this context our research aims to investigate the dynamics of MEV in the context of fixed gas-price blockchains, specifically focusing on the Algorand blockchain.

We seek to address the following objectives:

1. To analyze the theoretical arbitrage-related MEV as an upper-bound estimate on the Algorand blockchain.
2. To identify potential opportunities for profitable cross-DEX arbitrage transactions.
3. To study the behavior of market participants in the Algorand DeFi ecosystem by identifying arbitrage-related transactions.

The significance of this research lies in its potential to provide first insights into the MEV dynamics of fixed gas-price blockchains, which have been relatively underexplored compared to their dynamic gas-price counterparts. By analyzing the Algorand blockchain, our research will contribute to a more comprehensive understanding of the implications and risks associated with MEV.

2. Background

In this section, we will begin by examining the fundamental principles of blockchain technology and smart contracts, emphasizing their crucial role in creating a conducive environment for decentralized finance (DeFi). Subsequently, we will explore the distinct features of the Algorand blockchain and describe in detail their platform-specific ramifications for Maximal Extractable Value (MEV) extraction. We will introduce the concept of stablecoins and discuss the broader landscape of DeFi, with a particular emphasis on decentralized exchanges (DEXs). In this context, we will introduce how arbitrage opportunities on Algorand arise and lead to MEV.

2.1. Blockchain and Smart Contracts

Blockchain technology, a decentralized and distributed digital ledger, has revolutionized the way data is stored, verified, and shared in a trust-minimizing way across networks. By utilizing cryptographic hashing, consensus algorithms, and peer-to-peer communication, blockchains offer enhanced security, transparency, and immutability. These features enable trustless, tamper-proof transactions, eliminating the need for central intermediaries (1).

Smart contracts are self-executing digital agreements built on blockchain platforms, most notably Ethereum. They leverage the blockchain's inherent security and trustless nature to facilitate automated, conditional transactions. Programmed using languages like Solidity, smart contracts contain predefined rules and logic, which are executed automatically when specific conditions are met (2). By enabling the automation of complex processes and transactional interactions, smart contracts are able to streamline operations with the development of decentralized applications (dApps) (3).

A crucial aspect of this research is the sequence in which transactions are executed. When a transaction is initiated, it is propagated through the network, with nodes validating and subsequently relaying it to their peers. Upon validation, the transaction is temporarily stored in the mempool, which serves as a waiting area for pending transactions. The mempool is accessible to everyone but generally operated by block producers, who are responsible for assembling and proposing new blocks (4). Block producers, depending on the consensus algorithm, can be miners, validators, or delegates. They select transactions from the mempool and determine the order in which they will be included into the block. In doing so, block producers consider factors such as transaction fees, prioritizing those with higher fees to maximize their incentives (4).

2.2. Algorand Blockchain

Within the scope of this research paper, we focus on the Algorand blockchain for our analysis of Maximal Ex-

[1] https://defillama.com/

tractable Value (MEV).

Algorand is a scalable Proof of Stake (PoS) blockchain that employs a consensus mechanism called Pure Proof of Stake (PPoS) (5). Block production on Algorand is unique compared to other blockchains, as it utilizes a verifiable random function (VRF) to randomly and secretly select block proposers and committees responsible for validating and approving blocks (5).

Algorand supports atomic transfers, which are transactions allowing multiple, independent operations to be executed simultaneously, ensuring that either all operations succeed or none at all. On Algorand, atomic transfers are implemented through grouped multi-signature transactions, which combine a set of transactions and submit them to the network as a single entity, ensuring all transactions within the group are executed together (5).

The minimum transaction-fee on the Algorand blockchain is 0.001 ALGO (5), equivalent to a fraction of a cent at the time of writing[2]. Due to ample block space, the transaction volume is insufficient to facilitate the emergence of a fee-market. As a result, most transactions only incur the minimum transaction fee. This factor, combined with the allocation of all transaction fees to an address managed by the Algorand Foundation (5), eliminates any incentive for block producers to prioritize transactions based on fees alone. The official software cabides by a first-come, first-served principle for transaction processing, disregarding prioritizing transactions for fee considerations (6). This methodology deviates from that of Ethereum, where transaction fees influence the prioritization of transactions as incentivized by block-producers (2).

2.3. Decentralized Finance on the Algorand Blockchain

Blockchain-based finance protocols, commonly known as DeFi, represent an emerging collection of applications that draw inspiration from and mirror traditional centralized finance systems. On the Algorand blockchain, examples of DeFi applications include asset exchanges (7) (8) (9) (10) (11) (12), option markets (13) (14), lending and borrowing platforms (15) (16) (17) (18), prediction markets (19) and stablecoins.

Stablecoins are digital assets designed to minimize price volatility by pegging their value to conventional fiat currencies or other stable assets. These cryptocurrencies alleviate the fluctuations commonly associated with blockchain-native assets (20). There are different types of stablecoins, such as fiat-backed, crypto-asset collateral-backed, or algorithmic stablecoins, which facilitate more predictable conditions in the decentralized finance ecosystem (20). We will ignore these differences in the scope of this research. The primary stablecoins available on the Algorand blockchain and utilized for analysis in the scope of this research are USDT (21), USDC (22), and goUSD (23).

In this research, our focus is specifically on the arbitrage opportunities within asset exchanges, therefore, we will primarily concentrate on Decentralized Exchanges as a key component of the DeFi ecosystem on Algorand blockchain.

2.4. Decentralized Exchanges

Conventional exchanges typically leverage an exchange design known as Continuous-Limit Order-Books. In this design, the order-book consists of a list of all open offers within the system, continuously matching buyers and sellers. Orders are processed in the sequence they are received (24).

In Decentralized Exchanges (DEXs), smart contracts play the role of an exchange, utilizing a design called an Automated Market Maker (AMM) replacing a traditional order-book. An AMM consists of a smart contract that holds reserves of tokens, called a liquidity pool, and maintains a balanced ratio of the tokens. The smart contract enables users to trade between tokens at any time, using the liquidity pool's reserves as a counterparty at a predetermined rate, as defined by the AMM's swap invariant (24).

One such swap-invariant is the Constant-Product Market Maker (CPMM), which ensures that the product of the asset-amounts in the liquidity pool remains constant for any arbitrary asset pair. When a user performs a trade, the smart-contract automatically performs price discovery, with the swap invariant setting the market-price. AMMs accept the respective tokens as input, deduct a fee, and facilitate the transfer of the purchased token from the liquidity pool's balance to the user (25).

In general, there are three types of swap invariants: constant-product (26), weighted constant-product (27),

[2]https://coinmarketcap.com/currencies/algorand/

and bounded-liquidity constant-product (28). In the scope of the research, we focus on the constant-product market-maker, which are implemented across all analyzed DEX's on Algorand.

Price slippage refers to the adjustment in price between the expected execution-price and the real execution-price of a trade. The expected price-slippage is the anticipated change in price based on the volume to be traded and the available liquidity (29). As the expected price-slippage is derived from a past blockchain state and may change during the intervening period between the submission of a transaction and its execution, this can lead to unexpected slippage. The combined effect of both expected and unexpected price-slippage constitutes the overall price impact of a trade (30).

2.5. Maximal Extractable Value

Maximal Extractable Value (MEV) refers to the total value that can be extracted from the blockchain by changing the order and inclusion of transactions within a block (24). MEV extraction on the Algorand blockchain can be broadly categorized into extraction on state-level and network-level[3].

State-level MEV extraction, which can also be described as user-controlled MEV extraction, involves actors that continuously monitor the mempool and the blockchain state for potential profitable transactions. These actors identify arbitrage opportunities, liquidations, and other time-sensitive trades. By front-running or back-running certain transactions, these bots can gain a financial advantage by exploiting the ordering of transactions within a block (31).

Network-level MEV extraction occurs during the relay and block production process. This type of extraction is controlled by the block-producers and relay-node operators. In this scenario, the actors monitor the mempool for candidate transactions. Since the block-producer controls the order of transactions within a block, they can insert arbitrary valid transactions to maximize their profit. This could include activities such as censoring competing transactions or inserting their own trades to exploit market inefficiencies (31).

[3]Unpublished notes, Burak Öz, Technical University of Munich

3. MEV Dynamics in Fixed Gas-Price Blockchains

MEV is mostly associated with blockchains that use the first-price auction mechanism to allocate limited block space (32). In Ethereum, block-producers include transactions from the mempool and propose a block with a subset of transactions in an arbitrary order, with the incentive of maximizing their profit from a given block. Users compete by offering higher gas prices to get their transactions included, leading to gas bidding as one of the most important aspects of MEV (24). In contrast, some blockchains do not take dynamic gas-prices into account to prioritize transactions. These can be considered fixed gas-price blockchains, often implementing a first-come-first-serve transaction processing mechanism. This difference heavily impacts the role and behavior of MEV searchers and leads to an MEV landscape with its own unique dynamics (32).

In blockchains with fixed gas prices, non-block-producer searchers' edge is to recognize an MEV opportunity before other actors and respond quickly enough. However, their ability to control the positioning of a transaction within a block is limited (33). At the same time block-producers and relay nodes hold a power-asymmetry due to their ability to control transaction-ordering or influence the transaction-flow in the network. This situation could lead to dominant network-level MEV extraction. However, there is still the possibility for state-level extraction. Although Algorand does not have fixed gas-prices (5), it shares similar dynamics with fixed gas-price blockchains. On the Algorand blockchain there is no prioritization of transactions due to the lack of congestion of block-space[4] and at the same time due to the fact that higher transaction-fees do not incentivize block-producers as fees are send to an address controlled by the Algorand Foundation (5). This design choice effectively eliminates certain state-level MEV-related issues found on other blockchains, such as e.g. sandwich attacks. However, state-level extraction still remains theoretically possible (e.g. arbitrage and liquidations). Despite the differences in the MEV landscape, searchers can still generate profits, although with potential limitations compared to dynamic gas-price blockchains (33).

[4]https://algoexplorer.io/blocks

In fixed gas-price blockchains, network-level MEV can be more dominant than state-level extraction. Block producers are the only actors that have the ability to influence the order of transactions within a block, while relay nodes can potentially corrupt the flow of transactions. These factors contribute to a unique set of MEV dynamics that distinguish fixed gas-price blockchains from their dynamic gas-price counterparts (32).

4. Analysis of Arbitrage-Related MEV on the Algorand Blockchain

The arbitrage process, which involves taking advantage of differential pricing for the same asset, is an expected component of capital markets. It develops naturally whenever exchange prices for the same or correlated assets deviate (25). Price differences are also inherent in an environment such as smart-contract-based exchanges (24). Consequently, the Algorand blockchain also presents opportunities for theoretical MEV and therefore profitable arbitrage transactions.

As one can anticipate an AMM's pricing model and construct a profitable arbitrage transaction by grouping transactions to be atomic, an actor can interact with different exchanges within a single transaction. Atomic transactions guard against the risk of unfavorable AMM price changes between the different execution times on different exchanges (25). This creates an opportunity for risk-free arbitrage.

Constant arbitrage between exchanges is required to keep the rate offered in lockstep with the market rate. Notably, most trading of the ALGO token occurs on centralized exchanges (CEX), with less than 1% of the volume being traded on decentralized exchanges (DEXs)[5].

4.1. Analysis of Arbitrage-Related MEV

In our research, we focus on state-level MEV extraction in the form of DEX arbitrage on the Algorand blockchain. Our analysis concentrates on identifying theoretical MEV by examining the states of various DEXs.

Due to the limitation of the Algorand Indexer in handling past inner transactions, we gathered DEX-states for a specific time period to be analyzed. We use block-numbers ranging from 27410001 (timestamp 1677963988054, Saturday, 4th March 2023, 21:06:28) to 27427904 (timestamp 1678030155898, Sunday, 5th March 2023, 15:29:15).

For our analysis, we consider the following AMM markets:

- HumbleSwap (ALGO - USDC, USDT, goUSD)
- Pact (ALGO - USDC, USDT)
- Tinyman version 1 (ALGO - USDC, USDT)
- Tinyman version 2 (ALGO - USDC)
- AlgoFi (ALGO - USDC, USDT)

All the named exchanges operate with a 0.3% fee on swaps on the listed pairs. We ignore the Algorand transaction fees, as they are 0.001 ALGO (are negligible in US dollar terms). In our calculations we integrate expected slippage per definition of a CPMM and ignore potential unexpected slippage.

In our research, we disregard the fees for centralized exchanges, as our primary objective is to assess the theoretically extractable value from the arbitrage opportunities in the DEX's on Algorand. By focusing on these specific parameters, we aim to provide a comprehensive understanding of the potential for arbitrage-related MEV extraction in the Algorand ecosystem.

4.2. Theoretical Maximal Extractable Value

In a CPMM two equations always remain to be true. The first equation holds per definition of a CPMM and the second equation reflects the price ratio of X and Y denoted with variable p. We assume in the scope of this paper X to be the amount of Algorand tokens and Y to be a the amount of USD stablecoin tokens. Accordingly, the variable p reflects the current Algorand price per USD, called the market-price.

$$X \cdot Y = k \tag{1}$$

$$X \cdot p = Y \tag{2}$$

We take the two following formulas[6] for calculating the fee tolerance on CPMMs as given. The formulas indicate

[5] https://coinmarketcap.com/currencies/algorand/markets/

[6] Author of formulas, Burak Öz, Technical University of Munich

at which price-deviation of a DEX with CPMM relative to the spot-market an arbitrage opportunity arises, considering the fee f of the respective DEX. Let D be the DEX price and S the spot-price of an arbitrary CEX.
In case the DEX price D deviates to the upside ($S > D$), it holds that

$$D < S(1-f)^2$$

If the DEX price D deviates to the downside ($D > S$), the following holds to be true.

$$D > S/(1-f)^2$$

Given the spot-price S and a fixed DEX-fee f, one can calculate the DEX price-deviation for an arbitrage opportunity considering its fee-tolerance.

In general, the following inequality[6] has to be valid to achieve a profitable arbitrage transaction (assuming X~ALGO to be traded for Y~USD) for an arbitrageuer to sell the gained Y in the spot market.

$$p \cdot X_{in} + y_{out} > 0 \tag{3}$$

The standard equations for a CPMM (1) and (2) can be transformed to the following terms.

$$X = \sqrt{k/p}$$

$$Y = \sqrt{k * p}$$

Considering the mechanism of a CPMM, it allows us to calculate the change in quantities of tokens in an liquidity pool.

$$\triangle X = X_{new} - X_{old} = \sqrt{k/p_{new}} - X_{old}$$

$$\triangle Y = Y_{new} - Y_{old} = \sqrt{k * p_{new}} - Y_{old}$$

Using this simple transformation, we can derive the required amount of a transaction's input in order to allign the DEX price p_{old} (which can be implied by X_{old} and Y_{old}) to the respective spot-market price p_{new}.
If we substitute the formula for calculating the inputs into the inequality (3) and generalize the formula for trades in either direction, we arrive at the equation for calculating the theoretically MEV for a given state described by the liquidity pool amounts.

$$mev = p_{new} \cdot (\sqrt{k/p_{new}} - X_{old}) + (\sqrt{k * p} - Y_{old})$$

For our simplified algorithm to measure the lower-bound of theoretical MEV for DEX to DEX arbitrage, we need to compute the subsequent price of a DEX, which value has not been fully leveraged.

$$(\triangle X + X_{old})^2 = \frac{k}{p_{new}}$$

Taking into account the fee, which is paid on the incoming amount, the following equation is obtained.

$$p_{new} = \left(\frac{1}{1-f}\right) \cdot \frac{k}{(\triangle X + X_{old})^2}$$

4.3. Analysis of Arbitrage-Related Transactions

One of the goals of our research is to analyze the behavior of MEV participants on the Algorand blockchain, focusing on identifying and examining arbitrage-related transactions.
To achieve this, we parse and analyze transactions interacting with the analyzed DEXs executing token swaps. This process, however, lacks generality, as the structure of transaction-groups of swaps is not standardized across AMMs, protocol versions, or even different markets. Consequently, a non-trivial amount of manual effort was required for each individual DeFi application to extract a high-level financial interpretation of the activity that occurred within a transaction. Despite these challenges, our algorithm[6] allows for a characterization of participants involved in on-chain swap-activity on the Algorand blockchain.
There are limitations of our swap identification algorithm. The algorithm can only recognize one-hop swaps and is limited to Algorand-stablecoin pairs. Additionally, it does not provide information about potential interactions with centralized exchanges (CEXs). Despite these limitations, our analysis still provides insights into potentially arbitrage-related transactions and the behavior of MEV participants on the Algorand blockchain.

5. Results

In this section, we present the results of our analytical evaluation of theoretically MEV from various perspec-

[6] https://github.com/jonasgebele/algo_mev/src/block_parser.py

tives. Our analysis aims to provide a first understanding of MEV in different scenarios, particularly focusing on CEX-to-DEX, and cross-DEX arbitrage opportunities.

5.1. Theoretical Maximal Extractable Value

In this part we expand on our analysis of theoretical MEV by incorporating specific data and visualizations. Figure 1 and 2 provide a graphical representation of our findings, illustrating the relationship between the DEX price, deviation boundaries, and theoretical MEV.
For example the plot in figure 1 displays in blue the DEX price of ALOG/USDC on Tinyman version 1 over the analyzed time period. The gray lines represent the profit-deviation boundaries of the DEX's price compared to the spot reference-price on Binance[7]. When the DEX price is outside of these profit-deviation boundaries, there exists theoretically extractable value coming from an arbitrage opportunity between the DEX and CEX. The orange line, plotted on a logarithmic scale, shows the amount of theoretical extractable value in US dollars that could maximally be extracted. When the blue line is outside of the deviation-boundaries, the amount of theoretical MEV is greater than 0. It is important to note that this is an upper-bound estimate, as we assume that there are no fees on CEX (for large volumes far below 0.1% taker-fees on major exchanges[8]) and no price impact (slippage) on the CEX (realistic assumption considering that most trading occurs on CEXs as established in section 4).
Our analysis indicates that there are multiple arbitrage opportunities across all DEX's that persist in many cases over a larger number of blocks. In extreme situations, the theoretically extractable value goes up to several thousand dollars, as exemplified by block 27422960 on Algorand (up to $1,950.90 on Tinyman version 1.1 on the ALGO/USDC market, which was immediately captured in the very next block as can be seen in figure 1).
We identify a correlation between the liquidity of a given DEX and the duration for theoretical MEV. In AMMs with a high liquidity pool, the extractable value is only temporarily available. In contrast, small liquidity pools offer opportunities over more extended durations.

In total, across all analyzed DEXs, the average extractable value is over the whole period around $30. However, in extreme situations, such as in round 27422960, this value can soar up to $16,920.55, as demonstrated in the chart in figure 2. This finding underscores the potential for significant MEV in certain market conditions.

5.2. Lower-Bound DEX to DEX Arbitrage Estimation

In this subsection, we analyze the actual extractable value by examining the opportunities for DEX to DEX arbitrage. Our goal is to determine an estimate for MEV from DEX to DEX arbitrage by employing a naive arbitrage algorithm.
The algorithm follows the following steps:

1. Search for DEX markets with theoretically extractable value due to the price being below the profit-deviation boundary
2. Search for DEX markets with theoretically extractable value due to the price being above the profit-deviation boundary
3. For each set of markets identified in steps 1 and 2, select the ones with the highest extractable value
4. Perform transactions on both markets (with their respective fee) that bring the respective prices inside the profit-deviation boundary, using the input volume of the smaller liquidity pool

It is important to note that this approach is not an optimal strategy, thus it provides a lower-bound estimate. The actual problem can be considered as a constraint optimization problem (34) and warrants further research.
Figure 3 presents the amount of MEV in the analyzed time-period derived from this strategy, which indicates a much lower amount of MEV than previously suggested, with the highest value reaching $33.54. If we take that state lower-bound MEV estimate in block 27424778 with the following markets:

1. ALGO/goUSD on HumbleSwap with price: 0.2282$
2. ALGO/USDC on HumbleSwap with price: 0.2341$

To execute the arbitrage, the following actions could have been performed:

1. Buy ALGO with goUSD on HumbleSwap using 2,472.06 goUSD to obtain 10,746.32 ALGO with a resulting DEX price on HumbleSwap of 0.2305$

[7] https://www.binance.com/en/trade/ALGO_USDT?type=spot
[8] https://www.binance.com/en/fee/schedule

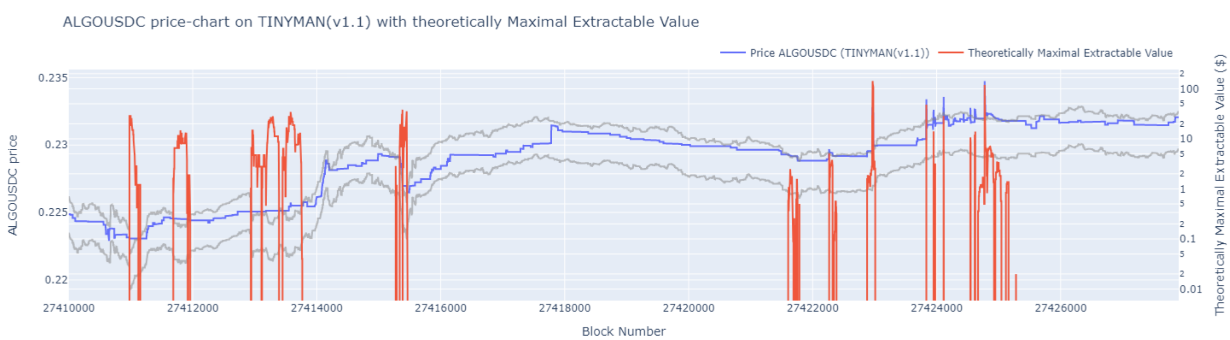

Figure 1: Theoretical MEV on Tinyman v1.1 on the Algorand/USDC market

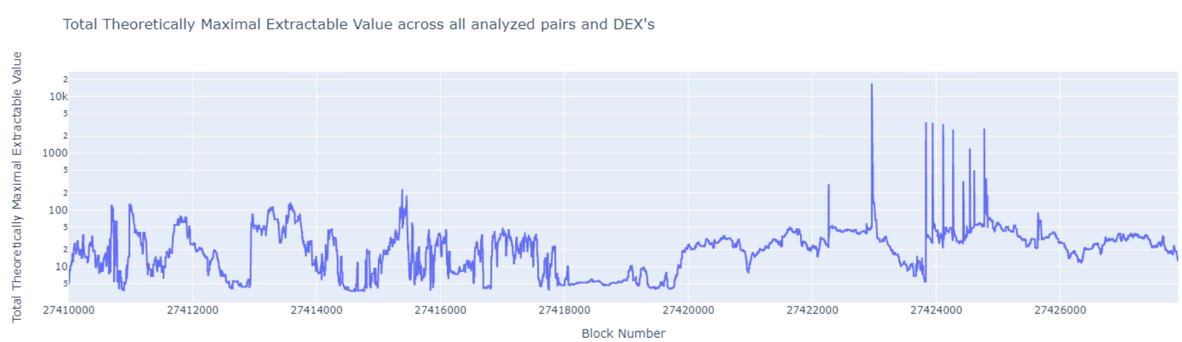

Figure 2: Total theoretical MEV across all analyzed pairs and DEX's

2. Sell the 10,746.32 ALGO on the ALGO/USDC market on Humbleswap for 2,505.61 USDC with a resulting DEX price of 0.2336$

In this example, the strategy of this naive algorithm would have resulted in a profit of 33.55 USD (assuming constant stablecoin prices).
This lower-bound estimate highlights that the actual extractable value from DEX-DEX arbitrage is considerably lower than the theoretical MEV previously indicated.

5.3. Analysis of Market Participants

In this subsection of the results, we delve into the market participants' behavior by the transactional DEX-interactions in the analyzed time period and DEX markets on the Algorand blockchain. Our analysis reveals that the majority of these interactions are dominated by three main addresses:

- EVESCVBC6VDIJAZM3HMUGYVQLKWH-H4YJBMDV5EF65RMS67TFS5URZQ5YNY
- AACCDJTFPQR5UQJZ337NFR56CC44-T776EWBGVJG5NY2QFTQWBWTALTEN4A
- J4BJWP67LHXT7LQTWZYWJGNSB25V-ZMO6SFZPKBSY7HJUCXJIFVE2PEOTVA

These addresses exhibit a high likelihood of being controlled by bots, as they frequently execute multiple transactions within the same blocks[9]. Interestingly, no transactional interaction was found between the three addresses during the analyzed time-period.
The activity patterns of these addresses suggest that they may be involved in either market-making on DEXs or CEX to DEX arbitrage, as in some cases they execute trades in opposite directions even on the same exchange within the same block. Moreover, these actors often react to price changes on CEX with same-directional trades on DEXs, further supporting this hypothesis.
Despite the observed activity of these actors, our analysis found no evidence for systematic extracted value through DEX to DEX arbitrage for any of the mentioned addresses. Also we found no relevant systematic trades of these actors when DEX prices where outside of the price-deviation boundaries. This finding indicates that the primary focus of these market participants may be on market-making or CEX to DEX arbitrage opportunities, rather than DEX to DEX arbitrage.
Additionally, we found no evidence for increased transaction volume (measured either in USD transacted or by the number of transactions initiated) correlating with an increased amount of theoretically MEV. This observation suggests that the potential for MEV does not necessarily drive market participants to engage in a higher volume of transactions.
In conclusion, our analysis of market participants highlights the dominance of a few key actors in the Algorand blockchain ecosystem. These actors appear to be primarily focused on market-making and CEX-DEX arbitrage opportunities, with no significant evidence of systematic extracted value through DEX-DEX arbitrage.

6. Discussion

Our research provides first insights into the MEV dynamics on the Algorand blockchain, which to the best of our knowledge has not been previously studied in-depth. While the Ethereum blockchain has received significant attention regarding MEV, our study broadens the understanding of MEV in fixed gas-price blockchains such as Algorand.
Our findings indicate that, theoretically, there are numerous arbitrage opportunities across various DEXs, highlighting the potential for MEV exploitation. However, when analyzing actual market participant behavior, we discovered no systematic cross-DEX related MEV exploitation during the time period for analysis. This finding is noteworthy as it suggests that market participants may not be taking full advantage of the available arbitrage opportunities or that other factors may be preventing them from doing so.
The observed dominance of a few key actors in the Algorand DeFi ecosystem raises interesting questions about their strategies and objectives. While these actors seem to be primarily focused on market-making or CEX to DEX arbitrage opportunities, we found no significant evidence of systematic extracted value through DEX to DEX arbitrage.
It is essential to recognize the limitations of our research. The analyzed time period is relatively short, and the

[9]https://github.com/jonasgebele/algo_mev/data

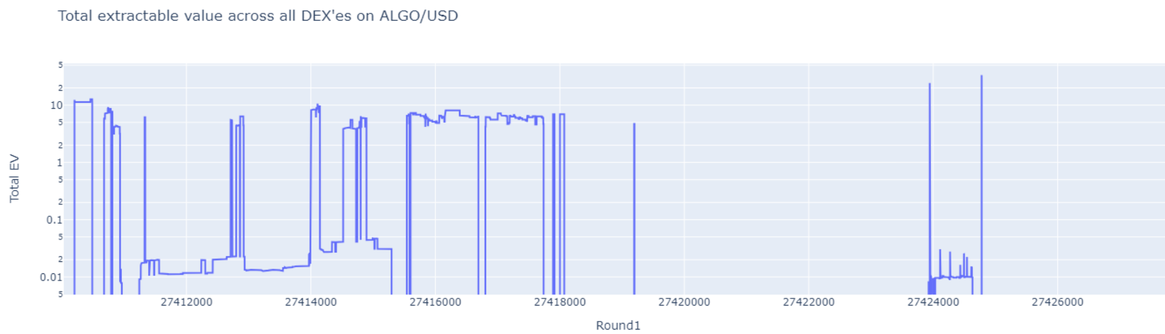

Figure 3: Lower-Bound for DEX to DEX Arbitrage MEV on Algorand Blockchain

conclusions drawn may not be generalizable to different time frames. Additionally, our algorithm for estimating the lower-bound arbitrage-related MEV is not an optimal strategy, which underestimates the actual extractable value.
Future research could explore the reasons behind the absence of systematic cross-DEX related MEV exploitation, as well as investigate the strategies of key market participants in greater depth. It would also be beneficial to apply more advanced strategies for identifying profitable transactions capturing arbitrage-related MEV in fixed gas-price blockchains. Ultimately, our study serves as a starting point for understanding MEV dynamics in the Algorand blockchain.

7. Conclusion

In conclusion, our research provides a first-of-its-kind analysis of MEV dynamics on the Algorand blockchain. By examining theoretical arbitrage-related MEV and actual market participant behavior, we have shed light on the presence and exploitation of MEV in the Algorand DeFi ecosystem.

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