Overview

This post provides an update and brief analysis on the performance of the Smart Burn Engine from launch (18 July 2023) to 30 July 2023.

This is provided purely for informational purposes, and to grow a deeper understanding of the SBE mechanism among community members. A further post with potential parameter updates will be shared soon, with any parameter changes expected to be submitted for voting later in August.

Raw Data

All data is pulled and presented as of 16:00 UTC on 30 July 2023.

We pulled data from Etherscan on Uniswap v2 DAI/MKR LP acquisition by the DSS Pause Proxy, as well as DAI tokens transferred from the dss flapper. This provides a general overview of the amount of DAI expended and LP tokens acquired which can help determine total execution costs, efficiency, and LP focused metrics.

Smart Burn Engine - Performance to 30 July 2023

Further information can be found on the Makerburn site.

Analysis

Below are a few insights from a review of SBE performance in the first weeks of operations.

Total Volume

To date, the Smart Burn Engine has spent a total of 5,620,140 DAI to acquire 80,139 units of Uniswap v2 DAI/MKR LP token.

Of this, 2,810,000 DAI has been spent acquiring MKR and 2,810,140 has been paired with the acquired MKR to supply to the liquidity pool and mint LP tokens. The slight difference between DAI used to purchase MKR and supply to the LP position is accounted for by market impact of DAI to MKR trades undertaken by the SBE (this will tend to push the MKR/DAI exchange rate up, requiring a greater amount of DAI to be paired with MKR to mint LP tokens), and fees charged on the trade amount by the pool (this results in a lower value of MKR received per trade, which means a lower amount of DAI needed to pair with MKR and mint LP tokens).

While at the beginning of the SBE roughly 5,015 DAI was paired with MKR on each execution, currently this amount is roughly 4,993. This likely reflects the growth in pool size, with each 5,000 DAI swap resulting in relatively lower market impact.

Unadjusted Profitability

The aggregate value of these LP tokens is currently $5,976,500. Comparing total acquisition cost versus current value, this indicates a gain in value of $356,360, or ~6.3%. However, this is highly volatile based on the MKR price. Given the standard Uniswap invariant curve, a MKR price fall of ~11.5% or greater would push the market value of LPs back to breakeven with cost.

Further, when accounting for divergence (impermanent) loss, Maker protocol may have achieved a higher return from simply buying back MKR rather than adding to the liquidity position. Change in value of LP token position is not considered a core goal of the Smart Burn Engine so this profitability metric should not be considered a core KPI. Instead, SBE is intended to drive improvements to MKR liquidity which will become important for various tokenomic mechanisms in the Endgame.

Frequency vs Block Times

The hop

parameter determining the minimum time period between SBE purchases is set at 1,577 seconds. However, since Ethereum's migration to PoS consensus block times are a fixed 12 seconds, meaning that the minimum time period between blocks where SBE can be triggered will be slightly longer at 1,584 seconds (132 blocks). This 7 second delay means the maximum frequency of SBE execution will be roughly ~0.44% lower than target. This won't have a material impact on SBE performance but is an interesting quirk to keep in mind for this and other mechanisms using a time based delay; block time impacts precision of these parameters.

Frequency vs MKR Price Changes

A bigger impact on frequency and actual versus target SBE throughput is driven by MKR price volatility and the want

parameter which governs maximum permitted difference between oracle and execution price. Currently want

is set at 0.98, indicating up to 2% deviation is permitted; this is meant to account for potential market impact of trades as well as small oracle latencies, while preventing bad fills and limiting potential for front running or sandwiching trades. However, in cases where MKR price rises significantly, this can prevent the execution of the SBE on schedule because the market price for execution will be higher than the oracle price.

Taking the blocktime constrained minimum delay between trades, we can calculate how much additional time has elapsed between trades to determine the actual rate of DAI spending and LP token acquisition. In the vast majority of cases this additional delay will be caused by MKR price increasing above the oracle price by a margin greater than the want

parameter.

So far, there has been a cumulative additional delay of ~36.5 hours (2,195 minutes, or 10,973 blocks). Considering total time within the period of 284 hours (11 days, 20 hours), this represents a roughly ~12.9% decrease in throughput versus the target level.

With pool depth having considerably increased, it is likely that Maker will move to a larger bump

(lot size) parameter, longer hop

, and smaller permitted slippage (higher want

). While this will tend to increase efficiency and reduce maximum execution costs, on the other hand this makes the SBE more susceptible to changes in the MKR price delaying purchases until oracle prices are aligned with market prices. This may tend to cause throughput of purchases to fall further below target.

Frequency vs Gas Price

Maker keepers are set up not to call the SBE if gas prices rise above 138 gwei. This helps prevent operating expenses from becoming excessively high. However, in cases where gas prices spike, this can lead to prolonged delays in execution. If broader bullish conditions emerge (eg. another meme coin season) then there may be periods of days or weeks where the SBE is effectively paused.

Distribution of Delay Periods

The Smart Burn Engine executed a total of 418 times in the covered period. This compares with a theoretical maximum of 484 times with the given hop

of 1,577 seconds.

The data shows a significant majority of swaps take place with minimal delay.

- 15.5% of trades took place in the first available block
- 36.9% of trades took place within 1 minute
- 79.6% of trades took place within 5 minutes
- 98.2% of trades took place within 10 minutes

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Source: Smart Burn Engine - Performance to 30 July 2023

However there were a few significant outliers that comprised a large share of the total delay time, despite accounting for only a few delayed swaps. This includes individual SBE swap executions delayed by:

- 157 minutes
- 116 minutes
- 57 minutes
- 36 minutes

Note that each of the above delays over 30 minutes occurred within the first 3 days of activation of the SBE. Recent delays have been significantly lower. In total, 10 individual SBE swaps delayed for more than 10 minutes accounted for 28% of the overall delay period between swaps, or roughly 8.3 hours.

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Source: Smart Burn Engine - Performance to 30 July 2023

The takeaway here is that exact throughput of MKR purchases and LP acquisition is subject to long tail delay events, and is therefore likely to be highly variable on a day to day basis depending on market conditions. However, the pace of acquisitions should never significantly exceed the target rate implied by the hop

and bump

parameters, and the SBE is also constrained by the hump

(minimum target surplus buffer limit) parameter, so this variance should not impact protocol safety or lead to undercapitalization.

If Maker governance sees that SBE execution is falling below target by a predictable margin on average, then the SBE parameters could be padded to increase throughput and achieve a realized purchase rate closer to target. However we don't believe this is necessary at this time.

Market Impact

We can calculate realized market impact of the SBE's trades (delta between initial pool price of the DAI/MKR pool and final average execution price for the trade) by looking at the amount of DAI that must be paired with MKR to provide in the LP.

In a theoretical case with infinite liquidity and no market impact the only cost of trading would be the pool's 0.3% swap fee, meaning that a 5,000 DAI trade would receive 4,985 worth of MKR. Therefore, any amount of DAI paired with the received MKR to add to LP above 4,985 (or 0.997 times the bump

lot size parameter) must result from market impact.

Marginal market impact is simply the difference between pool prices before and after a SBE swap is executed.

To calculate the average market impact of each execution, we use the following equation:

1 - square_root[(0.997 * lot size) / amount of DAI paired with MKR for LP]

We can see that the average market impact is quite low, beginning at around 0.3% when the SBE first began operations, and falling to only 0.08% currently due to the growing size of the pool. However, note that this does not account for potential trading costs from the Uniswap DAI/MKR pool quoting an unfavorable off market price (or alternatively trading surpluses from the pool offering a more favorable/cheaper price), or from sandwich attacks.

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Source: Smart Burn Engine - Performance to 30 July 2023

Discontinuous up or down ticks in market impact are due to third party users adding or removing liquidity from the pool. Now that Maker is almost the entire pool's liquidity, market impact should decline monotonically and further upticks are unlikely.

MEV Searcher Activity

A key goal of SBE parameterization is to minimize the effects of harmful MEV, such as front running or sandwiching that results in worse execution for Maker swaps.

One way to measure value extraction from MEV is to directly look at searcher activity surrounding Maker SBE transactions.

From a review of transaction records, we see one account in particular is responsible for the overwhelming majority of front running activity on the SBE.

Contract address: 0x81CC8d5afA9CF066eac4fE4A0b13C3AA0577B558

Linked EOA triggering contract: 0xCAab55E52A2c5DD3fB37407e333BEeE98720A86B

The 0xCAab account was funded with 1 ETH from Aztec Connect (a L2 privacy solution) on 3 October 2022. The account was dormant since then, until becoming active shortly before SBE activation to create the 0x81CC contract to use for MEV on the SBE.

From then until 24 July 2023, the searcher performed a total of 127 transactions involving the SBE, resulting in a profit of ~0.5217 ETH and ~195 DAI. During this time they also incurred a total of ~1.5 ETH in gas costs. This indicates a total of ~2.1266 ETH equivalent or ~3964 DAI equivalent value extracted from MEV (DAI<>ETH conversions calculated using ETH price at time of writing of $1864). Amortizing over the entire 5,620,140 DAI spent via the SBE, this amounts to a ~0.07% loss, which is fairly insignificant. Even over just the time the searcher was active (roughly half the covered period) this would still only amount to ~0.14% value extracted to MEV, which is acceptably low.

No MEV front running or sandwiching transactions have been performed since July 24. While it is possible that the searcher may have voluntarily decided to stop performing sandwich attacks, the more likely cause is that sandwiching became no longer profitable. Their last transaction resulted in a net profit of roughly $13.

We have continued to see some backrunning and arbitrage activity in the pool after sandwiches stopped. This is generally positive, as it ensures that the Uniswap v2 DAI/MKR pool closely tracks broader market prices and avoids unfavorable off market SBE swaps. As pool size increases this arbitrage should grow more efficient over time, as it will be less constrained by arbitrageurs' market impact. The pool's adherence to broader market prices will trend towards staying within outer bounds implied by pool swap fees or CEX spreads (for example the Uniswap v2 price should not be greater than 0.6% different from the Uniswap v3 price, based on each pool's 0.3% swap fee).

Front Running and Sandwiching

The SBE can be triggered by a public function, which potentially makes it vulnerable to front running and sandwich attacks by MEV searchers in the mempool. This is demonstrated by the 0xCAab activity detailed above.

A key insight of the economics of sandwiching in AMM pools is that it is only profitable for searchers in cases where the lot size of a swap is large enough to generate a sufficient change in price (market impact) to compensate for the swap fees searchers must pay on both sides of the sandwich as well as gas costs for submitting the transaction.

Additionally, because Maker itself comprises almost all of the DAI/MKR pool balance, it is in a position to recapture any swap fees paid by MEV searchers, reducing the negative financial impact of any sandwich attacks that occur.

This indicates that while the want

parameter is important for mitigating sandwich attacks when the bump

lot size parameter is high relative to available market liquidity, it is less prominent when liquidity is very deep as is the case currently. As long as the lot size is small enough to not cause high marginal market impact, it should not be profitable to sandwich SBE swaps. Reviewing 0xCAab activity, we see that many of the MEV transactions involved not only sandwich swaps in the Uniswap v2 DAI/MKR pool, but also trades through other pools such as Uniswap v3 MKR/ETH; in cases where there is already a degree of price divergence between pools this can increase profitability of MEV activity and make sandwiching more likely.

The defi-sandwi.ch tool provides a useful simulator to see whether sandwich attacks might be profitable at various trade and pool sizes. The researchers' paper provides more details on methodology and economics of sandwiching.

Based on current pool TVL and want

of 0.98 (maximum 2% premium), sandwich attacks are unprofitable on an absolute basis (even excluding gas costs) up to bump

lot sizes of 9,000 DAI. Incorporating reasonable gas costs, it should not be profitable to sandwich trades up to 10,000 DAI or even slightly higher.

If LP acquisition continues at the same average pace of ~$468,000 per day, and assuming stable MKR prices, by August 15 the pool will hold a TVL of roughly $14-15 million. At this pool size, trades of up to 20,000 DAI will not be profitable to sandwich regardless of gas cost. This is a reasonable estimate of the state of the Uniswap v2 pool at the time when it may be possible to vote on and execute the next updates to SBE parameters.

Conclusions

Below are a summary of takeaways from the above analysis:

- LP acquisition will be somewhat slower than the maximum target values implied by bump

and hop

, due to block time intervals, MKR price volatility, and gas spikes

- It may be possible to achieve a pace of LP acquisition closer to target by slightly overshooting with higher bump

and/or lower hop

parameters

- Increasing want

(reducing maximum premium for SBE purchases) may lead to greater variance in rate of LP acquisition and cause it to fall further below target

- The lot size bump

is arguably the most important variable to limit negative effects of MEV extraction on the SBE

- MEV value extracted has been fairly low, even in cases where bump

was high relative to pool size

- Given relatively low observed market impact and MEV extraction, keeper gas costs and oracle costs likely account for the majority of the cost involved in operating the SBE

- Maintaining relatively low want

, longer hop

, and larger bump

can help minimize keeper gas costs, and allow for lower oracle sensitivity which also limits oracle cost

References

Data sheet: Smart Burn Engine - Performance to 30 July 2023

Intro to Smart Burn Engine Post: Introduction of Smart Burn Engine and Initial Parameters

External resources:

- https://etherscan.io/token/0x517f9dd285e75b599234f7221227339478d0fcc8?a=0xbe8e3e3618f7474f8cb1d074a26affef007e98fb
- https://etherscan.io/token/0x6b175474e89094c44da98b954eedeac495271d0f?a=0x0c10ae443ccb4604435ba63da80ccc63311615bc
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