Parameter Tuning in the Lien protocol

Lien Protocol[*]

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Abstract

Our stable coin system, *the Lien protocol*, is going to be deployed on the Ethereum mainnet very soon. In this white paper, we explain the detailed parameter selection processes implemented in the protocol. This paper complements our previous two white papers, Lien Protocol (2020a,b), which described the main ideas behind the protocol while examining and verifying the protocol performance.

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1 Purpose of This Paper

In the previous two white papers (Lien Protocol (2020a) and Lien Protocol (2020b)), we introduced the grand design of *Lien*, a protocol for issuing stable coins in a whole new way. Taking advantage of investors having diverse risk attitudes towards the USD/ETH exchange rate, the Lien protocol produces *iDOL*, a crypto-backed stable coin that does not require over-collateralization. To enhance the liquidity of iDOL, we have also developed *Lien FairSwap*, which is a decentralized exchange that is customized for trading of iDOL-related crypto derivatives.

At the heart of the Lien protocol lies the *iDOL contract*, a smart contract mechanism designed to be *radically* governance free — once it is deployed on Ethereum, no one, including our team, is able to modify it. We believe that this is the only way to create a truly decentralized system. Needless to say, we should not have an administrator who operates the system. Alternatively, we could create a governance mechanism supported by governance tokens that are associated with voting rights, but historically such systems have suffered from poor governance.

All the actions necessary for minting/burning iDOL coins are taken by the users themselves according to a set of rules prespecified by the smart contract, with no centralized entity having control over the protocol mechanism. In other words, when we deploy the iDOL contract on Ethereum, we have to commit to all the parameter values, which we denoted as abstract Greek letters in the previous two white papers. In this paper, we will explain how these parameter values are determined.

2 Oracle Choice

2.1 Chainlink as the Main Oracle

When ETH is split into a Solid Bond Token (SBT) and a Liquid Bond Token (LBT) after a contract is initiated, the contract needs to know the current USD/ETH exchange rate. Here, we need a reliable oracle to obtain this information. As we announced on May 20, 2020[1], after extensive research, we concluded that *Chainlink* was the only oracle solution capable of satisfying our oracle requirements.

The Lien protocol will integrate with Chainlink's ETH/USD Price Reference Contract[2], which is secured by a collection of 21 independent nodes that collectively source data from at least seven different high-quality data aggregators. Price updates occur every time a price deviation of more than 0.5% is observed from the most recent price. Prices are also updated on a regular basis (i.e. every hour).

2.2 Emergency Measure

Chainlink is one of the most reliable oracles as of 2020. Thus, we have no reason to believe that it may become dysfunctional in the near future. In the long run, however, some unexpected defects of Chainlink could be discovered, which could lead to the collapse of the system. Since a reliable oracle is essential to the smooth functioning of the Lien protocol, we need to find another reliable oracle should that occur.

The switch of the main oracle cannot be conducted algorithmically. Hence, once the iDOL contract finds a malfunction in Chainlink,[3] it automatically (i) switches the oracle to a sub

[1] https://medium.com/lien-finance/lien-to-integrate-with-chainlink-and-use-its-eth-usd-defi-oracle-7ff7c6034bc6

[2] https://feeds.chain.link/eth-usd

[3] Specifically, the iDOL contract shifts to the emergency mode if one of the following four conditions is satisfied: (i) the exchange rate returned from ChainLink is 0, (ii) the latest exchange rate is eight times or more higher than the second latest rate, (iii) the latest exchange rate is one-eighth time or more lower than the second latest rate, (iv) the timestamp of the latest oracle return is 24 hours or more later than that of the second latest oracle return. Except during these four scenarios, no one has the ability to change the main oracle.

oracle, which is specified in the iDOL contract upon initiation, and (ii) allows one of the Lien developers to change the main oracle. In such an emergency situation, the Lien developer will quickly find another reliable oracle before cancelling the emergency declaration. This is the only exception to the governance-free nature of the Lien protocol.

3 Buffer Parameter β

When a user deposits an SBT that returns K USD on the maturity date (assuming that the USD/ETH exchange rate is sufficiently higher than the SBT's strike price), the iDOL contract issues $\lambda(1-\beta)K$ iDOL immediately and reserves $\lambda\beta K$ iDOL in the lock pool. Here, λ is the iDOL/USD exchange rate, which is algorithmically determined based on the value of the basket of SBTs owned by the iDOL contract and the total amount of the iDOL coins in circulation. On the other hand, we will set this buffer parameter, β, to a constant value when the protocol is launched.

In the Lien protocol, the buffer parameter β is fixed to 10%. Hence, if a user deposits an SBT whose strike price is K USD and the current iDOL/USD exchange rate is λ, $0.9 \cdot \lambda \cdot K$ iDOL is issued immediately and $0.1 \cdot \lambda \cdot K$ is reserved in the lock pool. The reserve is returned to the iDOL issuer if the revenue obtained through the SBT auction is sufficiently high.

If the parameters used to create the SBT are too risky (i.e. the maturity date is too far out and/or the current ETH/USD exchange rate is too low compared with the per volume strike price, K/Q USD/ETH), we expect that the revenue resulting from the SBT auction is smaller than $0.9 \cdot \lambda \cdot K$ iDOL, in which case the devaluation of iDOL will occur (see Section 9 of Lien Protocol 2020a). To make sure that this does not happen, the iDOL contract does not allow users to deposit such risky SBTs (see also Section 6).

Conversely, users can always deposit "overly safe" SBTs, whose current value is much larger than $0.9 \cdot \lambda \cdot K$ iDOL. In such a case, the iDOL contract is theoretically able to issue more iDOL coins immediately, as such overly safe SBTs are very likely to be auctioned off at a high price. However, to simplify the computation procedure, we do not adjust the buffer parameter β for each SBT and instead fix it to the constant value as described above. The users who deposit an overly safe SBT do not lose too much as the reserve will be returned to the users on the maturity date.

4 Estimation of the USD/ETH Rate Volatility σ

4.1 Estimator

The Lien protocol references the volatility of the USD/ETH exchange rate to decide (i) whether to start an emergency auction (Subsection 6.1), (ii) whether to accept a new SBT deposit (Subsection 6.2), and (iii) the level of the Lien FairSwap commission rate (see Section 4 of Lien Protocol 2020b).

However, the volatility is not directly observable. Furthermore, there is no established ETH option market as of 2020, and therefore, we cannot calculate the implied volatility from the option prices. Accordingly, we should use the *historical volatility*, the sample standard deviation of the exchange rate, as a proxy of the true volatility. Because there is no oracle that provides the historical volatility data, the Lien protocol needs to compute it on its own, using historical exchange rates obtained from Chainlink.

Compared with the exchange rate data collected from a centralized exchange, the data provided by Chainlink is less organized due to technical limitations. Chainlink does not update the exchange rate in an equal interval (e.g. every hour). Moreover, timestamps associated with the exchange rate may not be accurate because block creators are not obligated to write an accurate timestamp to each block. Hence, we need to ensure that those small errors in timestamps do not affect the volatility estimation process.

We implement a volatility estimator from the Chainlink data in the following way. We use the percentage differences for the most recent 24 exchange rates returned from Chainlink. We first calculate the elapsed time by subtracting the timestamp of the 25th newest exchange

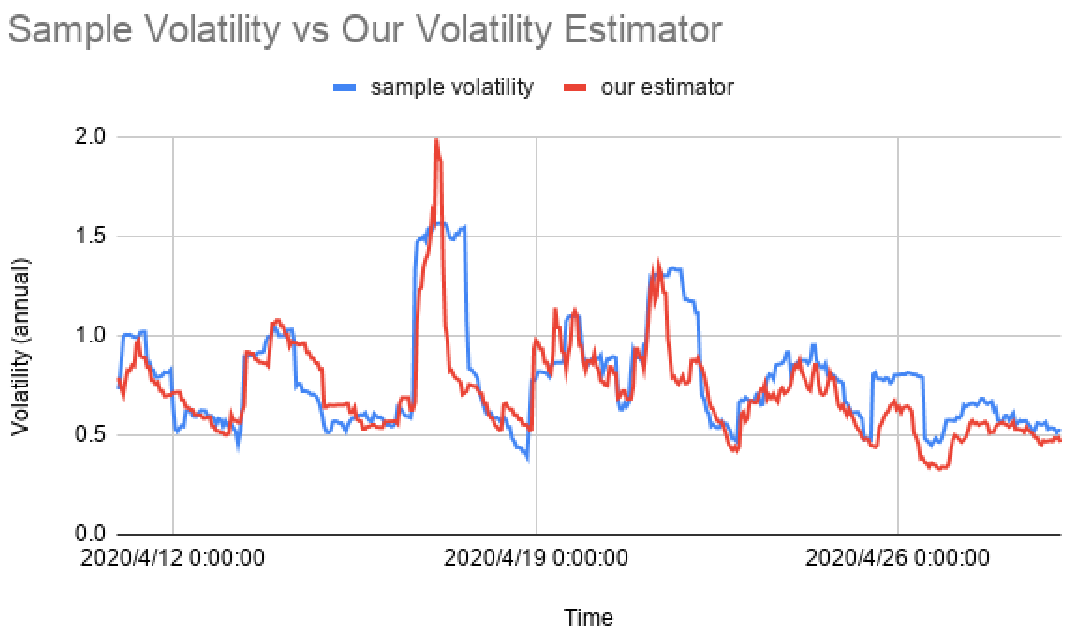

Figure 1: Blue: The sample volatility calculated from the hourly USD/ETH exchange rate data collected from Binance.
Red: Our volatility estimator, based on the uneven-interval data collected from Chainlink.

rate from the most recent exchange rate. Then, we compute each percentage difference by dividing the new exchange rate by the old exchange rate and subtract 1 from it. We compute the standard deviation of the 24 exchange rates and normalize it to an annual volatility:

$$\begin{aligned}&\text{Volatility Estimator}\\&= \text{std (latest 24 percentage differences)} \times \sqrt{(\text{One year})/(\text{Elapsed Time})}.\end{aligned} \tag{1}$$

This volatility estimator would be efficient if the exchange rate data could be obtained at equal intervals. In reality, the intervals are uneven, and therefore, our volatility estimator might not be efficient. In order to implement an efficient estimator, we should actually calculate the *weighted* average of the squared deviation, where the weight is the function of the elapsed time for each data point. However, such an efficient estimator is sensitive to the timestamp associated with each data point, and therefore, might not be reliable.

Figure 1 compares the behavior of our volatility estimator with a “standard” estimator. As a benchmark, we collected the hourly exchange rate data from a centralized exchange, Binance, and computed the rolling one-day annualized historical volatility of the USD/ETH exchange rate. This is a standard way of computing the historical volatility, provided that the iDOL contract can access a well-organized data set. This benchmark is shown as the blue line. The estimated volatility, which was calculated with the data obtained from Chainlink, is shown as the red line. As we can see, our estimator roughly traces the benchmark volatility measure and thus is expected to provide enough accuracy.

4.2 200% Rule

Since our estimator attempts to estimate the instantaneous volatility, it only looks at the latest 24 data points. Accordingly, even when the true volatility is relatively small, our volatility estimator may produce a larger value than the actual volatility due to the limited number of sample data used.

As we explain in Section 6, we make the criterion for holding emergency auctions tighter when the estimated volatility is large. At the same time, if we blindly trust the precision of the estimated volatility, emergency auctions may be triggered too often.

To prevent this from happening, we introduce an upper bound on the estimated volatility; if the estimated volatility is larger than 200%, the Lien protocol will assume that the market volatility is exactly 200%. According to the historical data, the volatility rarely exceeds 200%. Thus, introducing the 200% rule does not change the structure of the Lien protocol substantially.

5 Timing of Holding Regular Auctions

As described in Section 8 of Lien Protocol (2020a), when the maturity date of a deposited SBT nears, the iDOL contract starts a *regular auction* to sell the token.

The regular auction should be closed before the maturity date arrives — the SBT turns into ETH upon maturity, with its value denominated in USD being no longer stable. However, we should not hold a regular auction long before the maturity date because the value of an SBT with a long maturity is volatile.

The iDOL contract starts an SBT auction 36 hours before the maturity. Users have 12 hours to submit their bids to the iDOL contract by sending a hashed message. The bidding period is closed 24 hours before the maturity. After that, the bidders reveal their bids and the auction outcome is determined.[4] See Section 8 of Lien Protocol (2020a) for details of the auction procedure.

6 Risk Evaluation for SBTs

6.1 Emergency Auction

To stabilize the iDOL/USD exchange rate, we have to ensure that the value of STBs sold during an auction (denominated in iDOL) is higher than the value of the iDOL coins issued after the SBTs are deposited to the contract. When the USD/ETH exchange rate drops, the SBT value also declines. To ensure that the iDOL contract can collect a sufficiently large revenue from the auction in such a scenario, we give the contract the ability to execute an auction before the regular auction is held. This is where the *emergency auction* comes into play.

Let us look at the specific timing at which an emergency auction is triggered. Suppose S USD/ETH is the current USD/ETH exchange rate, K USD is the strike price of a deposited SBT, σ is the estimated historical volatility of the USD/ETH exchange rate, and T is the maturity date of the SBT. We normalize the volume of the SBT to one and ignore the risk-free interest rate, assuming the rate to be zero. Since the value of SBT is equal to the value

[4] If a user does not reveal his bid, he is forced to buy SBTs at "full price" (i.e. the theoretically highest price) as a penalty.

of ETH minus the value of LBT, we can calculate the value of the SBT as follows:

$$S - C(S, K, \sigma, T) \text{ USD}, \tag{2}$$

where C denotes the value of the LBT (call option) issued alongside the SBT when the contract was initiated. Per put-call parity, (2) is equal to:

$$K - P(S, K, \sigma, T) \text{ USD},$$

where P denotes the value of the put option, the strike price of which is K USD.

When a user deposits the SBT, the iDOL contract issues the iDOL coins worth:

$$(1 - \beta) \cdot K \text{ USD}, \tag{3}$$

where β is fixed to 10% (see Section 3).

Originally, (2) is always larger than (3) (as the iDOL contract refuses to mint iDOL coins in exchange for such risky SBTs). The emergency auction should be held right before (2) becomes smaller than (3). Hence, the threshold exchange rate S^* is given as a solution of the following equation:

$$P(S, K, \sigma, T) = \beta \cdot K.$$

The put option value can be calculated by the Black-Scholes formula (Black and Scholes 1973). Ignoring the risk-free interest rate, we have:

$$P(S, K, \sigma, T) = K \cdot N(-d_2) - S \cdot N(-d_1), \tag{4}$$

where N is the cumulative distribution function of the standard normal distribution, and:

$$d_1 = \frac{\log\left(\frac{S}{K}\right) + \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}},$$
$$d_2 = d_1 - \sigma\sqrt{T}.$$

Dividing both sides of (4) by K, we have:

$$N(-d_2) + \frac{S}{K}N(-d_1) = \beta. \tag{5}$$

Equation (5) involves only two variables — $s \coloneqq S/K$ and $v \coloneqq \sigma\sqrt{T}$. Rewriting (5), we obtain:

$$N(-d_2(s,v)) + sN(-d_1(s,v)) = \beta, \tag{6}$$

where

$$d_1(s,v) = \frac{\log(s) + \frac{1}{2}v^2}{v},$$
$$d_2(s,v) = d_1(s,v) - v.$$

Note that:

$$\frac{d}{ds}\left\{N(-d_2(s,v)) + sN(-d_1(s,v))\right\} = s \cdot n(d_1(s,v)) > 0,$$

where n is the probability density function of the standard normal distribution. Accordingly, for any v, there exists a unique $s^*(v)$ at which we should start an emergency auction.

We also take into account another risk factor — the time lag for closing the auction. The bid period of the emergency auction is (about) one hour, during which the USD/ETH exchange rate could potentially go through a significant change. To make sure that a sufficiently

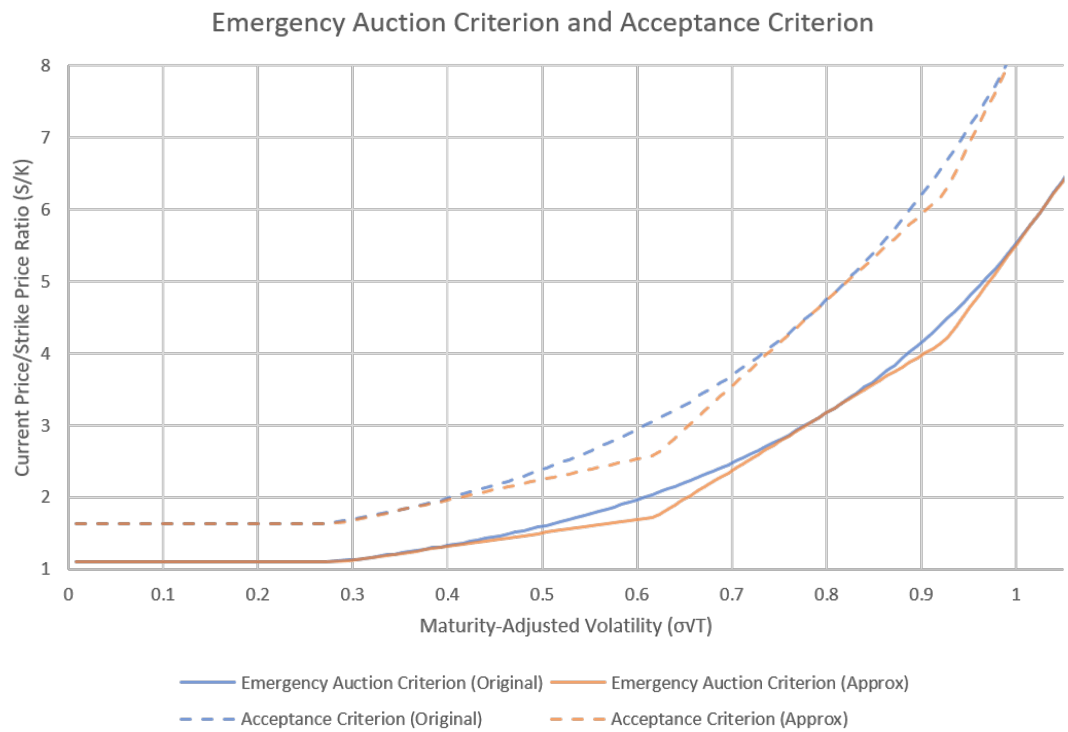

Figure 2: The emergency auction criterion and the acceptance criterion.

large revenue is generated during an emergency auction, we trigger emergency auctions at a slightly more conservative timing. Specifically, we hold an emergency auction if we have:

$$s = s^*(1.25 \times v).$$

We solve (6) to obtain $s^*(v)$ numerically for various values of v. Then, we compute its piecewise linear approximation and store it as one of the parameters for the iDOL contract. The contract then uses this piecewise linear approximation to decide when to hold an emergency auction. The criterion is illustrated in Figure 2. The emergency auction is triggered when $S = 1.1K$ with a small $\sigma\sqrt{T}$. On the other hand, it is triggered much earlier when the market is volatile.

6.2 Acceptance Criterion

Next, we describe the criterion that determines whether a new SBT deposit to the iDOL smart contract can be accepted. The idea behind this acceptance criterion is similar to the criterion for launching an emergency auction; the iDOL contract should not hold risky SBTs as the backing assets for the iDOL token, and therefore, it should only accept SBTs with relatively low risks.

We use the following three rules to decide whether the iDOL contract accepts an SBT deposit.

1. The estimated annual USD/ETH exchange rate volatility should be smaller than 200%. (There is an exception — see Subsection 6.3.)

2. The period until the SBT's maturity is longer than 36 hours but shorter than three months.

3. The ratio between the current price and strike price should be below a threshold value.

First, when the estimated annual exchange rate volatility is larger than 200%, the iDOL contract does not accept any SBTs. As we explained in Section 4, when the estimated volatility exceeds 200%, the Lien protocol abandons the calculation of the precise volatility, with the protocol adopting a conservative approach. Consequently, the protocol stops accepting new SBT deposits until this "200% rule" for volatility estimation is no longer in effect.

Second, the period until the deposited SBT's maturity should be longer than 36 hours but shorter than three months. The period that is shorter than 36 hours means that a regular auction cannot be held because the auction is designed to start 36 hours before the maturity date. If the maturity is longer than three months, the SBT is too risky for the contract to accept the deposit.[5]

[5] Although the risk of the SBT can be canceled out if the SBT has a very low strike price, we expect that no user would want to generate such an SBT.

Third, just like the emergency auction criterion, the iDOL compares the current price/strike price ratio with the threshold function to decide whether to accept an SBT deposit. Here, we will design the acceptance criterion to be stricter than the emergency auction criterion to make sure that emergency auctions are not triggered too frequently — if the acceptance criterion were to be more or less similar to the emergency auction criterion, even a small shock on the USD/ETH exchange rate could cause an emergency auction to be triggered, rendering the Lien protocol unstable.

Based on the emergency auction criterion, we construct the acceptance criterion in such a way that a newly deposited SBT is not likely to meet the emergency auction criterion within one day. More precisely, the criterion is such that the probability of a new SBT being auctioned off within one day is smaller than 1%. We looked at the historical data and found that the probability that the USD/ETH exchange rate drops by more than 33% is approximately equal to 1%. Accordingly, we set the acceptance criterion as follows:

$$(1 - 0.33) \times s > s^*(1.25 \times v). \tag{7}$$

If an SBT satisfies (7), a user is allowed to deposit the SBT to mint new iDOL coins. Otherwise, the iDOL contract refuses to issue new coins because the SBT is too risky.

The acceptance criterion is also displayed in Figure 2.

6.3 Super Safe SBTs

Although we should be conservative while the 200% rule is in effect, we should also avoid making the criteria for issuing new iDOL so strict that there is not enough liquidity for the token. For this reason, the iDOL contract allows for creating "super safe" SBTs at any time. For an SBT to be considered "super safe", the following two conditions must be met: (i) the period until its maturity is longer than 36 hours but shorter than two weeks, and (ii) its strike price is lower than 40% of the current USD/ETH exchange rate. We have found that

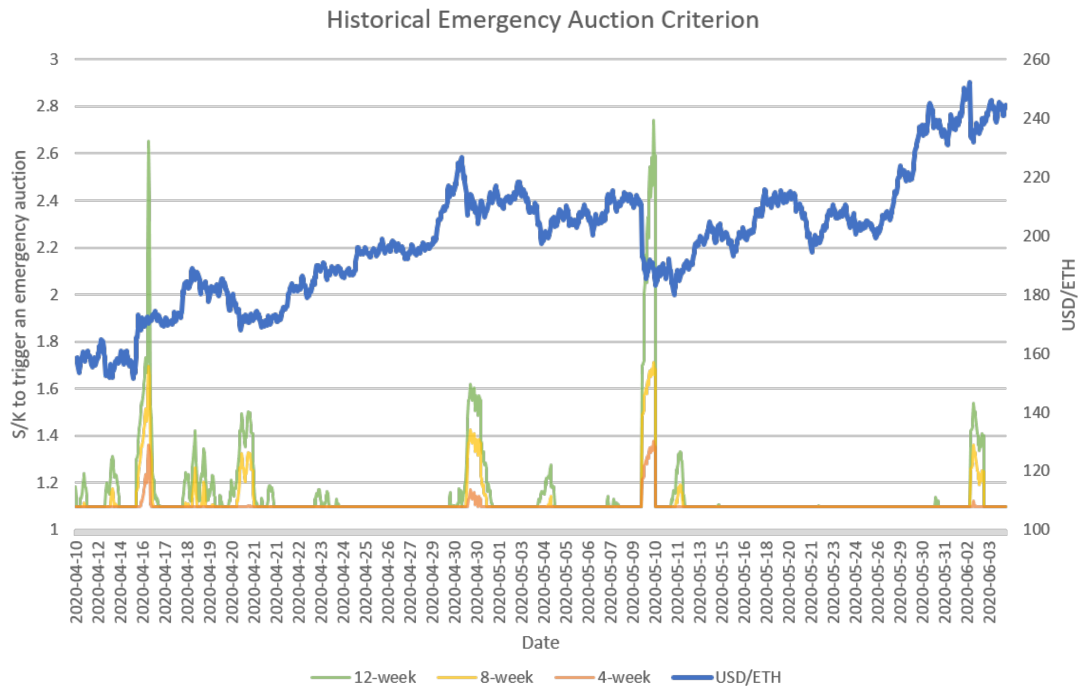

Figure 3: The behavior of the emergency auction criterion based on the data collected from Chainlink.

the USD/ETH exchange rate has never dropped by 60% points within a two-week period (as of June 2020, the historical maximum is a 59% drop). Hence, we can say with enough certainty that the "super safe" SBT can always be auctioned off at a sufficiently high price.

6.4 Historical Behavior of the Criteria

Let us see what the emergency auction criterion and acceptance criterion actually looked like in the past, using the historical USD/ETH exchange rate data fetched from Chainlink.

Figure 3 exhibits the behavior of the emergency auction criterion. The acceptance criterion can be evaluated by multiplying the value of the emergency auction criterion by $1/0.67 \approx 1.5$.

In a normal situation, an emergency auction is triggered when the current price reaches 110% of the SBT strike price. However, when there is a large price shock due to an increase in the exchange rate volatility, the iDOL contract increases the safety ratio and tightens the condition for holding an emergency auction. The SBTs that have longer maturities are more sensitive to volatility changes — a significant change in the ETH price can easily result in a long-maturity SBT being auctioned off. Note, however, that (i) the iDOL supply would be hardly affected in that scenario as short-maturity SBTs are robust against the volatility shock, (ii) even when an emergency auction is triggered, the iDOL devaluation will not occur as long as the auction revenue is higher than the amount of the iDOL coins already in circulation, and (iii) after the market stabilizes, the users can again start depositing long-maturity SBTs to receive the iDOL coins.

7 Simulation Results

7.1 Simulation Settings

To ensure that our parameter selection process is properly set up, we conduct a numerical simulation by using a discrete time model where 10 minutes is treated as one interval.

To verify the performance of the Lien protocol under a time-varying volatility, we use the Heston model (Heston 1993) for the numerical simulation. Specifically, the USD/ETH exchange rate in period t, denoted by S_t, is determined exogenously in the following manner:

$$\frac{S_{t+1} - S_t}{S_t} = \sigma_t \cdot \sqrt{\frac{(10\text{ minutes})}{(\text{one year})}} \cdot \epsilon_t^S,$$

where ϵ_t^S is drawn from an i.i.d. standard normal distribution and σ_t represents a (time-varying) annual volatility of the USD/ETH exchange rate in period t. The instantaneous variance, σ_t^2, follows the Cox–Ingersoll-Ross process (Cox, Ingersoll Jr, and Ross 1985) with a jump term:

$$\sigma_{t+1}^2 - \sigma_t^2 = \kappa(\theta^2 - \sigma_t^2) + \xi \cdot \sigma_t \cdot \sqrt{\frac{(10\text{ minutes})}{(\text{one year})}} \cdot \epsilon_t^\sigma + J_t^2, \tag{8}$$

where ϵ_t^σ follows an i.i.d. standard normal distribution. θ^2 is the long run average exchange rate variance, κ is the rate at which σ_t^2 reverts to θ^2, and ξ is the (annual) volatility of the volatility itself.[6] We collect the USD/ETH exchange rate data from Binance and configure the parameters to account for the real-world data. In this simulation, we use $\kappa = 0.01$, $\theta = 0.75$, and $\xi = 0.75$.

To verify that the Lien protocol is robust against volatility jumps, we also introduce a jump term, J_t^2. The jump term is zero for most of the periods, but it occasionally and suddenly takes a large value. We assume that J_t is drawn from the following i.i.d. multinomial distribution:

$$J_t = \begin{cases} 0 & \text{with probability } 0.99988, \\ 0.5 & \text{with probability } 0.0001, \\ 1 & \text{with probability } 0.00001, \\ 2 & \text{with probability } 0.00001. \end{cases}$$

Recall that the length of each period is 10 minutes. Therefore, an event with $J_t = 0.5$ is expected to happen once every two or three months (70 days), while we expect those with $J_t = 1$ and $J_t = 2$ to occur once every two years (700 days). Figure 4 shows a sample trajectory of the USD/ETH exchange rate generated by this process.

The equation (8) specifies the behavior of the *true* volatility, which the iDOL contract cannot observe directly. Instead, the contract estimates the volatility by inputting the exchange rate data into (1). To mimic the Chainlink's data provision, we assume that a new exchange rate data point arrives when (i) the exchange rate has changed by more than 0.5% after the last update, or (ii) one hour has passed after the last update.

[6] Since we also have a jump term J_t, the actual long-run average variance and volatility of the volatility are larger than θ^2 and ξ, respectively.

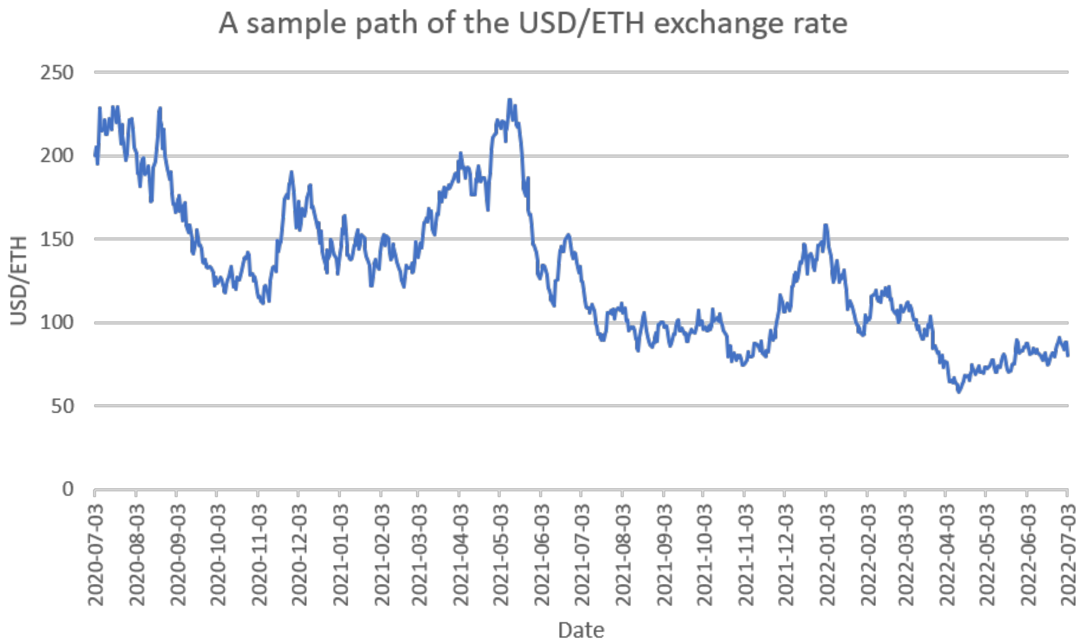

Figure 4: A sample path of the simulated USD/ETH exchange rate.

7.2 Frequency of Emergency Auctions

Using the Heston model, we first look at whether the acceptance criterion is sufficiently stricter than the emergency auction criterion. We assume that a user deposits a 12-week SBT (i.e. an SBT that matures in twelve weeks) that exactly satisfies the acceptance criterion. We generated 1000 different sample paths independently and counted the number of paths in which the token is sold off by an emergency auction. Such an event happened in 377 sample cases. Thus, the empirical probability that the most risky SBTs (i.e. the longest possible maturity and highest strike price) can trigger an emergency auction is 37.7%.

As you can see, an emergency auction is actually not an "emergency" in the strict sense of the term — the Lien protocol is designed to hold emergency auctions occasionally to protect the value of the SBT basket from exchange rate risks. Indeed, the occurrence of an emergency auction is not bad news for the iDOL holders; as long as sufficiently large revenues are generated from emergency auctions, the iDOL devaluation will not occur.

7.3 Growth of the Pegged Exchange Rate λ

Next, we check the behavior of the pegged exchange rate, λ. Ideally, we would like to make λ fixed to a constant value. However, the Lien protocol needs to devalue iDOL when it cannot collect sufficiently large revenues from SBT auctions, causing the value of λ to fluctuate. In this section, we will demonstrate that the pegged exchange rate does not change too rapidly based on a numerical simulation.

Our simulation covers a period between the midnight on July 3rd (Fri), 2020 and the midnight on July 3rd (Sun), 2022. Every Friday midnight, the investors split ETH to generate new SBTs and LBTs. Their maturity dates were set to 11:00 pm on each Friday. For simplicity, we assume that the investors generate an equal amount of one-week SBTs, two-week SBTs, ..., and twelve-week SBTs. Their strike prices are chosen in such a way that the generated SBTs were safe enough to be accepted by the iDOL contract (i.e. the SBTs satisfy (7) when generated). To the extent that all three conditions (described in Subsection 6.2) are met, the SBT holders can deposit their SBTs to the iDOL contract to mint new iDOL coins.

In addition, we assume that the SBT price is kept around its theoretical price derived by the Black-Scholes formula, (2). Specifically, we assume that the SBT price is drawn from a uniform distribution over $[0.99 \times (\text{SBT value}), 1.005 \times (\text{SBT value})]$. This is a conservative assumption; although the emergency auction criterion is such that the SBT value cannot be smaller than $(1-\beta)\lambda K = 0.9 \times \lambda K$, it is not designed to always have $0.99 \times (\text{SBT value})$ be larger than $0.9 \times \lambda K$. Hence, even if the emergency auction and acceptance criteria work well, there is still a possibility of iDOL being devalued.

Figure 5 exhibits a sample movement of the pegged iDOL/USD exchange rate (λ). Since regular and emergency auctions occasionally fail to generate a sufficiently large revenue, the iDOL is gradually devalued. However, since we select the parameters conservatively, the rate of devaluation is not too fast — in this example, iDOL is devalued only by 3% in two years.

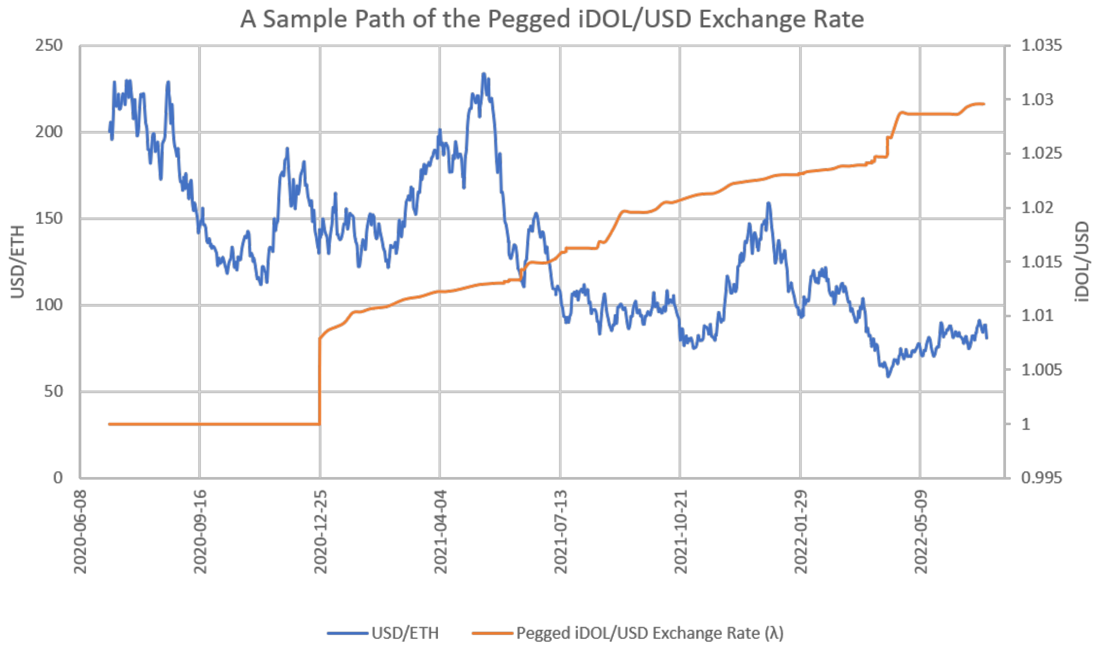

Figure 5: A sample path of the pegged iDOL/USD exchange rate λ.

7.4 ETH Price and iDOL Market Capitalization

While we would eventually like to see iDOL used widely around the world, in its infancy its primary userbase would probably be the communities of crypto enthusiasts. These early investors' financial capacity depends on the cryptocurrency market conditions, and therefore, a sharp reduction in the USD/ETH exchange rate could severely reduce the market capitalization of iDOL. In such a case, there may not be as many iDOL users as we would like to see in the market, which could undermine the quality of iDOL as a medium of exchange. To address this concern, we analyzed the relationship between the USD/ETH exchange rate and the iDOL market capitalization.

Figure 6 shows a sample development of the iDOL market capitalization, which corresponds to the sum of the strike prices of SBTs backing up the value of iDOL, and the USD/ETH exchange rate. Assuming that the investors own some ETH positions, they would provide more SBTs to the iDOL contract when the value of their ETH denominated holdings increases.

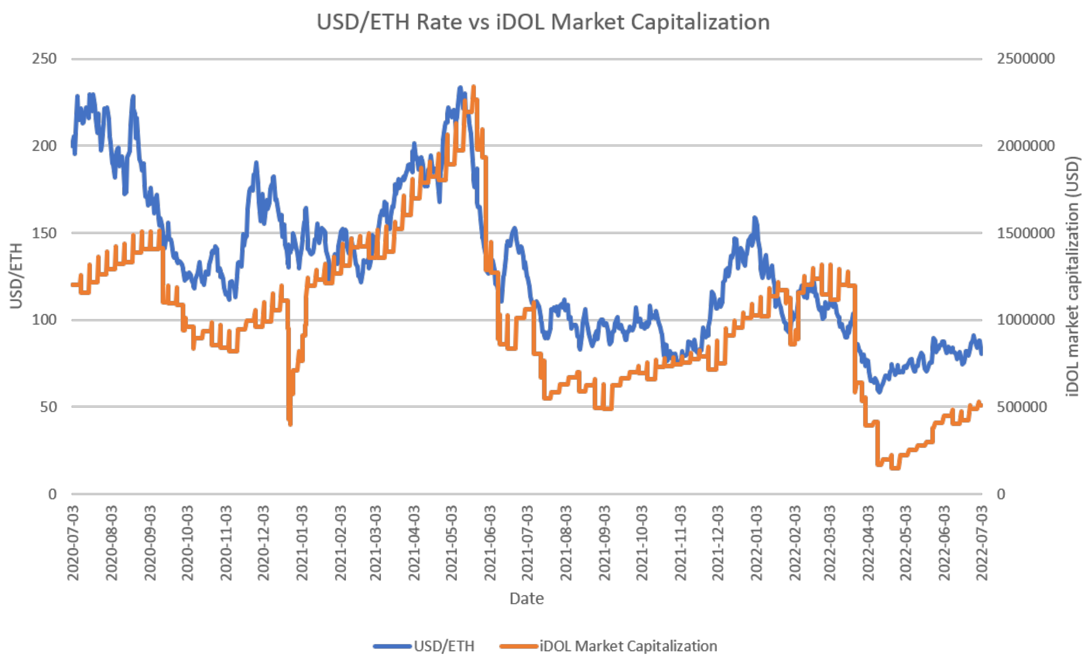

Figure 6: The behavior of the iDOL market capitalization.

As expected, we could identify a correlation between the iDOL market capitalization and the USD/ETH exchange rate. In particular, when the USD/ETH exchange rate drops, the iDOL market capitalization also tends to go down due to an emergency auction being triggered. With that being said, we can see that a sharp decrease in the USD/ETH rate will not entail an immediate collapse of the the iDOL system.

8 Lien FairSwap Commission Rate γ

Lien FairSwap is a decentralized exchange (DEX) designed to help provide liquidity for iDOL-related derivative tokens, with iDOL and LBT expected to be the most typical assets traded on the platform. The price is algorithmically adjusted to an appropriate level (see Lien Protocol 2020b for more details).

A liquidity provider will collect commission in exchange for providing an opportunity for people to trade the assets. In accordance with market practice, we set the rate of commission (denoted by γ in Lien Protocol (2020b)) to 0.3%.

Note that, unlike the parameters specified in the iDOL contract, the parameters utilized on the Lien FairSwap platform can be modified after its launch. If necessary, we can upgrade Lien FairSwap by deploying another marketplace on Ethereum. Alternatively, the users have the option of utilizing a centralized exchange to trade those tokens if such a platform provides support for the tokens in the future.

9 Lien Token

Thus far, we have discussed how the Lien protocol is designed to issue iDOL. Now, in order to encourage the adoption of iDOL, we need the involvement of (i) developers who engage in building infrastructure for the iDOL ecosystem, (ii) investors who provide liquidity to the iDOL market, and (iii) ambassadors who help spread the word on the project to the end users around the globe.

Here, it is important that their incentives be aligned with the growth of the iDOL community so that they can serve the community effectively. Within the cryptocurrency community in general, this has traditionally been conducted through the issuance of a governance token, which rewards the community members for the service they provide (e.g. voting). However, the Lien protocol is governance-free; the iDOL contract has no "administrator" in the sense that no one is able to edit the contract once it is deployed on the Ethereum blockchain. Hence, the Lien protocol does not provide a "governance token" by design.

To promote early adopters' involvement, the Lien protocol issues the *Lien token*, which gives the token holders the right to receive commission from the protocol users. Specifically, the protocol users pay 0.2% when they split ETH to generate SBT and LBT. In addition, the Lien protocol takes 20% of the commission paid to the liquidity providers of Lien FairSwap. These fees collected by the Lien protocol will be distributed to the Lien token holders.

When we launch the Lien protocol, the Lien tokens will be made available to developers, investors, ambassadors and community members who are interested in supporting the organic growth of the project.

References

Black, F. and M. Scholes (1973): "The pricing of options and corporate liabilities," *Journal of political economy*, 81, 637–654.

Cox, J. C., J. E. Ingersoll Jr, and S. A. Ross (1985): "A Theory of the Term Structure of Interest Rates," *Econometrica*, 53, 385–407.

Heston, S. L. (1993): "A closed-form solution for options with stochastic volatility with applications to bond and currency options," *The Review of Financial Studies*, 6, 327–343.

Lien Protocol (2020a): "iDOL white paper," https://lien.finance/pdf/iDOLWP_v1.pdf.

——— (2020b): "Lien FairSwap white paper," https://lien.finance/pdf/LienFairSwapWP_v1.pdf.