

LP Finance

Designing an improved stablecoin model v1.1

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Abstract

Stablecoin is an on-chain asset that has its value pegged to a certain asset class. Most stablecoins are backed by collateral in order to allow users to redeem collateral at 1:1 value, which justifies its value. However, the current designs are not capable of stabilizing their price, scaling properly, and securing decentralization. Simply using a collateralization method fails to meet the true requirements of a stablecoin. In this paper, LP Finance introduces aCBS (Algorithmic Collateral Backed Stablecoin), which suggests design solutions such as typeless repayment, dynamic stability fee, algorithmic collateralization control, and incentivized liquidity providers. Along with the stablecoin design, potential vulnerabilities and the model's defence mechanism are explained to ensure the real-life validity of the model.

1. Introduction

LP Finance is a synthetic asset issuance protocol that allows users to lock collateral and mint synthetic tokens.

Available synthetics are as follows

- lpUSD (USD)
- lpBTC (BTC)
- lpETH (ETH)
- lpSOL (SOL)

With interest-free loans, through minting synthetics, users can take advantage when leveraging positions with lower risks.

The minted synthetics would be backed by overcollateralized pool and borrowers would be able to redeem the corresponding amount of collateral. If there are risky vaults, which might affect the over-collateralization, funds from the auction pool would be utilized to liquidate vaults.

However, even with over-collateralization and proper liquidation models, there still exist methods that can harm the peg of synthetics.

By proposing new concepts, such as Typeless Repayment, Dynamic Stability Fee, Incentivized LPs, and Overflow Collateral Model, LP Finance is solving the trilemma of existing synthetics and stablecoins.

In this paper, lpUSD (USD Stablecoin) will be solely used to provide examples for a better understanding of the protocol.

2. Problems of Stablecoin

Overcollateralized stablecoin does not have a potential of a bank-run, where 1 USD token cannot be exchanged for the corresponding amount of collateral unless a pool exploit

happens. However, the market price of stablecoin can diverge due to different scenarios, which is a vulnerability for a stablecoin.

Additionally, overcollateralized stablecoins are often considered capital inefficient as only a portion of collateral is required to back the minted stablecoin.

In this section, problems and vulnerabilities of overcollateralized stablecoin are addressed.

2.1 Interest-Free Loans

On lending protocols, where “lenders” and “borrowers” exist, interest-free loans are impossible or unsustainable as they cannot provide motivation for lenders to provide liquidity, therefore borrowing is impossible.

Although by minting stablecoin backed by collateral, interest-free loans are possible and are already used on existing protocols. This provides users with a stable option for leveraging positions, as it does not have volatile loan interest.

However, interest-free loans would cause the stablecoin to fall below its peg eventually, as there is no motivation to encourage users to pay back their loans. As more stablecoin are minted over time, more liquidity of stablecoin would be added to the liquidity pool and result in an imbalanced pool.

If users intend to take more loans and sell stablecoin in the market continuously, the market price of stablecoin would not be recoverable unless a mass liquidation or repayment occurs.

There should exist a method to increase the demand for stablecoin as it falls below the peg without solely relying on arbitrageurs.

2.2 Capital Efficiency

Overcollateralized stablecoin cannot be 100% capital efficient. As the collateral is often non-USD tokens (BTC, ETH, SOL, etc.), over-collateralization is required.

However, a simple mechanism of adding collateral and minting is extremely capital inefficient, as around 30%~50% of collateral would be locked without any usage.

A method to maximize capital efficiency should exist to maximize the usage and utility of provided collateral.

2.3 Securing Peg

As explained above, over-collateralization does not ensure the peg. There should be market interaction, incentives, or penalties to maintain the peg.

For example, if the user adds 100 SOL ($\approx \$50$) as collateral and borrows 800 lpUSD interest-free, the initial position would be as follows.

- Collateral: 100 SOL ($\approx \$5000$)
- Loan: 800 lpUSD ($\approx \$800$)
- LTV: 16%

Now, lpUSD price falls below peg ($1 \text{ lpUSD} \approx \0.8).

- Collateral: 100 SOL ($\approx \$5000$)
- Loan: 800 lpUSD ($\approx \$640$)
- LTV: 12.8%

If this occurs, there might be two scenarios, where the user believes the peg recovers or fails permanently.

- If peg recovers, it is better to repay loan at a discounted price.
- If peg fails permanently, it is better to not repay loan until it completely fails.

In case of a planned selling action to depeg the stablecoin, the scenario below is likely to happen, and the peg would not recover until a mass repayment event occurs.

Therefore, there should be a method to discourage people to mint stablecoin as the peg

fails and encourage users to buy stablecoin when it is below peg.

2.4 Third-party Dependence

Most DeFi protocols rely heavily on each other, which in the worst case, can cause a domino effect.

A stablecoin or synthetic asset protocol relies on the following third-party protocols.

- Bridge: Collateral tokens (ex. wBTC, wETH)
- AMM: Liquidation, Swap (ex. Curve, Saber)

Even if the stablecoin should utilize third-party protocols, there should exist a risk management plan, where the stablecoin's stability or decentralization is not affected by third-party protocol's decision or exploit.

3. aCBS Protocol

Synthetics on LP Finance are named aCBS, which is an abbreviation of Algorithmic Collateral Backed Stablecoin. aCBS is minted, burnt, locked, and market interacted by aCBS Protocol, which is designed to improve scalability, capital efficiency, decentralization, and peg stability.

3.1 Introduction to aCBS

aCBS is fully backed by native collaterals along with algorithmic design to secure peg. aCBS that can be minted on LP Finance are as follows.

- lpUSD (USD)
- lpBTC (BTC)
- lpETH (ETH)
- lpSOL (SOL)

Among these synthetics, lpSOL has a unique functionality, where it could be repaid in alternative assets, which is explained in section 4.1 (Typeless Repayment).

3.2 Minting aCBS

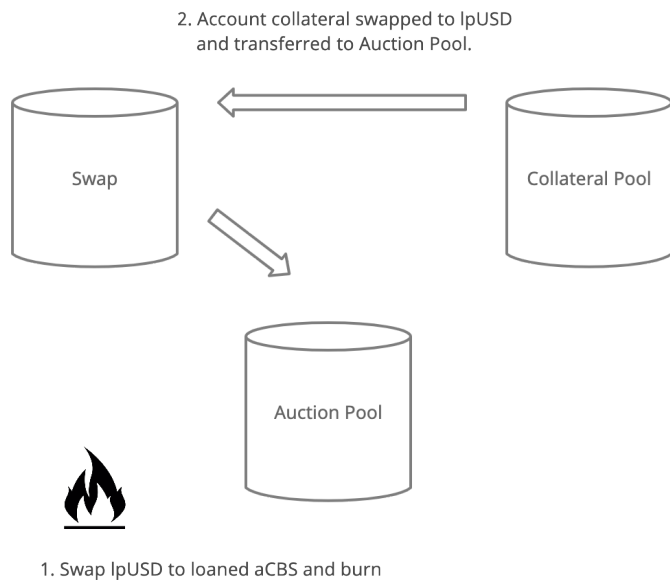
Minting aCBS is a simple process, where users add collateral and mint(borrow) aCBS. Users can mint up to 80% LTV, regardless of the type of collateral.

Minting contract assumes the price of synthetics based on the oracle price data. For example, if user mints lpSOL, lpSOL's price is calculated as SOL price.

3.3 Democratized Liquidation

Liquidation is required to close risky vaults that can harm the over-collateralization of the pool. Instead of a first-come-first-served basis, liquidation is democratized, where any users can deposit lpUSD to the Auction Pool and earn liquidation fees.

The process is as follows.



1. Account LTV reaches 90%
2. Loaned aCBS (Account's loaned token/amount) is burnt from Auction Pool
3. Total collateral of the account is swapped to lpUSD
4. Swapped lpUSD is transferred to Auction Pool

The single epoch (single liquidation) profit rate when auction pool volume is equal to the liquidated account's borrowed amount would be

$$\textit{Profit Rate} = \frac{100-90}{90} \times 100\% = 11.11\%$$

However in most cases, funds in the auction pool would be larger than the single epoch liquidation volume. The profit rate considering the ratio of these volumes would be

$$\textit{Profit Rate} = 11.11\% \times \textit{Participation Rate} = 11.11\% \times \frac{\textit{Liquidation Volume}}{\textit{Auction Pool Volume}}$$

Therefore, if the auction pool volume is low, the profit rate would be extremely high, encouraging users to deposit lpUSD to earn liquidation fees.

3.4 Adding aCBS

More aCBS can be added, such as lpAVAX and lpMATIC by the decision of LP Finance DAO. The steps of adding new aCBS would be as follows.

1. LP Finance DAO votes for new aCBS to be added.
2. User deposits corresponding tokens to the DAO pool.
 - ex) Proposal to add lpAVAX → User provide AVAX tokens to the program
3. If sufficient funds are provided, preparation period starts, where users can now mint new aCBS and deposit the same amount to the DAO pool.
4. After preparation period ends, provided tokens in DAO pool are used to provide liquidity and the LP Tokens are locked for one year vested staking. (Section 5.1)

4. Stability

Stability should be the priority of stablecoins. LP Finance introduces new mechanisms, such as typeless repayment and dynamic stability fee that can bring back the price of stablecoin to peg if it goes up or down in price.

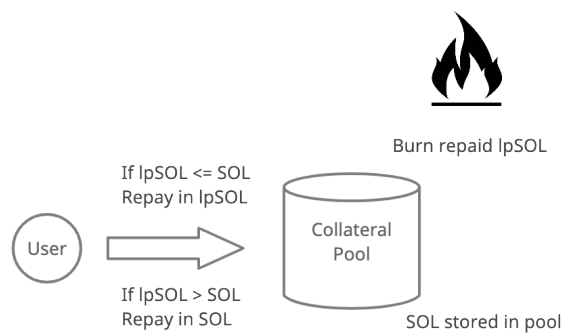
4.1 Typeless Repayment

For lending protocols, users have to pay back their loan in the same token. However, LP Finance allows users to pay back in alternative tokens that have the same type (peg).

lpSOL loans would be eligible for typeless repayment. Users have an option to repay in SOL, mSOL, or stSOL. This action is considered as “Debt Transfer”, where the users’ debt is not transferred to LP Finance DAO. The repaid tokens would be a collateral and loan amount would be now subject to LP Finance DAO.

If SOL is used for repayment, repaid amount of token is required to be equal, regardless of price. This way, users can repay their loans at a lower price.

If liquid staking SOL (mSOL, stSOL, daoSOL) are used for repayment, the repayment value would be discounted by 0.5%. This is determined by the price data from the oracle, and users can take instant 0.5% profit by using this method. Further details are addressed in section 4.2 (Typeless Repayment for Liquid Staking Assets).



Alternative tokens used to repay are stored in a separate collateral pool. The tokens in this pool are restricted for following usage.

1. Swap to lpSOL and burn
2. Redeem SOL on Marinade Finance and Lido

At some period, alternative tokens would be used to purchase lpSOL and burn.

4.2 Typeless Repayment for Liquid Staking Assets

On section 4.1 (Typeless Repayment), repayment using liquid staking SOL is explained. The users' debt position is now subject to LP Finance DAO, and the repaid token would be used as collateral for the position.

As the debt position is transferred, the tokens used for typeless repayment could be transacted by the DAO's decision, which is intended to create profit by purchasing/burning lpSOL in case the price drops below peg.

The reason for providing 0.5% discount on the repayment event is to maximize the profit of LP Finance DAO.

If users repaying with liquid staking SOL increases, the underlying collateral of synthetics would decrease as a discount is applied. However, assuming the current APY for staking (5.2%), it would take around 35~36 days to cover the loss. If the tokens are not used to purchase/burn lpSOL over this period, LP Finance DAO would be able to hold positions with minimum liquidation risk and take profit once the DAO's decision is confirmed.

4.3 Limit of Typeless Repayment

In the section above, lpUSD has not been mentioned as an option for typeless repayment. This is because typeless repayment requires an **“original asset”** to be used as an alternative option. As the “original asset” of lpUSD, real USD should be repaid, but this is impossible on-chain.

This also applies for lpBTC and lpETH. As LP Finance does not accept non-native tokens, typeless repayment would be possible only on local chains. This is to minimize the impact of bridge exploitation.

4.4 Dynamic Stability Fee (DSF)

Preventing the aCBS price to rise above peg can be simply solved with typeless repayment. However, in case the price of aCBS drops below the peg, there should exist a method to increase the demand to raise buying pressure of aCBS.

As aCBS can be borrowed interest-free, there is no motivation for users to pay back their loans. If aCBS price depegs, users have an opportunity to repay at a lower price, but this might not be enough to bring back to peg.

To discourage users to mint aCBS and ensure arbitragers that the price would retain peg, stability fee should be applied. However, if the depeg increases, stability fee should be adjusted dynamically, without having to wait for the DAO proposal to increase stability fee passes.

The dynamic stability fee is calculated corresponding to the depeg bracket.

p = Price of original asset

$max(i)$ = Maximum loan interest for original asset

Depeg Bracket	Stability Fee (%)
0.5%~1%	$max(i) + 7$
1%~2%	$max(i) + 14$
2%~4%	$max(i) + 28$
4%~6%	$max(i) + 56$
6%~	$max(i) + 112$

For example, if lpUSD price drops to \$0.97 (-3%) and the highest loan rate for USD token (USDT, USDC) is 4%, the stability fee would be 32%, which is extremely high.

This would enforce users' to repay loans or possibly be liquidated, bringing the price back to peg. However, this method has a high potential to harm users' vaults and discourage users to mint synthetics due to high risks of interest rate spike.

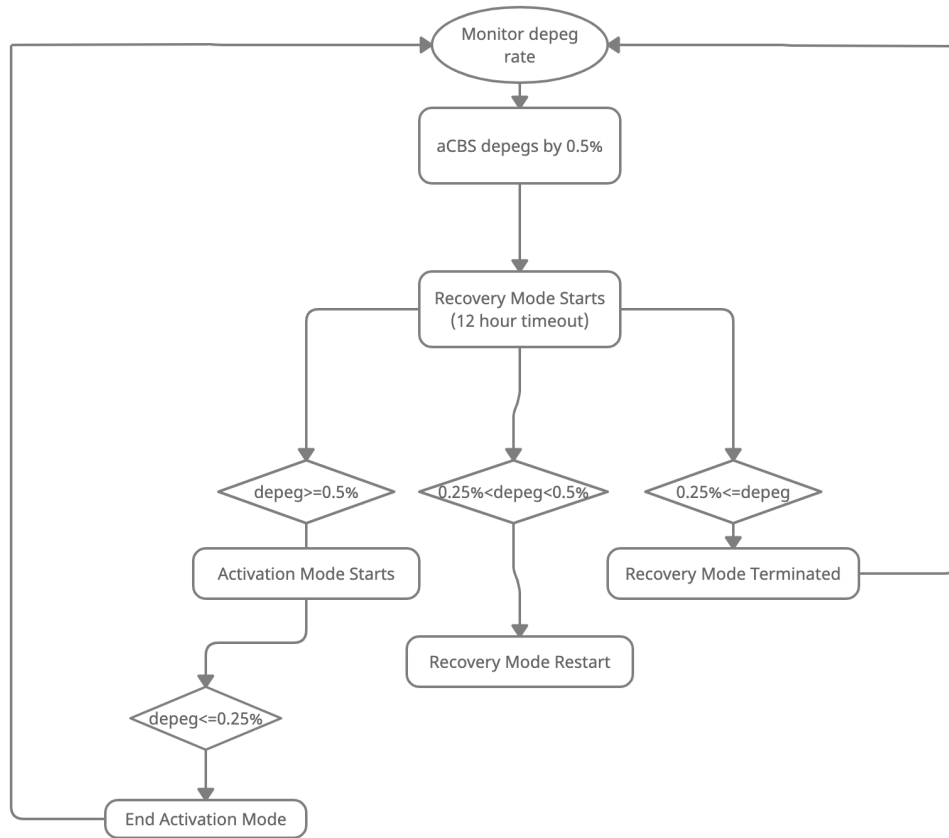
To prevent this, dynamic stability fee are activated in a delayed manner to provide time for arbitrageurs to bring the price back to peg and users to lower risks.

4.5 Delayed Stability Fee Activation

Dynamic stability fee is a mechanism to secure price stability of aCBS. In the worst case, the dynamic stability fee would increase at an extremely fast rate, which would increase risk for mass users. As there should be enough time given for arbitrageurs to stabilize the price of aCBS and users to lower risks on open vaults, stability fee is applied 12 hours after the depeg event is triggered.

Every one minute, the price of aCBS and the depeg percentage is calculated. Once the depeg percentage exceeds the tolerance (0.5% on LP Finance), "Recovery mode" is announced. Once recovery mode is announced, the stability fee would be applied in 12 hours, which is "Activation Mode". In this period, arbitrageurs will purchase aCBS at a discount as it is ensured that aCBS will recover peg even if arbitrageurs does not participate. After 12 hours, if the depeg percentage is still over tolerance, activation mode is announced and stability fee is applied until the depeg percentage is below 0.5%.

Here is a flow of the situation.

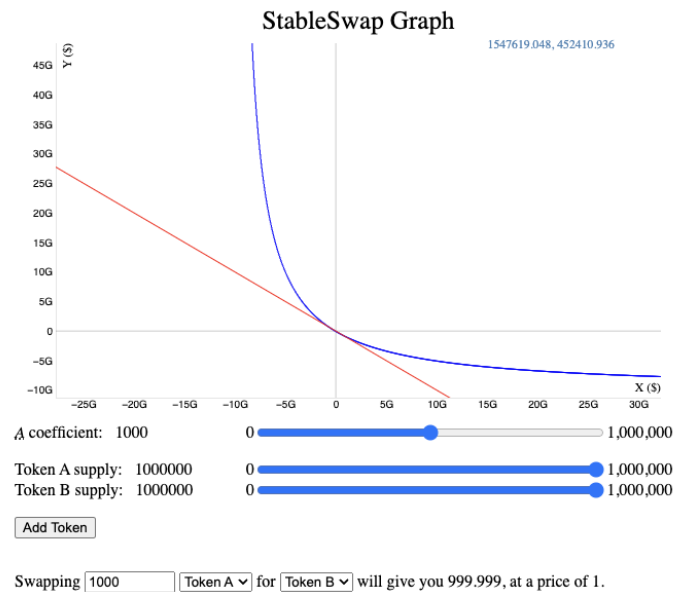


By providing a recovery period, arbitragers would be able to take the opportunity at minimum risk and aCBS would be able to retain peg safely without performing intense liquidation.

4.6 Stableswap and Risk of High Stability Fee

Dynamic stability might appear as an intense method which might put a lot of users at risk. And a depeg of 0.5% is likely to occur often. However, as aCBS are mainly tradable on stableswap pools, the risk is not as high as it appears.

The graph below displays the Curve stableswap algorithm. (Amplification coef=1000)



(<https://miguelmota.com/blog/understanding-stableswap-curve/>)

Instead of using a linear invariant algorithm, token A and B can be exchanged at a near to 1:1 ratio until the pool exceeds a certain imbalance ratio. By increasing the amplification coefficient, the pool is able to tolerate a higher imbalance ratio.

As LP Finance's dynamics stability fee activates when the aCBS depegs by 1%, we can check how much pool imbalance would cause this. (Assume 1USDC=1USD)
If the pool reserve is at (89% lpUSD + 11% USDC), the price of lpUSD is at \$0.99, which is de-pegged by 1%. This ratio explains that the pool is extremely risky. If more lpUSD is sold on the market, the price will drop at a higher rate compared to when the pool was balanced.

Therefore, an intense method, dynamic stability fee activation is required to rebalance the pool and secure the stability of aCBS.

5. Scalability

In order for a stablecoin to scale, the peg should sustain as the supply grows. However, this is extremely difficult to achieve, especially if a stablecoin can be minted/borrowed interest-free as selling pressure will continuously increase.

The most straightforward method of scaling would be increased liquidity in the pool, minimizing price impact as aCBS scales.

5.1 aCBS LP Token Vested Staking

In order to increase liquidity in the pool, liquidity providers should be incentivized, creating motivation for users to provide liquidity. LP Finance provides incentives to staked LP Tokens.

To secure a larger amount of liquidity in the pool, the liquidity should not be withdrawn rapidly. Vested staking for LP Tokens would be able to solve this.

First, the list below displays the liquidity pairs that would be eligible for staking. All pairs are subject to stableswap pools.

- lpUSD - USDC
- lpBTC - BTC
- lpETH - ETH
- lpSOL - SOL

In order to attract people to stake LP Tokens for a vested period, the following incentives are provided.

	Deposit Fee Shares	Liquidation Fee Shares	Liquidity Mining
One month vested	5%	2%	0.1% of LPFi supply/year
One year vested	10%	5%	0.5% of LPFi supply/year
Two years vested	15%	10%	1.5% of LPFi supply/year

Vested staking for LP Tokens would have near-to-zero risk of impermanent loss as the dynamic stability fee algorithm makes de-pegging impossible. Also, as it is a stable pair, there would be minimum risk for locked up staking.

As the aCBS supply grows, the most ideal situation is the liquidity of pool growing at an equal rate. With incentivized LPs, where the reward emission growth is constant, this would be achievable, making aCBS scalable.

5.2 LPFi Inflation and Scaling

By creating motivation to stake LP tokens, LP Finance is able to scale better due to higher liquidity for aCBS.

A negative view might be on LPFi token's inflation ($\approx 2.1\%/y$). However, the inflation can be considered as an investment to scale aCBS minted on LP Finance, which would result in higher revenue and fees for LP Finance DAO. This would benefit both parties.

LPFi token emission would be adjusted overtime as LP Finance scales. When liquidity is sufficient, emission would decrease by the decision of LP Finance DAO.

6. Capital Efficiency

Capital efficiency is not the most crucial factor in the design of stablecoins. However, under the condition that the peg is secured, capital efficiency should be maximized. LP Finance utilizes collaterals that are not required to back minted aCBS to generate profit, which increases capital efficiency and users' return on investment.

6.1 Algorithmic Collateralization Control (ACC)

aCBS is a collateral backed stablecoin, which means the minted stablecoin should be overcollateralized. However, over-collateralization also leads to capital inefficiency. Therefore, LP Finance uses an overflow collateral model to supply unnecessary collateral to lending protocols to maximize capital efficiency and generate profit.

Definitions

- **Overflow Collateral:** collateral which are not required to back minted aCBS
- **Overflow Collateral Percentage:** percentage of collateral to be supplied for yield generating activities

Users can set a percentage of collateral to be transferred to lending protocols. As the maximum LTV is 80%, corresponding amount of collateral should be remaining in the collateral pool. Even if portion of collateral are lost due to third party exploits, minted aCBS should remain overcollateralized. Therefore, maximum threshold of overflow collateral percentage is limited to 10%.

The overflow collateral supply and redeem conditions are set as below.

- If LTV rises above 88% → Redeem overflow collateral from lending protocols
- If LTV drops back to 75% → Supply overflow collateral to lending protocols
- If utilization rises above *utilization threshold* – 5% → Redeem

Collateral tokens are supplied to selected lending protocols that have the highest return. By this, the liquidity would be distributed among lending protocols. In the worst case, if a single lending protocol fails or gets exploited, the impact on LP Finance would be smaller if overflow collateral is supplied to multiple lending protocols, and as the required collateral to back minted stablecoin remains in the pool, there are no risks of bank-run or insufficient backing assets.

7. Decentralization

Decentralization should not be an option, but a mandatory component of the stablecoin design. For a collateralized stablecoin, tokens that are used as collateral would be the key factor that determines the decentralization of a stablecoin.

7.1 Collateral Options

Requirements for collateral would be as follows.

- Should not be bridged (Native asset of a blockchain)
- Should not be issued or backed by a central entity (ex. USDC, DAI etc.)
- Should have sufficient liquidity in the market

The reasoning for the first requirement (Should be a native asset of a blockchain), is because a bridge exploit might lead to under collateralization of aCBS.

8. Fee / Profit Allocation

Fee and profit generated on LP Finance are distributed to the stakeholders.

	Liquidation Fee	Deposit Fee
Auction Pool	73%	NA
LP Finance DAO Treasury	5%	10%
Staked LPFi	5%	60%

LP Token Staking (1 month vested)	2%	5%
LP Token Staking (1 year vested)	5%	10%
LP Token Staking (2 years vested)	10%	15%

The allocation of profits can be modified under LP Finance DAO's decision.

9. Potential Vulnerabilities and Solutions

In theory, aCBS are impossible to depeg for a long period. However, common vulnerabilities of stablecoins should be considered in order to ensure the validity of the stablecoin model.

9.1 Lack of Arbitrage Motivation

Lack of arbitrage motivation occurs when the protocol loses trust among the public audience/users. This would lead to aCBS de-pegging for a long period of time or possibly permanent depeg. Market sentiment is a crucial factor in this case.

Below explains the worst-case scenario that can happen to any stablecoins.

(exUSD is used as a symbol for example)

1. User deposits 100 SOL (≈ 5000 USD) as collateral
2. User mints 3000 exUSD (≈ 3000 USD)
3. exUSD market price drops 30% and arbitragers are not active
4. Liquidity Providers start withdrawing liquidity and sell exUSD for USDC
5. exUSD price drops even more and volatility increases due to lack of liquidity
6. User starts repaying loan at a cheaper price to redeem collateral, but lack of liquidity creates immense volatility

To prevent this, dynamic stability fee exists.

Dynamic stability fee might be a harsh emergency protocol to force aCBS to retain peg, but it is rather a “limiter”. It ensures that in any case, aCBS would retain peg. In the worst-case, if there are no buyers, the whole collateral would be liquidated and bring the price back to its peg. Therefore, this systemic trust would encourage arbitrageurs to rebalance the price (pool) whenever aCBS depegs.

9.2 Attempt to Raise Stability Fee

As LP Finance uses bracket based calculation for stability fees, the stability fee could be extremely high even if a 5% depeg occurs. If a certain party utilize funds to sell immense amount of aCBS, the stability fee could be high enough to liquidate most positions.

However, this event is not going to happen due to delayed activation (Section 4.5). After a depeg event occurs, 12 hours recovery mode is announced, where stability fee is not applied. During this period, arbitrageurs can purchase aCBS at a discount to take profit once the peg recovers.

Arbitrageurs are highly motivated to do so as aCBS would recover peg anyway even if no one buys aCBS. LP Finance DAO would also play a role to purchase lpUSD using arbitrage funds. This is not to assist aCBS to recover peg, but to solely take arbitrage profit.

9.3 Third-party Dependence

LP Finance’s aCBS model minimizes dependence on third-party protocols. However, there are still risk points which can affect LP Finance.

9.3.1 Failure to Liquidate

Failing to liquidate might cause undercollateralization of CBS. The reason for liquidation failure are as follows.

- Network congestion / halt
- Insufficient liquidity

First, if network is congested, liquidation transaction would fail. There are no solutions in this case.

Next, if the liquidity is insufficient in the pool, liquidation would go through with an extremely high price impact. As this can cause fund loss for liquidation on auction pool, collateral should be chosen carefully and reconsidered every certain period.

9.3.2 Lending Protocol Exploit

For all collateral supplied to LP Finance, maximum 10% are supplied to diverse lending protocols. This improves capital efficiency, but might be a risk point once a lending protocol loses liquidity/exploited.

Even though this event occurs, the aCBS minted are still fully collateralized so it would not affect aCBS itself. However, users can be liquidated immediately if the LTV rises after the funds supplied to lending protocols are lost. aCBS DAO and LP Finance DAO should vote for overflow collateral percentage (on Section 6.1) carefully to manage the risk.

9.3.3 Bridge Exploit

Bridge exploit can cause catastrophic event for most stablecoins that are backed by bridged collaterals as the value of the bridged tokens might drop to 0.

LP Finance only accepts native tokens as collateral, which ensures aCBS's collateralization to stay safe even if a bridge is exploited.