

Platypus Stablecoin Design

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Abstract

Platypus USD (USP) is an overcollateralized stablecoin built on the foundations of the Platypus stableswap. The introduction of USP improves capital efficiency in the Platypus system and reduces the dependency on external assets in its operation. We propose the peg stability of a stablecoin root from its perceived ability to redeem into its represented assets can be understood as a confidence game. Further improving the peg are two innovative mechanisms: Adaptive Peg Stability and Autonomous Coverage Optimizer.

1 Introduction

The Platypus stableswap was designed to improve capital efficiency in the stableswap market. It introduced the open liquidity pool design, which solves liquidity fragmentation into different pools and enables the addition and removal of pool constituents. Platypus USD, referred to as USP, extends this foundation by utilizing the staked tokens to improve capital efficiency, protocol profitability, and ecosystem sustainability.

The single-sided staking pools on Platypus are naturally suited to collateralizing staked assets. The Liquidity Provider tokens (LP tokens) on Platypus represent only one underlying token, while those of established designs represent multiple. In most cases, this means one less layer of calculation in LP token prices, which reduces points of failure and protocol risks.

The Platypus stableswap algorithm will establish a robust peg maintenance mechanism. Previous exploits of overcollateralized stablecoins targeted collaterals without deep liquidity to be deployed quickly. We integrate stablecoin liquidation and stableswap routing mechanisms with the proven Platypus stableswap to achieve low-risk designs.

However, the fundamental factor to stablecoin pegs is the user's confidence in their redeemability. We address this issue by publishing the live balances of USPs and collaterals, showcasing continued solvency to ensure such confidence. This is strengthened by the Adaptive Peg Stability mechanism linking borrow interest rates with the pool coverage ratio and the Autonomous Coverage Optimizer mechanism covering USP positions with protocol-owned liquidity. Both mechanisms improve peg stability.

USP's introduction to the Platypus ecosystem comes with several significant benefits:

1. Increased protocol revenue from USP's creation
2. Increased protocol revenue from the liquidation of positions

3. Increased protocol revenue from the swapping of USP
4. Increased total value locked by raising utilization for liquidity staked on Platypus
5. Increased composability with other protocols from USP adoption
6. Improved protocol safety through incentivizing the coverage ratio balance
7. Improved protocol independence by possibly using USP as the default routing asset between Platypus stableswap pools

The following sections will detail the system designs and address their advantages.

2 System Design

2.1 Inspiration

The USP design is primarily inspired by MakerDAO Dai, and credit must be given to their pioneering efforts. Dai has proven to be the most robust decentralized stablecoin with wide adoption in Ethereum ecosystems and beyond. Using their designs, USP will be on a journey built on solid foundations.

2.2 Notations

This part provides a summary of the properties and parameters in the system, providing information on the mechanics of Platypus stableswap.

Denotation	Definition
t	An LP token available to be collateralized
r_t	Coverage ratio of the LP token in the stableswap pool
a	A cryptocurrency address

2.2.1 Collateral Factor

The collateral factor of collateral t defines the maximum ratio of USP that can be borrowed, given the collateral value. It is a configurable variable from protocol governance. This value should reflect the risk of the underlying token of the collateralized LP token, where a more stably priced token with less price risk should be allowed a higher ratio. It is denoted and with the interval set as

$$\text{Collateral Factor}_t \in (0, 1)$$

In most cases, the $\text{Collateral Factor}_t$ for two LP tokens t representing a common underlying token should be equal. This value for each LP token would be published.

To retain some margin in the event of liquidation, the collateral factor for price-volatile collaterals should be lower. This is to cover the possibly higher withdrawal fee on the Platypus stableswap.

2.2.2 Liquidation Threshold

The liquidation threshold of collateral t defines the percentage of which a position would be defined as under-collateralized and open to liquidation. It is a configurable variable from protocol governance. Its lower boundary should be not less than $\text{Collateral Factor}_t$ or else

positions borrowed at this percentage would suffer from a risk level higher than deemed acceptable. It should be significantly far away from it, considering price volatility. It is set in the interval of

$$\text{Liquidation Threshold}_t \in (\text{Collateral Factor}_t, 1)$$

2.2.3 Collateral Value

The collateral value of token t and address a is calculated from the amount of LP token to be collateralized, factored by the coverage ratio:

$$\text{Collateral value}_{t,a} = \frac{\text{Pool liability}_t}{\text{LP token supply}_t} \times \text{Underlying token price}_t \times \text{Amount of LP tokens}_a$$

where the underlying token price is fetched from Chainlink.

2.2.4 Borrowing Limit

The borrowing limit of collateral t of address a is a calculated value that defines the maximum amount of USP to be borrowed. Note that each address can only open one position per collateral type. Each position would contain precisely one collateral type.

$$\text{Borrowing Limit}_{t,a} = \text{Collateral value}_{t,a} \times \text{Collateral Factor}_t$$

2.2.5 Minimum Borrow Amount

The minimum borrow amount defines the minimum amount of USP that can be borrowed in each position. Bad debts accumulate when the liquidation bonus from the position is less than the gas fees to be paid by liquidators, to be prevented by the minimum borrow amount. It is a configurable variable from protocol governance, and the initial value will be set to 200 USP.

2.2.6 Borrow Fee

A borrow fee will be incurred upon borrowing as a percentage of the borrowed amount configurable by protocol governance. This is initially set to 0%.

2.2.7 Liquidation Limit

The liquidation limit of collateral t of address a is a calculated value that defines the upper boundary of borrowed USP amount. Positions with borrowed USP amounts greater than this limit will be flagged as open to liquidation.

$$\text{Liquidation Limit}_{t,a} = \text{Collateral value}_{t,a} \times \text{Liquidation Threshold}_t$$

2.2.8 Health Factor

The health factor of collateral t of address a is the indicator of its collateralization level, calculated by the value of the borrowed USP and the liquidation limit of collateral. Users can use this to determine the risk of liquidation of a particular position. Health factors close to 1 are risky, and lower than 1 indicates the position can be liquidated.

$$\text{Health Factor}_{t,a} = \frac{\text{Liquidation Limit}_{t,a}}{\text{Borrowed USP amount}_{t,a}}$$

As described above, the liquidation limit is constantly re-evaluated based on the change of collateral value. USP value is assumed to be \$1 in all of the above calculations. Note that the borrowed USP amount includes the accrued stability fee overtime.

2.2.9 Stability Fee

An interest rate i would be incurred and added to the position debt if a USP borrowing position is open. It's termed stability fee. It is determined by the coverage ratio to incentivize pool balance in the stableswap:

$$i = \frac{r_{\text{USP}}^k}{100}, \text{ where } 1 \leq k \leq 10$$

where k is a parameter to be specified by protocol governance. It determines the sensitivity of the stability fee, which can be raised or dropped based on general risk assessments or any other factors.

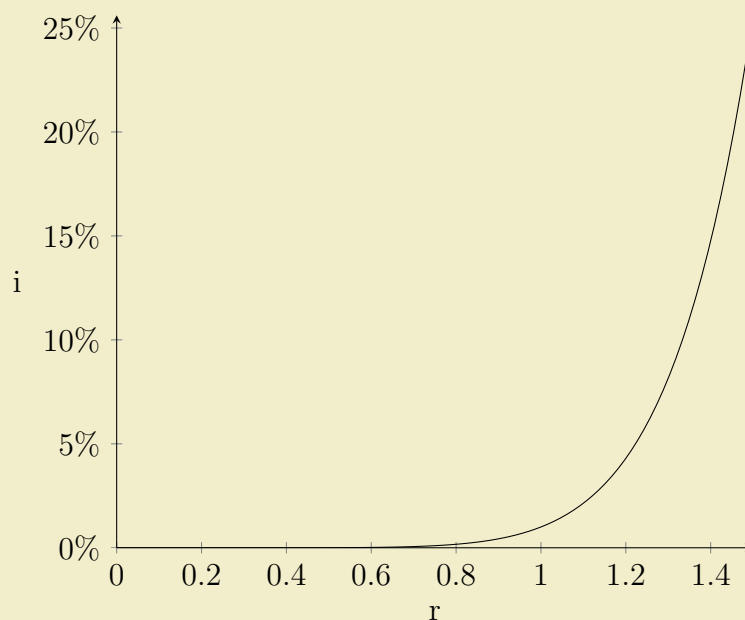
Recall that the coverage ratio of a token in a Platypus pool is its asset divided by liability. Assets are the tokens held in the contract, and liabilities are the number of tokens deposited by users. Although an increased coverage ratio from swaps indicates a lower default risk for the token, it implies the opposite for the other tokens. Thus a pool with imbalanced coverage ratios would suffer from the insolvency risk of its low coverage ratio tokens. Hence the slippage function employed in the Platypus stableswap encourages pool balance by incentivizing swaps that lead to a more balanced pool.

USP will be listed on the Platypus stableswap. i is a rising function with respect to the

coverage ratio r_{USP} , further incentivizing the balance of the pool and the peg of USP. This is illustrated in the below section "Adaptive Peg Stabilizer".

Suppose $k = 8$, we obtain the following curve:

Figure 1: Stability Fee Function



Note that $i = 1\%$ when $r = 1$ in all cases.

2.2.10 Other Parameters

Name	Definition
Kick Incentive	The amount of reward to kickstart the liquidation auction
Penalty	The proportion of repaid debt deducted from users to the system in liquidations
Buffer	Modification factor of starting price to extend liquidation period
Borrow cap	The upper boundary to borrowed USP for collateral to limit risk exposure

With the below constraints and specifications:

$$\text{Collateral Factor} \times (1 + \text{Penalty}) \times (1 + \text{Buffer}) < 1$$

This would ensure the collateral liquidation price reaches a discounted level under the liquidation auction model, thus ensuring the participation of liquidators.

$$\text{Kick Incentive} < \text{Penalty} \times \text{Minimum borrow amount}$$

This would reduce the system's likelihood of accruing a liquidation deficit. The minimum total penalty is determined by the minimum borrow amount.

$$\text{Penalty}_t \propto \text{Risk of Collateral}_t$$

The penalty can vary across different LP tokens based on their individual risk levels. The liquidation penalty for price-volatile and risky collaterals should be higher, as these pools may incur a higher withdrawal fee that needs to be covered by the liquidation penalty.

2.3 Borrowing

Users can borrow USP once they have staked any eligible LP tokens in the Platypus pool. Each position is backed by only one type of collateral. The user can borrow USP of an amount not more than the borrowing limit, and not less than the minimum borrow amount. Chainlink price oracle will be used to determine the price of the underlying token, which is assumed to be equal in value to the LP token collateralized.

The eligible list of LP tokens would be decided by governance based on the level of risks it exposes USP to.

The borrowed USP will be minted. A borrow fee will be deducted from the borrowed amount to be collected by the protocol after minting. For example, if 1000 USP is borrowed and the borrowing fee is 0.3%, 997 USP will be received by the user and 3 USP by the protocol.

Stability fees are accrued in real-time to the borrowed USP amount. Thus users should be aware that their health rate may drop over time when other factors stay constant.

Borrowing will be unavailable if any collateral stablecoins' price drops by more than 2% from its peg.

2.4 Repaying

Users can repay any debt positions at any time with USP. The repaid USP would be burnt immediately. If not all borrowed USPs are repaid, the position would still be open and accrue interest.

2.5 Withdrawing Collateral

Users can withdraw collateral, subject to the limitation that the health factor of the respective position is not less than 1. Effectively the required amount of collateral to maintain the health rate is locked in the pool.

2.6 Liquidation

Positions with a health rate lower than 1 would be open to liquidating the collateral at a discount to prevent under-collateralization and protocol insolvency. It takes the format of dutch auctions and can be filled partially. Portions of the liquidated collaterals would be

taken by the liquidator and the protocol, respectively. The liquidator will repay a percentage of the USP debt positions, which would be burnt immediately.

From a smart contract implementation perspective, a dutch auction would be held with the following steps:

1. Anyone can trigger a smart contract check of all position health rates. If health rates are below 1, the auction process would be kickstarted. The kickstarter will receive a reward to compensate for their incurred gas fees and efforts.
2. The contract asks the oracle for the price of the collateral and calculates the collateral value.
3. Calculate the auction Starting price by multiplying the collateral value by $(1 + \text{Buffer})$. If the buffer is 0, the auction Starting price would equal the collateral value.
4. Anyone can purchase the liquidated collaterals with the given auction starting price in USP, where USP is assumed to be at \$1. The maximum amount that can be purchased is equivalent to the USP debt owed. The liquidator can choose to buy only a portion of the collateral, in which its Purchased value = Starting price \times Portion bought.
5. When the collaterals are not purchased yet, the auction price drops at a set rate described by the function below. The Current price = Starting price \times Auction price factor.
6. When the collaterals are purchased partially, the liquidator pays the Current price $\times (1 + \text{Penalty})$ to receive the respective amount of collateral LP tokens. The penalty would be retained by the system and distributed to vePTP holders when fee sharing is active.
 - (a) If the debt amount reduces enough that health rates are now above 1, the auction will be terminated, and the user will be left with some positions.

- (b) If the health rate is still below 1, the auction will continue, and the price will continue to drop.
 - (c) If all USPs debts are repaid, the position will be closed .
7. Any outstanding collateral after liquidation is completed would be given back to the position owner.

2.6.1 Auction Model

The benefit of adopting this auction model is straightforward: Given a constant price of collateral and liquidator-set conditions, liquidators would purchase the liquidated collaterals at the highest acceptable price. This generates the least profit for liquidators (who tend to be bots and would still perform the liquidation action) and retains the most value for debt positions.

When the price of collateral drops quickly, the positions would initially be unfilled because the asking price plus the gas fee would be higher than the market price. They would likely be purchased when the stepwise asking price function is slightly higher than the actual price curve to ensure a slight profit after gas fees.

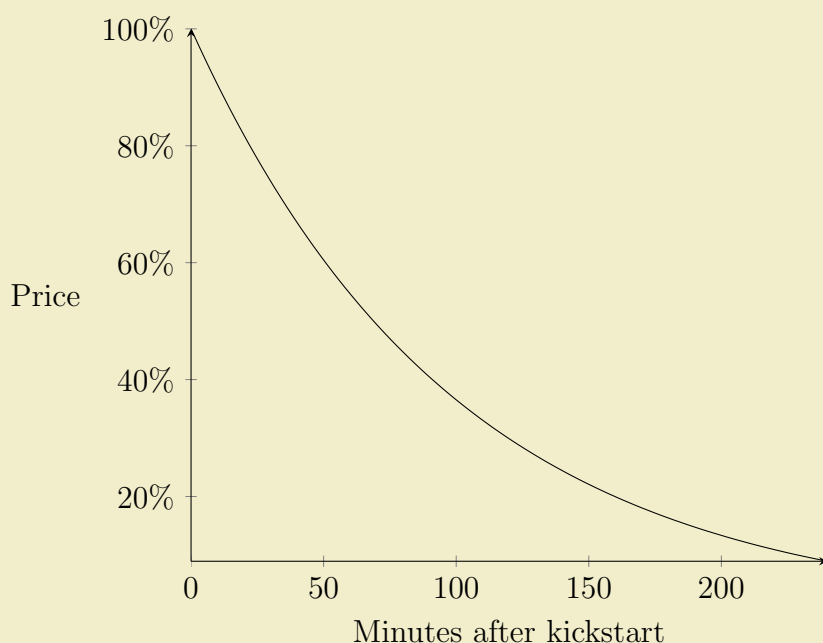
The liquidator would only need to purchase part of the amount of collateral. Liquidations will continue if the position health rate remains under 1 after the purchase.

There is an emergency liquidation pause configuration in protocol governance to pause liquidation during events, including but not limited to price oracle manipulation and smart contract failures.

2.6.2 Auction Price Function

To further illustrate the auction price drop, it is a stepwise exponential function with a configurable rate of decrease and steps, i.e., how much it drops and how often it drops. The minimum step is 1 second. The drop rate can be changed based on market conditions and governance procedures. Assuming the drop rate is 1% for every 60 seconds with no buffer, we would obtain the following auction price chart:

Figure 2: Liquidation Price Discount Function



2.7 Flash Loan

Flash loans for USP without collaterals can be undertaken as long as the transaction is executed in one block only. Withdrawal fees in the stableswap for LP tokens are removed in flash loans to prevent coverage ratio and price manipulation.

The cost of the flash loan is subject to governance and is set to 0.09% initially. The maximum USP loanable is 50 million USP.

3 Security and Sustainability

3.1 Peg Maintenance

Keeping the peg to the USD is our top priority when designing a stablecoin. We propose the peg of a stablecoin lies on the general confidence of its redeemability to the represented real-world asset. USP will adopt 4 ways to ensure such confidence at all times.

3.1.1 Main pool listing

USP will be listed on the Platypus stableswap main pool, alongside USDC and USDT variations, BUSD, and DAI. Users can easily swap from and to USP with other stablecoins at a rate close to 1.

This ensures the immediate redeemability of USP to other fiat-backed or overcollateralized stablecoins, building confidence to the representation of USD.

3.1.2 Adaptive Peg Stabilizer

As discussed in above sections, the stability fee balances the supply and demand to retain a stable exchange price. In details:

1. The coverage ratio of USP in main pool rises above 1 from swapping actions.
2. The price of USP decreases to slightly below \$1.
3. The stability fee to borrow USP increases from the stability fee function.
4. Users swap back from other stablecoins to USP to repay their more expensive loan.

5. USP assets in the main pool decreases.
6. Main pool USP coverage ratio decreases.
7. The price of USP rises back to \$1.

In reverse, when the coverage ratio is below 1 and price is above 1, users are incentivized to borrow a larger position and swap to other stablecoins. This mechanism is adaptive as the degree of imbalance of the price and coverage ratio is equivalent to a stronger incentive and pressure to the respective swapping direction.

3.1.3 Autonomous Coverage Optimizer

A portion of revenue in non-USP stablecoins will be automatically retained to the protocol to mint USP and supply to the main pool. The retention ratio defined in the Platypus AMM Technical Specification yellowpaper will determine this portion. There are several benefits of doing so:

1. Protocol-owned positions would not be withdrawn. This increases the "hard" coverage of USP and reduces the potential size of bank run in extreme situations.
2. Main pool liquidity increases with staked USP and other stablecoins. It optimizes the USP price by reducing fluctuations; As well as allowing larger trade volumes to accrue more fees.
3. By staking extra USP in the main pool, some PTP rewards will be retained by the protocol. This reduces inflation and benefits PTP price.

3.1.4 Public balance sheet

While the practical liquidity would be ensured by the above measures, it is more important if their information is transparent and easily accessible. Therefore the below balance sheet will be updated live on the frontend interface, where users will be able to examine the USP solvency. This instills confidence in users that directly contributes to peg stability.

Collateral	USP
User's LP token collateral	USPs backed by user's LP tokens
Platypus-owned collateral	USPs backed by Platypus

At all times, the total amount of assets should be larger or equal to the total amount of liabilities. A larger asset means the protocol is at surplus and can defend against bad debts and potential deficits from liquidations. Thus, users can gauge USP risks based on published values.

3.2 Protocol Revenue

The USP system generates revenue for Platypus through three mechanisms: USP stability fee, liquidation penalty, and additional swaps fees on stableswap. Uptrend markets increase collateralization, leverage and adoption of USP to increase stability fee revenues, in which the amounts are smaller but accrued more frequently. Downtrend markets lead to liquidations with a large amount of penalties. Swapping actions and the fees generated would be plenty in both cases. The Platypus protocol benefits either way.

3.3 Risk Management

Risks faced by the USP system and their respective mitigations are discussed below.

3.3.1 Collateral Risks

As all collateralized lending markets would face, the USP system is subject to collateral risks. This includes the case where a collateral price plummets so that liquidations cannot catch up and the point where a stablecoin depeg triggers mass sales from losing confidence.

For the first case, it is extremely unlikely, albeit not a zero probability, that a non-stablecoin collateral price would drop as fast as the auction price function and approaches 0. Price volatility of blue-chip large-cap cryptocurrencies like Bitcoin and Ethereum gradually decreases with growing confidence in the market of its long-term development. Thus unless a highly critical and foundational blockchain error is found, it is not expected to affect the USP system. Therefore, only relatively low volatility, high system safety, and battle-tested tokens should be chosen as potential collaterals.

As for stablecoins, the USP system inherits the protection mechanism of halting new borrows after a 2% deviation in stablecoin collateral price. This prevents using devalued stablecoins to mint USP worth 1 USD, leading to system insolvency.

3.3.2 Smart Contract Risks

All smart contract blockchain protocols bear the smart contract risk. The Platypus team has been consulting different smart contract auditors in the process of designing the system in the past and the future.