$f(x)$ Protocol 2.0: Delivering High Leverage and High Yielding Decentralized Stablecoins

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Abstract

$f(x)$ Protocol version 2.0 advances the groundbreaking mechanics introduced in its initial release, $f(x)$ Protocol v1.0. While maintaining the robust stablecoin design (fxUSD) from version 1.0, this upgrade significantly enhances the leveraged position feature (xPOSITION), offering high fixed-leverage trading without the risk of individual liquidations or funding fees. Additionally, version 2.0 introduces enhanced stability mechanisms, prioritizing a streamlined and intuitive user experience.

1 Introduction

Stablecoins are a cornerstone of decentralized finance (DeFi), facilitating fully on-chain swaps into and out of fiat-denominated assets and enabling the creation of a wide range of decentralized financial instruments. Given the volatility of cryptocurrencies, even the most crypto-native organizations and individuals must plan for expenses in fiat terms, necessitating the holding of fiat-denominated reserves. Despite their critical role, stablecoins have introduced significant risks and have been at the center of some of DeFi's most notable failures. Pure algorithmic stablecoins have collapsed so dramatically that their risks are self-evident. However, even current stablecoin models suffer from structural weaknesses that jeopardize their long-term viability.

In this document, we introduce f(x) Protocol version 2.0, which leverages an innovative mechanism to enhance the protocol's flagship stablecoin and leverage products: fxUSD, a hard-pegged stablecoin, and xPOSITION, a non-fungible, high-beta leveraged long position. The leveraged long position offers a powerful decentralized tool for on-chain high-leverage trading, while

the zero-volatility fxUSD provides a novel alternative to existing stablecoins. fxUSD eliminates centralized risk and scales efficiently, addressing the stablecoin trilemma in a way current solutions have yet to achieve.

2 Motivation for Evolution from v.1.0 to v.2.0

Since its inception, the original design of $f(x)$ Protocol has successfully demonstrated the innovative and secure application of the $f(x)$ invariant (see section 5) method to modulate token volatility. This groundbreaking approach enables the creation of both stablecoins and zero-funding, non-liquidating leveraged tokens.
The protocol has created demand for both the yield generated from reserve collateral (accrued to the stability pool), and the equity capture within the system via the non-liquidating leverage token, xTOKEN. While the original design of $f(x)$ Protocol has proven successful, achieving the ambitious goals of Aladdin DAO requires further optimization to ensure that leveraged positions appeal to both perpetual futures traders and long-term holders. For the protocol to scale, these positions must consistently offer sufficient and relatively predictable leverage against the value of reserve assets across all market conditions.
As such, outlined below are the components and mechanisms of version 2.0 of $f(x)$ Protocol. Together, they represent the next step in realizing the grand vision of $f(x)$ Protocol and Aladdin DAO.

3 Design Goals of $f(x)$ Protocol 2.0

$f(x)$ protocol is designed with the aim of creating a symbiotic system that decomposes a yield bearing token into two distinct yet complementary assets. Specifically, for xPOSITION, the protocol creates a leveraged long position on TOKEN with the following key features:

1. Provides up to 10X leverage
2. Is fully decentralized
3. Eliminates individual liquidation risk
4. Charges zero (0) funding fees under normal circumstances

For fxUSD, the goal is to produce a zero volatility token with these characteristics:

1. Is fully decentralized
2. Maintains a perfect peg
3. Is minted and redeemed instantly in direct response to the xPOSITION demand
4. Derives its liquidity from the backing asset (TOKEN)
5. Generates sustainable, on-chain yield

4 Decomposing a Yield Bearing Token using $f(x)$ Protocol 2.0

At genesis the $f(x)$ reserve will exclusively consist of Lido's liquid staked ETH (stETH). Supplying stETH allows a user to mint fxUSD and open xPOSITION, with quantities based on the price of stETH and the current net asset value (NAV). Conversely, users can redeem fxUSD and close xPOSITION for their NAV worth of stETH from the reserve at any time. As the stETH reserve generates ETH staking rewards, those rewards are harvested and primarily used to maintain system stability and generate protocol revenue.

5 The $f(x)$ Invariant

The NAV of fxUSD and xPOSITION fluctuates with the price of TOKEN, ensuring that the total value of all fxUSD combined with the total value of all xPOSITIONs always equals the total value of the TOKEN reserve. This guarantees that every fxUSD and xPOSITION is fully backed and redeemable for its NAV at any time. Put mathematically, at all times the invariant will hold:

$$ns = n_f f + n_x x \tag{1}$$

Where n is the number of TOKEN collateral, s is the TOKEN price is USD, n_f is the number of fxUSD, f is the fxUSD NAV in USD, n_x is the number of xPOSITION units, and x represents the NAV of xPOSITION in USD.

The protocol dampens the volatility of fxUSD by adjusting its NAV in response to fluctuations in TOKEN price so that 0% ($\beta_{\mathrm{f}} = 0$) of the TOKEN price change is reflected in fxUSD. Simultaneously, the protocol adjusts the NAV of xPOSITION by a factor greater than the change in TOKEN price

to satisfy the $f(x)$ invariant (equation 1). This results in xPOSITION providing leveraged returns on TOKEN, while fxUSD exhibits zero volatility, while maintaining full decentralization. The association of an fxUSD and an xPOSITION is referred to as a stable-leverage position.

6 Main functions of $f(x)$ Protocol 2.0

6.1 Minting and Redeeming fxUSD and Opening and Closing of xPOSITION

To facilitate higher leverage, the opening of xPOSITION must be accompanied by the minting of fxUSD at a ratio determined by the target leverage for that specific pair. At any target leverage, for every unit of xPOSITION opened, a proportional amount of fxUSD must also be minted to maintain system stability. For instance, let's assume TOKEN price is $2,000. If a user wishes to open a $200 xPOSITION at a leverage of 10x, the protocol requires that $1,800 worth of fxUSD is also minted simultaneously, such that the total collateralization aligns with the desired leverage.
The closing of an xPOSITION must be done with fxUSD at the real-time fxUSD:xPOSITION ratio at the time of redemption.
When a user opens an xPOSITION, the process will be seamlessly facilitated by leveraging a flash loan. This occurs through an atomic transaction, ensuring that all steps are completed successfully or the entire transaction is reverted, maintaining the integrity of both the user's funds and the system.

6.2 Rebalance Operations

The leverage of an xPOSITION fluctuates as the price of the underlying collateral changes or when the position is adjusted through top-ups or reductions. To manage risks effectively, the protocol incorporates a Rebalance mechanism that ensures the leverage levels remain within safe and sustainable limits. When the leverage of an xPOSITION reaches a predefined threshold, the protocol automatically triggers a Rebalance operation to return the leverage back to the rebalance line. This operation involves redeeming a portion of the fxUSD to adjust the leverage back to the rebalance line (See section 6.5). By doing so, the protocol ensures that the leverage remains within the specified parameters, thereby:

1. Enhancing system stability by implementing proactive adjustments to prevent liquidation events.

2. Optimizing the rebalance efficiency and minimizing the costs for xPOSITION holders, by limiting the amount of collateral involved in each rebalance operation. This ensures that the bounty fee associated with fxUSD rebalancing remains as low as possible, thereby limiting the impact on users.

3. Acting as a liquidation brake, reducing collateral drawdown during market downturns and allowing users to retain more upside potential when markets rebound.

6.3 Liquidation Mechanism

In the event that a Rebalance operation fails to maintain the rebalance line, and the leverage of xPOSITION continues to increase beyond the specified threshold, the protocol will trigger a liquidation process. Once the xPOSITION leverage reaches the liquidation line, the system initiates a procedure to redeem all the fxUSD associated with the liquidated xPOSITION. This action is taken to preserve the fxUSD peg and maintain the stability of the system. Consequently, the value of the liquidated xPOSITION is reduced to zero (See sction 7.4).

6.4 Stability Pool

The Stability Pool is a key component of $f(x)$ Protocol, designed to provide both stability and yield opportunities for participants. Users can deposit fxUSD and/or USDC into the Stability Pool to earn TOKEN yield and perpetual trading commissions during normal market conditions.
The Stability Pool also functions as a peg stabilizer for the fxUSD/USDC AMM pool. USDC held in the Stability Pool will be exchanged for fxUSD from the AMM when favorable exchange conditions arise, allowing USDC to be swapped for a greater amount of fxUSD. Conversely, fxUSD will be swapped for USDC when it can secure a higher amount of USDC from the AMM. This mechanism ensures efficient balancing and maintains fxUSD's peg.
USDC deposits into the Stability Pool are conducted at the Chainlink oracle price to ensure accurate valuations. In the event of a USDC depeg, deposit and peg keeping (swapping fxUSD for USDC) functionalities will be temporarily disabled to safeguard users and uphold system integrity.

6.5 Rebalance and Liquidation Protocol Procedures

During Rebalance or Liquidation Operations, fxUSD is first redeemed from the Stability Pool and the underlying TOKEN is swapped for USDC. If the Stability Pool lacks sufficient fxUSD to fulfill redemption requirements, the protocol will liquidate a portion of the underlying TOKEN to acquire USDC and/or fxUSD. The proceeds are then utilized to cover the outstanding fxUSD obligations. Subsequently, the USDC is utilized to repurchase fxUSD at a ratio not exceeding 1:1. This repurchase can be executed either synchronously or asynchronously, depending on market conditions and protocol requirements. This mechanism ensures that the required liquidity is maintained, and the stability of the fxUSD peg is preserved.

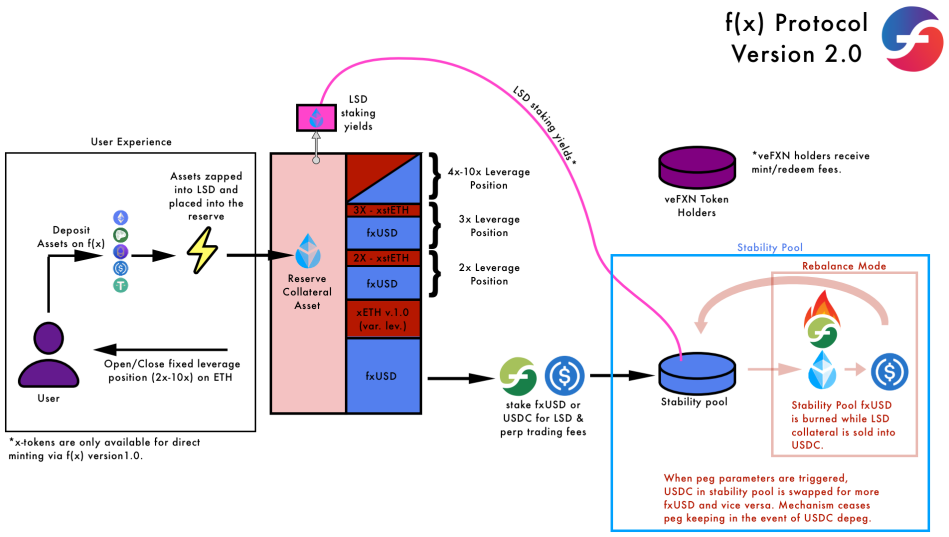

Figure 1: Main Functions of $f(x)$ Protocol 2.0

7 Risk Management

The assessment of system risks can be approached from several critical perspectives:

- *xPOSITION Leverage*: The ratio of collateral value to xPOSITION size.

- *Outstanding fxUSD Debt Percentage*: Percentage of outstanding fxUSD debt compared to collateral.
- *Collateralization Ratio*: The ratio of collateral value to outstanding fxUSD debt

The following equations illustrate the relationships between the critical parameters in the system:

$$l_t = \frac{n_t s_t}{n_{\mathrm{x,t}} \chi_t} \tag{2}$$

$$\mathrm{CR_t} = \frac{n_t s_t}{n_{\mathrm{f,t}}} = \frac{n_t s_t}{n_t s_t - n_{\mathrm{x,t}} x_t} = \frac{l_t}{l_t - 1} \tag{3}$$

$$\rho_t = \frac{n_{\mathrm{f,t}}}{n_t s_t} = \frac{l_t - 1}{l_t} \tag{4}$$

Where l is the Leverage, t is the time of the transaction, n is the number of TOKEN collateral, s is the TOKEN price is USD, n_x is the number of units for xPOSITION, n_f is the number of fxUSD, f is fxUSD NAV in USD, and x is xPOSITION NAV in USD.

Numerical relationships between xPOSITION leverage, collateralization ratio and percent of fxUSD of the entire collateral

L	**CR**	ρ
2	200.00%	50.00%
3	150.00%	66.67%
4	133.33%	75.00%
5	125.00%	80.00%
6	120.00%	83.33%
7	116.67%	85.71%
8	114.29%	87.50%
9	112.50%	88.89%
10	111.11%	90.00%
11	110.00%	90.91%
12	109.09%	91.67%
13	108.33%	92.31%
14	107.69%	92.86%
15	107.14%	93.33%
16	106.67%	93.75%
17	106.25%	94.12%
18	105.88%	94.44%
19	105.56%	94.74%

Table 1: Leverage (L), Collateralization Ratio (CR), and Percentage (ρ)

7.1 Risk Management Framework

In the $f(x)$ Protocol v2.0 design, the xPOSITION leverage ratio is a crucial parameter that is continuously monitored and managed to ensure system stability. The leverage ratio can be defined in several contexts:

- *Target xPOSITION Leverage* (L_0): The user-defined leverage ratio, ranging between 2X-10X
- *Real-Time xPOSITION Leverage (L_R)*: The current leverage ratio, which fluctuates based on market conditions and system activities.
- *Rebalance xPOSITION Leverage (L_{RR})*: The threshold at which a Rebalance operation is triggered to restore the leverage to the rebalance line.

$$L_R \geq L_{\text{RR}} \implies TriggerRebalance \tag{5}$$

- *Liquidation xPOSITION Leverage (L_L)*: The critical leverage ratio at which the system initiates liquidation to protect fxUSD's peg and ensure system stability.

$$L_R \geq L_L \Longrightarrow TriggerLiquidation \tag{6}$$

7.2 Events Affecting Real-Time xPOSITION Leverage (L_R)

- *Changes in TOKEN Price*: Fluctuations in the price of the underlying collateral directly impacts the leverage ratio.
- *Changes in the xPOSITION*: Opening more or partially closing xPOSITION alters the leverage ratio.

7.3 Rebalance and Liquidation Triggers

- When the real-time xPOSITION leverage (L_R) reaches the rebalance threshold (L_{RR}), a rebalance operation is triggered to adjust it back to the rebalance line (L_{RR}).
- If the real-time xPOSITION leverage (L_R) continues to increase and reaches the liquidation threshold (L_L), the system initiates liquidation. This process redeems all fxUSD associated with the liquidated xPOSITION, effectively closing the position.

7.4 Risk Management Parameters

To maintain the stability of the system, specific risk management parameters are established: the Rebalance threshold and Liquidation threshold. Both are carefully calibrated to trigger corrective actions when the probability of xPOSITION's value dropping to zero in the near term exceeds a predefined limit.

Our Value at Risk (VaR) methodology applies across various assets, with each asset's volatility and liquidity considered. For example, based on our calculations for ETH, a 7.5% decline in the price of TOKEN has a 0.0001% probability of occurring within a span of 5 blocks. To mitigate the effects of such market volatility, the maximum leverage for xPOSITION is calibrated to provide adequate protection against these events. The time period for this calculation is selected based on the estimated duration required for the protocol's risk management mechanisms to respond effectively and mitigate risks posed by market fluctuations.

In summary, if the leverage of xPOSITION exceeds the rebalance threshold,

it is essential to reduce it back to the rebalance line. Should liquidation occurs, the remaining collateral will be used to redeem fxUSD, with market participants incentivized with an auction discount, regardless of whether fxUSD is redeemed from the Stability Pool or purchased via an AMM, triggering the liquidation of the xPOSITION.

7.5 Reserve Fund

The Reserve Fund is designed to strengthen $f(x)$ Protocol's resilience against potential failures of the Rebalance and Liquidation mechanisms. To further bolster the protocol's stability and ensure robustness in adverse scenarios, a portion of the protocol's fees and revenue (see Section 10) will be allocated to the Reserve Fund. The specific allocation percentage for this fund will be determined by governance.

7.6 Bad Debt Redistribution

In the event that the Reserve Fund is insufficient to cover losses, the undercollateralized debt will be proportionally distributed across all active xPOSITIONs.

7.7 Recapitalization

If the protocol's total collateralization ratio falls below 100%, a recapitalization process will be initiated. During this time, no new xPOSITIONs can be opened, and existing xPOSITIONs can only be closed. The protocol will deploy all available resources, including treasury assets and governance tokens, to restore fxUSD's peg.

8 Advanced Peg Protection Mechanisms

$f(x)$ Protocol utilizes a range of mechanisms to maintain a stable and reliable peg for fxUSD at all times. These systems are designed to ensure stability, mitigate volatility, and uphold the integrity of the stablecoin under all market conditions.

8.1 Stability Pool as Peg Keeper

The Stability Pool acts as a peg keeper for the fxUSD/USDC AMM pool. USDC held in the Stability Pool will be utilized to purchase fxUSD from the AMM when favorable exchange conditions allow for acquiring more fxUSD.

Conversely, fxUSD will be exchanged for USDC when it can be traded for a greater amount of USDC from the AMM.

8.2 Operational Restrictions During Depegging

If fxUSD depegs, no new xPOSITION can be opened, preventing the minting of additional fxUSD until the peg is restored. Restoration can occur by either closing existing xPOSITION or depositing more fxUSD from the AMM pool to the Stability Pool.

8.3 xPOSITION Funding Fee

In the event of an fxUSD depeg, each xPOSITION will incur a funding fee equivalent to the USDC money-market funding rate for the duration of the depeg. 100% of these fees will be directed to the Stability Pool to enhance yields and attract additional fxUSD deposits.

8.4 Redemption of fxUSD

If fxUSD falls below $1.00, users can acquire fxUSD from the secondary market, initiating a redemption for $1.00 worth of TOKEN from the collateral in the system and is subject to a redemption fee. Redemptions are prioritized by the highest leveraged positions first, proceeding in descending order through successive leverage levels. For each cycle, only 20% of the outstanding fxUSD debt from these positions is available for redemption. This process continues across all leverage levels until the peg is restored.

9 Band System

All collateral positions are placed into a band system based on their rebalance lines. Each band encompasses a specific price range, with the upper limit set at 0.15% above the lower limit. This band system enhances the efficiency of rebalancing and redemption transactions by consolidating all positions within the same band into a single transaction.

9.1 Rebalance Operations

For rebalance operations, all xPOSITIONs within a band can be triggered when the current price of TOKEN falls below the upper limit of that band's price range.

9.2 fxUSD Redemption

During the redemption of fxUSD, the process will start with the bands that have the highest leverage.

9.3 Position Adjustments

Collateral xPOSITIONs will be reorganized into new bands whenever their leverage is adjusted due to rebalance, redemption, user-initiated changes to the xPOSITION, redistribution of bad debt, or the accumulation of funding fees.

10 Fees and Revenue

$f(x)$ Protocol v2.0 will charge fees and earn revenue from:

- *TOKEN Yields from Collateral*: The protocol will earn yields from the entire collateral held, providing a continuous revenue stream.
- *Redeeming Fees for fxUSD*: Fees will be applied when fxUSD is redeemed on a single-sided basis. The redeeming fee effectively sets the minimum peg defended by the system.
- *Opening and Closing Fees for xPOSITION*: A fee will be applied when opening or closing an xPOSITION, calculated based on the total value of the xPOSITION.
- *Rebalance Fees for xPOSITION*: The protocol will charge fees for the rebalance operations of xTOKEN which will be solely offered as an auction discount for market keepers.
- *Liquidation Fees for xPOSITION*: The protocol will charge fees for the liquidation operations of xTOKEN which will be solely offered as an auction discount for market keepers.
- *Funding Fees for Holding xPOSITION*: When fxUSD is depegged, users that have an open xPOSITION will incur a funding fee. This fee will be calculated based on the money-market's USDC interest rate multiplied by a factor, which is initially set to 1 but can be adjusted via governance.

All fees generated will be distributable to the stability pool and/or the $f(x)$ treasury. The percentage of distribution between the stability pool

and/or the treasury will be managed by governance. Additionally, 75% of the revenue allocated to the $f(x)$ treasury will be distributed to veFXN holders.

11 Conclusion

AladdinDAO has successfully upgraded $f(x)$ Protocol to version 2.0, introducing essential enhancements that expand its functionality. This new version significantly improves user access to leverage through the introduction of xPOSITION, a novel DeFi primitive that allows users to engage in fixed leverage trading with zero funding costs and no individual liquidation risk. These groundbreaking features provide an appealing option for users seeking leveraged exposure to assets such as ETH, BTC, and other blue-chip tokens in the DeFi ecosystem.

In addition, version 2.0 maintains the protocol's original stablecoin framework, with USD-based, delta-neutral stability pools that offer users perpetual trading income and collateral yield. As the protocol continues to evolve, its decentralized and composable architecture will be crucial in addressing the growing demand for leveraged exposure and high-yield stablecoin strategies, positioning $f(x)$ Protocol for massive growth within the DeFi space.