Stake Exchange: The Liquid Staking AMM

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Abstract

Stake Exchange (STEX) is a novel Automated Market Maker (AMM) designed specifically for withdrawable liquid derivatives such as Liquid Staking Tokens (LSTs). Traditional stable swap pools suffer from LVU (Loss vs. Unstaking) where Liquidity Providers (LPs) sell LSTs at a discount, receiving less underlying token than they would earn from unstaking and waiting for the unbonding period.

STEX AMM prevents LPs from selling LSTs below their true peg by interfacing with the native withdrawal mechanism of a Liquid Staking Protocol (LSP). Through a modular architecture that separates withdrawal logic, fee pricing, lending protocol integrations, and core trading functions, STEX AMM is adaptable across any Liquid Derivatives Protocol where withdrawals are enabled.

1 Introduction

Smart-contracts have enabled a new class of token derivatives which can be automatically redeemed for their underlying tokens at face value: Liquid Staking Tokens (LSTs) being a premier example. Traditional AMMs fail to recognize this innovation and typically trade LSTs below their true peg by relying solely on secondary-market reserves and demand. Moreover, LPs for LST on AMMs forgo profits by allowing secondary-market depegs.

Stake Exchange solves this problem by integrating directly with the LST's native withdrawal mechanism. When there are not enough secondary-market buyers for the LST token, the AMM redeems its LST reserves into the Native Token at face value using an LSP's native withdrawal mechanism, removing depeg arbitrages. Furthermore, reserves of the native token in STEX AMM can be lent out on external markets in order to earn extra yield, and withdrawn back to the pool at swap time or during LP withdrawals.

Increasing yield for AMM LPs creates deep liquidity to absorb secondary market sells of an LST. STEX creates a more harmonious relationship between LSPs and their secondary-market liquidity venues.

2 Background

Stake Exchange is built on the Valantis Protocol in collaboration with Thunderhead.
Valantis is a modular Decentralized Exchange.
Thunderhead is a Liquid Staking Solution.
STEX AMM is built as a Valantis Sovereign Pool[1]

3 Pricing Modules

The Liquidity Module enforces trading according to the LST's face value using an Exchange Rate Adapter: a custom module that calls an LSP's native contracts to determine the current peg. Pool exchange rates automatically adjust to reflect slashing events and yield accrual whenever said information is available natively to the integrated LSP, supporting both rebase and reward tokens.

The Swap Fee Module determines the fee logic individually for each swap direction. Native Token swaps incur no fee, matching the rate of an LSP's native 'stake()' functions. LST 'instant withdrawals' incur a non-zero fee that generates yield for Liquidity Providers. This fee logic is interchangeable without disrupting other core mechanics.

4 Withdrawal Module

The Withdrawal Module defines two key functions (1) when LST reserves are sent for withdrawal and (2) how native token reserves earn yield on external markets.

This module includes a custom integration with an LSP's withdrawal functions and external yield markets like lending/borrowing protocols. Native token deposited into external markets are always made available at swap time. Triggering LST withdrawals can occur instantaneously at swap time or can be periodically triggered.

Periodically triggering LST withdrawals allows LST reserves to accumulate in the pool, so that secondary-market swaps can refresh the pool's Native Token liquidity faster than illiquid withdrawal

processing. Conversely, triggering native withdrawals at swap time ensures the fastest "rebalancing" in the complete absence of secondary-market buyers.

Withdrawal strategies should be optimized for different staking implementations. For example, validator exits on Ethereum L1 can face congestion and extended wait times [2]. Furthermor LSPs like Lido are only able to settle withdrawals at regular intervals [3]. In these cases, flexible withdrawal strategies can manage prolonged illiquidity risk and mediate withdrawal queue pressure.

5 Ratio of Reserves Swap Fee

The first implementation of STEX AMM uses a dynamic "Ratio Fee" for LST to Native Token swaps. The fee increases when the ratio between LST reserves and Native Token reserves increases beyond a threshold- compensating LPs for increased exposure to the LST. Fees naturally are lowered as native withdrawals are processed.

$$\texttt{ratio} = \frac{R_{\texttt{LST}} + R_{\texttt{Pending}} + \texttt{amountIn}}{R_{\texttt{Native}} + R_{\texttt{Lending}}}$$

Numerator "liquid derivative reserves" includes:

- LST reserves in the pool ($R_{\texttt{LST}}$).
- LST reserves pending in the LSP's withdrawal queue ($R_{\texttt{Pending}}$).
- LST added by the user's swap (`amountIn`).

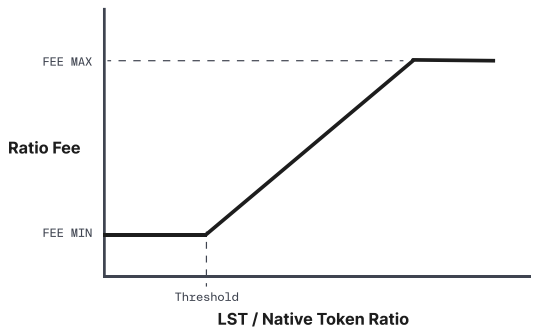
Denominator "native token reserves" includes:

- native token reserves in the pool ($R_{\texttt{Native}}$).
- native token in an external yield strategy ($R_{\texttt{Lending}}$).

$$\texttt{r} = \begin{cases} 0 & \text{if } \texttt{ratio} < \texttt{Threshold} \\ \texttt{ratio} & \text{if } \texttt{ratio} \geq \texttt{Threshold} \end{cases}$$

$$\texttt{fee} = \texttt{FEE\_MIN} + \texttt{r} \times (\texttt{FEE\_MAX} - \texttt{FEE\_MIN})$$

$$\texttt{FEE\_MIN} \leq \text{fee} \leq \texttt{FEE\_MAX}$$



6 LP Positions

Liquidity Provider Positions are a tokenized fungible representation of the pool's reserves denominated in: Native Token, Liquid Staking Token, external yield positions, and Pending Withdrawals. Deposit are only in the Native Token. Fees, LST yield, and external market yield accumulates directly into an LPs share of the pool. When a Liquidity Provider burns their LP token balance, they are given the option to take their claim 100% and instantly in the Native Token, paying the fee to convert their LST shares, or to withdraw their liquid proportion of Native Token immediately and wait for their LST's share to mature at their face value.

Exiting Liquidity Providers who wait for maturity have their illiquid share entered into a FIFO LP Withdrawal Queue.

7 stHYPE AMM

STEX AMM's first implementation is the stHYPE AMM on Hyperliquid's HyperEVM. stHYPE AMM uses a custom Withdrawal Module integrated with the Thunderhead' Overseer contract for native stHYPE withdrawals [4]. stHYPE AMM is also integrated with Hyperlend[5] to lend out HYPE reserves for extra yield. An off-chain keeper refreshes pool reserves periodically in the absence of new stakers and manages the fraction of native token reserves deposited in the lending protocol. stHYPE AMM is deployed with the Ratio Fee Swap Fee Module, upgradable under a time-lock delay.

The stHYPE Overseer contract from Thunderhead features a native integration with stHYPE AMM, prioritizing that stHYPE AMM LPs are refreshed with incoming deposits before allocating stake to new validators.

References

[1] Valantis Sovereign Pool and Modules

[2] Just How Fast Are Ethereum Withdrawals Using the Lido Protocol?

[3] Lido Accounting Oracle

[4] Thunderhead Withdrawals

[5] Hyperlend docs