stETH Volatility Vault (stETHvv): A Principal-Protected Strategy Utilizing Derivatives

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1 Context

This whitepaper aims to provide an overview of the of stETHvv. stETHvv is a principal-protected strategy that utilizes derivatives to allow users to benefit from the volatility of ETH. The strategy can benefit users regardless of the direction of the market movements. It uses a hybrid on-chain/off-chain approach. The principal part of the investment remains on-chain, and the yield used to buy the derivative structure can be used off-chain or in different chains.

2 Assumptions

The stETHvv assumes that the ETH price is highly volatile and will continue to be volatile. Therefore, the product creates a derivative structure to benefit users from ETH's volatility. The direction of the market movements does not matter as the strategy can benefit both when the asset price goes up and when it goes down. The strategy also assumes that Lido is a reputable source of a base yield on ETH. Find more about Lido.

3 The Structure

stETHvv has two main components: a yield source and a derivative structure.

3.1 The Yield Source

Currently, the Vault can only receive deposits in stETH (ETH deposits are coming soon). stETH is an interest-bearing token representing Ethereum 2 staking rewards within Lidos liquid staking implementation. stETH tokens generate returns daily. Those returns compound every week.

3.2 The Derivative Structure

The Vault applies a principal-protected strategy using derivatives. Being a principal-protected strategy, it will never apply market risk to the principal. This means the derivative strategy only uses the yield accrued within the Vault to set up the structure - never the principal. The strategy accumulated the daily yield from Lido stETH over a week, and every Friday, it separates 50% of the accrued yield to buy the derivative structure. The derivative structure comprises buying calls and puts, ranging from 10% to 20% OTM with weekly maturities. This structure is also known as a strangle.

4 The Scenarios

- If the ETH price moves up considerably, the call option may enter in-the-money and return more than the yield used to purchase it.
- If the ETH price crashes, the put option may enter in-the-money, returning more than the yield used to purchase it.
- If there were not enough volatility, the Vault would only lose 50% of the yield generated by Lido that week.

This way we can preserve the principal deposited and let it grow with Lido, risking only part of the yield to assemble the strangle strategy.

5 The Users

This strategy is perfect for those that hold ETH, believe ETH will continue to be a volatile asset and want to accumulate more ETH over time with controlled risks.

6 System Actors

The stETHvv system involves six main actors, each with a specific role in the system's functionality:

1. Depositors
2. Yield Source
3. Investor
4. Vault Controller
5. Round Processor
6. Vault

Let's take a closer look at each actor and their responsibilities:

6.1 Depositors

Depositors are the users who deposit stETH (and soon ETH) into stETHvv. They can be either an EOA (Externed Owned Account) or a contract. Depositors will later be able to withdraw their funds alongside their earnings.

6.2 Yield Source

The Yield Source is the source of the base yield for this strategy. In the case of stETHvv, the yield source is Lido.

6.3 Investor

The Investor EOA (or Multisig) is responsible for buying the put and call options and setting the strangle strategy weekly. The Investor wallet receives part of the weekly yield from the Yield Source, which we call the Investor Ratio (currently set at 50%), and buys the options manually. In case the options bought end in-the-money, the profit from the exercised options stays in this wallet and later is sent back to the vault so that they are redeposited into the Yield Source, respecting users' shares proportionately.

Note: Currently this part of the process is centralized and could even be held off-chain. We intend to automate the option purchases as we see more liquid options available. As of now holding the options purchases on-chain would represent a much worse execution, impacting the strategy's profitability significantly.

Admin keys only have access to the 50% of the weekly yield, usually, this represents less than 1% of the TVL.

6.4 Vault Controller

The `VaultController` is a Multisig responsible for calling the `startRound` and `endRound` functions round. He can also act as a Depositor and as a `RoundProcessor`.

6.5 Vault

A Vault is a smart contract that connects all the players to make the strategy work. The Vault:

- Receives funds from depositors.
- Calculates the generated interest in the week.
- Creates shares for the depositors.
- Receives the profit from exercised options.
- Sends part of the yield to the investor's address.

6.6 Round Processor

The role of this actor is to process the queued deposits after the `endRound` function was called and before the `startRound` was called, meaning only when the flag `isProcessingDeposits` true.

In our internal process, the actor `VaultController` will also be responsible for processing the deposits of the week to create a smoother user experience. However, it is essential to highlight that any address could process its own or other deposits, which means that this step does not rely on the `VaultController` itself.

7 System Workflow

stETHvv is composed of rounds, and three main events/periods are essential to understanding the system's workflow: the `StartRound`, `EndRound`, and Deposits Processing Window. Each period triggers specific functions, which we will cover in this section.

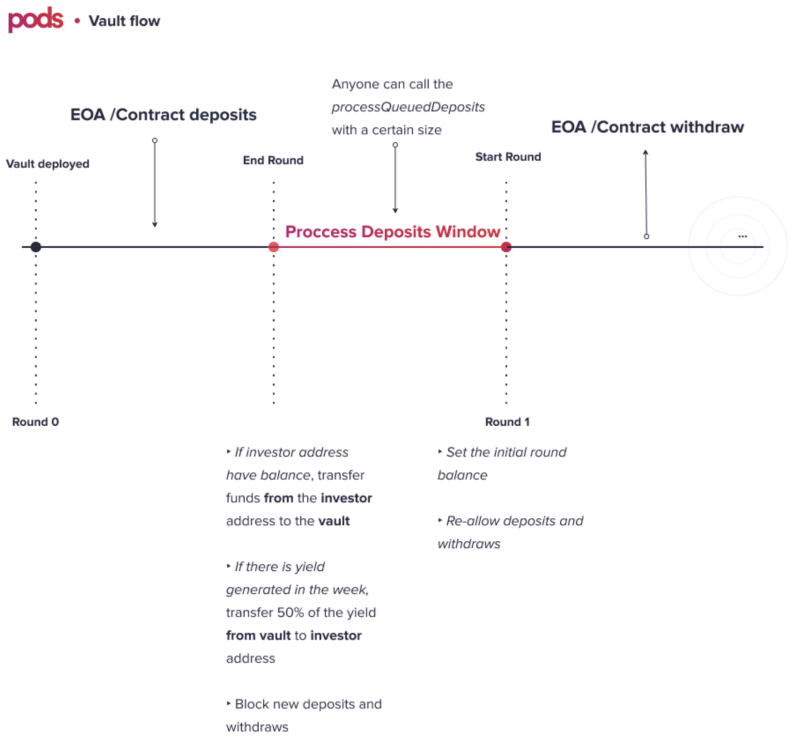

Figure 1: workflow example

Deposits and withdrawals occur when the flag `isProcessingDeposits` is set

to false. If an address wishes to withdraw before their shares are processed, they can use the function `withdrawFromTheQueue`, which removes their address from the queue and returns their funds to them.

7.1 Start Round

The Start Round moment triggers the following events:

- The allowance of new deposits into the vault.
- The processing of deposits is no longer allowed.
- The allowance of withdrawals from the vault.
- It also sets the `lastRoundAssets` variable that will be used to calculate the total yield generated during the round period.
- The creation of the vault sets the start of the rounds system, known as moment zero or round zero.

7.2 End Round

The `EndRound` defines the moment where:

- Deposits and withdrawals are blocked until the start of the next round.
- Any premium won from exercised options is moved from the Investor Wallet to the Vault.
- The weekly yield is calculated based on the `lastRoundAssets` variable and the current balance.
- Part of the yield (Investor Ratio) is transferred to the Investor's wallet, which will be used to buy new options.

7.3 Deposits Processing Window

As the name suggests, all the funds deposited from the Start to the `EndRound` are processed during this window between the end of the current round and the start of the next round. During this period:

- Newly deposited funds are moved from the vault to the Yield Source (in this case, Lido Finance).

8 Risks

Investing in any asset or strategy comes with risks, both in TradiFi and in DeFi. In this section, we analyze and classify different sources of risk that may impact funds allocated in our vault. Currently, funds invested in our protocol have exposure to at least three different protocols: Pods Vault, Lido, and Ethereum Mainnet. Each exposure has different probabilities of an event happening, and if they do occur, they will impact the vault with different intensities. The following sections will explain how we analyze each exposure, attribute the likelihood of events, and score the impacts of potential events.

8.1 Market Risks

1. Opportunity cost on stETH return in case none of the options end ITM: This strategy takes 50% of Lido's weekly return and invests in a strangle. In the worst-case scenario where none of the options that we buy are profitable, you end up losing 50% of the yield.

2. Compared to holding ETH: Currently, there is no direct way to unstake your staked ETH. This feature will only be available after the Shanghai upgrade, planned to be in 2023-Q2. So, if you want to exit your position earlier, you will be exposed to stETH price on the secondary market. Depending on the staked version you are using, you will be exposed to the size of the liquidity, the trading venue, etc. That is one of the reasons why we picked Lido. We see them as the lower market risk to exit a position earlier in case the user wants.

3. stETH de-peg: In 2022, much was said about a wider de-pegging event on the ETH-stETH pair. According to Lido, stETH should not be considered to be pegged to ETH in any way. On the other hand, it is important to remember that stETH could enter a spiral selling situation if stETH price diverges too much from ETH.

8.2 Smart Contracts Risks

1. Compared with having exposure only to Lido or other staking services: You will add on top of your staking services contracts, the risks of Pods Smart Contracts risk. In our smart contracts, we made some architectural decisions to reduce a lot of our smart contract risks:

    - The Admin/Multisig does not have access to the principal.
    - The Admin/Multisig cannot stop withdrawals.
    - The contracts are not upgradeable (no malicious upgradability can happen).
    - You can leave the position at any point in time.

- The Multisig/Admin only has access to the weekly yield. This represents less than 1
- The Pods Vault itself is not exposed to Oracle Risks.

2. Compared with holding ETH: Apart from our contracts, we interact with the Yield Source contract (Lido). Lido has three pillars that bring security to the system: Heavy investment in audits, battle-tested TVL, and a good bug bounty. An issue in the smart contracts from Lido that affects liquidity in secondary markets could indirectly impact our users. This issue is because users would be holding stETH, and stETH could run low on market liquidity.

9 Appendix

9.1 Numeric example

9.1.1 Round 0: Vault Creation

9.1.2 Round 0: Start Round

The Vault is created, and in Round 0, the following happens:

- User A: deposits 100 stETH
- User B: deposits 200 stETH
- User C: deposits 300 stETH

9.1.3 Round 0: End Round

As Round 0 is the very first round, no yield was accrued. With the `EndRound`, the deposits and withdrawals are paused.

9.1.4 Round 0: Deposits Processing Window

After the `endRound`, the deposits from users A, B, and C are processed, and their shares are created according to the following function:

newShares = amountDeposited $\times \frac{totalSupply}{totalAssets}$

As User A was the first one to deposit into the vault, he is the one that sets the starting number of `totalSupply` and `totalAssets` of the vault, where:

sharesA = amountDeposited = totalSupply = totalAssets sharesA=amountDeposited=totalSupply=totalAs

Considering this, the amount of shares each user gets is:

- `sharesA`: $100 \times \frac{100}{100} = 100$ shares
- `sharesB`: $200 \times \frac{100}{100} = 200$ shares
- `sharesC`: $300 \times \frac{300}{300} = 300$ shares

9.2 Round 1

9.2.1 Round 1: Start Round

At the start of Round 1:

- New deposits and withdrawals are re-enabled;
- The processed deposits (600 stETH) are moved from the vault to the Yield Source, in this case, Lido Finance; and
- The initial position is set: 100 (user A) + 200 (user B) + 300 (user C) = 600.

Right after the deposits are allowed again, a new deposit is made into stETHvv:

- User D: deposits 100 stETH

9.3 Round 1: End Round

Considering that 600 stETH remained idle in the contract, and 4.2 stETH was generated in interest (considering a 0.7% weekly yield on stETH). From this 4.2 ETH, we will take 50% (2.1 ETH) of that and transfer it to the Investor Wallet.

The 2.1 ETH transferred to the Investor Wallet is used to pay for the premium of buying the put and call options, setting up the strangle strategy for the next week.

9.4 Round 1: Deposits Processing Window

The deposit window is very short, and it shouldn't take more than an hour.

- User D's deposit is processed;
- User D's shares are created:
  1. amount = 100 stETH
  2. `totalSupply` = 600 shares
  3. `totalAssets` = 600 stETH + 4.2 stETH (interest) - 2.1 stETH (yield sent to Investor Wallet) = 602.1 stETH
  4. `sharesD` = $100 \times 600/602.1 = 99.65$ shares

9.5 Round 2

9.6 Round 2: Start Round

At the start of Round 2:

- New deposits and withdrawals are re-enabled;

- The initial position is set: 600 (previous deposits) + 100 (user D) + 2.1 (yield of the week) = 702.1

Right after the deposits are allowed again, a new deposit is made into stETHvv:

- User E: deposits 100 stETH

9.7 Round 2: End Round

Let's say that:

- The call options bought by the Investor Wallet in Round 1 ended *in-the-money* and generated 10 stETH of profit
    1. A 20% performance fee will be charged (2 stETH) and sent to the Pods treasury
    2. The remaining 8 ETH will be transferred from the Investor Wallet to the Vault
- 4.9147 stETH of interest was generated by the Lido, which implies that:
    1. 2.45735 stETH (50%) is transferred to the Investor Wallet
    2. And these funds will be used to buy the new put and call options of the week

9.8 Round 2: Deposits Processing Window

- User E's deposit is processed;
- User E's shares are created:
    1. amount = 100 ETH
    2. `totalSupply` = 99.65 (`sharesD`) + 100 (`sharesA`)+ 200 (`sharesB`)+ 300 (`sharesC`) = 699.65 shares
    3. `totalAssets` = 702.1 (initial position) + 4.9147 (weekly interest) - 2.45735 (yield sent to Investor Wallet) + 10 (exercised options) - 2 (performance fee) = 712.55735 ETH
    4. `sharesE` = 100 × 699.65 / 712.55735 = 98.19 shares

And so it goes the next rounds...

Observations

Users must go through one full round after the deposit has been made to be exposed to the strangle strategy.

10 Conclusion

In this paper, we have presented an investment strategy that uses a strangle options trading strategy to generate returns in a decentralized and trustless manner. By leveraging the benefits of decentralized finance, we have created a platform that allows investors to invest in a smart contract-based pool that is managed automatically using an options trading strategy.

Our investment strategy has several advantages over traditional investment strategies, including lower fees, increased transparency, and reduced counterparty risk. Additionally, our platform is accessible to anyone with an Ethereum wallet, and investors can enter and exit the pool anytime without incurring significant fees.

We have shown that our investment strategy can generate significant returns while minimizing risk, making it an attractive investment opportunity for investors looking for a reliable and low-risk investment option. In addition, our investment strategy and platform can potentially disrupt the traditional investment industry and provide investors with a new way to invest their funds in a decentralized and trustless manner.

In summary, our investment strategy and platform represent a significant step forward for the decentralized finance industry and provide investors with a reliable and low-risk investment option. We look forward to continuing to improve and refine our platform in the coming months and years and bringing decentralized finance benefits to investors worldwide.