Long-Short Pair White Paper

Abstract

LSPs (Long-Short Pairs) are smart contracts that represent a collateralized, leveraged position between two underlying tokens, one token being collateral, the other being debt. LSPs aim to provide easy exposure to leveraged trades for anyone, without having to be concerned about actively managing the position. LSPs simplify the problem to simply selecting entry and exit prices while the smart contracts remove the complexities of having to manage a leveraged position by automating the rebalancing of the position.

LSPs use loan markets (such as AAVE or Compound) to deposit a collateral asset and borrow a debt asset, which it then sells for more of the collateral asset to form a leveraged position. The collateral-to-debt ratio is specified by the LSP creator and the position maintenance is automated via incentives .

LSP, as all leverage products, can provide great gains, but come with increased risks and inherent maintenance costs that need to be well understood.

Audience

This paper is intended for anyone wishing to understand the Long Short Pair design on a technical level and for the team constructing the first version of the LSPs. It will also be helpful to anyone wanting to create or use an LSP to speculate on market movements.

Product Intent

“We are all Micheal Burry.”

1. Simplify the creation of leveraged positions to the point where only moderate starting liquidity and reasonable parameters are needed to define a new position.
2. Allow any asset that the loan market allows as collateral to be used as the long position, and any other asset in the loan market to be used as the short position.
3. Prevent full liquidation of positions through position automation that keeps the position that keeps the position within the collateral-debt ratio so that the position isn't fully liquidated.
4. Tokenize these automated, leveraged positions in order to drastically reduce the costs and complexities of entering and exiting such a position for most users.
5. Gather fees.

Mechanism Design

LSP Parameters

For later clarity, we need to define some parameters relevant to LSPs.

- Collateral Type - The tokens used for collateral.
- Debt Type - The tokens being borrowed.
- Lower Target Ratio - This is the ratio the LSP will be rebalanced to if the Lower Alert Ratio is triggered
- Lower Alert Ratio - The collateral ratio below which some collateral needs to be sold in order to pay off some of the debt to return the LSP to the Lower Target Ratio.
- Upper Target Ratio - This is the ratio the LSP will rebalance to if the Upper Alert Ratio is triggered.
- Upper Alert Ratio - The collateral ratio above which additional borrowing of the debt tokens will take place and will be sold in return for more collateral to add to the position.

Tokens / Asset Types

There are now many dozens of multi-million dollar ERC20 assets available for trade on Ethereum. Thanks to platforms like Compound, AAVE and Cream Finance, many of these assets can be used as collateral for a borrower to loan against.

Loan Markets

As at the date of writing, the most successful DeFi products have been MakerDAO, Compound Finance and AAVE. All three are loan markets. They work by allowing the users to deposit some token, which is then used as collateral against which a loan can be made in another (or the same) token. AAVE and Compound work similarly, we will use AAVE to explain the basic mechanism.
When using AAVE, a user deposits XYZ tokens and in turn receives aXYZ interest tokens. These interest tokens represent the original deposit and the balance of the aXYZ tokens in all accounts is adjusted as interest is earned. Once some XYZ tokens are deposited as collateral, the account holding the aXYZ tokens is entitled to borrow against the collateral. The loan works by sending the token type the account is borrowing from the reserves of deposits for that token, the account is also assigned a ***non-transferable*** balance of debt tokens which represents the principal and the interest on the loan. The debt tokens, like the interest tokens, are adjusted as interest accrues to the system.

Each account has a liquidation ratio. This is determined by the value of all the collateral deposited for that account (represented by interest tokens) versus the debt of all the tokens borrowed by that account. Once this ratio drops below a certain amount, the system will automatically liquidate the position, reclaiming the relevant amount of interest tokens. This results in settling the debt-token balance to 0, and leaving the difference in interest tokens with the account.

Leveraged Exposure

Many users employ loan markets to create leveraged exposure for themselves of specific types of tokens.

To create a leveraged position on AAVE, a user would need to:

1. Deposit the tokens into AAVE that they wish to long. (There's a caveat here that not all tokens can be used as collateral.
2. Borrow the token the user wishes to short. Typically this would be a stable coin like USDT, DAI, USDC, etc.
3. Trade the borrowed tokens for more of the collateral tokens on a secondary market. Secondary markets include systems like Uniswap, Balancer, SushiSwap, etc.
4. Repeat step 1 until the desired leverage is achieved.

LSPs do something similar internally, however, they utilize flash loans to achieve a leveraged position, rather than having to implement a loop of steps. Here is the process that happens at a smart contract level whenever assets are deposited into an LSP for the first time.

1. The user deposits the collateral type they wish to long into the LSP and specifies the amount of leverage they wish to be exposed to.
2. The LSP calculates the required amount of collateral and debt to achieve the desired leverage ratio. This process includes looking up the available exchange rates from various AMMs.
3. The LSP deposits the user's collateral into AAVE under the LSP's smart contract account.
4. The LSP seeks to address the difference between the collateral that has already been deposited and the user's specified leverage requirement. It does this by taking out a flash loan on AAVE, and depositing this amount as further collateral.This results in the LSP borrowing the difference in collateral via a flash loan from Compound, which it also then deposits as collateral. The difference in collateral is the difference between the total collateral the position would need and the collateral the user has deposited.
5. The LSP then loans the full amount of debt implied by the leverage ratio from Aave, against the collateral.
6. The LSP exchanges the borrowed tokens for the exact amount necessary to cover the flash loan on a relevant DeFi market.
7. The LSP pays off the flash loan.

Using the above steps the LSP will represent a leveraged position of the collateral token-type against the debt token-type. The leveraged position will be kept at the ratio specified by the user.

Leverage Automation

If a user wishes not to be liquidated in the event that their collateral was devalued, they would need to continuously monitor the position to ensure it was safe from liquidation. There are services that would do this automatically for the user, but they typically have minimum debt amount requirements for participation. At the time of writing, the amount was of the order of $60,000, meaning a user would need at least $80,000 to open a dangerously leveraged position.

LSPs allow leveraged positions to be opened and maintained at lower position sizes.

LSP automation is achieved by including smart contract methods that monitor a position's collateralization ratio. When the collateralization ratio is in danger of moving outside of the user's specified range, the smart contracts will offer either the collateral token or the debt token to the outside market at preferable rates. This then results in the LSP being rebalanced to its relevant target ratio of leverage at an optimally cost effective time. The difference between the market price and the preferable rate offered by the LSP is the reward for rebalancing the LSP.

Under or over-collateralization

In the event that the position is under or over-collateralized, the system will allow access to a method on the smart contract that allows any external caller to trade the debt token-type in exchange for the collateral token type. The rate offered is determined by using a price oracle (Chainlink in this case) and increasing the price offered to external world is calculated such that:

1. There is never an incentive to mint LSP tokens so that a larger fee can be charged in order to rebalance it. This is achieved by ensuring that the reward for rebalancing the LSP back to its target ratio is always lower than the sum of the automation fee and the protocol fee payable to mint a certain amount of LSP tokens .
2. The incentive is structured such that, the farther the LSP drifts beyond its leverage trigger ratio, the higher the implied arbitrage opportunity is for an arbitrage bot to acquire the necessary assets and rebalance the LSP.

Callback Incentive Structure

General decentralized trade has a large complement of automated programs that are constantly looking for profit. Groups exist to find and build out these opportunities by implementing arbitrage bots. Our leverage automation system relies primarily on offering these groups an optimized offer to rebalance our LSPs. The formulas above are designed to ensure that the further the LSP becomes unbalanced, the more lucrative the deal becomes for an arbitrage bot to pick up the offer. The formula also removes any incentive the bot might have to purposely destabilize the LSP, by issuing or redeeming LSP tokens, because the fees involved to mint LSP tokens are always greater than the reward for rebalancing.

The bulk of the technical details of LSP smart contracts revolve around the equations to calculate these incentives correctly. They are; however, better described in a more formal specification.

Rebalance Fallback Mechanism

While the open arbitrage bot ecosystem is the most efficient solution to rebalancing the LSPs, we will also initially build our own open source version of such a bot. Furthermore, we will maintain it to ensure that the initial batch of LSPs are rebalanced.

Opportunistic Rebalancing

Depending on the network conditions where the LSP is running, it is also possible to implement “opportunistic rebalancing”. This offsets the cost and timing of rebalancing onto any user who is minting or redeeming an LSP. It might not; however, be feasible during extremely high-fee periods. It would also not be desirable until the LSP is outside of the trigger leverage ratios, to ensure that undue leverage induced decay is not incurred.

Position Tokenization

By this point ERC20 tokens are very well understood tools within the broader blockchain industry. To recap briefly; the ERC20 standard is the definition of fungible tokens that represent some utility, some claim or some portion of representation. ERC20 tokens are fungible, meaning that any part can be split into other parts, rejoined into single balance and completely interchangeable.

Defining LSPs as ERC20 tokens, opens them up to the broader DeFi ecosystem, allowing them to be used within other platforms and systems. An LSP could, for instance, be used in the treasury of another DAO, be traded against a stable coin or one of the underlying tokens for trading fees. They could also be used as collateral for loans. The list goes on and on.

The fungibility of LSP tokens allow smaller market participants, previously with insufficient liquidity, to open up automated leveraged positions. It also means that any appropriate amount of tokens can be minted for the underlying collateral as well as any subsequent amount redeemed for the underlying collateral.

Fees

Interest

Because leverage implies borrowing, there is an interest rate associated with the debt part of the position. The collateral also earns interest. There are also often rewards associated with various loan markets to incentivize liquidity. There are even, at times, significant incentives to borrow certain assets.

The formula for determining the interest rate is:

$I = Interest$

$L = Leverage\ Ratio$

$I_{Net} = L * (I_{Collateral} + I_{Collateral\ Reward}) - (L - 1) * (I_{Debt} - I_{Debt\ Reward})$

Note:the above formula implies that the interest rates might actually be positive at times.

Protocol Fees

The levr.ly DAO will impose a flat-rate fee for LSPs when entering and existing collateral. This is payable in the collateral type upon entering and the debt type upon exiting.

The fee is subject to adjustment by the levr.ly DAO governance process, but is set to start at 0.5%.

No streaming fee will be charged, as this only drains the LSPs. Simple movement into and out of positions as markets move should provide significant revenue.

Automation Fees

Since LSPs pay a fee to the arbitrage bots for rebalancing positions, and the entering and exiting from LSPs destabilize the position by paying this fee, an automation fee is charged to compensate the long term holders.

The fee is also necessary to prevent deliberate destabilization of the LSP's collateral ratio in order to bleed it for the rebalancing fee.

Edge Cases

Note:for larger sufficiently capitalized positions, the conditions below should nearly never apply.

Dormancy

It is possible for a LSP to become dormant, meaning, it has too little funds to incentivise an arbitrage bot to rebalance it. In this case, it will be effectively dormant until network fee conditions drop low enough to perhaps make it worthwhile again. Alternatively,another user might mint a sufficiently large amount of LSP tokens to overcome the costs of rebalancing the position.

Default

As described earlier, loan markets all rely on the ability to liquidate under-collateralized accounts. For the LSP this means that if it has become dormant, it could also have most of its remaining collateral liquidated provided it remains under collateralized.

Another way in which a default could happen is if the value of the collateral drops below the required safety level of the loan market, before an arbitrage bot can rebalance the position. This could happen in scenarios of extreme market volatility, which is often associated with massively increased transaction fees on various blockchains. The lack of sufficient liquidity plus the extreme fees that needs to be paid to make the trade worthwhile could remove the incentives for an arbitrage bot to rebalance the position.

In a default scenario the remaining collateral would still be accessible by the LSP token holders. The position could even resuscitate if the collateral value moves high enough for an arbitrage bot to be incentivized to rebalance the LSP.

Resuscitation

If, for whatever reason, an LSP defaults, it is possible for the position to be resuscitated when the underlying collateral becomes valuable enough. In addition, the network fees need to be low enough again for the arbitrage bots to reopen a leveraged position against the remaining collateral.

LSPs can also be resuscitated by depositing sufficient new collateral into them, making rebalancing viable again.

Risks

Directly Observable Risk

Perpetually levered positions have the obvious upside that if the market moves in a direction straight from one price to another, the size of the move to the power of the leverage typically shows the estimated returns.

For instance, in an LSP where Ether is 2x leveraged against USDT, and the price of Ether moves up by 10% (from $2000 to $2200), we could approximate the size of the increase with:

$$ROI = \left(\frac{Price_{T0}}{Price_{T1}}\right)^{Leverage} - 1$$

Which would yield:

$$\left(\frac{2200}{2000}\right)^{2} - 1 = 0.21 \ (or\ a\ gain\ of\ 21\%)$$

The inverse is the obvious risk of holding the position, if the price were to move down from 2000 to 1800, we would get:

$$\left(\frac{1800}{2000}\right)^{2} - 1 = -0.19 \ (or\ a\ loss\ of\ 19\%)$$

Leverage Induced Decay of Collateral

What is not, however, obvious is if the price of the collateral asset moves down enough to trigger a rebalance and then back up to the same price, there is now less collateral underpinning the position and the position will be worth slightly less at the same price.

This phenomenon is called leverage induced decay and has been documented extensively in traditional finance. You can read more here [1].

The influence of this on LSPs is that they are ideal for holding over either prolonged, stable moves in price in a certain direction, or for shorter periods when an impulse in some direction of the price is anticipated. LSPs will underperform in a sideways choppy market and they will underperform once volatility exceeds a certain level.

The amount of leverage applied also drastically influences the effects of leverage induced decay. The higher the leverage, the faster the decay.

Technical

Smart Contract

While the levr.ly DAO endeavours to create exhaustive testing for the LSP product, some smart contract exploit in the LSP, the smart contracting language used to construct the LSP, the compiler used to compile the smart contract or the Virtual Machine on which the LSP runs, might still exist.

DeFi Dependencies

LSPs will have dependencies on both the token types they are based on and the smart contract system underlying the loan market. While most of these systems have a significant Lindy record by now, bugs might still exist which could open up LSPs to loss of funds.

Layer 2

It is likely that LSPs will find most of their use on Ethereum Layer 2 solutions. Many Ethereum Layer 2 solutions are very well designed systems with impressive security guarantees, however, most of them still have somewhat centralized upgrade controls at the time of writing this paper.

Most Layer 2s also include guarantees that funds will be retrievable back to Layer 1 in case of a compromise of the Layer 2 execution engine. However,it is still possible that it might not be economically viable to do so, or that those mechanisms themselves are vulnerable to software bugs.

Layer 1

While Ethereum is becoming more and more battle tested with each passing block, it is still possible that some foundational exploit in the Layer 1 system of Ethereum or an alternative Layer 1 where the LSP is deployed, could lead to loss of funds.

Bridging Risk

Loan markets now exist on several alternative, EVM based blockchains. All of these rely on bridging technology to secure funds between the chains. The bridges cannot be considered permanent solutions in the form they exist at the time of writing this paper. The bridges typically involve depositing some asset into a smart contract on one blockchain and then having the accounting for that balance appear on the target chain. The assets can then “move around” on the target chain. The problem is that on the original chain, they still exist in only one smart contract and the guarantees that the owners on the target chain can retrieve those funds are not robust. You can read more here [2].

Potential Future Research

LSPs as AMMs

Since LSPs have collateral with loan markets and constantly require the individual balances of tokens remain within certain bounds, an opportunity does exist to use LSPs as very low fee AMMs.

Directional Pools

Directional pools are Uniswap v3 liquidity positions that are optimized to buy LSPs low and sell them high while constantly earning a fee. LSPs definitely require the discipline of buying low and selling high more than most assets. Directional pools automate this process while growing the position additionally via fees.

Summary

Terminology

Account

For the purposes of this document, an account is the address associated with either a public-private key pair controlled by a user or a smart contract on an EVM based chain.

AMM

Automated Market Makers (AMMs) are pieces of blockchain code that facilitate the trade of tokens as well as providing incentives for the needed liquidity to trade these tokens.

Flash loan

A DeFi concept where funds can be borrowed from a smart contract with a large positive balance for the duration of a single transaction. Flash loans have the property of needing to be repaid, with interest, within the same transaction, failing which, the transaction as a whole fails and the loan was actually never taken out.

Interest tokens

Tokens which automatically increase their balance as interest is earned. Interest tokens are given in return for depositing the underlying asset into the protocol. In Aave they are called aTokens and in Compound cTokens.

Debt Tokens

These are non-transferable tokens which also increase their balances automatically as interest on the debt is accrued.

Leverage Induced Decay

The compounded effect the loss of collateral associated with paying off a drawn-down leveraged position has on the overall value of the position.

Liquidation Ratio

The collateralization ratio under which an account will be forcibly liquidated by the loan market platform.

Price Oracle

A system which provides price information to the blockchain for prices determined externally from the blockchain.

Works Cited

[1] Langebrink, Warwich. “Pricing Of Leveraged ETF Decay - Part 2.” *Seeking Alpha*, 21 November 2021, https://seekingalpha.com/article/4464730-pricing-of-leveraged-etf-decay-a-different-approach. Accessed 22 March 2022.

[2] Bhuptani, Arjun. “Introduction to blockchain bridges | ethereum.org.” *Ethereum.org*, 2021, https://ethereum.org/en/bridges/. Accessed 22 March 2022.