LENDLAND.IO

Whitepaper

LendLand Foundation

LendLand is an algorithmic decentralized lending and borrowing system, built on top of Boba Network. It enables users to supply cryptocurrency collateral on the network that may be borrowed by pledging overcollateralized cryptocurrencies. This creates a secure lending environment where the lender receives a compounded interest rate annually (APY) paid per block, while the borrower pays interest on the cryptocurrency borrowed.

Based on learnings from previous attempts at borrowing protocols, such as Compound and AAVE, LendLand focuses on risk management, decentralization and user experience, aiming to bring a superior product to the market.

Introduction

LendLand is designed to enable a fully algorithmic money market on Boba Network. The protocol design is architected on top of Compound and MakerDAO, while taking the crucial learnings from the latest developments in AAVE.

Problems

The emergence of decentralized finance has forged a rich financial landscape directly atop blockchains, characterized by transparency and cryptographic verification via smart contracts. These platforms are reshaping the framework of monetary markets, eliminating the necessity for central authorities or intermediaries. Unlike the conventional realm, where users must establish creditworthiness, demonstrate income, and meet various criteria for lenders to make decisions, even when offering collateral such as real estate or vehicles, traditional lenders fail to accommodate digital assets and cryptocurrencies for pledging and loan acquisition, or for earning interest rates by providing them to banks and lenders.

Solution

Creating a protocol that enables a traditional money market, with pools of assets with algorithmically derived interest rates, based on the supply and demand for the asset. Suppliers and borrowers of an asset can interact directly with the protocol, earning and paying a floating interest rate, without having to negotiate terms such as maturity, interest rate, or collateral with a peer or counterparty.

1.3 Use Cases

Alice is on a mission to purchase her dream home, but conventional lenders have turned down her loan application. Despite her substantial cryptocurrency holdings, she's hesitant to sell due to potential capital gains taxes and missed appreciation opportunities. Yet, she remains bullish on the long-term prospects of cryptocurrencies.

In a bid to secure funding without liquidating her assets, Alice explores LendLand, a decentralized finance platform built on the Boba Network. Steering clear of traditional banking channels, she opts for a different approach. Leveraging the available bridges, she seamlessly transfers her Bitcoin to the Boba Network without incurring significant fees.

With her Bitcoin now within the Boba Network ecosystem, Alice accesses the LendLand Dashboard via her browser to supply her Bitcoin as collateral. This move allows her to capitalize on potential Bitcoin price appreciation while earning a respectable APY on her holdings. Next, she calculates her borrowing needs and swiftly secures a loan in USDC directly from the dashboard, without the involvement of bankers or intermediaries. The protocol assesses her collateral's value and grants her an over-collateralized loan, providing her with instant access to USDC.

Alice promptly converts the USDC to her local fiat currency using her crypto exchange account, enabling her to proceed with the purchase of her dream home while awaiting favorable market conditions. Remarkably, she isn't bound by monthly payments, and any appreciation in her collateral works in her favor. Additionally, she has the flexibility to make payments at her convenience, with interest rates compounded per block.

LendLand Money Market

- Borrow cryptocurrencies and stablecoins with no credit check and fast origination directly on Boba Network.

- Supply cryptocurrencies and stablecoins and earn a variable APY for providing liquidity to the protocol, which is secured by over-collateralized assets.

- Without having to wait for a fulfilled order, or requiring off-chain behavior, dApps can borrow tokens to amplify their tools in the ecosystem.

- Traders can finance new ICO investments by borrowing funds, using their existing portfolio as collateral

- Traders looking to short a token can borrow it, send it to an exchange and sell the token, profiting from declines in overvalued tokens

Supplying Assets

LendLand users have the option to deposit various supported cryptocurrencies or digital assets onto the platform. These deposits serve multiple purposes: collateral for loans, providing liquidity to earn an APY, or minting synthetic stablecoins.

By depositing assets like cryptocurrencies or digital assets into LendLand, users can effectively act as lenders while ensuring the security of their collateral within the protocol. Users will earn an interest rate that fluctuates based on the utilization of the yield curve in the specific market. All user assets are aggregated into smart contracts, facilitating withdrawal at any time, provided that the protocol maintains a positive balance.

Users who deposit their cryptocurrency or digital assets into LendLand will receive a leToken, such as leBTC, in return. This leToken serves as the exclusive token for redeeming the underlying collateral deposited. Through this mechanism, users can hedge against other assets or transfer them to cold storage wallets compatible with the Boba Network.

Borrowing Assets

Users interested in borrowing any of the supported cryptocurrencies, stablecoins, or digital assets from LendLand must provide collateral, which will be locked within the protocol. These assets must exceed the loan amount and can facilitate borrowing of up to a percentage of their collateral value. These collateral ratios are set on a per token basis.

Once assets are deposited, borrowing is determined by the collateral ratio of the asset. Typically, collateral ratios range from 40% to 75%. For instance, if Bitcoin has a collateral value of 75%, borrowers can access up to 75% of their BTC value. For a user with $100,000 in BTC supplied to the LendLand protocol, they can borrow up to 75% of that value. However, if a user's collateral value drops below the specified collateral ratio, it could trigger a Liquidation event, which will be discussed later.

Users are subject to a compound interest rate applied per block on these assets, with no monthly payment obligations. To redeem the collateral, the user must settle their origination balance and compounded interest with the protocol.

Market interest rates are determined by the specific yield curve designated in the contract. Depending on market utilization, the interest rate for the specified market will be determined accordingly.

Risk Management

LendLand enhances risk management across various aspects: separate pools for securely onboarding long-tail assets, a pioneering price feed composed of multiple oracles to mitigate single points of failure, and more sophisticated risk parameters to bolster the protocol's resilience against insolvency.

Separate Pools

Traditional lending protocols, such as Compound, typically amalgamate assets into a single liquidity pool. However, this setup poses significant risks to the protocol's overall liquidity in the event of extreme volatility in any included token. Additionally, the process of listing new tokens is hindered by the absence of specific risk parameters.

LendLand introduces separate pools as a solution to address the limitations of a single liquidity pool. Isolated pools consist of segregated asset collections with customized risk management configurations, offering enhanced diversification to manage risk and facilitate lending and borrowing. By separating pools, potential failures are contained, preventing them from impacting unrelated markets and the overall risk profile of the protocol. Moreover, rewards within isolated pools can be tailored per asset, providing personalized liquidity incentives to users.

Risk Fund and Shortfall Handling

Shortfall accounts, which have borrowed beyond the value of their collateral, pose a significant risk to decentralized lending protocols. There's minimal incentive for borrowers to repay these loans when the unlocked collateral is worth less than the loan itself. These accounts strain the protocol's liquidity, and in most previous protocols, there was no mechanism to address these accounts.

LendLand establishes a risk fund for each pool, where a portion of protocol revenue will be allocated to cover insolvencies. In the event of insolvency after liquidation, a shortfall handling mechanism will be activated, involving the auctioning of the risk fund for the appropriate asset.

Liquidations

Liquidations are a crucial aspect of risk management within lending protocols like LendLand, as asset price fluctuations can endanger protocol liquidity. To mitigate this risk, a liquidation mechanism is employed.

When an account's collateral falls below a predefined threshold, liquidator bots, operating for their own profit, sell a portion of the collateral on the market to repay the borrower's debt. The liquidation threshold varies based on the quality of the collateral, with more volatile assets requiring a lower threshold, thereby necessitating more collateral to secure a position from liquidation.

Researching previous implementations, we noticed issues in the liquidation process of some protocols, and decided to resolve the potential issues in advance.

- Underwater positions were typically not liquidated in full. Liquidations occurred incrementally, with only a portion of the borrowed amount being repaid in each event. This incremental liquidation process could result in inefficient liquidation, where remaining collateral became insufficient to cover gas costs for liquidators, rendering further liquidation economically unviable.

- Ensuring adequate liquidator incentives was a challenge. It was difficult to determine on-chain if liquidators had sufficient motivation to perform necessary liquidations. Distinguishing actual account insolvency from positions potentially requiring further liquidation to track total bad debt was often impractical.

- Liquidation incentives were often not correlated with the quality of the collateral. As a consequence, liquidators tended to prioritize seizing stable assets over volatile ones, potentially exacerbating risks for accounts with volatile collateral.

- Adjusting collateral factors for specific assets could trigger liquidations, potentially leading to additional sell pressure for the collateral asset and further liquidations.

To address these issues and draw lessons from the failures of other protocols, LendLand introduces the following liquidation logic:

- The liquidation threshold is configured separately from the collateral factor. For instance, setting the collateral factor to zero prevents new borrow positions without affecting the solvency of existing loans. This adjustment also allows users to borrow up to 100% of their borrowing limit without immediate liquidation risk.

- Liquidation incentives can be configured per asset, providing better alignment with collateral quality.

- Two special kinds of liquidations, batch liquidation and account healing, are introduced to allow liquidating the position in full. Batch liquidations incentivize liquidators to address small accounts, while account healing handles bad debt by allowing liquidators to seize remaining collateral and write off leftover bad debt.

Redundant Price Oracles

Many protocols use a single oracle data provider setup. Unfortunately, this lacks a mechanism to validate prices and safeguard against price manipulations or stale data, posing an existential threat to the protocol and establishing a single point of failure.

To address these vulnerabilities, LendLand introduces a redundant oracle system capable of fetching prices from multiple feeds and validating them using other decentralized sources. A price validation algorithm is employed to cross-reference prices obtained from two or more price oracle sources. In the event that a primary source is deemed untrustworthy or fails to provide data, the resilient oracle can seamlessly switch to a secondary source.

This advanced oracle system brings the additional benefits of enabling the integration of new price oracles on the fly and supporting the activation and deactivation of price oracles for individual assets.

Variable Interest Rates

LendLand takes a unique approach to managing liquidity risk and optimizing utilization, while preserving modularity by implementing interest rate models.

The interest rate for each market pair is dynamic, and determined based on the ratio of borrowed assets and supplied assets in the market. This exact ratio is determined based on the interest rate model implemented for the pair.

Simply said, the interest rate model manages liquidity risk by incentivizing users to support liquidity: when capital is high, low interest rates encourage loans and when capital is scarce the high interest rates encourage repayment of loans and additional deposits.

Thus, the interest rate models are functions of utilization the more of an asset is borrowed, the higher the interest rate will be for it.

LendLand operates variable interest rates for different markets using two models: Linear and Kinked.

Utilization

In our lending model, we define two different utilization rates: U and U_s . These rates are crucial in determining the interest rates for borrowers and suppliers.

The utilization U rate is defined as the ratio of the total amount borrowed to the total amount of resources available for borrowing. It is calculated as follows:

$$u = \frac{\text{borrows}}{\text{cash} + \text{borrows} + \text{bad debt} - \text{reserves}}$$

This rate represents the proportion of available resources that are currently being used by borrowers. It does not take into account bad debt, which means it purely measures the actual usage of the available resources.

On the other hand, the utilization U_s rate is defined as the ratio of the sum of the amount borrowed and the bad debt to the total amount of resources available. It is calculated as follows:

$$u_s = \frac{\text{borrows} + \text{bad debt}}{\text{cash} + \text{borrows} + \text{bad debt} - \text{reserves}}$$

The U_s rate includes bad debt in its calculation, which means it measures the total risk exposure of the lender. This is particularly important for suppliers, as they would want to consider the risk of bad debt when supplying their assets.

We define these two utilization rates separately because they serve different purposes in our lending model. The U rate is used to calculate the borrow interest rate, which should reflect the actual usage of the available resources. The U_s rate, which includes bad debt, is used to calculate the supply interest rate, as suppliers need to consider the risk of bad debt in their decision to supply assets. By defining these rates separately, we can more accurately model the behaviors of borrowers and suppliers and set fair and risk-adjusted interest rates.

Linear Model

In the linear model, the interest rates are calculated using simple linear equations. The borrow rate and supply rate are given by the following formulas:

For the borrow rate:

$$borrow\_rate(u) = a \cdot u + b$$

And for the supply rate:

$$supply\_rate(u) = borrow\_rate(u) \cdot u_s \cdot (1 - reserve\_factor)$$

In this model, the borrow rate is a linear function of the utilization rate U, and the supply rate is a function of both the borrow rate and the adjusted utilization rate U_s. The reserve factor represents the part of the interest income that is withdrawn from the protocol and not distributed to suppliers.

Kinked Model

The Kinked model introduces a kink in the interest rate curve when an asset surpasses a certain level of utilization. This adjustment aims to dissuade borrowers from taking out excessive loans and encourages the repayment of outstanding loans.

For the borrow rate, the formula is different depending on whether the utilization rate is less than or greater than the kink:

If u < kink:

$$\text{borrow\_rate}(u) = a1 \cdot u + b$$

If u > kink:

$$\text{borrow\_rate}(u) = a1 \cdot \text{kink} + a2 \cdot (u - \text{kink}) + b$$

And for the supply rate:

$$\text{supply\_rate}(u) = \text{borrow\_rate}(u) \cdot u_s \cdot (1 - \text{reserve\_factor})$$

In this model, the borrow rate is a piecewise function of the utilization rate U, with a kink at the optimal utilization rate. The supply rate is a function of both the borrow rate and the adjusted utilization rate U_s. The reserve factor represents the part of the interest income that is withdrawn from the protocol and not distributed to suppliers.

2.4.4 Models in practice

The main difference between the models is that the Kinked model introduces a kink in the interest rate curve when an asset surpasses a certain level of utilization. This adjustment aims to dissuade borrowers from taking out excessive loans and encourages the repayment of outstanding loans.

The main difference between the models is that the Kinked model introduces a kink in the interest rate curve when an asset surpasses a certain level of utilization. This adjustment aims to dissuade borrowers from taking out excessive loans and encourages the repayment of outstanding loans.

For instance, if we designate 70% as the optimal utilization rate for an asset, borrowing up to or less than 70% of a pool's reserves will not trigger a kink in the interest rate. The interest rate slope will gradually increase as assets are utilized. However, once more than 70% of the liquidity is borrowed from the reserves, a kink occurs, and the interest rate slope steepens rapidly. This sharp increase in interest rates discourages further borrowing and encourages loan repayment, thereby lowering the pool's utilization rate back towards the optimal level of 70%.

This is especially useful when large amount of volatile tokens are collateralized, while the other side of the pair consists of bigger, more stable tokens such as BTC or ETH. In case of a significant drop in relative price, the collateral amount becomes insufficient to support the loan. By applying the Kinked model, the borrowers now face significantly higher interest rate compelling them to reduce borrowing or repay the loan.

The optimal utilization rate is determined based on market simulations and analysis, but can be adjusted on the fly in case of significant changes to an assets economy. This change not only reduces liquidity risk but also adjusts interest rates to match high-demand periods.

In the above model, the dashed lines represent the Kinked model, while the solid lines represent the Linear model. The blue and orange lines represent the borrow interest rates, while the green and purple lines represent the supply interest rates. The reserve factor and bad debt factor are also taken into account in the supply interest rates. The graph is based on a simplified system parameter setup, where the slope before the kink is 0.05, the slope after the kink is 3, the interest rate at 0% utilization is 15%, the kink is at 70% utilization, the reserve factor is 0.1, and the bad debt factor is 0.05.

References

[Ehrsam(2016)] Fred Ehrsam. Blockchain tokens and the dawn of the decen- tralized business model, 2016. URL https://www.coinbase.com/blog/blockchain-tokens-and-the-dawn-of-the-decentralized-business-model.

[Gudgeon et al.(2020)Gudgeon, Werner, Perez, and Knottenbelt] Lewis Gud- geon, Sam Werner, Daniel Perez, and William J Knottenbelt. Defi protocols for loanable funds: Interest rates, liquidity and market efficiency. In Pro- ceedings of the 2nd ACM Conference on Advances in Financial Technologies, pages 92–112, 2020.

[Kuzenkov(2023)] Georgii Kuzenkov. Money loan process in centralized finance vs. decentralized finance: a comparative study of deutsche bank, aave and compound. 2023.