Qilin V1 Core

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Abstract

This whitepaper explains the mechanisms behind the Yilin v1 protocol, a decentralized risk optimizer protocol for asset derivatives trading on the Ethereum blockchain. This paper covers the protocol's core features, including an elastic liquidity pool model, the Rebase Funding Rate mechanism, which reduces the risk of naked positions for liquidity during market volatilities, and the Dynamic Algorithmic Slippage mechanism, which incentivizes against position imbalance. also introduces the core application built on top of the Yilin v1 protocol - futures position trading, which allows traders to purchase long and short positions at leverage.

1 Problem Statement

AMM started the normalization of non-custodial crypto asset trading and enabled pooled liquidity for long-tail assets. However, the time value of these assets is still unable to be traded. Predatory trading causes sustained high risks for the liquidity side, which limits market expansion for crypto assets.

At the same time, P2Pool only distributed the risk for liquidity providers but failed to systematically reduce risks. At the same time, requiring liquidity to both sides of the trading pair reduces capital efficiency for liquidity providers.

Order books can only serve low liquidity risk assets, but for crypto assets with higher risk, order books are not an optimal solution. The complex system infrastructure of orderbooks bears high risks to liquidity providers (usually professional market makers or the exchange itself) as counterparties. This also creates aggressive liquidation methods used by order-book-based exchanges, which lead to negative trader-side user experience.

We introduce Qilin, a decentralized risk optimizer protocol for asset derivatives trading on the Ethereum blockchain.

2 Qilin Protocol’s Terms & Parameters

Term	Abbreviation & Symbol	Definition	Formula

Long		an on-chain position that gives the buyer the right to bet on the future price of an asset with the expectation that the asset will increase in value	
Short		an on-chain position that gives the buyer the right to bet on the future price of an asset with the expectation that the asset will decrease in value	
Initial Margin	a	the deposit a trader pays to open a long/short position; it also serves as backstop during liquidation when the position suffers a loss (for example, position liquidation would happen before a margin of $100 is depleted)	
Total Margin Value (Long/Short)	$\Sigma a^L / \Sigma a^S$	the total value of all the margin deposits from long/short positions	
Leverage	l		
Entry Price	$\boldsymbol{p^0}$	the price of the asset at the time of purchase of the position	
Liquidation Price	$\boldsymbol{p^f}$	an algorithmically determined price threshold below which liquidation is initiated on a losing position before or after position bankruptcy or the price of the asset at the point of liquidation.	
Position Value	A	the value of a long/short position.	a * l
Total Position Value	$\boldsymbol{\Sigma L / \Sigma S}$	the total value of all long/short positions.	
Position Share	$\boldsymbol{L^c / S^c}$	the share of the current Position Value in the Total Position Value.	$\boldsymbol{\Sigma L^c / \Sigma S^c} * \frac{A}{\Sigma L / \Sigma S}$

Total Position Share	$\Sigma L^c/\Sigma S^c$	the amount of shares of the Total Position Value	
Net Profit		the profit of a position when liquidated	$\frac{\lvert p^f - p^0 \rvert}{p^f} * \frac{L^c/S^c}{\Sigma L^c/\Sigma S^c} * \Sigma L/\Sigma S$
Margin Loss		the loss taken on margin during liquidation	$A - \frac{L^c/S^c}{\Sigma L^c/\Sigma S^c} * \Sigma L/\Sigma S$

Terms for Elastic Liquidity Fund

Liquidity Fund (Liquidity Pool)	LF	the fund of liquidity deposits which acts as the counterparty to traders	
Liquidity Providers	LPs	the supplier of liquidity in Liquidity Funds	
Liquidators		actors which liquidate positions with margins depleted below a certain threshold in returns for liquidation rewards; accessible for Liquidity Providers with a certain amount of FS Token	
Constant Margin Ratio		a pre-determined constant (currently 0.2) used in determining if a liquidity pool will be open for new liquidity deposits.	
Initial Fundable Value		the initial total value of fundable liquidity of a liquidity pool	
Fundable Value		the value of newly fundable liquidity of a liquidity pool after initial funding, determined when an algorithmic threshold is met during high demand for liquidity	
LiquidityFund Share		the share of an amount of liquidity deposit in the liquidity fund	
LiquidityFund Token	FS Token	the share token representing the share of liquidity in the liquidity fund, redeemable for the corresponding asset and tradable as a crypto asset	

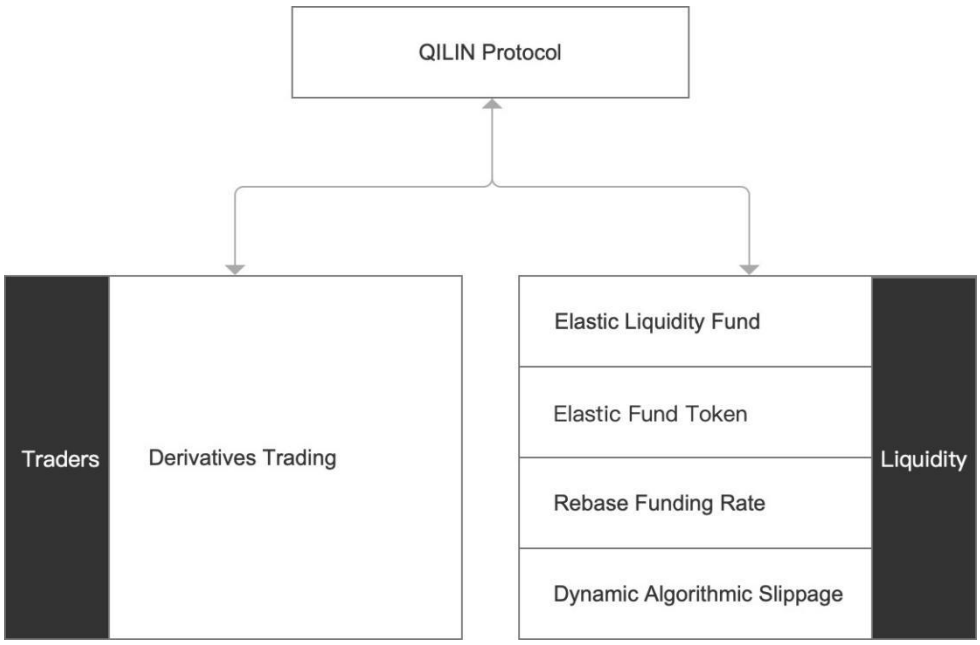
Terms for Rebase Funding Rate

Debase Funding Rate	RFRR	a risk-optimizer for liquidity against long/short imbalance, activated when the Deviation Rate exceeds the Imbalance Threshold	
Deviation Rate	D	the current rate of imbalance between long and short positions	$\frac{\lvert \Sigma \boldsymbol{L} - \Sigma \boldsymbol{S} \rvert}{\Sigma L + \Sigma S}$
Rebase Epoch	T	the period of rebalancing	
Rebasee Interval	t	the interval between each Rebalance Epoch	
Rebase Frequency	n	the number of times of rebalancing	$\frac{\boldsymbol{T}}{\boldsymbol{t}}$
Rebase Rate	r	the rate of rebalance in a single Rebalance Epoch	$\frac{\boldsymbol{D}}{\boldsymbol{n}} = \frac{\boldsymbol{tD}}{\boldsymbol{T}}$
Imbalance Threshold	I	a pre-determined constant used to determine when the rebalance mechanism is initiated, set at 0.1	
Rebalance Funding	B	the funding fee from a Rebalance Epoch	$r\ (\Sigma L + \Sigma S)$
Post-Funding Deviation	D'	the deviation rate at the end of a Rebalance Epoch	$\frac{\lvert \Sigma \boldsymbol{L} - \Sigma \boldsymbol{S} \rvert - \boldsymbol{B}}{\Sigma L + \Sigma S - B}$

Terms for Dynamic Algorithmic Slippage

Slippage Sensitivity Index	$\mathcal{P}$		$\frac{\boldsymbol{LP}}{\mathcal{E}\lvert \Sigma \boldsymbol{L} - \Sigma \boldsymbol{S} \rvert}$
Adjustment Constant	$\mathcal{E}$	a pre-determined constant	
Standard Asset Amount	x		
Position Asset Amount	y		
Uniswap Constant Product	K'		x * y
Qilin Constant Product	K		$\mathcal{P}$ * K’

3 How Qilin Works (Graph)



4 Elastic Liquidity Fund

Qilin’s Liquidity Funds provide a single-side exposure to liquidity providers. The token pair of each liquidity fund is set as TokenA/TokenB, and LPs can purchase Fund Tokens by depositing the pricing-side asset into the fund.

Qilin's Liquidity Funds adopt an elastic model to adjust the total value of the liquidity based on market demand for liquidity. This aims to solve the problem of the lack of risk-reward for early-stage LPs in an infinitely open liquidity pool. In an elastic liquidity model, early-stage LPs are rewarded with trading fees without the effect of reward dilution from additional liquidity that would otherwise be underutilized. The opportunity cost of early liquidity is realized in this model.

Each pool has a pre-determined initial fundable value. For example, the initial fundable value for the BTC/USDT fund is initially capped at $1million. Asset holders can purchase FS Token from the fundable pool until the cap is reached, at which point the fund is closed from further liquidity funding.

In the elastic model, the opening of a fund is determined based on the ratio of naked positions value to the LP value to ensure sufficient liquidity. When the ratio is above 500%, the fund is reopened for new

liquidity deposits. Until the ratio reaches 200%, FS Token will remain purchasable with liquidity deposits, before the fund is closed again.

The value of the FS Token is correlated with the value of the Liquidity Fund, when LF's value decreases, the value of FS Token per unit also decreases, making the capital to LiquidityFund share ratio lower hence cheaper to enter the fund, and vice versa.

5 Rebase Funding Rate

One issue that exists in on-chain derivatives trading which does not exist in asset swapping is the risk of naked positions for liquidity providers. During market volatilities, the imbalance of long and short positions poses a risk to the liquidity pool which provides the risk backstop. Dynamic Rebalance Funding Rate is hence created to incentivize liquidity against the risk of naked positions.

When the mechanism is initiated, an algorithmically determined amount of the margin balance is funded to the liquidity pool to incentivize against risk. A Deviation Rate (D) that measures the imbalance rate between long and short positions is calculated against the Imbalance Threshold (I):

$$D = \frac{|\Sigma L - \Sigma S|}{\Sigma L + \Sigma S};$$

$$I = 0.1.$$

If D > I,

A Rebalance Rate (r) of is calculated for a Rebalance Epoch:

$$r = \frac{D}{n};$$

Each Rebalance Epoch results in an amount of Rebalance Funding (B) transferred to the LF:

$$B = r\,(\Sigma L + \Sigma S);$$

A Post-Funding Deviation rate (D') is calculated at the end of the rebalance against I:

If $D' > I$, RFRR continues;

else, RFRR deactivates.

6 Dynamic Algorithmic Slippage

Slippage refers to the difference between the signaled entry or exit price of a trade and the executed price of the trade. It results from a variety of market scenarios including price volatilities and

non-optimal liquidity conditions and could incentivize against trading. However, the Dynamic Algorithmic Slippage mechanism utilizes the inherent slippage phenomenon of the market to incentivize against position imbalance.

Qilin's Dynamic Algorithmic Slippage implements a slippage on positions on the side of the naked positions by applying a Slippage Sensitivity Index ($\mathcal{P}$) on Qilin's market maker:

$$\mathcal{P} = \frac{\boldsymbol{LP}}{\mathcal{E}|\Sigma \boldsymbol{L} - \Sigma \boldsymbol{S}|}$$

$$\text{x} * \text{y} = \mathcal{P} * K'$$

7 How Futures Trading Works on Qilin v1

Below is a simulated time lapse of position trades made on Qilin v1.

Note that the initial liquidity pool value is et at 10,000 USD:

Position	Position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total Position Share (Long)	Total Position Share (Short)
Position A 100USD * 10 Long	**Position Value:** 1000 USD; **Position Share:** 1000; **Entry Price:** 10,000 USD; **Margin:** 100 USD;	100 USD	0 USD	10,000 USD	1,000 USD	0 USD	1,000	0
Position B 50 USD * 20 Short	**Position Value:** 1000 USD; **Position Share:** 1000; **Entry Price:** 10,000 USD; **Margin:** 50 USD;	100 USD	50 USD	10,000 USD	1,000 USD	1,000 USD	1,000	1,000

Table 1: first two positions traded on Qilin v1 in simulation

The liquidity pool has an initial funded value of 10,000 USD.

Position A has a margin of 100 USD and a leverage of 10x. This brings the Total position Value (Long) to 100 USD * 10 = 1,000 and the Total Trading Volume (Long) to 1,000 USD.

Position B has a margin of 50 USD and a leverage of 20x. This brings the Total position Value (Short) to 50 USD * 20 = 1,000 and the Total Trading Volume (Short) to 1,000 USD.

position	position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total position Share (Long)	Total position Share (Short)
Position C 50 USD * 10 Long	**position Value:** 500U; **Position Share:** 500 **Entry Price:** 10,000 USD; **Margin:** 50 USD;	150 USD	50 USD	10,000 USD	1,500 USD	1,000 USD	1,500	1,000
RFR mechanism	**Epoch 1:** D = 0.2 > I; r = 0.01; Margin (Long) -> 25 USD -> Liquidity Pool	125 USD	50 USD	10,025 USD	1,475 USD	1,000 USD	1,500	1,000
RFR mechanism	**Epoch 2:** D = 0.192 > I r = 0.0096 Margin (Long) -> 25 USD -> Liquidity Pool	100 USD	50 USD	10,050 USD	1,450 USD	1,000	1,500	1,000

Table 2: a new position transaction triggers the Dynamic Rebalance Funding mechanism

position C has a margin of 50 USD and a leverage of 10x. This brings the Total position Value (Long) to 50 USD * 10 = 500 and the Total Trading Volume (Long) to 1,500 USD.

Dynamic Rebalance Funding mechanism is triggered when

$$D = |1500 - 1000| / (1500 + 1000) = 0.2, \text{ larger than the Imbalance Threshold } I = 0.1$$

In Epoch 1,

$$r = D / n = 0.2 / 20 = 0.01$$

$$\text{Value Rebalanced} = (\text{Total Volume Trading (Long)} + \text{Total Volume Traded (Short)}) * r = 25 \text{ USD}$$

from the Margin Balance (Long) is funded to the Liquidity Pool, which leaves the Total Margin Balance (Long) to 125 USD, the Total Trading Volume (Long) to 1,475 USD, and the Liquidity Pool Value up to 10,025 USD.

After Epoch 1 D is recalculated：

D = |1475 - 1000| / (1475 + 1000) = 0.192, still larger than the Imbalance Threshold I = 0.1. RFR mechanism continues.

In Epoch 2：

25 USD from Margin Balance (Long) is funded to the Liquidity Poll, Which leaves Total Margin Balance (Long) to 100 USD, the Total Trading Volume (Long) to 1,450 USD, and the Liquidity Pool Value upto 10,050 USD.

position	position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total position Share (Long)	Total position Share (Short)
Position C liquidated	**Net Profit:** 0 USD **Margin Loss:** 17 USD; **Fee:** 1 USD; **Margin returned:** 32 USD	67 USD	50 USD	10,051 USD	967 USD	1,000 USD	1,000	1,000
RFR mechanism	D = 0.017 < I	67 USD	50 USD	10,051 USD	967 USD	1,000 USD	1,000	1,000

Table 3: a liquidation happens and a new epoch of RFR is not initiated due to changed trading volume

position C is closed by the trader. Net Profit is

|Liquidation Price - Entry Price| / Entry Price * position Share * Total Trading Value (Long/Short) / Total position Share (Long/Short) =

|10,000 - 10,000| / 10,000 * 500 * 1,450 / 1,500 = 0 USD.

Margin Loss is

500 - 500 USD * 1450 USD/1500 = 17 USD.

With 1 USD as trading fee funded to the Liquidity Pool as reward, 32 USD is returned to the trader.

Total Margin Balance (Long) is now 67 USD, Total Volume Trading (Long) is now 967 USD.

Before Epoch 3 is initiated, D is recalculated：

D = |967 - 1000| / (967 + 1000) = 0.017, smaller than the Imbalance Threshold I = 0.1.

RFRR mechanism is currently closed.

position	position Details	Total Margin Balance (Long)	Total Margin Balance (Short)	Liquidity Pool Value	Total Volume Trading (Long)	Total Volume Trading (Short)	Total position Share (Long)	Total position Share (Short)
Market Price Change 10,000 -> 10,500 USD								
Position D 100 USD * 10 Short	**position Value:** 1,000 USD; **Position Share:** 1,000 **Entry Price:** 10,500 USD; **Margin:** 50 USD;	67 USD	150 USD	10,051 USD	967 USD	2,000 USD	1,000	2,000
Position E 100 USD * 10 Long	**position Value:** 1,000 USD; **Position Share:** 1,034 **Entry Price:** 10,500 USD; **Margin:** 100 USD;	167 USD	150 USD	10,051 USD	1,967 USD	2,000 USD	2,034	2,000
Position F 200 USD * 10 Short	**position Value:** 2,000 USD; **Position Share:** 2,000 **Entry Price:** 10,500 USD; **Margin:** 200 USD;	167 USD	350 USD	10,051 USD	1,967 USD	4,000 USD	2,034	4,000
RFR mechanism	**Epoch 1:** D = 0.34 > I; r = 0.017; Margin (Long) -> 100 USD -> Liquidity Pool	167 USD	250 USD	10,151 USD	1,967 USD	3,900 USD	2,034	4,000

Market Price Change 10,000 -> 10,500 USD								
Position D liquidated	**Net Profit:** 28 USD **Margin Loss:** 25 USD; **Fee:** 1 USD; **Margin returned:** 102 USD	167 USD	175 USD	10,124 USD	1,967 USD	2,925 USD	2,034	3,000
Position B liquidated	**Net Profit:** -20 USD **Margin Loss:** 25 USD; **Fee:** 1 USD; **Margin Returned:** 4 USD	167 USD	150 USD	10,145 USD	1,967 USD	1,950 USD	2,034	2,000
Position A liquidated	**Net Profit:** 20 USD **Margin Loss:** 33 USD; **Fee:** 1 USD; **Margin returned:** 86 USD	100 USD	150 USD	10,126 USD	1,000 USD	1,950 USD	1,034	2,000
Position F liquidated	**Net Profit:** 56 USD **Margin Loss:** 50 USD; **Fee:** 1 USD; **Margin Returned:** 205 USD	100 USD	0 USD	10,071 USD	1,000 USD	0 USD	1,034	0
Position E liquidated	**Net Profit:** -29 USD **Margin Loss:** 0 USD;**Fee:** 1 USD; **Margin returned:** 70 USD **Fee:** 1 USD; **Margin returned:** 70 USD	0 USD	0 USD	10,101 USD	0 USD	0 USD	0	0

Table 4: a series of positions, RFR mechanism initiation, and liquidations.

8 Summary

- Qilin is a decentralized risk optimizer protocol for derivatives trading of Ethereum assets.
- Qilin introduces an Elastic Liquidity Fund for asset pairs to realize the early entry cost for LPs and FS Tokens to realize the time value of liquidity assets.
- A Rebase Funding Rate is switched on during long/short imbalance and applied to the naked-side positions to mitigate risks for liquidity.
- A Dynamic Algorithmic Slippage is applied on naked-side positions to incentivize against risks of position imbalance.