

# Liquid Finance

## **Version 2**

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<https://www.liqwid.finance/>



## **Abstract**

Liqwid v1 is a noncustodial, automated interest rate curve liquidity protocol. It is implemented on the Plutus smart contract platform for the Cardano extended UTxO blockchain. Liqwid v1 creates money markets by algorithmically calculated interest rates based on the supply and demand of pooled liquidity. These rates, alongside built-in stability mechanisms, enable users to seamlessly lend and borrow Cardano native assets in a decentralized and trustless protocol.

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## Introduction

Automated interest rate curve liquidity protocols pool liquidity to make it available for demand-side users to borrow assets and supply-side users to earn interest on deposits. The pooled liquidity removes the need for suppliers and borrowers to be independently paired based on loan amount, loan maturity date, and collateral type. This enables continuous liquidity provision with no reliance on the centralized custodians of lending and borrowing products in traditional finance (TradFi).

- Costly transaction fees on widely used smart-contract blockchains, such as Ethereum render the protocols unusable for small transactions
- Plutus platform has stronger security guarantees, and we aim to bring a solid DeFi protocol to the Cardano ecosystem

DeFi protocols in other popular smart contract ecosystems lacking a standard identity solution limits capital efficiency and credit-based product innovation. For these reasons Atala PRISM and other protocol-native decentralized identity solutions will be a key part of Liqwid V2.

As in TradFi fixed-income products, the interest repaid on outstanding loans drives lender yield in an automated interest rate curve liquidity protocol. However, unlike the opaque TradFi fixed-income model, Liqwid is an open-source and publicly auditable protocol that establishes a loan book with an archive of transactions and interest rates since genesis.

## The Liqwid protocol

The Liqwid protocol creates liquidity pools for rate curves allowing lenders to deposit assets, earning interest each block and borrowers to open loans in assets supported on the protocol. Unlike fixed income, interest rates are algorithmically calculated by the asset's lender supply and borrower demand for each block. Suppliers and borrowers of an asset connect directly to the market's smart contract within the protocol, earning and paying a variable interest rate each block with no requirement to settle contract terms beforehand.

Each liquidity pool is exclusive to a native asset on Cardano (e.g., ADA or a Cardano native stablecoin) which includes an archive of all transactions and the interest rate index for that market.

## Primary Users

By enabling users to easily access competitive interest rates from a set of global liquidity pools, Liqwid aims to disrupt the TradFi lending model while returning value to the core set of protocol users:

- Borrowers have access to competitive interest rate loans with zero fees, zero slippage, and no need to sell their collateral.
- Lenders accrue interest at the algorithmically calculated supply rate for each block.
- Developers can build integrations to directly connect their dApp's balances into a Liqwid Market to earn interest.
- Liquidators can earn profits by repaying defaulting loans to secure Liqwid Markets from risk.

## Liquidity Providers

In TradFi money markets or peer-to-peer solutions, liquidity providers' (LPs) assets are matched and lent to a borrower. In contrast, the Liqwid protocol combines each user's assets into a common liquidity pool in a "peer-to-pool" paradigm. When a user deposits a supported asset, it becomes fungible in the protocol. Depositors may withdraw their assets at any time, with no reliance on loan maturity dates.

Borrower demand for a particular asset drives the accumulation of interest in the liquidity pool. When a user deposits assets to the pool, the protocol issues a Cardano native token balance in interest-bearing "qTokens". These qTokens designate the bearer's claim to the yield generated via an increasing quantity of the underlying asset; earning interest is as simple as holding qTokens.

## LP Use Cases

A Liqwid Market can be used to generate yield on ADA or Cardano native asset holdings. Liqwid circumvents the need for users to send tokens to a centralized third-party custodian, actively manage their holdings, match borrows, or enter high default-risk loans with low-credit borrowers. As a native asset, qToken owners can use them to power any supported, yield-generating protocol on Cardano, unlocking composability, the defining property of open finance.

Developers building Cardano DeFi protocols can use the Liqwid protocol to monetize their dApp's balance as a source of additional returns and continuous yield by holding their balances in interest-bearing qTokens.

## Borrowing Assets

Liqwid enables users to borrow from the protocol, using qTokens as collateral. Contrary to direct lending, borrowing assets from Liqwid only requires a user to select a preferred asset; there are never any maturity loan dates, contract terms to settle, loan initiation costs, or capital-inefficient required collateral ratios (such as Synthetix protocol [\[1\]](#), where conservative stakers are encouraged to maintain collateral ratios over 700%). Akin to supplying an asset and earning the variable supply rate each Market has an adjustable borrow interest rate, calculated from lender supply and loan demand each block. This is how the cost of money for every asset in the protocol is determined.

## Collateral Requirements

User-supplied assets to the protocol (as witnessed by the ownership of qTokens) are posted as collateral to borrow from a Liqwid Market. Every supplied asset requires a loan-to-value ratio (e.g., 80) termed collateral factor which determines the maximum percentage of the underlying token value that can be borrowed from the protocol. A Liqwid Market with a collateral factor of 80 allows borrowers to open loans up to \$0.80 in any asset supplied to the protocol for every \$1 worth of the Market's asset committed as collateral. Lower market cap assets have lower collateral factors to mitigate risks stemming from lacking liquidity and heightened volatility. On the opposite end, high market cap assets have correspondingly higher collateral factors due to their increased liquidity, these assets function as

stronger collateral types. High liquidity stablecoins with low price risk and volatility (i.e., USDC, USDT) will command the highest collateral factors as these assets are the strongest collateral options.

The total value of a user's underlying token balances multiplied by the collateral factors equals a user's borrowing capacity. Users may borrow at or below their borrowing capacity. Users cannot trigger actions in a market (e.g., borrow or withdraw underlying assets) that would increase the sum value of borrowed tokens above their borrowing capacity. This secures the protocol from default risk.

## Risk and Liquidation

Borrowers with outstanding loan amounts surpassing their borrowing capacity are subject to liquidation, which seizes a proportion of the user's qToken collateral to repay the loan. An additional penalty is taken from the borrower's collateral balance to incentivize liquidations.

Liquid pools insolvent loans. This mechanism helps automate liquidations by allowing arbitrageurs to repay all or part of the loan over the borrower's limit in exchange for a portion of the borrower's collateral (including liquidation incentives). The pooling of default positions and associated collateral into a "Liquidation Pool" enables a mode of operation akin to a Decentralized Exchange (DEX); contrast this with current Ethereum DeFi lending protocols, which require liquidators to select specific account addresses for liquidation.

Pooling liquidations allows liquidators to quickly step in and reduce default risk in outstanding loans during volatile moments, even in the face of network congestion. Such congestion was a key factor in an event known as "Black Thursday", occurring on March 20, 2020, which rendered some DeFi borrowing protocols unsecure as they were unable to properly close defaulting positions.

The maximum proportion of an account's total borrowed value which can be repaid by liquidation is the close factor, ranging from 0 to 100%. If less than 100%, the liquidation process may continue until the borrowed asset value is under the user's borrowing capacity.

### Interest Rate Curve

The Liqwid protocol uses an interest rate model with several parameters to create an interest rate curve based on depositor supply and borrower demand in each Market. Borrowing interest rates increase as a direct function of demand for loans in that Market's underlying asset; if borrow demand is low, interest rates should be low, and the opposite when borrow demand is high. Borrowers pay this interest rate per USD value of the asset borrowed from the Market each block. Depositors supplying supported assets to the protocol earn the supply rate each block. The market utilization ratio for every Liqwid Market is the proportion of total value supplied to the market that is currently being borrowed from:

$$\text{Market Utilization} = \text{borrowedSupply} / (\text{borrowedSupply} + \text{marketSupply})$$

Liqwid DAO Token (LQ) holders who propose changes and vote on updates to system parameters via community governance processes, can modify the interest rate curve for each individual Market.

An example of a borrow interest rate model is:

$$\text{Borrow Rate} = \text{riskFreeRate} + (\text{marketUtilization} * \text{marketRate})$$

The supply rate earned by depositors is a function of the Market's current utilization level and borrow rate:

$$\text{Supply Rate} = \text{borrowRate} * \text{marketUtilization}$$

## Interest Rate Curve Functionality

Liquid markets have algorithmically calculated interest rates, which are applied to all borrowers equally and are dynamically updated to reflect the Market's current supply and demand conditions.

An archive of interest rates for each Market is stored via an interest Index, which is updated each time a Liquid market's interest rate updates. The interest rate is calculated as a function of the aggregate qToken minting, redeeming, borrowing, repaying, or liquidating in the Market's underlying asset. When user's complete any one of these actions it updates a Market's interest rate. Specifically, the protocol uses interestSlots to refer to the number of slots since the last time the interest index was calculated. The most recent slot is stored as interestSlotNumber and is stored whenever an interest index is stored. The interest index is a key function in the operation of the protocol and tangentially serves to provide transparency of historical interest rates.

## Market Actions

Every transaction that is executed in a Liquid Market updates the Interest Rate Index to accrue the interest since the last interest index (stored as the most recent interestSlotNumber). This uses the interest for the slots since the last index, established by rate \* slots, calculated using an approximately per-block simple interest rate:

$$\text{Index}_{a,n} = \text{Index}_{a,(n-1)} * (1 + \text{rate} * \text{slots})$$

A Liquid Market's total outstanding borrow value is periodically calculated to account for the interest accumulated since the last interest index:

$$\text{totalBorrowBalance}_{a,n} = \text{totalBorrowBalance}_{a,(n-1)} * (1 + \text{rate} * \text{slots})$$

The portion of repaid interest that is retained by a Market is utilized as a liquidity buffer for suppliers and cannot be borrowed. Market reserves are based on the total amount borrowed and the reserveFactor:

$$\text{reserves}_a = \text{reserves}_{a,(n-1)} + \text{totalBorrowBalance}_{a,(n-1)} * (\text{rate} * \text{slots} * \text{reserveFactor})$$

\*The reservesFactor is a parameter that may be adjusted via community governance.

## Liquidity Incentives

The Liqwid protocol depends on interest rate curves to incentivize liquidity providers to supply assets. In liquidity crunch scenarios, there is unusually high demand for an asset and the available supply for new loans or withdrawals decreases. The protocol relies on the interest rate curve parameters to gradually increase the borrow interest rates as market utilization grows to mitigate this scenario, incentivizing both new liquidity supply and borrow repayment while discouraging new borrows. Each market includes a parameter to define the Market utilization level where the slope of the borrow interest rate curve is increased.

Interest rates matrix:

		Demand of liquidity (Borrows)	
		High	Low
Supply of liquidity	High	Normal interest rate	Low interest rate
	Low	High interest rate	Normal interest rate

1. When liquidity is readily available, low interest rates encourage new loans.
2. When liquidity is scarce, high interest rates incentivize loan repayment and additional supply.

## Protocol Architecture and Design

Fundamentally the Liqwid protocol is a set of money markets implemented as a decentralized loan book that enables Cardano addresses to deposit or borrow assets and perpetually calculates interest each block. Liqwid Market Plutus smart contracts will be open source and made available with documentation for any developer to build atop the protocol.

### qTokens: Cardano Native Tokens

Every Liqwid Market is constructed with a smart contract computing mint (and burn) amount via the qToken minting policy script. Deposited funds are expressed as tokenized (qTokens) balances of supplier positions. As fungible Cardano Native Tokens qTokens can be transferred and traded on DEX's the same as any other cryptographic asset on Cardano. Users can mint qTokens on-demand by supplying assets to a Liqwid Market or withdraw assets from a Market by redeeming (burning) qTokens for the underlying native asset. The exchange rates between qToken and the underlying asset continuously increases over time, as interest is accrued by outstanding loans for the asset. The exchange rate formula is:

$$\text{exchangeRate} = (\text{marketSupply} + (\text{totalBorrows} * \text{reserveFactor})) / \text{qTokenSupply}$$

\*The Market reserves act as a liquidity buffer to ensure suppliers have sufficient liquidity to withdraw assets from the protocol.

As a Market's total value borrowed increases (perpetually accruing loan interest), the exchange rate between qTokens and the market's underlying native asset increases.

Description of primary qToken smart contract endpoints:

<i>Smart Contract Endpoint</i>	<i>Description</i>
Deposit	A deposit will accept a supported underlying asset and mint the corresponding qTokens at the current exchange rate.
Redeem / RedeemUnderlying	Accepts qTokens as transaction inputs and burns the qTokens, sending an equivalent amount of the underlying asset (determined by the current qToken to underlying exchange rate) to the user's wallet as the output. Redeem's parameters is denominated in the amount of qTokens while redeemUnderlying is denominated in the amount of the underlying asset to be redeemed.
Borrow	Accepts an amount of fungible qTokens as the user's collateral and a requested borrow amount in one of the supported underlying assets for a market. If successful, the collateral will remain locked by the contract and the borrowed asset will be released to the user.
RepayBorrow / RepayBorrowBehalf	Accepts the underlying asset, calculates outstanding interest, and deducts the repaid amount from the borrowed amount for the user's borrow balance. To repay borrow on behalf; users can supply an address who they are repaying the loan for.
Liquidate	Transfers the underlying native asset into a liquidation pool, updates the user's borrow balance, next transfers qToken collateral from the borrower to the liquidation pool address for suppliers to claim pro-rata.

## Borrower Actions

A user's borrow balance, accounting for accrued interest to their loan position, is calculated as the ratio of the current Interest Rate Index divided by the Index when the user's borrow balance was last updated.

## Borrowing Native Tokens



A user who wants to open a loan and has deposited collateral may call borrow on their preferred qToken contract. The Borrow endpoint checks the user's current account liquidity calculated by the value of their supplied assets after accounting for collateral factors. If enough collateral is supplied, the contract transfers the underlying native tokens to their Cardano address, updates the user's borrow balance, and updates the Market's variable interest rates and interest index.

Open loans accumulate interest each block according to the latest borrow interest rate in the Market's a user has borrowed from.

## Liquidation Events

If a Liqwid user's outstanding borrow balance exceeds their borrowing capacity, the public `liquidate` endpoint can be called. This endpoint seizes the collateral of the liquidated position and exchanges it against the liquidator-supplied assets. This mechanism is key for securing the protocol from default risk.

The collateral pools combine all defaulted borrowers' seized collateral amounts and exchange them against the assets deposited in the liquidation pools by liquidators. To incentivize the users who are securing the protocol from insolvency, liquidators are rewarded via a liquidation incentive; a multiplier representing the discount on a borrower's collateral that a user receives when liquidating the borrower's default position.

## Safety Pool

The core mechanism for securing the Liqwid protocol is the incentivization of LQ holders to lock tokens into a Plutus smart contract-based component of the Agora governance module [\[3\]](#) called the Safety Pool (SP). The staked LQ will be used as a mitigation tool in case of a Shortfall Event within Liqwid money markets. A Shortfall Event occurs when there is a deficiency in a Market. The working interpretation for the occurrence of a Shortfall Event is subject to updates through a community governance vote. The LQ Safety Pool is inspired by the AAVE Safety Module [\[2\]](#).

LQ holders are encouraged to deposit their tokens into the SP to serve as the reserve asset protecting the entire Liqwid ecosystem. In return for staking LQ, users will receive a part of the value captured by the protocol, termed the dividend factor; the portion of protocol income transferred to the DAO to be paid as dividends to LQ holders. The LQ token can be removed from the SP at any time but needs to remain at least one (1) Epoch (5 days in Cardano) to claim a right to receive the dividend for the value captured by the protocol during this interval.

## Price Feeds

Oracles in the protocol enable open price feeds through a set of decentralized data providers (e.g., Chainlink, exchange APIs, DEXs) that sign price data at fixed intervals using a known public key, which the oracle contract posts on-chain. The price feeds are core to the protocol functionality for determining borrowing capacity and collateral requirements.

## Community Governance

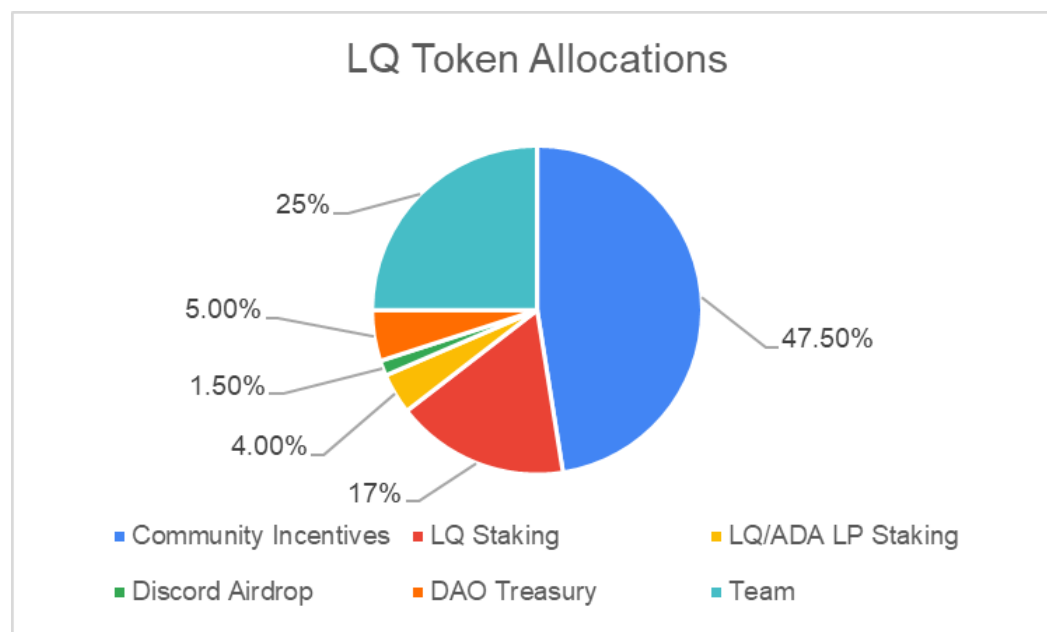
The Liqwid protocol is governed by LQ token holders and updated by ecosystem developers, using multiple core components; the LQ token, governance module (Agora), and a locking period. Agora is a set of Plutus smart contracts that compose together to form a governance system. In aggregate these contracts allow the community to propose, vote, and implement changes through system parameter updates. Proposals can adjust parameters, whitelist new markets, or allocate DAO treasury funds.

Agora supports liquid democracy enabling LQ token holders to delegate their voting rights to themselves, or an address of their choosing. Addresses delegating the minimum threshold can create governance proposals; any address regardless of LQ amount can create a draft proposal, which becomes a governance proposal after being delegated the minimum threshold.

When a governance proposal is created, it enters a draft review period if the proposer does not have the minimum LQ threshold required. If they do have the minimum LQ amount staked the proposal goes straight to vote; the voting power is recorded based on the sum LQ amount staked by all users and voting begins. Voting lasts for 3 days; if a majority, and the quorum of votes are cast for the proposal, it enters the locking phase, and can be implemented 2 days later. Successful proposals to update the protocol takes at least 5 days.

## DAO Token Distribution

The distribution schedule and token allocation are designed to facilitate a community governed DeFi protocol with sufficient incentives for early adopters while also aligning long-term incentives amongst key protocol users to drive future growth into the ecosystem.



## Fair Vesting

Tokens allocated to the Core Team will be distributed according to a fixed vesting schedule that will gradually release LQ to the core team, advisors, and tech partners over the course of the first 146 epochs (two years). The tokens allocated for the founding team, advisors, and technology partners (25%) are held by a smart contract that releases the tokens on a linear per epoch basis for two years. The vesting period begins at the time of v1 launch.

Total amount of LQ tokens: 21,000,000

LQ policy id: da8c30857834c6ae7203935b89278c532b3995245295456f993e1d24

## Summary

- The Liqwid protocol creates dynamically functioning Money Markets for selected Cardano native tokens.
- Every Liqwid market has interest rates that are calculated by the lender supply and borrower demand of the underlying asset; as loan demand increases relative to supply, interest rates increase, incentivizing additional users to supply liquidity and loan repayment.
- Users can supply tokens to a market to earn interest without giving up custody of their keys to a third party.
- Users can borrow a Market's native asset by locking their Liqwid qToken balance as collateral.

## References

[1] Synthetic Docs <https://synthetix.community/docs/staking-strategies>

[2] Aave Docs <https://docs.aave.com/aavenomics/safety-module>

[3] Agora Docs <https://github.com/Liqwid-Labs/agora>