Numina: a Multi-Chain Lending Protocol with Zero Liquidations.

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Abstract

Numina is a lending protocol presenting peculiar features that distinguish it from most of the protocol of this type. First of all, Numina will not provide for liquiditations, thus ensuring the safety of users assets. In the second instance, it will be multi-chain from the date of it launch, addressing interoperability challenges that often plague decentralized platforms.

1 Introduction

Numina essentially consists in a set of pools in which users are able to deposit a specific asset (different for each pool). These users are addressed as *liquidity providers* and the asset they provide to the pool will be referred to as *Core*.

Users can also borrow Core from the pool by providing a specific asset as *Collateral*: they will be referred to as *borrowers* and the amount of Core they receive is dictated by LTV (see subsection 3.1).

As already mentioned, Numina is composed by different pools that are independent from each other. Thus, users can choose to which pool provide liquidity, that is they can choose to which Collateral expose themselves.

Pools source prices from an oracle contract and track assets through the following quantities.

- **aCore (available Core)**: total amount of Core assets that are available to be borrowed.
- **lCore (locked Core)**: total amount of Core assets that has been issued as loans.

- **lCollateral (locked Collateral)**: total amount of Collateral assets deposited in the pool by users to borrow Core.
- **aCollateral (available Collateral)**: total amount of Collateral assets within the pool that are not related to any loan. They result from extinguished debt position (see section 3).

Now that Numina main elements have been presented, this paper will examine in depth some aspects of the protocol. Section 2 provides detailed information on how LP tokens are distributed and how the protocol compute their value. Section 3 explains when debt are extinguished. Section 4 describes how interest is computed. Section ..... Finally, section 6 concludes the paper.

2 Liquidity Provider Tokens

Liquidity providers play a pivotal role within Numina ecosystem, since they enhance liquidity by contributing to the Core asset. In return for their service, the pool issues *Liquidity Provider Tokens* (*LPTs*): these tokens serve as a receipt and represent the share of the pool belonging to the provider.

2.1 LPTs issue

When a user provide liquidity to the pool, a certain amount of LPTs will be minted and sent to him. In order to determine the precise quantity of LPTs, it must be first defined the total value of a liquidity pool.

$$PV = aCore + aCollateral + lCore \tag{1}$$

PV is the total value of the pool. Note that, for the formula to be consistent, all assets are evaluated with respect to the Core. As an example, consider the pool between USDC (Core) and BTC (Collateral) and assume that $1\,BTC = 20,000\,USDC$. If:

$$\begin{aligned} aCore &= 100,000\,USDC \\ aCollateral &= 0.5\,BTC \\ lCore &= 30,000\,USDC \end{aligned}$$

Then we can evaluate the total value as:

$$PV = 100,000\,USDC + (0.5 * 20,000)\,USDC + 30,000\,USDC = 140,000\,USDC$$

Now that is clear how to evaluate PV, it is possible to use the following formula to compute the amount of LPTs minted when providing Core to the pool:

$$LPTs\ minted = \frac{Core\ provided}{PV} * LPTs\ supply \tag{2}$$

Where:

- **Core provided** is the amount of Core tokens deposited by the liquidity provider.
- **LPTs supply** is the total number of LPTs issued and actually in circulation at the moment of the deposit.

2.2 LPTs redemption

Liquidity providers can withdraw their share of the pool (or just a part of it) at any moment by sending to the protocol the totality of their LPTs (or just a part of it). Numina evaluates the value of these LPTs according to the following formula.

$$LPTs\ value = \frac{LPTs\ withdraw}{LPTs\ supply} * PV \tag{3}$$

Where:

- $LPTs\ value$ is the value of LPTs sent to the protocol for the withdraw. It is evaluated with respect to the Core asset, similarly to the PV, and it represents the amount of assets that the liquidity provider will receive back.
- $LPTs\ withdraw$ is the number of LPTs send to the protocol in order to withdraw liquidity.
- $LPTs\ supply$ is the total number of LPTs issued and actually in circulation at the moment of the withdraw.

The share of the pool belonging to the liquidity provider is composed by Core and Collateral. The protocol uses the parameter r to evaluate this two quantities starting from the $LPTs\ value$ computed before.

$$r = \frac{aCore}{aCollateral + aCore} \tag{4}$$

For the formula to be consistent, $aCollateral$ is evaluated with respect to Core, as already done for PV and $LPTs\ value$.

$$Core\ withdraw = r * LPTs\ value \tag{5}$$

$$Collateral\ withdraw = (1 - r) * LPTs\ value \tag{6}$$

Where $Core\ withdraw$ and $Collateral\ withdraw$ are respectively the amount of Core tokens and Colateral tokens received by the liquidity provider at the end of the withdraw.

3 Loan duration

Diverging from traditional lending protocols, Numina introduces a predetermined lifespan for loans. When borrowing Core, users are asked to choose a certain period of time within which they are obliged to close their debt position. They can choose the amount of time that they prefer as long as it is inferior to a maximum time span established by the protocol: this time span will be different for each pool.

Users can repay their debt at any moment, however, in case the deadline is surpassed and the borrower has not closed his position, the debt is extinguished. As a result, the amount of lCore of the pool will decrease, while the lCollateral associated to the debt position will be converted into aCollateral and proportionally distributed among liquidity providers.

3.1 LTV

The *initial Loan-to-Value ratio* ($iLTV$) is a parameter of the pool and it dictates the quantity of Core a user can borrow given a certain quantitiy of Collateral.

$$Core\ borrowed = iLTV * Collateral\ deposited \tag{7}$$

This parameter is always set to be less than 1 and it is different for each pool. The higher the iLTV, the more lucrative it becomes for borrower to initiate a loan.

Since the value of Core and Collateral can change during the loan, the protocol associates to every debt position a LTV (*Loan-to-Value ratio*). This

parameter is the ratio between the value of Core borrowed by the user and the value (with respect to Core) of Collateral deposited into the pool.

In case the deposited Collateral value surpasses the borrowed Core value ($LTV > 1$), the debt position cannot be closed until the deadline initially set by the borrower. This feature is designed to ensure a robust and structured approach, maintaining the integrity of the lending process and offering both borrowers and liquidity providers a clear understanding of their commitments within Numina protocol.

4 Interest model

When closing a debt position, a borrower has to send back to the protocol the Core he borrowed plus a certain amount of Core that represents the *interest fee*. Proceeds deriving from this fee are distributed among liquidity providers of the pool proportionally to the amount of LPTs they own.

In traditional lending protocols, liquidity providers are those most exposed to risks and losses. The interest model aims to guarantee them sufficient returns and to incentivize users providing liquidity to pools. Every pool of Numina ecosystem will apply a specific interest model, however they are all based upon the *Utilization Ratio* (UR) that is defined as follows:

$$UR = \frac{lCore}{lCore + aCore} \tag{8}$$

The greater is UR, the greater will be the interest fee, even if the particular relationship between the two of them is dictated by the interest model.

In case the borrower partially repays the debt, interest repayment takes precedence over the debt settlement.

If a debt position is not closed within the deadline set by the borrower, the accrued interest fee is forfeited.

5 External swaps

A user can buy aCollateral from a pool in exchange for Core. Pools will source the swap price from an oracle contract. Users buying aCollateral will also pay a *swap fee* in Core asset that will be different for each pool. Proceeds deriving from the fee of a pool are distributed among liquidity providers of that particular pool proportionally to the amount of LPTs they own.

As an example consider the pool between USDC (Core) and BTC (Collateral) and assume that $1\,BTC = 10,000\,USDC$. A user sends $5,000\,USDC$ to the pool in order to buy aCollateral. If the swap fee is equal to 2%, only 98% of Core will be used for the swap, while the remaining part will be paid as a fee. Thus, the amount of aCollateral purchased by the user can be evaluated with the following formula:

$$aCollateral = (1 - 0.02) * 5,000\,USDC * \left(\frac{1\,BTC}{10,000\,USDC}\right) = 0.49\,BTC$$

This mechanism not only creates arbitrage opportunities, but also allows for the sale of collateral stemming from extinguished debt positions, enhancing flexibility and generating additional profits for liquidity providers.

6 Conclusions

This paper presented Numina