Anchor Liquidation Protocol

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Abstract

The Anchor liquidation protocol protects the principal of Anchor depositors by guaranteeing that all loans against them are sufficiently collateralized. The protocol finances liquidations via a pool of liquidation contracts, which undertake the task of paying back "at risk" loans in exchange for collateral plus a liquidation fee. In addition to the fee, contracts earn a passive premium which is determined algorithmically to incentivize high coverage of outstanding loans. The incentive structure of liquidation contracts thereby creates higher robustness and solvency guarantees compared to existing keeper systems. A "collateral" product of the liquidation protocol, the liquidation contract is a high-yield financial instrument which we expect to have broad demand in its own right.

1 Introduction

An essential feature of the Anchor savings protocol is principal protection: depositors can have peace of mind that their principal is safe. Unlike bank deposits, whose safety is a function of the bank's ability to assess the credit-worthiness of borrowers, Anchor deposits are secured by over-collateralized loans (debt positions). Deposits are safe insofar as all debts against them remain over-collateralized. The function of the Anchor liquidation protocol is to maintain deposit safety by paying off debts that are at risk of violating collateral requirements.

This short paper serves as a technical supplement to the Anchor white paper by covering the structure and mechanics of Anchor liquidations. We assume basic familiarity with the Anchor protocol. We start with an overview of the liquidation protocol, then proceed to cover liquidation contracts, the liquidation procedure and liquidation premia.

2 Protocol Overview

The core objective of Anchor's liquidation protocol is to pay back loans that are "at risk". Recall that Anchor borrowers are given a borrowing capacity – measured in Terra – that is determined by the amount and quality of their posted collateral. A loan is deemed to be "at risk" when it exceeds the borrower's borrowing capacity. The protocol pays back "at risk" loans using liquidation contracts.

A liquidation contract undertakes the task of paying back debt in exchange for collateral plus a fee – the "liquidation fee". Liquidation contracts are aggregated in a pool and tapped "on demand" when a loan needs to be liquidated, in ascending order of liquidation fee. In addition to the liquidation fee, contracts earn a passive premium charged to borrowers that is calibrated to ensure full coverage of outstanding loans.

A secondary objective of the protocol is to liquidate block rewards from collateral assets. Recall that Anchor uses a portion of block rewards that accrue to collateral bAssets (bonded assets) to subsidize the Terra deposit interest rate. Block rewards that are directed to depositors are liquidated for Terra at regular intervals using the same liquidation contract mechanism.

In what follows we cover each piece of the protocol in depth. For simplicity of presentation we restrict the remaining discussion to debt liquidation. We also restrict to the case of single-collateral loans – note that Anchor allows a single loan to be collateralized by multiple bAssets. Generalization of the liquidation mechanism to multi-collateral loans is straightforward.

3 Liquidation Contracts

The core building block of the liquidation protocol is the Liquidation Contract (LC). The "buyer" is the owner of a debt position that is being liquidated. The "seller" is the writer of the contract who pays the debt in exchange for collateral plus a liquidation fee. The contract is defined by the following terms:

- **Collateral asset**: the collateral asset of the debt position to be serviced
- **Size**: the amount of Terra covered by the contract
- **Liquidation fee**: the % fee the writer will be paid in excess of value of the debt if called to finance a liquidation
- **Withdrawal notice**: waiting period before a contract can be recalled – fixed at one month

Liquidation contracts are fully collateralized, meaning that the writer locks up an amount of Terra equal to the contract size. Contracts stand indefinitely until they are explicitly recalled by the writer. Withdrawing a contract requires a one month notice, during which contracts are fully eligible for exercise. The liquidation fee is capped at $\frac{1}{LTV} - 1$ where LTV is the collateral's loan-to-value ratio. For example, if the collateral's LTV is 80% the liquidation fee on contracts for loans with that collateral is capped at 25%. This is to ensure that the liquidation contract doesn't "bankrupt" the loan it is supposed to finance. Debt positions that are liquidated via contracts therefore guarantee the principal to the depositor.

Rather than requiring borrowers to purchase contracts directly from sellers, Anchor pools all outstanding contracts and sorts them in ascending order of liquidation fee (example below). When a debt position is liquidated, Anchor matches it with the cheapest outstanding contract and automatically exercises it. Multiple contracts may be exercised until the "at risk" loan has been fully repaid.

premium : 2%	130000 UST
premium : 3%	250000 UST
premium : 4%	120000 UST

4 Liquidation Procedure

We outline Anchor's liquidation logic in more detail. Let X be the collateral asset for a debt position. The condition for a liquidation to take place is the following:

$$debt > oraclePrice(X) \cdot collateralAmount(X) \cdot LTV(X)$$

On this trigger, Anchor performs the following procedure:

1. Iteratively exercise contracts from the X liquidation pool, in ascending order of liquidation fee, until the debt has been repaid.

2. Return any remaining X collateral to the debt position holder after liquidation fees have been paid.

In the unlikely event that a liquidation fails because there are no contracts left in the queue, Anchor activates a last-resort "keeper" system that allows anybody to seize 100% of a debt position's collateral in exchange for paying back the debt. This "emergency mode" circumvents the need for contract creation/long-term commitment and rewards the liquidator with 100% of the difference between collateral value and loan value. In the exterme case where the value of the collateral has dropped below the value of the loan, the liquidator receives an emergency liquidation fee of 25% and uses the remaining collateral to pay back the portion of the loan that can be covered. Anchor's incentive mechanism for both borrowers and liquidators makes this scenario extremely unlikely. We expand on this observation in the following section.

5 Liquidation Premium

From the perspective of a liquidation contract writer, locking up capital for an extended period of time has significant opportunity cost. In fact, they could be earning a sizable interest rate on an Anchor deposit with zero lockup. To offset this cost and make liquidation contracts attractive, Anchor offers two ways for contract writers to make profit:

1. **Passive premium**: Contracts earn a passive interest rate premium throughout their lifetime independent of exercise. This premium is dynamic and is charged to the borrower *in excess of* the Anchor interest rate.

2. **Profit from exercise**: In the event of an exercise, the contract writer profits insofar as revenue from selling the earned collateral plus the liquidation fee exceeds the value of repaid debt.

Before determining the algorithm for the interest rate premium we must first define a measure of Anchor solvency – **liquidation coverage**. Simply put, liquidation coverage is the fraction of borrowed Terra that is covered by liquidation contracts. Liquidation coverage can be more than 1 if the aggregate locked up amount in outstanding contracts exceeds the borrowed amount. A coverage of 1 or more implies full solvency. Lower coverage implies higher risk for depositors. More precisely, liquidation coverage at time t is defined as follows:

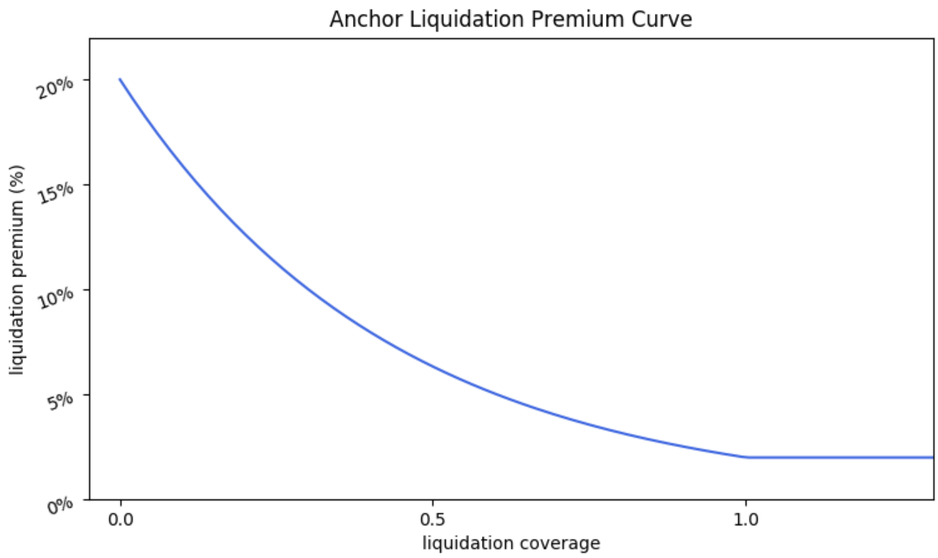
$$liquidationCoverage(t) = \frac{\left(\sum_{contracts} size\right)(t)}{borrowedAmount(t)}$$

Intuitively, we would like to pay a higher premium to liquidation contracts when coverage is low to incentivize new contracts, and lower premium when coverage is high to reduce uneccessary cost to borrowers. We formalize this idea by defining a transformation from liquidation coverage to liquidation interest rate premium:

$$premium(t) = g\Big(liquidationCoverage(t)\Big)$$

g is a continuous monotonically decreasing convex function mapping $[0, \infty)$ to an interval $[m, M]$ such that $g(0) = M$ and $g(1) = m$. Effectively, this function sets the premium to the upper bound M when liquidation coverage is 0 and to the lower bound m when liquidation coverage is 1 or more. Indicative values for m and M are 2% and 20%. There are additional constraints in the premium algorithm that we don't cover here, such as the maximum change of $premium(t)$ in a given time step.

The graph below shows a function g with the desired properties for the indicative m, M values:



The liquidation premium function here is $g(x) = \max\left(m^x \cdot M^{1-x}, m\right)$, where x is the liquidation coverage. By construction, $g(0) = M$ and $g(x) = m$ for $x \geq 1$.

An important piece of the mechanism to complete the picture is the distribution of interest premia among contracts. Contracts offering lower liquidation fees should naturally receive higher premia. Contracts are therefore paid inversely to the liquidation fee they are charging. To formalize this we define the weight of a contract in the liquidation pool as $\frac{1}{\lambda^2}$, where λ is the contract's liquidation fee. Premia are paid to contracts in proportion to those weights. This means that a contract asking for a fee of 1% receives 4 times the premia of a contract with a fee of 2% and 100 times the premia of a contract with a fee of 10%. Given that all contracts have the same withdrawal notice, the fee is the only distinguishing factor for premium distribution.

There are two key properties of the dynamic premium which in combination contribute to Anchor's robustness and solvency:

1. As liquidation coverage decreases, the payoff for writing a liquidation contract increases.

2. As liquidation coverage decreases, debt positions become increasingly expensive, which discourages new loans and encourages outstanding loans to be repaid.

Both of the above forces are expected to *increase* liquidation coverage. Dynamics for both the borrower and the contract writer therefore gravitate the system towards a high degree of solvency.

The structure and incentives built into liquidation contracts enable them to provide higher solvency guarantees compared to a traditional "keeper" system. Keeper systems rely on arbitrageurs to finance liquidations on a discretionary basis. The discretionary nature of keepers creates uncertainty as to whether and when they will step in to finance a liquidation, especially during collateral shocks when the risk of liquidating volatile collateral is high. This liquidity risk has materialized in practice in Maker's keeper system, resulting in huge losses for borrowers. A further implication of this uncertainty is that it is hard to reliably reason about liquidation coverage. Liquidation contracts, on the contrary, are fully collateralized and require a one month withdrawal notice. Liquidation demand is therefore predictable and stable in the face of temporary shocks, thus protecting both depositors and borrowers. Knowledge of liquidation coverage further allows the system to create incentives for full coverage of outstanding loans.

6 Conclusion

The Anchor liquidation protocol uses liquidation contracts to guarantee that "at risk" loans are paid back to depositors. Contracts are fully collateralized in Terra, and stand to profit both at the time of liquidation and via a passive premium, which is calibrated to ensure Anchor's solvency. We believe that the proposed protocol introduces key improvements relative to existing liquidation systems and sets a high bar for principal protection in DeFi.