Anchor: Gold Standard for Passive Income on the Blockchain

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Abstract

Despite the proliferation of financial products, DeFi has yet to produce a savings product simple and safe enough to gain mass adoption. The price volatility of most cryptoassets makes staking unfit for the vast majority of consumers. On the other end of the spectrum, the cyclical nature of stablecoin interest rates on DeFi staples like Maker and Compound makes those protocols ill-suited for a household savings product. To address this pressing need we introduce Anchor, a savings protocol on the Terra blockchain that offers yield powered by block rewards of major Proof-of-Stake blockchains. Anchor offers a principal-protected stablecoin savings product that pays depositors a stable interest rate. It achieves this by stabilizing the deposit interest rate with block rewards accruing to assets that are used to borrow stablecoins. Anchor will thus offer DeFi's benchmark interest rate, determined by the yield of the PoS blockchains with highest demand. Ultimately, we envision Anchor to become the gold standard for passive income on the blockchain.

1 Introduction

In the past few years we have witnessed explosive growth in Decentralized Finance (DeFi). We have seen the launch of a wide range of financial applications covering a broad range of use cases, including collateralized lending (Compound), decentralized exchanges (Uniswap) and prediction markets (Augur). Despite early success and a robust influx of brains and capital, DeFi has yet to produce a simple and convenient savings product with broad appeal outside the world of crypto natives. We believe that the path to mass adoption for decentralized finance is the savings product.

Anchor is a savings protocol that accepts Terra deposits, allows instant withdrawals and pays depositors a low-volatility interest rate. To generate yield, Anchor lends out deposits to borrowers who put down liquid-staked PoS assets from major blockchains as collateral (bAssets). Anchor stabilizes the deposit interest rate by passing on a variable fraction of the bAsset yield to the depositor. It guarantees the principal of depositors by liquidating borrowers' collateral via liquidation contracts and third-party arbitrageurs.

We believe that the provision of a stable interest rate to depositors is a necessary feature of a savings product with broad appeal. Anchor thus overcomes one of the key limitations of Compound and Maker as savings products: the highly cyclical nature of deposit interest rates. Beyond offering low-volatility yield, Anchor is an attempt to give the main street investor a single, reliable rate of return across all blockchains. The plethora of staking products, each with varying terms and yields, makes DeFi inaccessible and unappealing to average investors. By aggregating block rewards from all major PoS blockchains, Anchor aspires to set the blockchain economy's benchmark interest rate.

The rest of the paper is organized as follows. We start by introducing the concept of a tokenized stake in a PoS blockchain (bAsset). In the following section we cover the basics of the Anchor money market, which serves as the building block for the savings protocol. Next we introduce the Anchor Rate as a benchmark interest rate, and propose a mechanism that stabilizes the deposit interest rate at that benchmark. After that we cover the liquidation mechanism that implements Anchor's principal protection. In the last section we discuss a number of applications of Anchor money markets beyond savings.

2 Tokenized Stakes (bAssets)

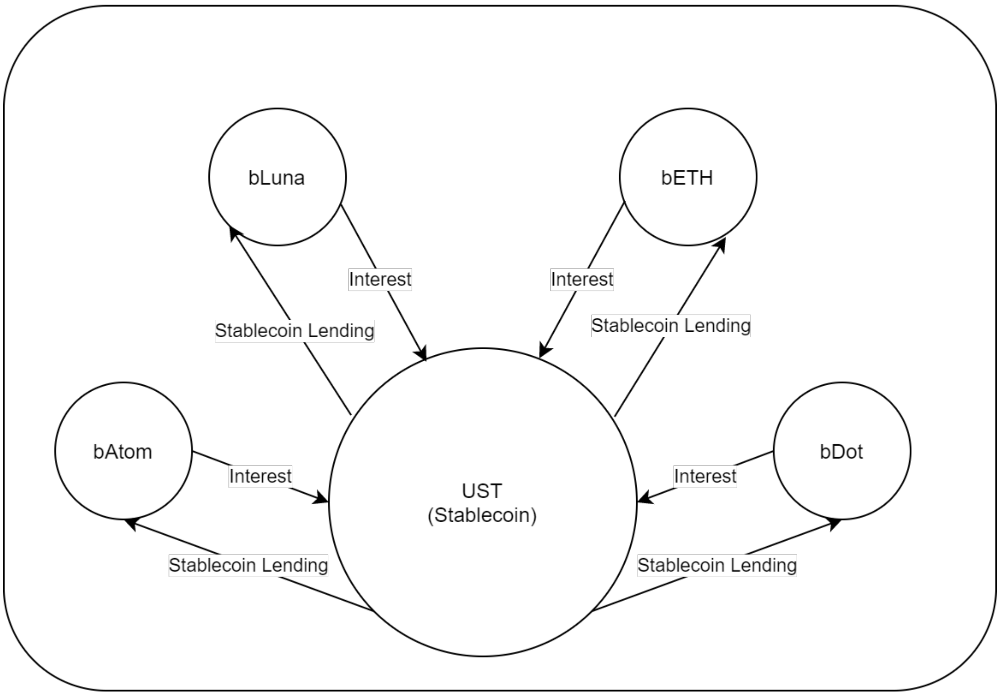
One of Anchor's core primitives is the bAsset (bonded asset) — a tokenized stake on a PoS blockchain. A bAsset is a token that represents ownership of a staked PoS asset. Like the underlying staked asset, a bAsset pays the holder block rewards. Unlike the staked asset, a bAsset is both transferable and fungible. Users can therefore transact with bAssets with the same ease as the underlying PoS asset. In summary, a bAsset allows the holder to earn block rewards while maintaining the liquidity and fungibility that staked assets forego. bAssets are broadly usable – they can be generated on any PoS blockchain that supports smart contracts. bAssets are a central component of Anchor – we will soon explain their key role in offering a stable interest rate to Terra deposits.

The precise mechanism of bAssets involves intricacies that are beyond the scope of this paper. We will be releasing a separate technical specification for bAssets that will cover the precise mechanics. For the purposes of Anchor we assume the existence of a tokenized staking smart contract that adheres to the above properties.

3 The Terra Money Market

The core building block of the Anchor savings protocol is the Terra money market – a WASM (Web Assembly) smart contract on the Terra blockchain that facilitates depositing and borrowing of Terra stablecoins (TerraUSD, for instance). The money market is defined by a pool of Terra deposits that earns interest from borrowers. Borrowers put down digital assets as collateral to borrow Terra from the pool. The interest rate is determined algorithmically as a function of borrowing demand and supply, which is encoded by the pool's utilization ratio (fraction of Terra in the pool that has been borrowed).

Anchor Money market structure



3.1 Debt Positions

Borrowing from the Terra money market is as straightforward as locking up collateral in exchange for a loan. The main parameter of a debt position is its *borrowing capacity*: the maximum amount of debt an account can accrue. An account's borrowing capacity is determined by the amount and quality of locked-up collateral. Anchor defines a *loan-to-value ratio* (LTV) for each type of collateral, which indicates the fraction of a collateral asset's value that contributes to a debt position's borrowing capacity. LTV ratios range from 0 to 1 and are a function of an asset's volatility and liquidity. Stable, liquid assets will have high LTV ratios, while volatile illiquid assets will have low LTV ratios. If an account holds an asset X with an LTV ratio of 80%, then 80% of X's value contributes to the account's borrowing capacity. The Anchor smart contract sums the value of all collateral assets multiplied by their LTV ratios to determine an account's total borrowing capacity. In the following section we discuss how Anchor determines the interest rate for debt positions.

3.2 Algorithmic Interest Rates

Anchor uses an algorithmic interest rate algorithm to determine depositor and borrower rates for Terra based on borrowing demand and supply. The key input to the algorithm is the Terra pool utilization ratio. The utilization ratio represents what fraction of Terra in the pool is borrowed. More precisely:

$$u(t) = \frac{borrowedDeposits(t)}{totalDeposits(t)}$$

The interest rate algorithm charges borrowers more and pays depositors more as the utilization ratio increases. On the other hand, as the utilization ratio decreases, the borrower pays less interest, resulting in lower interest for the depositor. The algorithm lowers borrower interest to incentivize borrowing when the utilization ratio is low, and increases borrower interest to disincentivize borrowing when the utilization ratio is high. This algorithm can be formulated generally as follows:

$$depositRate(t) = u(t) \cdot borrowRate(t)$$

$$borrowRate(t) = f(u(t))$$

where f is a continuous increasing function.

This formulation has a key shortcoming – one that is shared by the Compound protocol which first introduced the idea: both rates are increasing functions of the utilization ratio, and therefore both are highly sensitive to market cycles. A pattern that emerges clearly from historical data on Compound is that the utilization ratio on stablecoin money markets is highly correlated with Ethereum price movements. Upswings in Ethereum's price increase demand for leveraged long positions on Ethereum, which results in increased borrowing from stablecoin money markets. The opposite is true during Ethereum price downswings: a decrease in leveraged long demand, in combination with liquidations of Ethereum debt positions, results in less stablecoin borrowing. See the Appendix for data on this pattern collected from the past 12 months of stablecoin borrowing on Compound.

The interest rate equations demonstrate that cyclicality in utilization ratio directly translates to cyclicality in borrower and depositor rates. We believe that cyclicality of interest rates on DeFi protocols is a key barrier to broad adoption. To solve this problem, we propose a benchmark interest rate and a stabilization mechanism to achieve it in the following section.

4 Interest Rate Stabilization

We define an interest rate benchmark, the Anchor Rate, and propose a mechanism to stabilize the deposit interest rate to the benchmark.

4.1 The Anchor Rate

There is a plethora of staking and savings products, each with its own risk/return profile, and each with a rate that fluctuates over time. Given all those options, what interest rate does the main street investor keep track of, and how much confidence does she have in its stability? There is no good answer to this question at the time of writing. Anchor aspires to be the answer by setting DeFi's benchmark intest rate.

Unlike central banks, which control the supply of money to set interest rates, Anchor takes a different approach. In the absence of a printing press, Anchor uses block rewards across blockchains to derive DeFi's benchmark rate. With Anchor, the return that depositors can expect is a function of borrowers' on-chain income. The Anchor money market is a unique enabler of "yield transfer" from borrower to depositor by accepting bAssets as collateral. The resulting diversified yield, the **Anchor Rate**, reflects the market's preferred sources of yield on the blockchain. For this reason the Anchor Rate has the potential to be more stable than any individual yield, or any *fixed* collection of yields.

We define the Anchor Rate formally by considering the bAssets used as collateral for borrowing from Anchor's Terra money market. Let $a_{1,}a_{2,...,}a_n$ be those assets, with yields $y_1, y_2, ..., y_n$ and collateral value locked up in open debt positions $c_1, c_2, ..., c_n$, where yields and value are Terra-denominated. The Anchor smart contract computes 12 month moving averages for the yields $\tilde{y_1}, \tilde{y_2}, ..., \tilde{y_n}$. The Anchor Rate at time t is defined as follows:

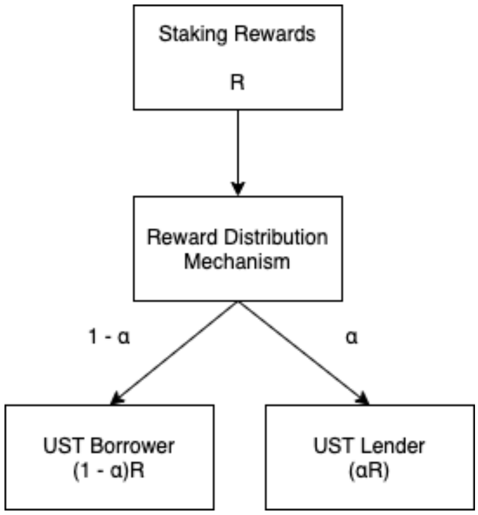
$$AR(t) = \frac{\sum_{i=1}^{n} c_i(t) \cdot \tilde{y}_i(t)}{\sum_{i=1}^{n} c_i(t)}$$

The Anchor Rate is the average of the rolling yields of all bAssets used as collateral for borrowing the stablecoin, weighted by the aggregate (Terra-denominated) collateral value of each asset. Collateral values are a natural choice of weight, as they determine the amount of block rewards that are eligible for transfer from borrowers to depositors. We therefore weigh yields by the potential for contribution to the depositor. For instance, if 3mm UST worth of bLuna and 1mm UST worth of bAtom were held as collateral in

UST's money market, with yields of 15% and 10% respectively, the Anchor Rate would be 13.75%.

4.2 Interest Rate Stabilization Mechanism

The Anchor Rate plays a foundational role in the Anchor protocol: it is the interest rate target for Terra deposits. The Anchor smart contract dynamically distributes block rewards from collateral bAssets between borrower and depositor to achieve the target rate. This is achieved via a time-varying parameter $\alpha(t)$ between 0 and 1:



By introducing the dynamic contribution of block rewards to the depositor, the equations from the previous section become:

$$depositRate(t) = u(t) \cdot \Big(borrowRate(t) + C \cdot y(t) \cdot \alpha(t)\Big)$$

$$borrowRate(t) = f(u(t))$$

$$netBorrowRate(t) = C \cdot y(t) \cdot (1 - \alpha(t)) - borrowRate(t)$$

where $y(t)$ is the staking yield of the bAsset, C is the average collateral ratio and $\alpha(t)$ is the fraction of the staking yield paid to depositors. Intuitively, the rate paid by the borrower to the depositor is supplemented by a dynamic fraction of the bAsset's block rewards multiplied by the collateral ratio. We also note the $netBorrowRate(t)$, which includes the portion of the bAsset yield paid to the borrower (inflow), as well as the rate paid by borrower to depositor (outflow). $netBorrowRate(t)$ may be either positive or negative.

An important component of dynamic yield distribution is liquidation of block rewards. The deposit interest rate is denominated in Terra, while block rewards can be denominated in arbitrary PoS assets. To solve this, Anchor liquidates the block rewards that are directed to the depositor at regular intervals. This is done via the liquidation mechanism outlined in Section 5.

The key to the stabilization mechanism is the adjustment of $\alpha(t)$ to maintain a deposit interest rate that is close to the Anchor Rate $AR(t)$. The calibration algorithm for $\alpha(t)$ takes place in discrete time steps as follows:

$$\alpha(t+1) = h\left(\frac{AR(t)}{depositRate(t)}\right) \cdot \alpha(t)$$

where h is a continuous monotonically increasing concave function with a fixed point of 1 ($h(1) = 1$), square root being a simple example.

For instance, continuing the earlier example where the Anchor Rate is 13.75%, assume that the deposit rate is 10% and $\alpha(t)$ is 50%, i.e. 50% of the yield from bLuna and bAtom collateralizing Terra loans is paid to depositors. The deposit rate is undershooting the Anchor Rate, therefore a larger fraction of the collateral's yield needs to be paid to depositors. Using the square root for h, $\alpha(t+1)$ would increase to roughly 59%, thereby increasing the deposit rate and closing the gap to the Anchor Rate. On the other hand, if the deposit rate was higher than the Anchor Rate, the value of $\alpha(t+1)$ would decrease to achieve the opposite effect.

The key idea here is that the value of α *increases* when the deposit rate lags the Anchor Rate to offer a boost using part of the block rewards, and *decreases* when the deposit rate exceeds the Anchor Rate to reduce contribution of the block rewards. The value of α remains unchanged when the deposit rate equals the Anchor Rate. We note that there is a number of constraints in this calibration that are beyond the scope of this paper, such as the maximum change of $a(t)$ in a given time step.

Why is this stabilization possible? In lieu of a formal argument, we note that in the trivial case where borrowers pay depositors only via block rewards, i.e. do not contribute additional interest, the deposit interest rate equation becomes

$$depositRate(t) = C \cdot u(t) \cdot \alpha(t) \cdot AR(t)$$

In this case it is sufficient for $C \cdot u(t) \cdot \alpha(t)$ to be equal to 1 for the target rate to be achieved, which would be the case if e.g. $C = 2$, $u(t) = 0.5$ and $\alpha(t) = 1$. This will naturally not always be possible, in which case additional interest from the borrower will be necessary to meet the target.

5 Principal Protection

Anchor implements a liquidation protocol designed to guarantee the principal of depositors. 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. The Anchor liquidation protocol is outside the scope of this paper – we will be releasing a separate technical specification that covers the mechanism in depth. In what follows we offer a very brief overview.

To ensure that all Anchor loans are sufficiently collateralized, the liquidation 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 can be written by anyone, 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.

The structure and incentives built into liquidation contracts enable them to provide higher robustness and solvency guarantees compared to a traditional "keeper" system. Keeper systems rely on arbitrageurs to finance liquidations on a discretionary basis, which can result in a liquidity crunch at times of high market volatility. This risk has materialized in practice in Maker's keeper system, resulting in huge losses for borrowers. Liquidation contracts, on the contrary, are fully collateralized and enforce a lengthy withdrawal period. Liquidation demand is therefore predictable and stable in the face of temporary shocks, thus protecting both depositors and borrowers.

6 Applications

Beyond the savings product, Anchor's money market can support more financial appilcations than the authors can envision. A few immediate applications that we see, starting with the savings product itself:

6.1 Savings product

Given cryptoassets have high price volatility, they may not be the ideal choice for users who seek passive income with low price exposure. Anchor offers a solution with Terra stablecoin money markets. Users who deposit Terra stablecoins will get stablecoins in return, thereby avoiding the high volatility of most cryptoassets. Anchor's deposit interest rate stabilization mechanism offers additional protection from volatility by providing stable returns.

6.2 Price and staking yield leverage

Users can leverage their positions by putting their assets as collateral to borrow stablecoins and buy more of the same asset. Users can similarly take advantage of low-rate periods by borrowing stablecoin cheap and purchasing bAssets whose yield exceeds their borrowing cost. Users who seek extra stablecoin liquidity can do so while paying little to no additional interest, given the deposit interest rate is subsidized by their assets' block rewards.

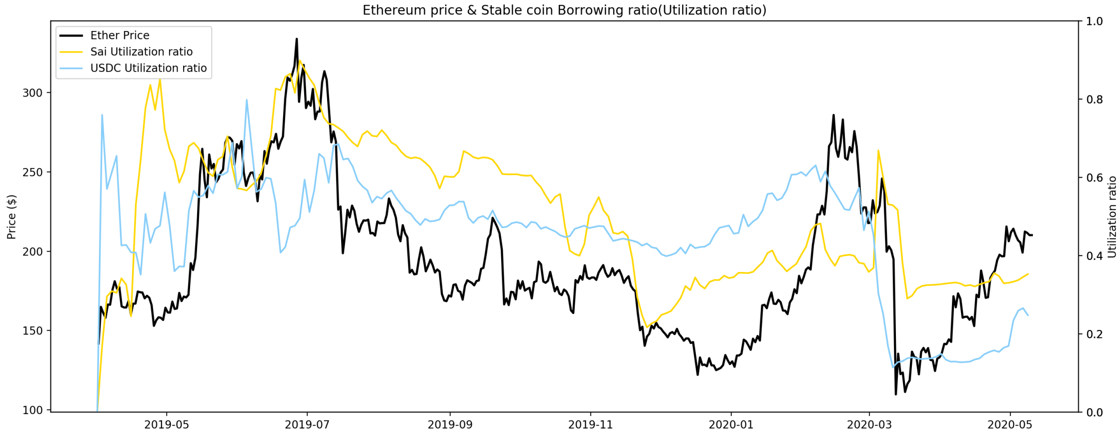
6.3 Liquidation contracts

If users are not interested in depositing or borrowing, they can participate in the Anchor liquidation pool which is a higher-risk, higher-return product that provides liquidation financing for Anchor debt positions. Liquidation contract writers can profit from passive premiums, as well as from liquidation fees earned on contract execution.

7 Conclusion

We have presented Anchor, a savings protocol on the Terra blockchain powered by a money market that is collateralized by tokenized stakes (bAssets). The protocol defines the Anchor Rate, derived from the yield of the market's highest-demand PoS assets, as the blockchain economy's interest rate benchmark. Anchor utilizes the block rewards of bAssets to offer depositors a stable return equal to the Anchor Rate. We believe that Anchor's simplicity and robustness make it a fitting answer to the search for a household savings product powered by cryptocurrency.

Appendix



Utilization ratio on stablecoin money markets on Compound is highly correlated with Ethereum price movements. The graph above shows Sai and USDC money market utilization ratios vs Ethereum price over the last 12 months.

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