Anchor Interest stability simulation

Introduction

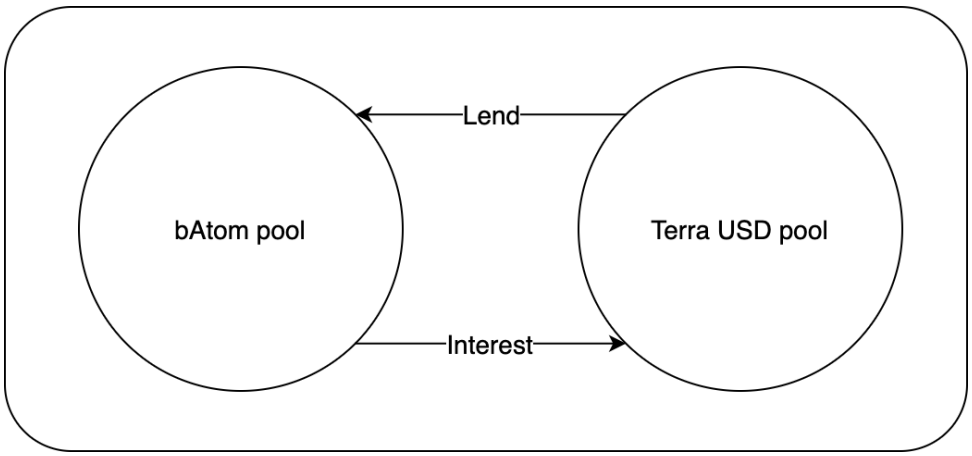
In this research, we see how the Anchor interest stability mechanism operates in different market cycle with the inflation-based collateral. To see how the inflation-based collateral affected by different market cycle, we run simulations to see the effects of the declining price of inflation-based collateral and how actually stability mechanism of Anchor affects the deposit rate. Before we get into the details of research, let's walk through three key concepts of this research.

The key concepts of this research are, utilization ratio, global collateral ratio and price of the collateral. First, utilization ratio represents how much of a total stablecoin deposit is currently borrowed by the borrowers compare to the funds in the lending pool. Second, global collateral ratio is, the ratio between total borrowed stablecoin and total collateral's value. Lastly, price of a collateral represents of market price of the collateral, as we don't have a liquid staking asset and market for liquid staking asset at the moment, we will use market price of atom for this research.

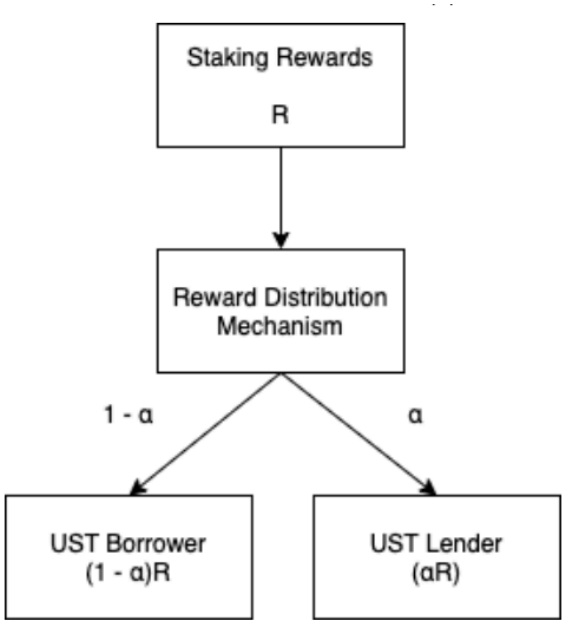
To simplify the simulation itself, we will assume that there's only one collateral for the Anchor money market, which is Atom. Also, we will set a fixed inflation rate for the Atom, fixed amount of money market deposit pool(stablecoin pool) and fixed target rate for Anchor.

We will have two types of simulation. In the first simulation, we project utilization ratio of Atom using the ethereum price and utilization ratio of USDC(Special thanks to Nicolas Andreoulis who actually done most of work on projection), and we use a fixed global collateral ratio using the price change of atom. Goal of first simulation is to compare deposit rate with Anchor interest stability mechanism and without mechanism. In the second simulation, we will set more harsh assumption on the utilization ratio side, and change the utilization ratio and global collateral ratio.

Interest stability mechanism



Before we get into detailed simulation, here's basic structure of Anchor money market. In this simulation, we will only have bAtom for collateral asset. Users can borrow Terra USD using bAtom as a collateral and paying Terra USD as an interest. You can simple think it as blockchain based money market which only allows user to use bAtom(liquid staking position of Atom) as a collateral. But difference between Anchor and other blockchain based money market is that Anchor use a liquid staking asset as collateral, and the staking reward from the liquid staking asset to subsidize the deposit interest. To decide how much of the staking rewards to subsidize deposit interest, we use variable 'a'.



Unlike other blockchain-based money market, Anchor use liquid-staking assets as a collateral, leveraging its staking reward to stabilize the interest rate of Lenders. More specifically, when the deposit rate is lower than the target rate, we increase the 'a' value to subsidize the Lender's deposit rate, on the other hand, when the deposit rate is higher than the target rate, we decrease the 'a' value to decrease the deposit rate. To change the 'a' value over time, we first set the initial value for 'a' and change the 'a' value using the target rate AKA 'Anchor rate'.

a(t+1) = math.sqrt(AR(t)/depositRate(t)) * a(t)

As the bAtom return Atom as a staking reward, and the lending pool use Terra USD, we need to liquidate staking reward of bAtom(which is Atom) to Terra USD, In this simulation, we simply assume there's third party liquidator who liquidates Atom to Terra USD with fixed liquidation fee.

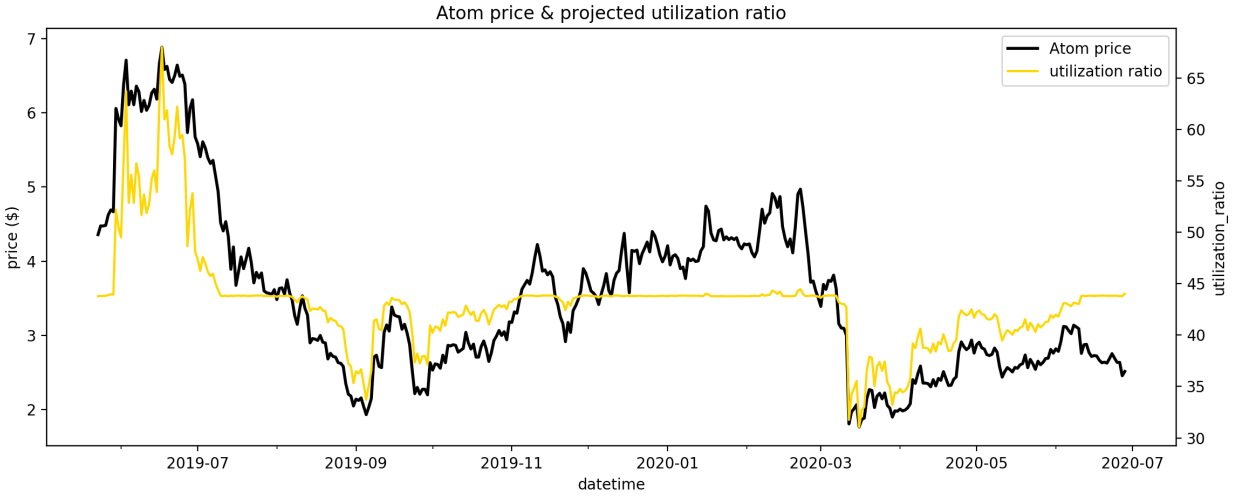
Interest equation

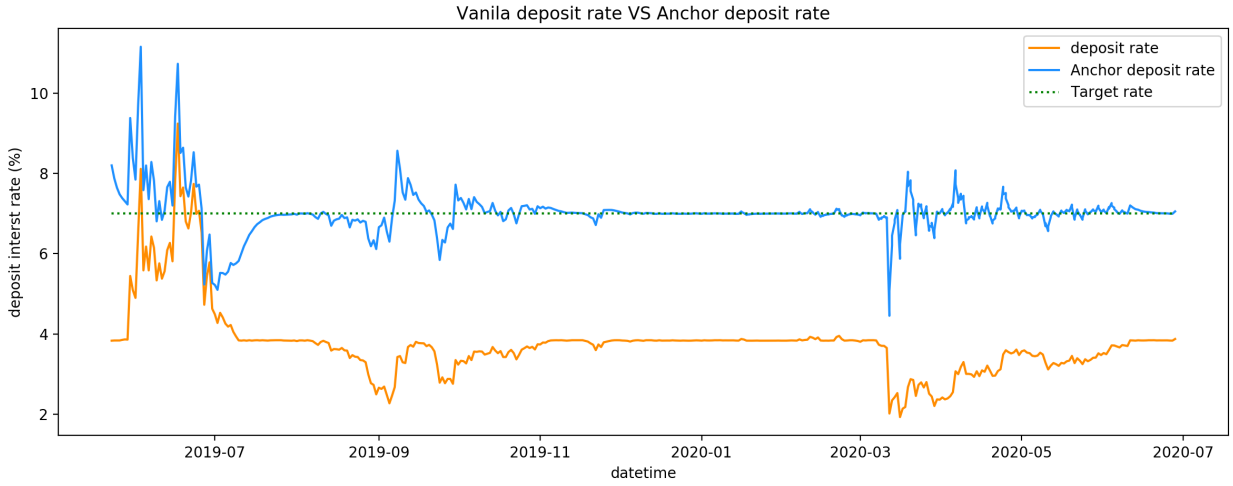
borrow_rate(t) = base_rate + utilization_ratio(t) * borrowing_multiplier
deposit_rate(t) = borrow_rate * utilization_ratio(t) * (1 - spread)

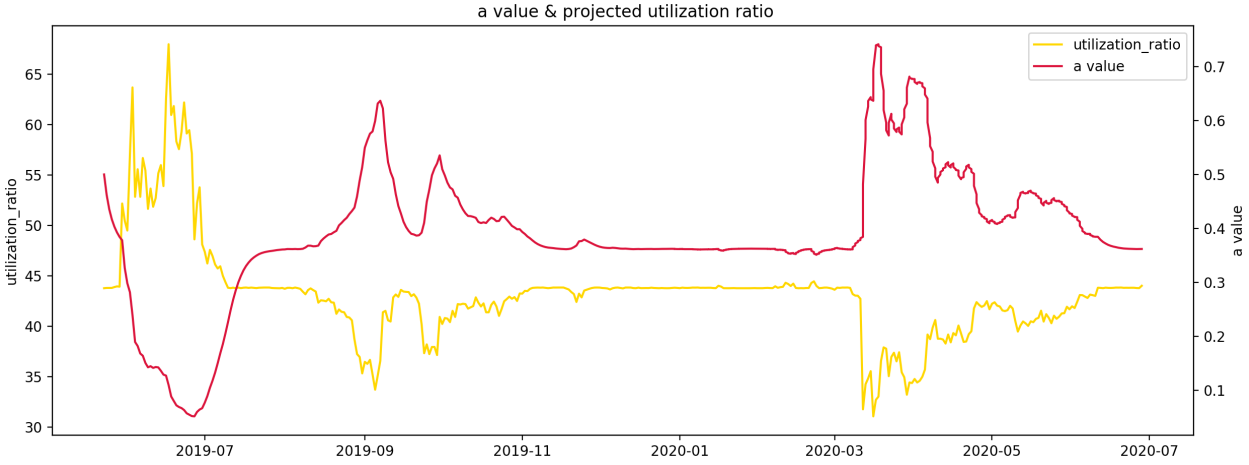
Main Variables for simulation

- **base_rate** : minimum borrow rate
- **borrowing_multiplier** : key factor for interest rate equation
- **spread** : spread between borrow_rate and deposit_rate
- **liquidation_fee** : fee for staking reward liquidation
- **global_collateral_ratio** : total_collateral_value/borrowed_value
- **initial_utilization_ratio** : initial utilization ratio

Simulation-1







In the first simulation, we use projected utilization ratio and fixed global utilization ratio, by fixing global collateral ratio, the price change of Atom does not have impact on this simulation. Key point of this simulation is to see the difference between the utilization ratio based deposit rate and Anchor deposit rate. First graph shows the Atom's price and utilization ratio of Terra USD. Second graph shows the deposit rate and Anchor deposit rate. Last graph show the 'a' value and utilization ratio.

Second graph is a key for this simulation, We can actually see the difference between the normal deposit interest and Anchor deposit interest. Although we assume very naive assumption on the utilization ratio(around 30% ~ 60%), we can say that this interest stability mechanism and using liquid staking position as collateral makes significant difference in deposit rates.

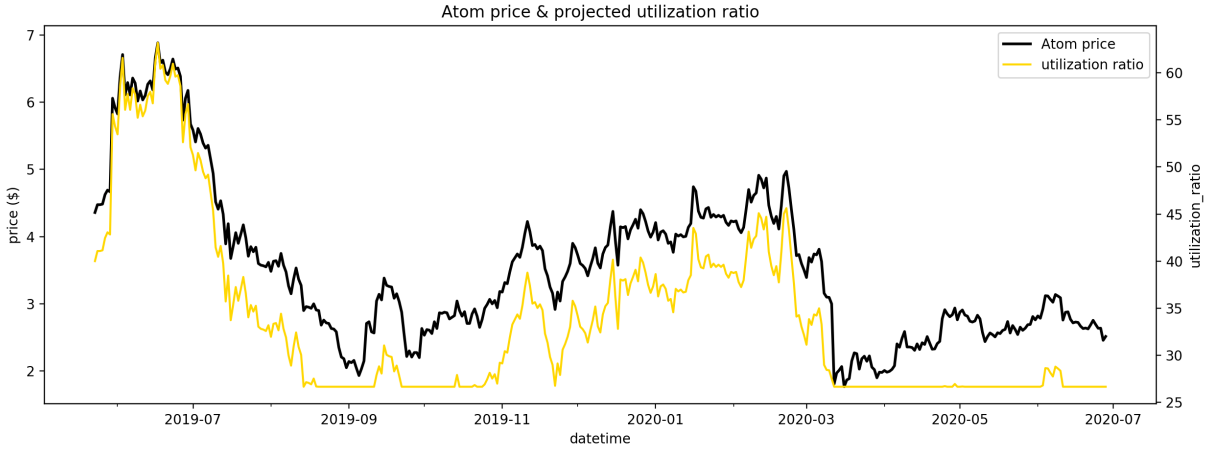
Volatility

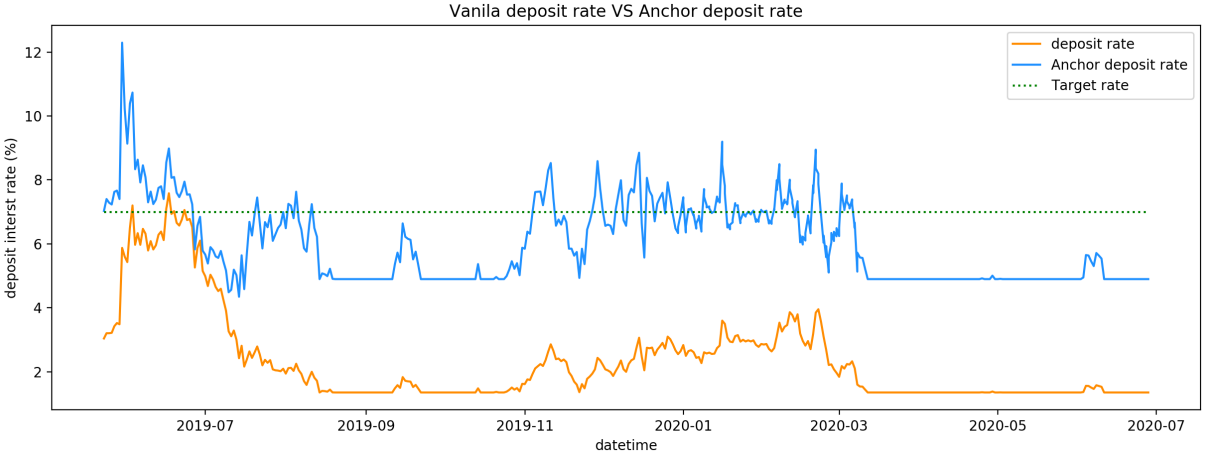
	A	B
1		Daily volatility
2	Normal deposit rate	0.678
3	Anchor deposit rate	0.248

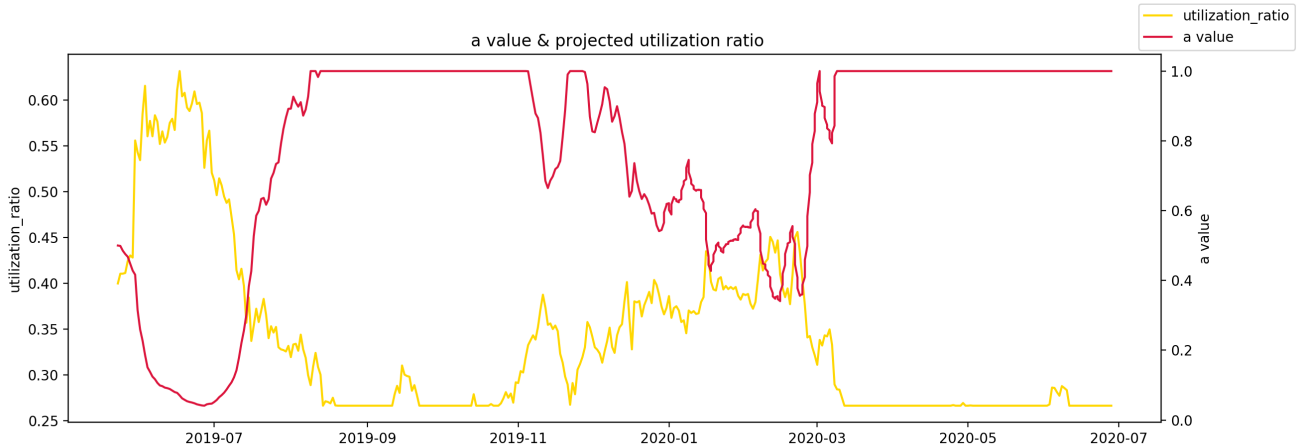
Also, in terms of interest stability, we use daily volatility of deposit rate to measure the deposit rate stability. As you can see above result, the volatility of Anchor deposit rate is smaller than the normal deposit rate. So in terms of interest stability, Anchor interest stability mechanism is superior than normal interest equation.

But, as we set very naive utilization ratio for this simulation, and also does not take the price change of Atom into account(use fixed global collateral ratio), this simulation have some limitations.

Simulation-2







Unlike first simulation, we set more harsh assumption on utilization ratio (around 26% ~ 63%). Also, we set initial numbers of atom using the initial price of atom and initial global collateral ratio and recalculate the global collateral ratio using the price change of atom. In this simulation, we use 300% initial global collateral ratio and 200% minimum global collateral ratio to prevent money market default.

What we find from this simulation is there's certain failure point on the utilization ratio that makes impossible to meet the target rate. During the 2019/09 ~ 2019/11 'a' value hits 1, which means that the Anchor stability mechanism using all of the staking reward to subsidize the deposit rate but it fails to meet the target rate. Second, if the users does not rebalance their debt position, price of collateral only has direct effect on the global collateral ratio as the amounts of collateral asset and borrowed positions are fixed. But, if users start rebalancing their debt position, the price of collateral can indirectly effects on the both utilization ratio and global collateral ratio. But, in generally, as the global collateral ratio decreases even if the users does not change their positions during the price fall, we can say that the price decline of inflationary collateral asset effects on the interest rate by directly changing the global collateral ratio and indirectly changing the utilization ratio. For instance if the current collateral bAtom's amount is 1000, and current price of bAtom is 3$ and global collateral ratio is 300%(means there's 1000$ worth borrowed stablecoin). Assume that there's no user rebalancing on debt position and if price of bAtom goes 2$, the global collateral ratio will hits 200% as there's no rebalancing.

Volatility

	A	B
1		Daily volatility
2	Normal deposit rate	1.62
3	Anchor deposit rate	1.47

Also, in terms of interest stability, we use daily volatility of deposit rate to measure the deposit rate stability, as we set more harsh assumption on the utilization ratio, daily volatility of both deposit rate was bigger than the daily volatility of first simulation. Also, Anchor deposit rate relatively has lower volatility compare to normal deposit rate.

Failure point Calculation

As we see on the second simulation, there's failure point on the utilization ratio. If the utilization ratio goes below x%, it becomes impossible for Anchor to meet the target rate. The equation for failure point will be :

(base_rate + utilization_ratio * borrowing_multiplier) * utilization_ratio * (1-spread) + utilization_ratio * global_utilization_ratio * (1 - liquidation_fee) * 1 * inflation_rate < target_rate

For instance, If the conditions are:

base_rate = 0%
borrowing_multiplier = 20
spread = 0%
global_collateral_ratio = 300%
liquidation_fee = 5%
inflation_rate = 7%
target_rate = 7%

The failure point for utilization ratio will be **utilization_ratio < 27.5%**. It means, If we support 27.5% of utilization ratio with 300% global collateral ratio(more specifically, 82.5% deposit coverage), The Anchor will meet the 7% target rate without any outside user participation.