Terra Money:
Analysis of Luna Staking Rewards

Nicholas Platias

May 2019

1 Introduction

Luna lies at the core of Terra's security and stability, acting both as the PoS token, and as the reserve asset that absorbs volatility in Terra's price. The Terra Protocol compensates Luna stakers for their service to the network with stable rewards. Staking is rewarded in two ways: Terra transaction fees, which are paid directly to staked Luna, and Luna burn, which controls Luna supply. Rewards are thus denominated in Terra[1]. The most important metric for Luna staking is *unit* rewards, i.e. rewards per Luna. The protocol controls transaction fees and Luna burn rate to produce stable growth in unit rewards. The purpose of this paper is to discuss the key factors that determine staking rewards, and to analyze sensitivity of rewards to changes in those factors.

2 Methodology

At the most basic level, staking rewards depend on two key variables: aggregate Terra transaction fees and number of staked Luna. We break those down into the following factors:

- **Transaction Volume (year 1)**: The transaction volume to go through the Terra network by the end of the first year. We expect the vast majority of this to originate from e-commerce purchases using Terra. To standardize across years, we consider *annualized* end of year transaction volume. We project a range of 2.5-7.5 billion USD in first year annualized volume to come from our growing alliance of e-commerce partners, which we expect to account for 40 billion USD in GMV by end of year 1 (already stands at 25 billion USD). Our base case for year 1 transaction volume is 5 billion USD, which represents a 12.5% market share.

- **Transaction Volume annual growth**: The compound annual growth rate of Terra's transaction volume. We project three sources of growth: addition of new e-commerce partners, growth in Terra's payments market share and passive growth of the e-commerce sector in the markets where Terra operates. We expect to at least triple the base size of the alliance (120 billion USD), as well as to double our market share from 12.5% to 25%, over the next 5 years. We benchmark our market share estimate off of two mobile payment companies (Payco & KakaoPay) who achieved 20%+ penetration when they ran 5% discount promotions over a course of a month. We expect Tera's long-term promotion strategy to have an effect at least as strong.

[1] TerraSDR, to be precise.

Passive e-commerce growth in East[2] and South-East[3] Asia is projected to be 20-30% over the period. Those three factors in combination (increase in base size of alliance, increase in market share and passive market growth) yield a base case estimate of 100% annual growth over the next 5 years. Our projected range is 80%-120%. This growth rate will naturally decline over time, yet we consider the 5-year estimate conservative given our compelling value proposition to e-commerce companies and the rapid growth of the sector as a whole.

- **Transaction fee**: The fee charged by the protocol for all Terra transactions. Based on protocol simulations, we expect the protocol fee to range between 0.125% and 0.5%. E-commerce transactions will need to initiate two on-chain transactions each (one to purchase Terra for the user with fiat, the other to sell Terra for fiat to pay the e-commerce company). As such, the effective transaction fee for e-commerce is twice what the protocol charges. The range of likely values is therefore 0.25% to 1%, with a base case of 0.5%.

- **Staking Ratio** (year 1): The fraction of Luna's total supply that is staked. We expect a year 1 staking ratio in the 10-20% range with a 15% base case (Luna's staking ratio is 18% at the time of writing).

- **Staking Ratio annual growth:** We expect the staking ratio to grow over time, as ownership of Luna becomes increasingly decentralized and the track record of rewards increases. As a benchmark for staking ratios that we can expect, some of the prominent PoS networks have the following: 57% (Cosmos), 49% (Decred), 43% (EOS) and 7.2% (Ontology)[4]. Based on those data points and our expectation of first year staking ratio, we project a wide range for growth: 20-40% annual growth, corresponding to a year 5 staking ratio in the 30-60% range.

- **Luna Supply Inflation**: Increase in Luna supply as a result of contraction in Terra supply. We expect Luna supply inflation to be very low, if any, during the first few years. First, Luna burn rate increases when supply exceeds the genesis mark in order to counteract inflation. Second, auxiliary stability mechanisms will usually obviate the need for Luna inflation when Terra needs to be bought back. We see the 0-1% range as most likely, though we consider 10% as scenario worth analyzing[5]. We use a 1% inflation rate as our base case.

We use the factors above to conduct a scenario analysis for unit staking rewards in the following section.

[2]https://www.statista.com/statistics/261340/b2c-e-commerce-sales-growth-in-southkorea/

[3]https://www.thinkwithgoogle.com/_qs/documents/5334/APAC-Google-Temasek-2017-spotlight.pdf

[4]Data from stakingrewards.com. Note that we use total rather than circulating token supply in our calculations.

[5]While our stress tests suggest the possibility of higher Luna supply inflation during demand shocks, they do not take into account the auxiliary mechanisms we have in place and are designed to test severe but highly unlikely scenarios.

3 Scenario Analysis

We use the factors discussed in the previous section to conduct a scenario analysis for unit staking rewards over the next 5 years. We vary all six factors relative to their base values to examine sensitivity of rewards to changes in each factor. We aggregate the results in a sensitivity table.

		Staking Rewards ($ per Luna)				
Factors	**Values**	**Years from Genesis**				
		1	2	3	4	5
Transaction Volume	2500	0.08	0.13	0.19	0.29	0.45
($mm, year 1)	**5000**	0.17	0.25	0.39	0.59	0.90
	7500	0.25	0.38	0.58	0.88	1.35
Transaction Volume	80%	0.17	0.23	0.31	0.43	0.59
Growth (annual)	**100%**	0.17	0.25	0.39	0.59	0.90
	120%	0.17	0.28	0.47	0.78	1.31
Transaction fee	0.25%	0.08	0.13	0.19	0.29	0.45
(avg)	**0.50%**	0.17	0.25	0.39	0.59	0.90
	1.00%	0.33	0.51	0.77	1.18	1.79
Staking Ratio	10%	0.25	0.38	0.58	0.88	1.35
(year 1)	**15%**	0.17	0.25	0.39	0.59	0.90
	20%	0.13	0.19	0.29	0.44	0.67
Staking Ratio	20%	0.17	0.28	0.45	0.75	1.24
Growth (annual)	**30%**	0.17	0.25	0.39	0.59	0.90
	40%	0.17	0.24	0.33	0.47	0.67
Luna Supply Inflation	0%	0.17	0.26	0.39	0.61	0.93
(annual avg)	**1%**	0.17	0.25	0.39	0.59	0.90
	10%	0.17	0.23	0.33	0.46	0.64

For each factor in the first column we consider three possible values in the second column, where the middle value is our base case for that factor. In each modeled scenario (a single row) we vary a single factor, holding the remaining fixed at their base values. For instance, when considering staking rewards under a 0.25% average transaction fee, we are assuming base year 1 transaction volume ($5,000 mm), base transaction volume growth (100%), base staking ratio (15%), base staking ratio growth (30%) and base Luna supply inflation (1%). We express rewards in USD terms for simplicity. Note that total genesis Luna supply is 1 billion. Also note that rewards shown are the total amount credited to Luna stakes by the protocol. Validator and delegator then share this reward based on the agreed-upon commission rate.

We observe that rewards grow rapidly over time, as expected. We also observe relatively smaller variance in year 1 rewards compared to rewards 5 years from now, also to be expected. Transaction volume and staking ratio appear to be the factors to which staking rewards are most sensitive. We can use this table to estimate changes in rewards as a function of changing conditions.

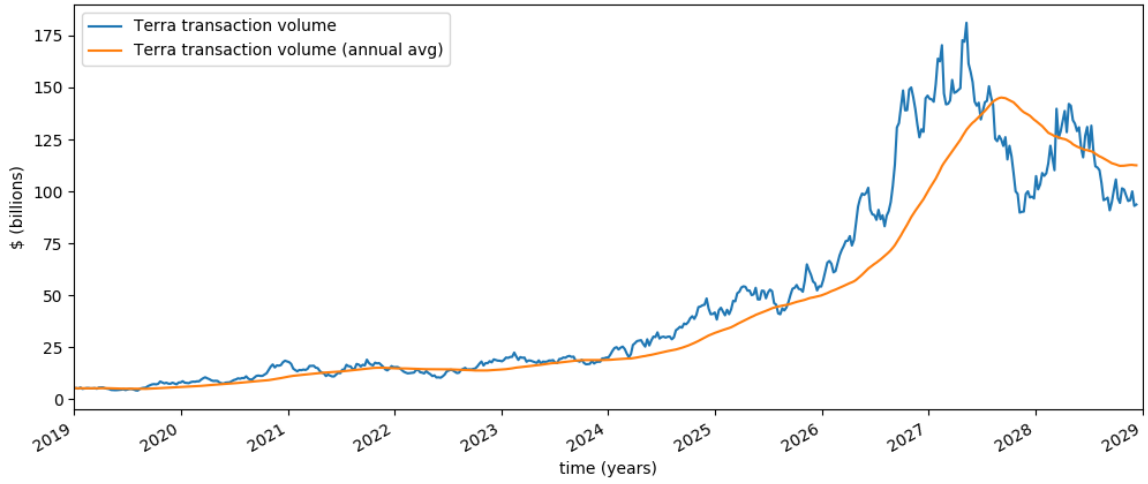
4 Reward Stability

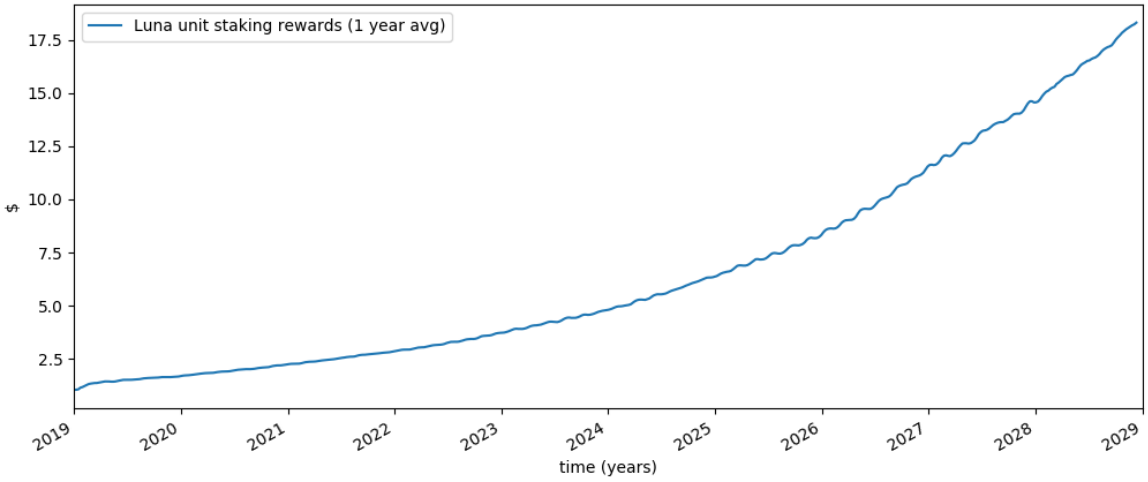
Stable demand for Luna is key to Terra's security and stability. The Terra Protocol therefore makes stability of rewards a core priority. Volatility of some degree is inevitable, so there will be periods during which transction volume surges and Luna supply shrinks to issue new Terra, or conversely transaction volume drops and Luna supply increases to buy back Terra. In both cases unit rewards will have a tendency to move strongly in one direction or the other (up when the economy grows, down when the economy shrinks). To make changes smooth and increase predictability in rewards, the protocol uses two levers to oppose changes in unit rewards: transaction fees and the rate of Luna burn, i.e. the rate at which Luna earned from issuing new Terra (seigniorage) is burnt as opposed to being deposited to the Treasury. Transaction fees affect total rewards, while the rate of Luna burn affects Luna supply – the two determinants of unit rewards. The basic logic is therefore the following:

- if rewards are *increasing*:
  - *decrease* fees
  - *decrease* Luna burn
- if rewards are *decreasing*:
  - *increase* fees
  - *increase* Luna burn

The end-result is unit staking rewards that are highly predictable and unperturbed by volatility in transaction volume.

We demonstrate what stable rewards look like with a 10-year simulation of transaction volume and resulting staking rewards (numbers are for illustration purposes). Terra transaction volume in our simulation experiences several ups and downs, including a significant decrease over the last two years. Unit staking rewards, nevertheless, grow at a steady rate over the decade with minimal fluctuations. Transaction fees and Luna burn are varied to achieve this. This mechanism allows us to project the growth of rewards, as we did in the previous section, with higher confidence. Our stress test paper explores the topic in much greater depth.





5 Value Capture, Not Inflation

We believe what sets Luna apart from its PoS peers is that staking rewards are the result of capturing real value on the network, not inflation. Most PoS networks reward stakes by minting more of the native asset, thereby offering "yield" (this is true of Cosmos, EOS, Tezos, Ontology and so on). For example, a fictitious PoS token called Sol may pay a 10% annual yield, which means that if Alice stakes 10 Sol for a year the network will print 1 new Sol and give it to her as a reward. If Bob holds 10 Sol over the same period without staking he receives no reward. What's happened here is that Alice's share in the network has increased (her stake relative to Sol's total supply), while Bob's has decreased. In other words, the network has used inflation to redistribute Sol ownership, thereby taxing people like Bob who do not stake. What if everyone stakes (say Alice and Bob, the only two holders)? Then they both maintain their network ownsership, so their yield *net of inflation* is zero. In other words, staking is a way to protect one's ownership in the network from being diluted, rather than a way to earn a tangible reward, and

"yield" is a *measure of punishment* for not doing so. It is safe to assume that in stable state the majority of holders will stake precisely for this reason. All in all, knowledge of Sol's "yield" leaves us none the wiser as to what it is worth.

Contrast this reward scheme to Luna: when value is transferred on the Terra network, Luna captures a small fraction of that in the form of Terra rewards. This happens every time someone uses Terra to transact or make a purchase. Hence value external to the network accrues to Luna in a predictable manner, i.e. proportionally to aggregate "value flow" (see Burniske). In our case the underlying economy from which value is captured is well understood (e-commerce). It is in this vein that we are able to conduct straightforward analysis like in the previous section to project the value that will accrue to Luna over time. What is more, value accrues in a fiat-pegged currency (Terra) rather than in the staked asset (Luna), thus creating an objective basis for quantifying said value.

The stark contrast between value-based and inflation-based rewards mechanisms has significant implications for valuation of the staked asset. Assets which are rewarded in value-capture terms are easy to value: one simply needs to project value flow (in our case: Terra transaction volume) and the rate of value capture (in our case: transaction fee). As we demonstrated, analysis of this sort is straightforward for a concrete use-case (payments) in a well-studied space (e-commerce). On the contrary, inflation-based rewards offer zero basis for valuation – as we saw ealier the "yield" of a PoS asset has nothing to say about its value, only about how fast it inflates (how fast it *loses* value). One therefore needs to resort to more ill-defined valuation approaches, e.g. based on transactions or store-of-value demand, which tend to be highly unreliable for fledgling networks[6]. Being able to value an asset in a systematic way is a core requirement for stable and sustainable demand, so we see Luna's value-based rewards system as a significant advantage relative to its PoS peers.

6 Conclusion

Staking rewards compensate Luna stakers for their service to the network and are Luna's main value driver. In this analysis we examined the key factors that affect unit rewards and projected a range of likely values for each factor. We then examined the sensitivity of staking rewards to changes in each of those factors. While not exhaustive, the scenarios considered have broad coverage and offer insight into the rewards Luna stakers can realistically expect in the coming years. We moved on to discuss how the protocol achieves predictable unit rewards by varying transaction fees and Luna burn, therefore affording us greater confidence in our earlier projections. Finally, we argued that PoS rewards are sustainable only when they accrue from value captured on the network, and that inflation-based "yields" ought to be understood as a mechanism of punishment rather than reward. Luna is unique as a PoS asset in this regard, and makes it straightforward to quantify value capture.

[6] Valuing semi-mature networks like bitcoin based on those methods is just as unreliable and controversial.

References

Burniske, Chris, "Value Capture & Quantification: Cryptocapital vs Cryptocommodities"