

Angelo Tokenomics Audit

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Table of contents

Table of contents	2
Introduction	3
About the auditor	3
Tokenomics overview	4
Token supply and allocation	5
Rewards model for the curation economy	6
Token simulations	9
Appendix: Simulation details	11
Appendix 2: Tokenomics ranking framework	16

Introduction

The purpose of this document is to provide an audit of Angelo's token economy. The document describes any adjustments that have been made in order to improve the token economy, as well as simulations that were performed in order to test Angelo's assumptions.

Preliminaries:

- 1) The token allocations of Angelo have been provided, and checked. They are presented here, as well, for the sake of completeness, but no flaw was found.
- 2) Angelo has provided extremely detailed financial projections. These projections cover an optimistic and a pessimistic scenario. These projections were then taken as the base of the simulated stress tests.

Angelo's token economy is assigned a rating of AAA (highest possible rating). The rest of this document explains the tests conducted, and justifies the final score.

About the auditor

Dr. Stylianos Kampakis

Dr. Stylianos (Stelios) Kampakis is a data scientist and blockchain expert with more than 10 years of experience in technology. He has worked with decision-makers from companies of all sizes: from startups to organizations like the US Navy, Vodafone, and British Land. His work expands multiple sectors including fintech (fraud detection and valuation models), sports analytics, healthcare, general AI, medical statistics, predictive maintenance, and others. He has worked with many different types of technologies, from statistical models to deep learning to blockchain and he has 2 patents pending.

He was one of the first researchers in the area of tokenomics, as well as one of the first to create valuation models for NFTs.

He is a member of the Royal Statistical Society, honorary research fellow at the UCL Centre for Blockchain Technologies, editor at the Journal of the British Blockchain Association, a data science advisor for London Business School and CEO of The Tesseract Academy.

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Tokenomics overview

In short, Angelo is a blockchain-based investment platform for fractionalized fine art. Physical artworks are tokenized and fractionalized on the Ethereum blockchain. Fractions are offered for primary sale to investors and can then be traded freely on the secondary market.

The \$Angelo token functions as a form of both payment and reward for the Angelo ecosystem. The Angelo ecosystem is split into the following main parts:

- 1) A fractionalized fine art exchange
- 2) The curator economy

The art exchange sells fractionalized artwork. Each fractionalized artwork is represented on-chain by a single NFT and its fractions are ERC-20 tokens priced in \$Angelo or ETH (depending on the seller preference). Fiat can be used for fraction purchases and the fiat price is defined by the market. The users can also use \$Angelo directly, at a discount/cash-back, or other widely used cryptocurrencies (for example, ETH).

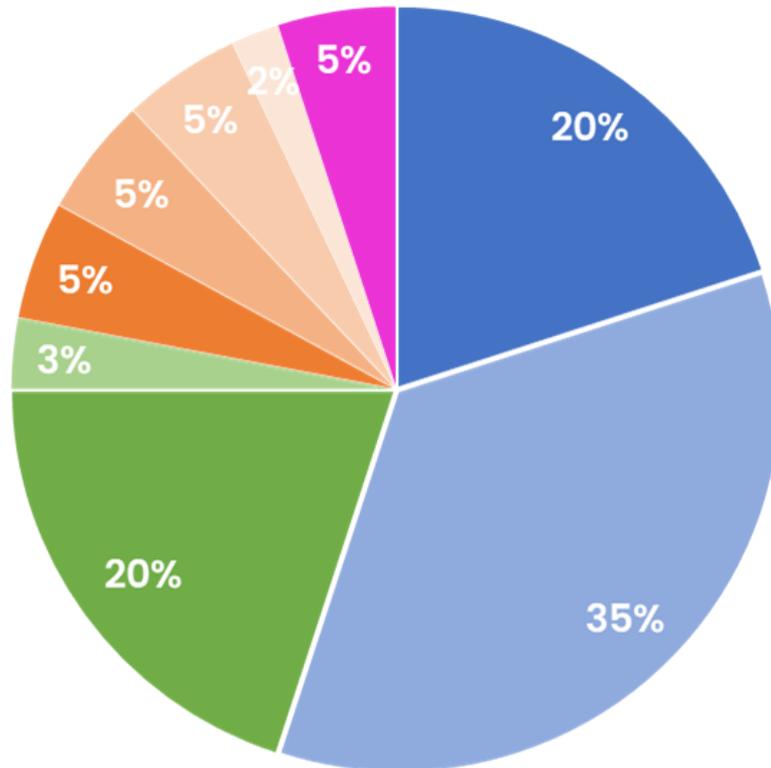
The curator economy consists of handpicked expert art curators who choose art they like and recommend it publicly on the platform. Curators get ranked periodically based on the aggregate price performance of the art they recommend.

Angelo users who do not have the inclination or expertise to actively trade art, can invest with a lower risk / lower reward profile by depositing \$Angelo with one or more curators. Users who do so periodically receive a positive return on their deposited \$Angelo based on the performance of the curator(s) they deposit with. The rewards model for the curators was redesigned during the audit so it rewards both performance and sustainability of the token economy.

Token supply and allocation

Total token supply is restricted to 1,000,000,000 (1bn) \$Angelo

The token allocation of Angelo is presented below:



- User Rewards
- Team
- Institutional Investors
- Public Sale
- Angelo Foundation
- Treasury & Ecosystem Fund
- Advisors & Development
- Private Sale (Pre-Seed / Seed)
- Liquidity & Market Making

	Allocation	Lockup (months)	Vesting schedule
User Rewards	20.0%	None	Linear monthly over 24 months
Treasury & Ecosystem Fund	35.0%	6	Linear monthly over 48 months
Total Platform Allocation	55.0%		
Team	20.0%	12	Linear monthly over 36 months
Advisors & Development	3.0%	12	Linear monthly over 36 months
Total Insiders Allocation	23.0%		
Institutional Investors	5.0%	12	Linear monthly over 24 months
Private Sale (Pre-Seed / Seed)	5.0%	12	Linear monthly over 24 months
Public Sale	5.0%	None	n.a.
Liquidity & Market Making	2.0%	None	n.a.
Total Float Allocation	17.0%		
Angelo Foundation	5.0%	6	Linear monthly over 48 months
Grand total	100.0%		

The token allocation was created based on market research from comparable projects. There are no negative comments about the current allocation plan.

Rewards model for the curation economy

The rewards model for the curator economy works as follows. First of all, each curator's performance is judged on a weekly basis based on the following formula:

$$Metric = (return * \sqrt{volume}) / volatility$$

For example, let's say the return is 10%, the volume is \$10,000. The volatility of the can be measured by the standard deviation, which we can assume (for this example) that it is 5%.

Therefore, this leads us to the following calculation

$$Metric = (0.1 * \sqrt{10000}) / 0.05 = 200$$

Each week, a curator is judged on that formula, and then the curators are ranked. The curator then receives rewards, based on their position on the weighted ranking and the following formula.

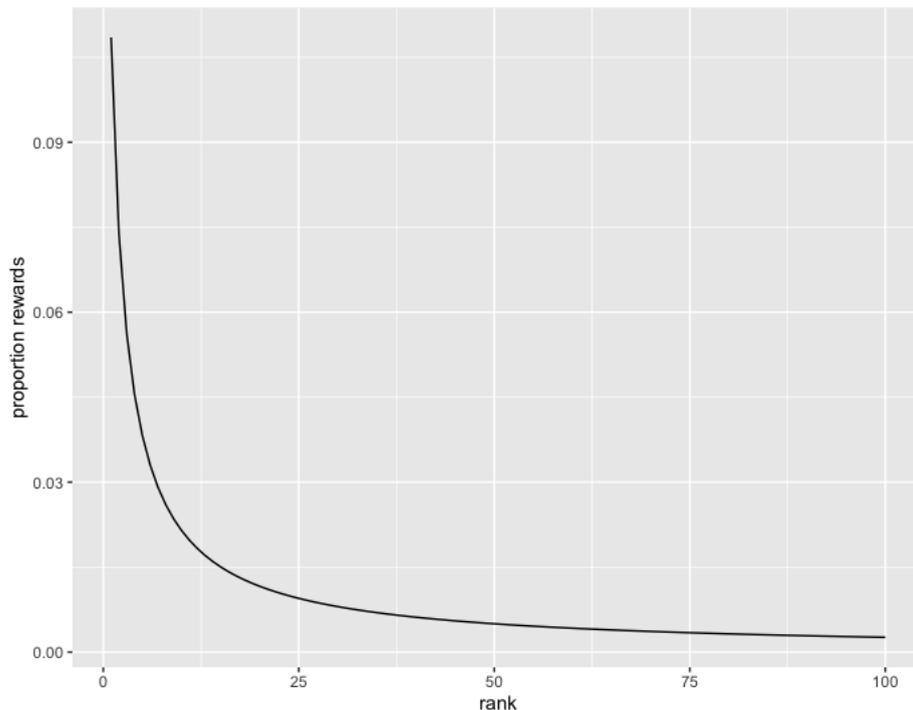
$$k = \frac{1}{(R+1)^{0.95}} * V$$

$$rewards = \frac{k}{\Sigma k}$$

Where

R: The weighted ranking of the player (more on this below).

V: The total amount of rewards released during that unit of time.



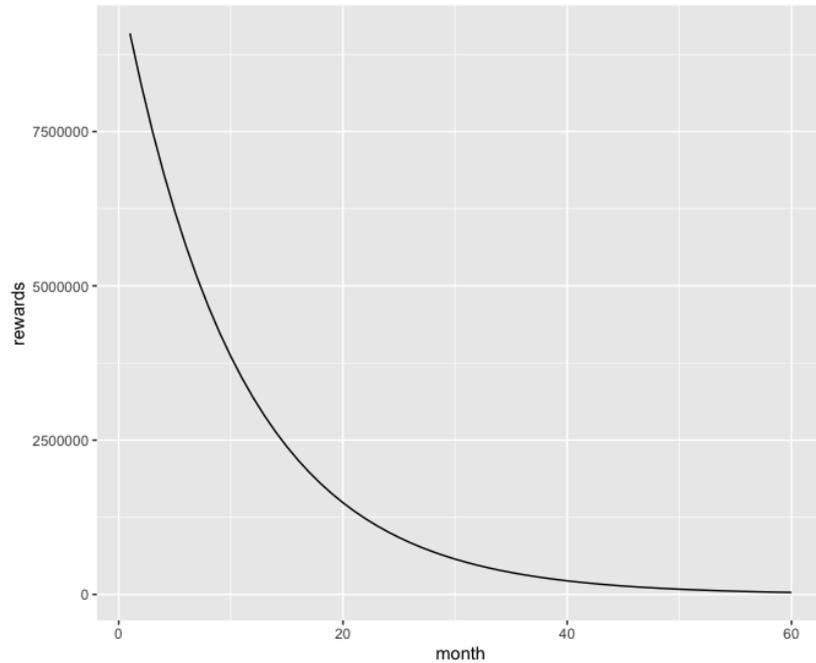
Graph of the rewards formula

The weighted ranking is simply defined as an exponentially smoothed weighted average over the ranks at time t and $t-1$. This allows curators who are very successful to have one or two bad weeks, while curators with very poor performance will need more consistency in order to climb up the ranks.

$$ranking_{new} = 0.5 * ranking_t + 0.5 * ranking_{t-1}$$

The rewards release schedule is determined by another process.

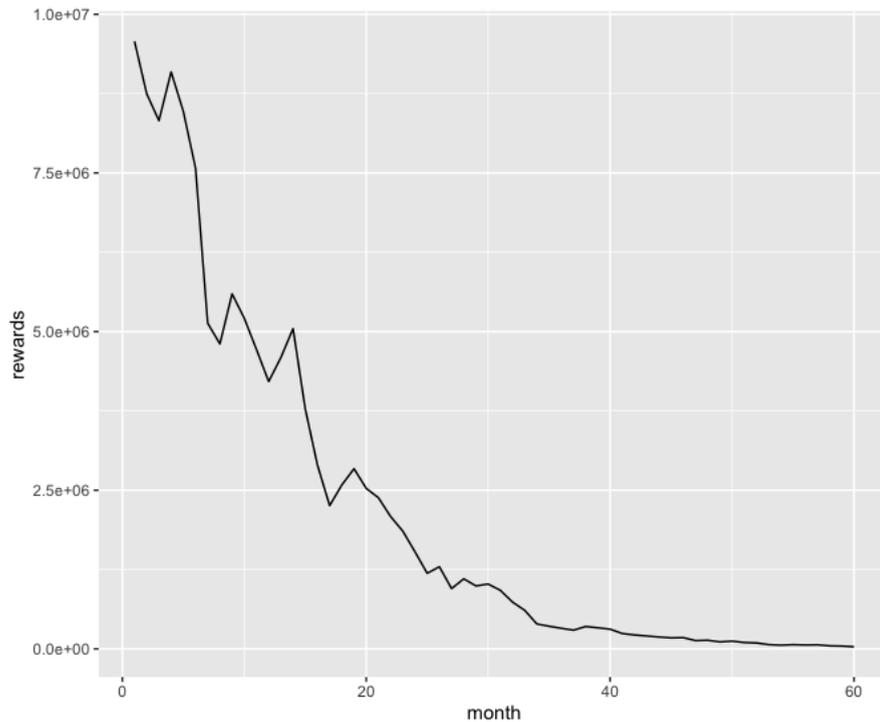
At its core, there is an exponential distribution schedule (base of the power is the value 1.1) over 5 years, assuming 100 million rewards (for sake of argument, actual figure might change).



Each time unit (in this example month) Angelo sets a trading volume target. If the volume target is not met, then the following applies:

- 1) Calculate the % deviation between the target and the actual volume traded.
- 2) Extract this % off the rewards
- 3) Roll over 3 months.

The example below shows the results of a simulation where we rollover the rewards over 3 months, everytime the targets are not hit. The deviation is sampled from a simple uniform distribution and every step has 50% of not hitting the target.



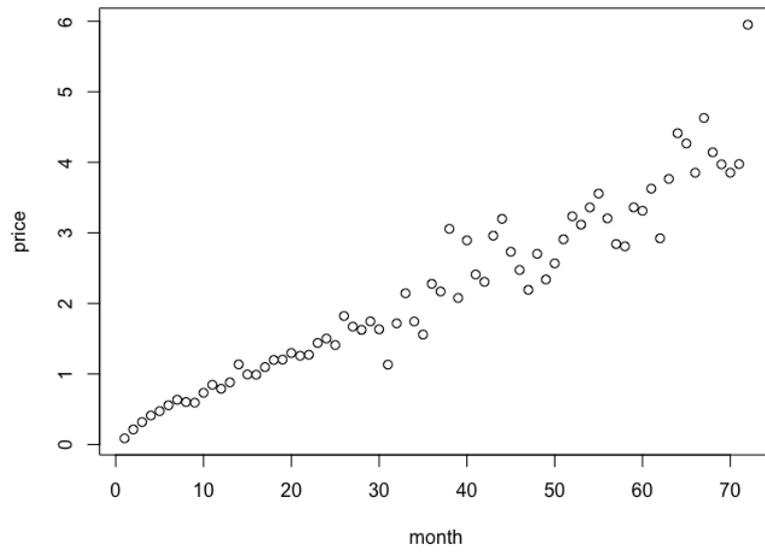
Token simulations

Two main sets of simulations were conducted. One set of simulations concerned optimistic price forecasts, and the other one consisted of the pessimistic forecasts done by the Angelo team.

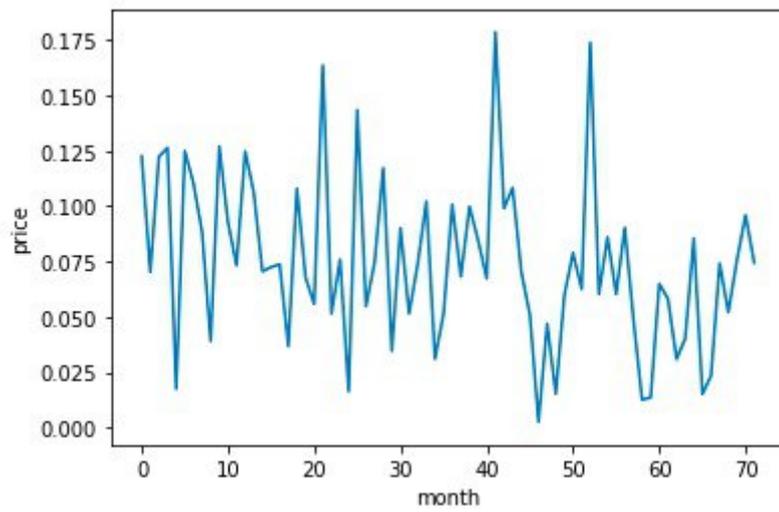
The simulations' objective was to test the assumptions behind the financial projections, and examine the key results. The details behind the simulations are presented in the appendix.

The two graphs below show the results from two typical runs. For the optimistic projections, the simulations found that there is price appreciation. For the pessimistic projections, there seems to be price stability without any growth.

In any case, the token doesn't seem to crash or experience pump and dump dynamics. That's not to say that this type of scenario cannot manifest in practice, but the design of the token itself does not facilitate this type of dynamic outside of market externalities.



Optimistic case, example of a typical run



Pessimistic case, example of a typical run

Appendix: Simulation details

Unit of time

Month

Valuation model

Price = Transaction volume * Holding time / Circulating supply

Transaction volume

The transaction volume was based off Angelo's financial projections. The following pools were included

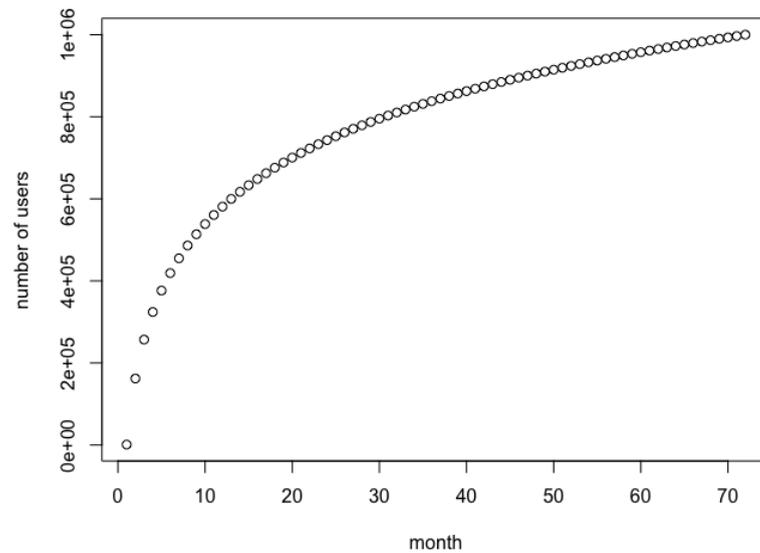
- 1) Luxury digital art fractional marketplace (primary and secondary)
- 2) Physical art marketplace (primary and secondary)
- 3) Own art (primary and secondary)

The pools contained assumptions around:

- 1) Growth
- 2) Active users
- 3) Listings
- 4) Average monetary value of the listings

The following methods were used to simulate those assumptions:

Growth: For growth, a logarithmic function was used, to simulate saturation. An example for 1 million users is shown below



Active users: Active users were simulated through a binomial distribution. The percentages of active users provided in the spreadsheet were used for the parameter p .

Listings: Listings were simulated through a poisson distribution. The expected number of listings per user per month was taken as the lambda parameter.

Monetary value: the monetary value was simulated by a normal distribution. The variance was defined as $\mu/7$.

Assumptions

- 1) All transactions outlined in the financials will be in the Angelo token, with a fiat equivalent in terms of value.
- 2) The rewards roll-over 3 months. The reward simulation (from the previous section) was just plugged into this simulation.
- 3) The holding time affects the pricing equation as a constant scaler. Given that Angelo has strong assumptions around the transaction value, this parameter comes of secondary importance. It was set to 0.1. Increasing it will simply have the effect of increasing the price by the same multiple.

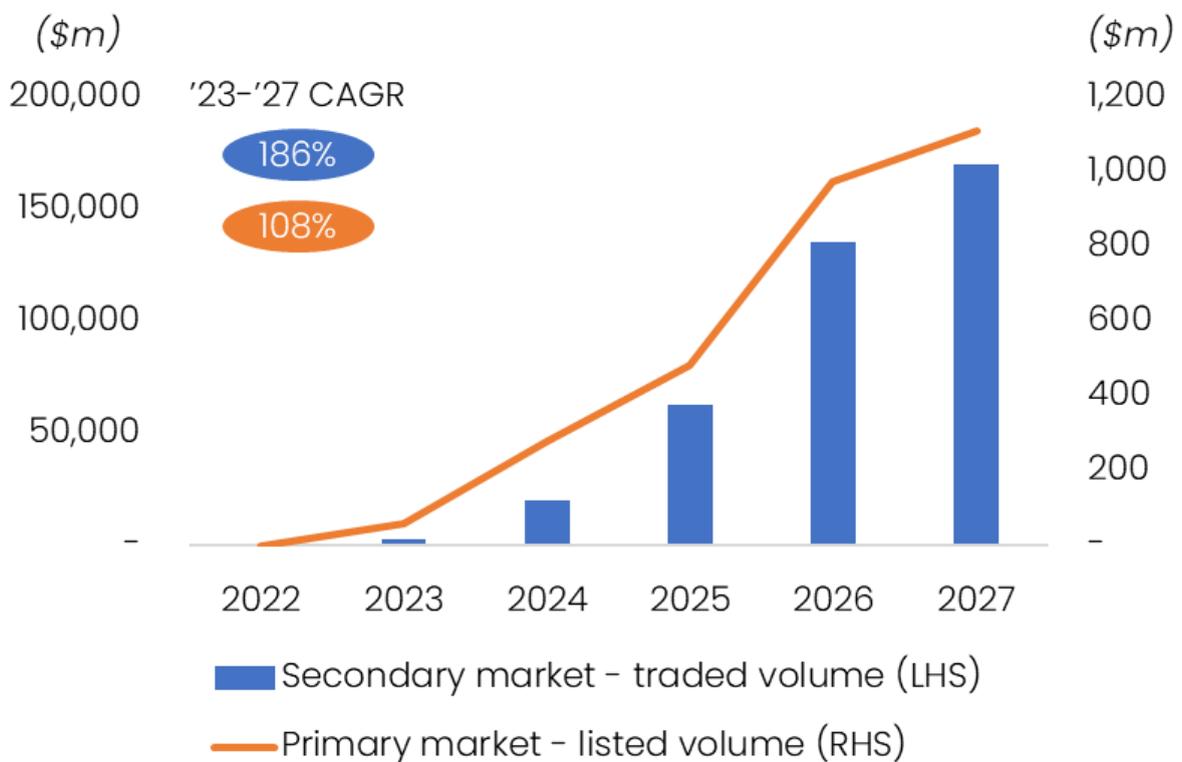
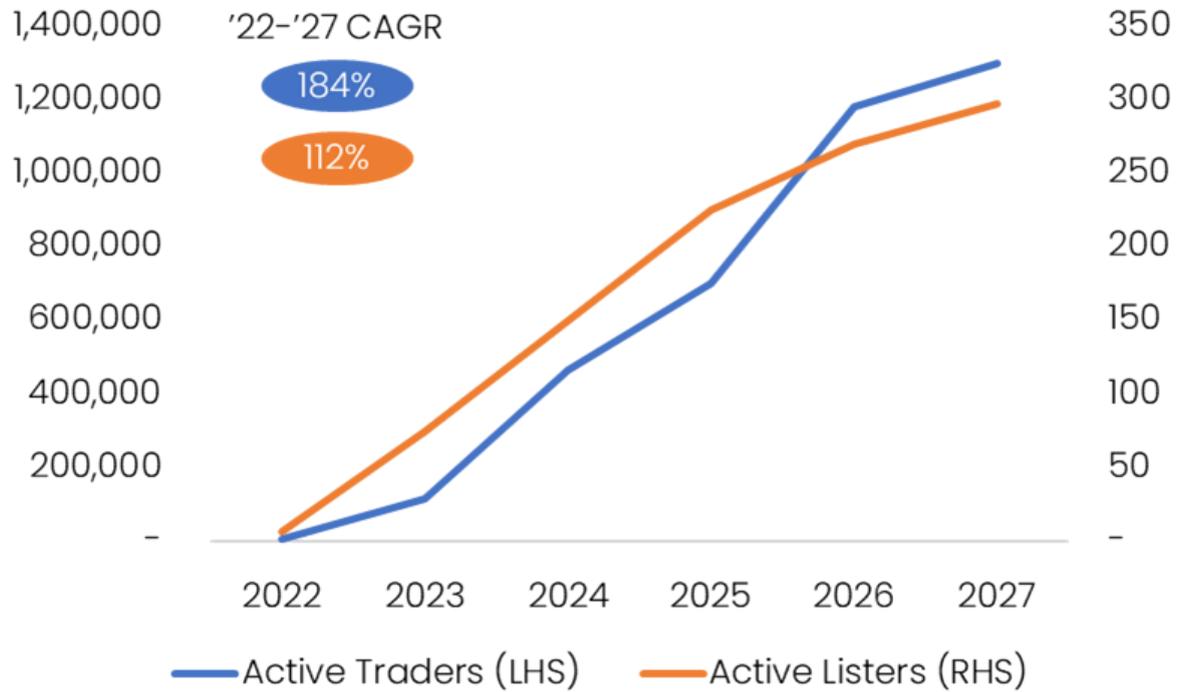
Distribution parameters

The parameters of each distribution were determined by financial projections of Angelo. There are two sets of assumptions: normal and pessimistic.

KPIs and Financial Projections

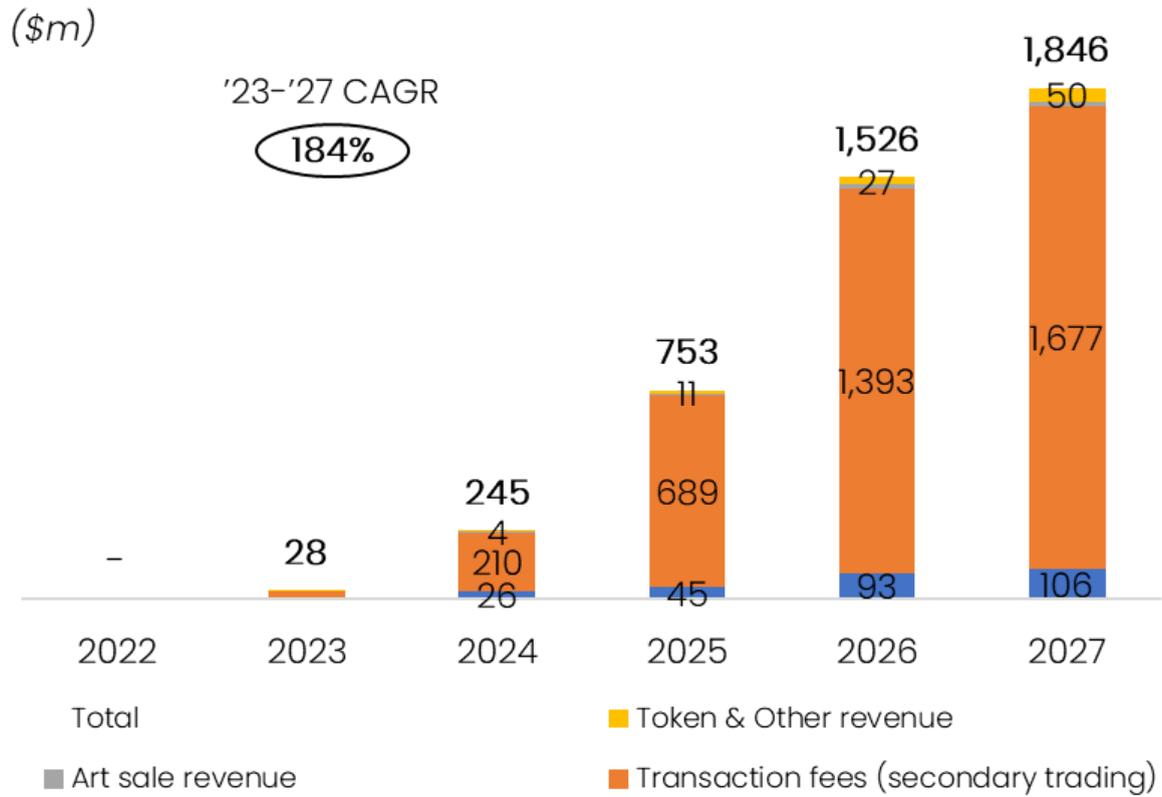
As a marketplace, our Key Performance Indicators relate to

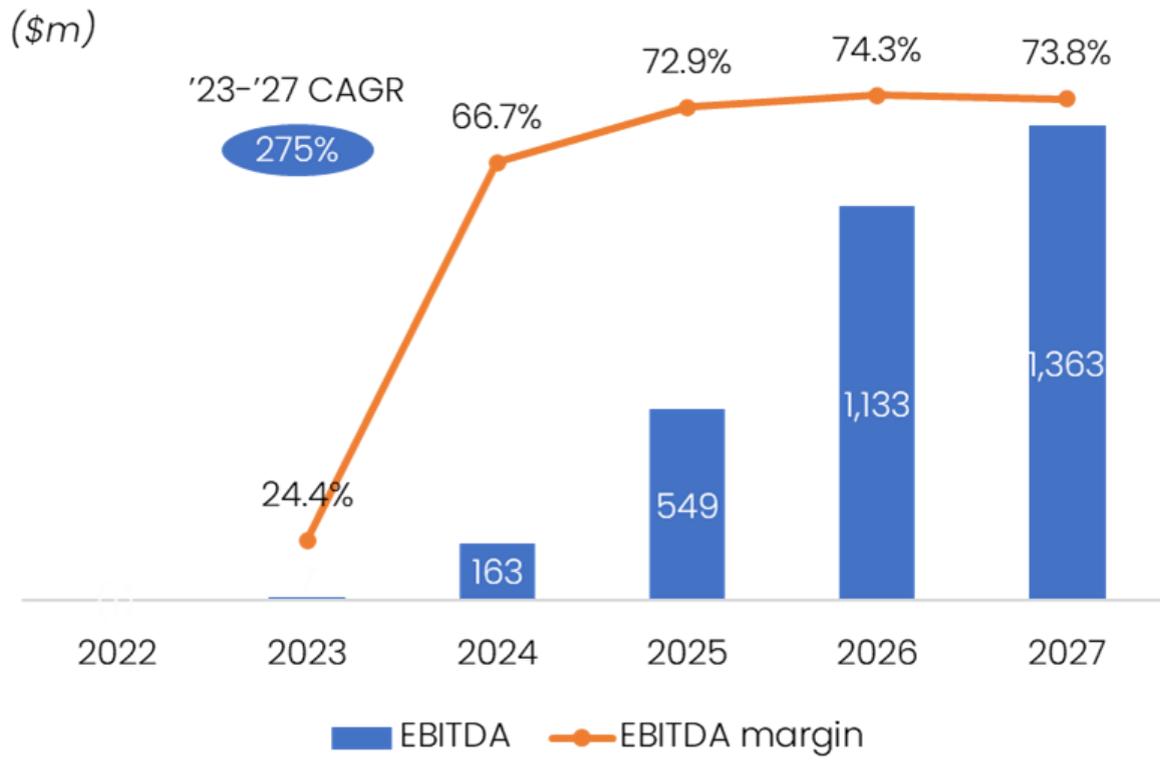
1. Active users – both sellers at primary auctions (“Listers”) and traders in the secondary market (“Traders”); and
2. Volumes of Art traded, ie the \$ value of both Art listed for primary sale and fractions traded in the secondary market



- We earn revenue from i) transaction fees levied on primary and secondary trades, ii) sale revenue on owned Art sold, and iii) token and other revenue

- Our key cost items are i) transaction costs borne by Angelo to execute trades, ii) customer acquisition & marketing, iii) crypto hedging and Art insurance costs, and iv) people costs





Appendix 2: Tokenomics ranking framework

Business-Token interaction

1. Do tokens improve the current business model? Yes:1, No:0
2. Is the token nice to have, or an essential part of the business model? Essential: 1,
Nice-to-have: 0
3. Can the project gain value (not the token) in fiat terms? Yes:1, No: -1

Structural analysis

1. *Cash-flows:*

1. Does the token economy have an influx of value (e.g. in fiat) coming in? Yes:0, No: -1
2. Does money stay in the token economy, or is there pressure to immediately sell? Stay: 1,
Sell-pressure: -1
3. Are there ponzi-like elements? Yes: 0, No: 1

2. *Mechanisms and all economic agents involved*

1. Do interactions generate additional value expressed in fiat? Yes: 1, No: 0
2. Does the project require a critical mass in order to be able to provide value? E.g. social networks are a good example of this. Yes: 0, No: 0.5
3. Are the incentives speculative? For example, rewards with no underlying value? Yes: -1,
No: 0

3. *Demand Drivers*

1. Do all the demand drivers depend on controllable factors or uncontrollable factors? An example of a controllable factor is product quality. An example of an uncontrollable factor can simply be the market conditions. Controllable: 1, Uncontrollable: 0
2. Are there levers the economy can use to influence demand? Yes: 1, No: 0
3. Do they depend on entities that generate real economic value or more on internal or speculative factors, e.g. expected token appreciation because of rewards? Real economic value: 1, Speculative: -1

4. *Governance: Not applicable*

- ~~1. Can a majority take over? Yes: -1, No: 1~~
- ~~2. Can governance cause sticky points? For e.g. votes need to take place, but no one is voting. Yes: 0, No: 1~~

5. *Empirical proof:*

1. Has there been proof that the mechanisms used in the project can work successfully? Yes: 2, No: 0

Allocation and Distribution

1. Does the allocation favour pump-and-dumps? Yes: -1, No: 0
2. Does it provide unnecessarily large stakes to certain actors? Yes: -1, No: 0
3. Does the distribution avoid creating unnecessary sell pressure? An example of this can be excessive airdrops. Yes: 1, No:0

Stability and stress tests

1. How exposed to shocks is the token? Answering this requires simulations. Use a scale from -2 to 2. A 2 represents a token that can withstand huge shocks (e.g. massive bear market), and a -2 represents a token that can only appreciate when conditions are perfect.: Score=2
2. Does the token appreciate when simulated? If the objective of the token is to provide a peg or some other functionality, then this question can be ignored. Yes: 1, No: -2:
3. Does the system have feedback loops, which could accelerate a crash (e.g. the Terra/Luna case)? Yes: -1, No: 1

Score: 14.5 over a maximum of 16.5 (since governance does not apply).

Final score: AAA