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The Tokenomics Audit Checklist: Presentation and Examples from the Audit of a DeFi project, Terra/Luna and Ethereum 2.0

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Abstract

With the increasing popularity of Web 3.0, tokenomics is becoming even more important as a scientific discipline. Tokenomics auditing is a new area of interest in the context of Web 3.0 whose aim is to stress test the design and structure of token economies, to ensure they are robust and safe. The importance of this area has increased considering multiple project failures and fraud that were witnessed in the recent history of the space.

In this paper we present a framework to audit the tokenomics of blockchain-based projects. The auditing framework can be used by stakeholders to audit their tokens and by investors to assess the risks associated with investing in a given token. We demonstrate how this framework can be applied to assess risks and improve the structure of a token economy.

We give three examples: First, an example is based on a real case study of a newly launched DeFi protocol called Algem which was the original inspiration for this protocol. Then, we perform retrospective study of Terra/Luna. Finally, we show how that framework could be used for the analysis of Ethereum 2.0. While the auditing framework is not without its shortcomings, it represents the first attempt at standardising tokenomics auditing. Therefore, this provides a foundation upon which the community will build and improve, as tokenomics auditing matures as a framework.

Keywords: *Tokenomics, Token economics, Agent based, Auditing, Monte carlo*

JEL Classifications: *G10*

1. Introduction

Tokenomics is the study of token economies. It's a field that emerged around 2017 once it became evident that the possibilities that Ethereum provided in creating tokens allowed for the generation of artificial economies that align incentives in novel ways, never seen before [1].

It was in 2018 in the inaugural issue of this journal when the question was asked, "Why do we need tokenomics?" [2]. This question is no longer relevant, simply because everyone in what is now termed the Web 3.0 space believes that we need tokenomics. Indeed, some of the major innovations we've seen in the area of blockchain, such as DeFi, have come primarily as tokenomics innovations, whether we are talking about powerful lending and borrowing protocols or failed experiments like Terra/Luna.

It looks like as we are entering a new era of wider adoption of blockchain, the focus on tokenomics has shifted from simple utility designs to more complicated interconnected economies. Another trend that has been observed is that of tokenomics auditing. Many founders in the blockchain space are better educated on the topic, and can often create interesting designs, without any external help. However, the designs often reach a level of complexity that makes it difficult to validate how well they would work in practice.

This has given birth to tokenomics auditing [3]. The goal of a tokenomics auditor is to analyse a token economy and suggest improvements if it is found that the design does not satisfy the goals. This journal had already published work in this area and outlined some of the techniques that can be used in auditing.

As the field of token economics matures and auditing becomes more widespread, it feels that the next stage of evolution requires more rigour. Tokenomics auditing must become less subjective over time and be based more on objective criteria agreed upon by experts. In an ideal world, there would be a framework that any tokenomics auditor could follow and would allow the auditor to hand out ratings based on objective criteria.

In order to achieve this goal, the authors are presenting here a simple tokenomics auditing framework. This was applied for

the audit of a DeFi project, with a complicated value flow design.

While the tokenomics audit checklist cannot be considered to be exhaustive or the final word on the topic, it nevertheless advances the state of the art on what currently is a green field.

2. Background information

Freni et al. [4] did a great job at summarising the objective of tokenisation:

"tokenization represents a form of digitalization of value and, just like the Internet enabled the free and fast circulation of digitised information, so the blockchain is allowing the almost free and borderless flow of digitised value."

This simple definition captures the plurality of applications that tokens have brought to the Web. However, it is this plurality that can often make standardising tokenomics such a challenging topic.

First, token economies can have radically different goals. For example, a stablecoin has a drastically different goal from a project based around a utility token. This leads to the observation that there are many different types of tokens. Freni et al. provide a framework with many different parameters, shown in Figure 1, which a token can abide by. The total number of possible parameter combinations ranges in the thousands.

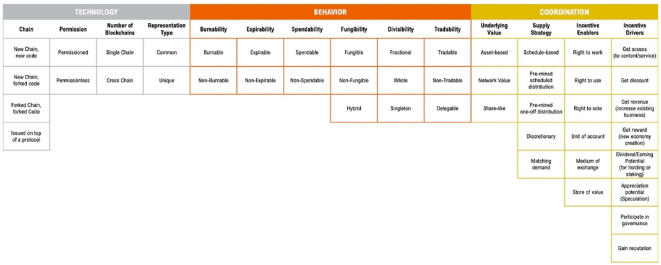


Figure 1. Classification of token types.

Secondly, when valuing a token, different tokens can have very different principles upon which they should be valued. For example, recent work investigated valuing NFTs [5], taking as a base their attributes, and then using hedonic regression. Other approaches have used tools from network theory, such as Metcalfe's law [6], the quantity theory of money [7], to simply using the total value locked or the market cap.

Finally, not all tokens will abide by simple classifications. A good example is the latest white paper by Cosmos [8] presents a token with multiple interlinked utilities: from security to wealth preservation and governance. This makes identifying potential feedback loops and issues more difficult and challenging. An excellent demonstration of the complex value flows that can be created in blockchain projects is shown by Kim et al. [9] who presented a case study of a token economy design from scratch. This is shown in Figure 2.

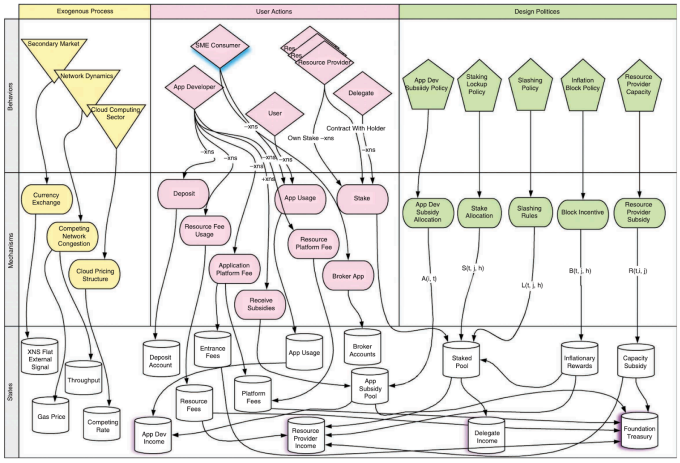


Figure 2. Case study of a token economy designed from scratch by Kim et al. [9]

All the above corroborate the conclusion that it is very difficult to create a simple tokenomics framework that can cover every eventuality. Also, in this discussion, we didn't mention the complex topic of simulations, where the preferred methodologies can range from agent-based modelling [10] to control theory [11].

Furthermore, we don't touch upon the complications that other factors can bring into the business, such as the successful execution of marketing, or product considerations.

Therefore, we decided that a framework should focus upon the following principles:

1. It should be abstract enough so that it can cover existing cases in blockchain, no matter the field: DeFi, GameFi, Layer 2 solutions, etc.
2. It should be simple enough, that at its most basic form, a blockchain project should be able to use the framework with no external help.
3. It should be able to accommodate the results from simulations, if such are available, without being constrained by them.
4. The framework ignores certain externalities, such as product-market fit. Tokenomics interacts with the business model, and this aspect is also recognised in this framework. However, tokenomics cannot replace product-market fit or marketing. Therefore, the framework recognises that such externalities exist, up to a point.

The framework combines various aspects of a project: business model analysis, identification of potential external shocks, token allocation, simulations and more. Since this work is novel, it's very difficult to cover every potential

scenario. Therefore, the main goal of this framework can be summarised in the following sentence:

"Given a set of certain criteria and areas to investigate, would a sceptical reader be convinced that the tokenomics of a project are robust, and achieve the goals of the project?"

Note that we are not naming any specific tools to be used, since the tokenomics auditor is free to use any tools, they deem appropriate. This open-ended definition places weight on both the auditor, but also the user and investor of a project.

We believe that this framework is more useful when identifying potential weak points which a protocol can improve, rather than when a perfect score is achieved. It is unlikely that this set of criteria is going to remain static over time, and it is expected that the tokenomics community is going to improve them.

However, each one of those criteria does cover common issues in tokenomics, and a weakness in any of them is something that must be addressed.

The framework is presented in the next section.

3. The Tokenomics Auditing Framework

The framework comprises an audit checklist that is split into four parts:

1. Business-token interaction
2. Structural analysis
3. Allocation and distribution
4. Stability and stress tests

Each part asks a certain number of questions. The answers are scored on a point system, with more points describing a more positive outlook for the token economy.

The first part (business-token interaction) investigates any relationships that exist between the token economy and the business model. The most important question that it asks is, "Does this business model really benefit from a token economy?"

The second part is the longest and most complicated. It tries to identify issues such as:

1. Ponzi-like elements. Something which protocols like OlympusDAO have been accused of [12].
2. Dynamics which can cause an implosion, e.g., the Terra/Luna case. [13]
3. Demand driver challenges.
4. Governance issues.

The third part deals with the allocation and distribution of the token.

The final part (stability and stress tests) is the only one that contains questions that do not have a Yes/No answer. Therefore, the fourth part is considered as an extra, since some projects might not have the capability to implement it, and it requires simulations that add a certain element of complexity. Ideally, in the future, the types of stress tests required will be standardised and will become more accessible.

The full questionnaire checklist is shown below so that the checklist can be simply printed. Another section follows with an explanation of the answers. Each section is accompanied by a "rationale" paragraph explaining what the intention behind that section is.

Business-Token Interaction

Rationale: The rationale behind these questions is that the use of blockchain should be a must-have, not a nice-to-have for a project. Obviously, there is a certain element of subjectivity in these questions, but they at least raise awareness of the issues.

1. Do tokens improve the current business model?
2. Is the token nice to have or an essential part of the business model?
3. Can the project gain value (not the token) in fiat terms?

Structural Analysis

Break down explaining main system mechanisms and interactions.

Rationale: The objective of this section is to do a thorough review of the structure of the token economy. This is by far the most important section. We believe that future work is going to expand and add more points to this section, since as protocols develop more and more advanced mechanisms, new points need to be addressed.

In general, we believe that a robust tokenomics structure creates value, while avoiding feedback loops that can cause implosion or explosion of the system, e.g., Ponzi-like elements or overleveraged positions. That's not to say that protocols that might have such elements might still provide value in other ways.

However, from a tokenomics perspective, such mechanisms can leave a system exposed to shocks.

Sections 1 to 3 deal with the utility and the practicalities of a project: Would the project generate cash flow? Does it suffer from feedback loops? Does it generate economic value? Can it control certain demand drivers?

Section 4 deals with governance, whereas section 5 simply asks the question as to whether there is empirical proof that

the protocol could work in practice. By empirical proof we refer to any similar protocols that might exist and have produced data that show that a particular design can work. For example, the existence of decentralised exchanges proves that automated market makers can work in practice.

The tokenomics auditor is free to use whatever tool is appropriate for structural analysis, e.g., game theory or mathematical modelling. However, simulations (agent based or otherwise) are explicitly mentioned in the "stress test" section, so they are not officially part of the structural analysis section, even though they can be used here, as well. The open-endedness of this framework is one limitation which is discussed later in this paper.

1. Cash-flows:
    1. Does the token economy have an influx of value (e.g., in fiat) coming in?
    2. Does money stay in the token economy, or is there pressure to immediately sell?
    3. Are there ponzi-like elements?

2. Mechanisms and all economic agents involved
    1. Do interactions generate additional value expressed in fiat?
    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.
    3. Are the incentives speculative?

3. Demand Drivers
    1. Do the demand drivers depend on controllable factors or uncontrollable factors? An example of an uncontrollable factor is simply conditions.
    2. Are there levers the economy can use to influence demand?
    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?

4. Governance:
    1. Can a majority take over?
    2. Can governance cause sticky points? E.g., votes need to take place, but no one is voting

5. Empirical proof:
    1. Has there been proof that the mechanisms used in the project can work successfully?

Allocation and Distribution

Rationale: Allocation and distribution are both very important considerations for any tokenomics design. The objective of this section is to primarily deal with the major problem of pumps-and-dumps and excessive market manipulation from powerful actors.

There might be some other allocation considerations that a project might want to consider, for example, how fair an allocation is. These are not addressed in the current framework since the main objective of the framework is to establish whether the tokenomics are robust.

1. Does the allocation favour pump-and-dumps?
2. Does it provide unnecessarily large stakes to certain actors?
3. Does the distribution avoid creating unnecessary sell pressure?

Stability and stress tests

Rationale: Failures in the recent history of tokenomics, such as the Terra/Luna crash, have demonstrated the important of stress tests. This is by far the most open-ended section, since it is unavoidable that a proper audit would require the use of simulations. It is hoped that this process will be standardised once the tokenomics auditing matures, in a similar way to which central banks might stress test the underlying financial infrastructure of their countries.

1. How exposed to shocks is the token?
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.
3. Does the system have feedback loops, which could accelerate a crash (e.g., the Terra/Luna case).

4. The Framework with Answers and Guidance

The following section presents the score that is assigned to each question. There is a certain element of subjectivity in the scoring. While other experts in this area might come forward with their own opinions, the authors believe that it would be difficult to assign the same weight to all questions.

As this area progresses, the scoring used in this framework is going to be improved based on data, and the success or failure of the different projects analysed.

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

Break down explaining main system mechanisms and interactions:

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:
    1. Can a majority take over? Yes: -1, No: 1
    2. Can governance cause sticky points? 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.
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

Points interpretation

The maximum score can be 18.5:

- Business-token interaction(3)
- Structural(10.5)
- Allocation and distribution(1)
- Stability and stress tests(4)

The lowest possible score can be -13:

- Business-token interaction (-1)
- Structural (-5)
- Allocation and distribution (-2)
- Stability and stress tests (-5)

Based on the ratings and most susceptible categories, the auditor should recommend adjustments and tangible solutions to increase the current system's resilience to economic exploitation and harmful feedback loops.

Table 1. Ratings and scores interpretations

Letter rating	Score	Percentage
AAA	16-18.5	86%+
AA	14-6	75%-86%
A	12-14	65%-75%
BBB	10-12	54%-65%
BB	8-10	43%-54%
B	6-8	32%-43%
CCC	4-6	22%-32%
CC	2-4	11%-22%
C	0-2	0%-11%
DDD	-4-0	-21%-0
DD	-8-4	-42%-0
D	<-8	<42%

The maximum score that can be awarded is 18.5. This score can be converted to letter ratings, in a similar fashion to the one that is used in mainstream finance credit ratings. This is detailed in Table 1. The right number is exclusive, that is, 0-2 means that the score is below (but not equal) to 2. The table also contains a column for percentages. This is done for

convenience since some questions might have to be removed for certain projects.

The goal behind this table is to simplify the interpretation of the final score. However, a score below AAA shouldn't necessarily be considered problematic. Going back to this definition:

"Given a set of certain criteria and areas to investigate, would a sceptical reader be convinced that the tokenomics of a project are robust, and achieve the goals of the project?"

it might be the case that a project achieves a score below AAA, simply because of its peculiarities or goals. Again, the investor or user of a project is assumed to be a sceptical reader of an audit, and it's up to them to decide whether the assessment or risk aligns with their investment profile. This is not different to how investments take place in traditional finance.

5. Case Study: Using the Framework for a Real Audit

The first tokenomics auditing framework was applied for Algem [14] - liquid staking and lending protocol on the Astar Network and Polkadot.

The main goals of this audit were to:

1. Determine whether Algem's economy is resilient and sustainable.
2. Determine whether Algem's price can rise or not.
3. Examine whether Algem is vulnerable to overleveraged positions that could destabilise the overall system.

Algem has three main mechanisms:

1. Liquid staking.
2. Liquid lending.
3. Algem stake to earn.

The interconnectedness of mechanisms can be observed in the token value flow shown in Figure 3.

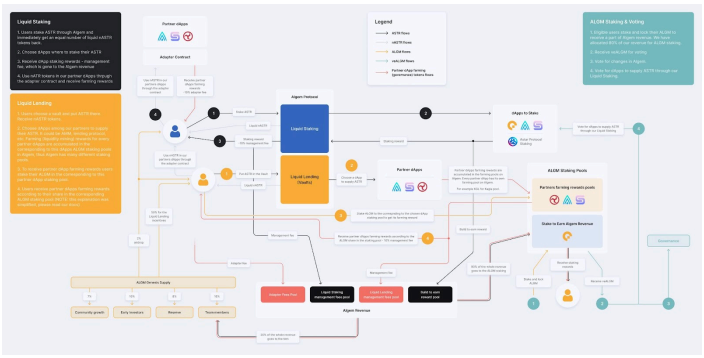


Figure 3. Algem's token flow.

After the initial audit overview, Algem scored 12.5 out of 18.5:

- Business-token interaction (3)
- Structural (5.5)
- Allocation and distribution (0)
- Stability and stress tests (3)

Algem, like many other early-stage crypto-projects, must use a considerable portion of its supply for investors, airdrops and community rewards in its early phases. This frequently results in an oversupply of tokens, putting downward pressure on the price.

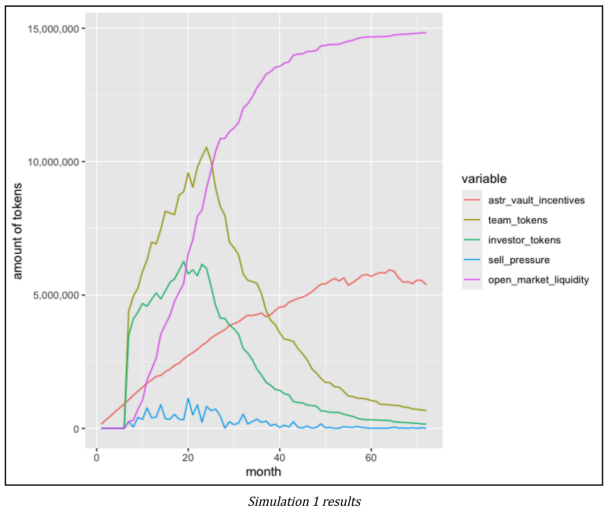
Therefore, this caused Algem to rate low on the demand drivers and the allocation and distribution sections. Algem had issues controlling its own demand, and the original design was increasing sell pressure unnecessarily.

Something which stood out is that Algem did not suffer from any feedback loops. Therefore, it achieved a perfect score to the following questions:

- *"Are there ponzi-like elements?"*
- *"Does the system have feedback loops, which could accelerate a crash"*

The audit resulted in the development of mechanisms for reducing sell pressure and refining token demand. Both systems are controlled by governance and hence adaptable, but they also provide additional incentives and motives for users to participate in governance.

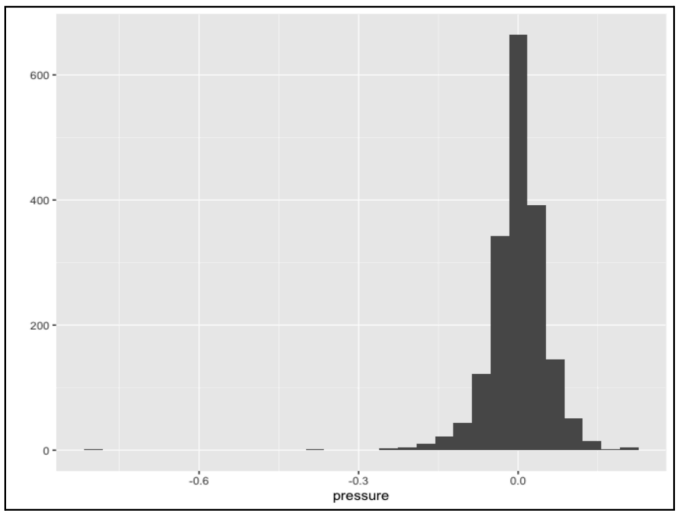
These mechanisms were further investigated using simulations that were necessary for answering the questions in the stress test and allocation sections. It was found that the sell pressure (blue line in Figure 4) did not exceed a critical threshold that would place the project at the risk of pump-and-dump.



Simulation 1 results

Figure 4. Simulation of sell pressure and demand [15].

The demand and the supply were based upon stochastic assumptions, as well as real data. For example, to simulate the distribution of demand, the authors resorted to extracting data from Ethereum, in order to understand what a realistic distributional shape for the simulation of the demand would look like. The full details of this process are presented in [15].



After these changes, Algem was rated again based on the framework questions. It was discovered to have robust and durable tokenomics after implementing the specified mechanisms. There are no issues with the system's internal design or the token allocation and distribution mechanism. Additionally, Algem is an adaptive protocol, with governance playing a key role in some of the mechanisms that control demand and supply.

Any troubles that develop in the project are more likely to be caused by external forces (such as market conditions). As a result, the project's tokenomics clearly pass all checks and receive the highest rating (18.5/18.5), which amounts to AAA.

This presents an example of how the framework was used in practice to rectify some of the weaknesses of a real protocol.

This doesn't imply that the protocol is perfect, or that its success is guaranteed, since there can be other external factors that could constrain its popularity, from market conditions to the core team falling apart.

However, going back to our original definition, as far as a sceptical reader is concerned, the arguments in favour of that rating are placed clearly, and any investor or user that disagrees is invited to make up their own mind.

The Web3.0 community has benefitted from this analysis in two ways:

- The protocol has become more robust, and if it succeeds, then it will generate economic value.
- Users and investors can now read an in-depth analysis about the protocol and decide whether it is investable or not.

6. Other examples: Terra/Luna and Ethereum

Performing a full audit of Terra/Luna or Ethereum would require a whole new paper for each project. However, in this section we present some ways in which this framework could be used.

Terra/Luna

One of the most famous examples of economic exploitation is TerraUSD (an algorithmic stablecoin). TerraUSD was one of the biggest cryptocurrency projects until it lost its peg on the 11th of May 2022 [16]. Terra had a dangerous feedback loop: swapping and burning UST for Luna (their native token) meant minting more Luna, diluting the supply and dropping the price of this token. Additionally, as the price of Luna drops, whenever you swap 1 UST for $1 worth of Luna, you steadily need more and more Luna to hit that $1 mark (which means minting even more Luna).

At some time, the price of Luna had fallen so low that there wasn't enough liquidity to provide an escape route for all the UST flowing in. This could have been prevented if the burn-and-mint mechanism had been audited and stress-tested in various supply and demand pressure scenarios. A more detailed analysis is presented in subsequent sections.

The main objective of Terra/Luna was to maintain a stable peg against the US dollar. Therefore, a tokenomics audit should assess how successfully the protocol would be able to perform that role.

We believe that Terra/Luna would successfully pass most of the sections with the exceptions of the following ones:

1. Does the project require a critical mass in order to be able to provide value? *Yes, algorithmic stablecoins require a critical mass of users.* Points retracted: -0.5
2. Do all the demand drivers depend on controllable factors or uncontrollable factors? *Demand is not fully controlled by the protocol.* Points retracted: -1
3. Do they depend on entities that generate real economic value or more on internal or speculative factors. *It could be argued that rewards were largely speculative.* Points retracted: -2
4. Are the incentives speculative? For example, rewards with no underlying value? Yes: -1
5. Do the demand drivers depend on entities that generate real economic value or more on internal or speculative factors, e.g., expected token appreciation because of rewards? Speculative -1
6. Are there ponzi-like elements? Yes: 0. The answer to this question is clearly a yes, as Anchor Protocol was effectively operating as a Ponzi [17].

The question "*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."* must be ignored giving the protocol a maximum potential score of 17.5.

Regarding the question "Has there been proof that the mechanisms used in the project can work successfully?" it could be argued that the seer fact that the protocol had existed for a certain amount of time was proof that it could work. Therefore, if the audit had taken place before the eventual crash, it would pass this question successfully.

Based on that, the project would get a score of 8/17.5 which would rank its tokenomics as BB. This can be interpreted as that the tokenomics are good, but far from perfect. This rating corresponds with what was observed in practice.

The tokenomics of Terra/Luna worked fine until market conditions and externalities caused enough pressure to lead it to complete failure.

The fully answered questionnaire is presented in the Appendix.

Ethereum 2.0

At the time of writing, Ethereum is the second biggest cryptocurrency, and one of the most pivotal ones in the history of blockchain.

Ethereum 2.0 will bring many changes in the underlying protocol and tokenomics, the major one being that it will transition to proof-of-stake. The upgrade has many goals, including decentralisation, improved security and scalability.

However, for the purposes of a tokenomics audit, the main concern is identifying what are the core tokenomics goals and whether they are achieved.

Apparently, the tokenomics goals of Ethereum 2.0 include lower gas fees, and an appreciation in the price of Ethereum, which will make it a more desirable asset.

Also, Ethereum is an established protocol. Therefore, questions around the economic value and the demand drivers do not require much elaboration since the success of the protocol makes the answers self-evident.

From that perspective, the analysis would proceed as follows:

- The business-token interaction gets a perfect score. The same for the allocation and distribution sections.
- The structural analysis sections get all perfect scores except for sections 4 and 5. These sections would require a more in-depth investigation, due to the nature of proof-of-stake, and the untested nature of Ethereum 2.0. A conservative auditor might want to consider giving the worst possible score to those sections.
- The stability and stress tests would require extensive work on simulations to answer properly.

Some other points worth noting are the following. The question *"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."* can be answered either way. Ethereum's power over Web 3.0 means that through its adaptive gas fees it has some power over the supply and the demand.

The question "How exposed to shocks is the token?" can be answered by a score of 1, since Ethereum has already withstood shocks, but the new protocol changes might make it more or less susceptible. Again, that's a point that would have to be simulated and such as simulation is out of scope for this paper.

Therefore, based on that the conservative auditor would give Ethereum a score of 12.5. Successfully passing the simulations for the question *"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."* would give a score of 13.5. If we assume that governance is not a concern, then the score goes even higher.

Therefore, even in the worst case, Ethereum 2.0's tokenomics are ranked at A or higher.

Obviously, a full analysis would require a detailed simulation of the system. However, the use of the framework has quickly allowed us to analyse some of the weak and strong points of the protocol, and give it a positive rating.

Perhaps, future work on this type of frameworks will also include other concerns, such as scalability and security, which can indirectly affect tokenomics.

7. Limitations

While this research is novel it suffers from certain drawbacks. This is a side-effect of being amongst the first of its kind, and it is expected that the community will improve upon this work done. Perhaps, tokenomics auditing will become a regulatory requirement in the future once the process gets standardised.

Some weaknesses of this framework include:

- Lack of standardisation of the tools used to perform the audit. Tokenomists can use a wide arsenal of tools, from game theory to simulations, set up in an arbitrary way. Eventually the community should try to come up with a certain set of standards.

- There are more areas that could be addressed (e.g., decentralisation and scalability), and are not covered in this framework.
- This framework might not be as applicable in specialised cases, like virtual land.
- The framework uses a scoring system which might objectionable, given that different auditors or even projects, might consider some other questions to be more important than others.

Nevertheless, we believe that the simple existence of such a framework can help identify weak points in tokenomics designs, and would help prevent catastrophic cases, such as the ones that have been witnessed in recent history.

Furthermore, it provides a body of work upon which new research can improve.

8. Discussion and Conclusion

This paper presented a framework for auditing tokenomics, as well as a case study as to how this can be applied in practice.

It's clear that as Web 3.0 adoption grows, the significance and importance of tokenomics in the world of blockchain will only rise.

The objective behind this framework is to set some standards around how tokenomic robustness is being measured and audited. While this framework is not perfect, it presents a significant advancement over the current state of tokenomics auditing which lacks any standards at the moment of writing.

Future research should focus on expanding upon this body of work. One clear area that can advance further is the use of standardised simulations and stress tests for auditing token economies. Other than that, as more projects are going live, the field will be able to accumulate more and more data to understand what makes tokenomics more robust and identify vulnerabilities and attack vectors.

The authors hope that this framework would be an important milestone in the standardisation of token economics.

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Appendix
Terra/Luna Analysis

Business-Token interaction

- Do tokens improve the current business model? Yes: 1
- Is the token nice to have, or an essential part of the business model? Essential: 1
- Can the project gain value (not the token) in fiat terms? Yes: 1

Structural Analysis

Break down explaining main system mechanisms and interactions:

Cash-flows:

- Does the token economy have an influx of value (e.g., in fiat) coming in? Yes: 0
- Does money stay in the token economy, or is there pressure to immediately sell? Stay: 1
- Are there ponzi-like elements? Yes: 0

Mechanisms and all economic agents involved

- Do interactions generate additional value expressed in fiat? Yes: 1
- 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
- Are the incentives speculative? For example, rewards with no underlying value? Yes: -1

Demand Drivers

- 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. Uncontrollable: 0
- Are there levers the economy can use to influence demand? Yes: 1
- 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? Speculative -1

Governance:

- Can a majority take over? No: 1
- Can governance cause sticky points? E.g., votes need to take place, but no one is voting. No: 1

Empirical proof:

- Has there been proof that the mechanisms used in the project can work successfully? Yes: 2

Allocation and Distribution

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

Stability and stress tests

- How exposed to shocks is the token? -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 – This question is ignored
- Does the system have feedback *loops*, which could accelerate a crash (e.g., the Terra/Luna case)? Yes: -1

Ethereum analysis

Business-Token interaction

- Do tokens improve the current business model? Yes:1
- Is the token nice to have, or an essential part of the business model? Essential: 1
- Can the project gain value (not the token) in fiat terms? Yes:1

Structural Analysis

Break down explaining main system mechanisms and interactions:

Cash-flows:

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

Mechanisms and all economic agents involved

- Do interactions generate additional value expressed in fiat? Yes: 1
- 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. No: 0.5
- Are the incentives speculative? For example, rewards with no underlying value? No: 0

Demand Drivers

- 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
- Are there levers the economy can use to influence demand? Yes: 1
- 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

Governance:

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

Empirical proof:

- Has there been proof that the mechanisms used in the project can work successfully? No: 0

Allocation and Distribution

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

Stability and stress tests

- How exposed to shocks is the token? 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
- Does the system have feedback loops, which could accelerate a crash (e.g., the Terra/Luna case)? No: 1