The Algorand Economic Evolution report

Sean Mann[1], Massimo Morini[2], Michele Treccani[3]

The Algorand Foundation Transparency report published on March 31, 2021, highlighted several evolutionary dynamics in the economics of the Algorand network - that in the following text we will briefly call Algonomics. The aspects which are relevant to this report are

- A significant acceleration of the distribution process in the first part of 2021, based mostly on an algorithmic element of Algonomics, that is the Acceleration feature of Early Backer vesting.

- The transformation of the rewards system, linked to the shift from Foundation governance to Community governance, confirmed by the community referendum on July 7, 2021, and becoming a reality between 2021 and 2022.

- An evolution in the utilization of the Foundation's resources, to increase the Foundation's autonomy as the curator of the much larger Community resources.

In this report we provide further information and analysis about these 3 aspects of Algonomics, essentially anticipating and explaining the forthcoming update of the Long Term Algo Dynamics (LTAD) page of our website incorporating these facts. In particular, the Long Term Algo Dynamic, which is the main economic document on our website, will receive a new, specific role with governance, balancing the power of choice of the Community with the analytic certainties about the future Algonomics until 2030 given in the LTAD. The structure of the report is as follows, starting from a brief recap of the main past evolutionary dynamics:

- The Algo Market Evolution So Far

- Algorithmic Vesting Acceleration in practice

- Evolving LTAD with Governance: the example of Rewards

- The current structure of Algo circulating supply

---

The Algo Market Evolution So Far

We start by reporting the chart of Algo supply vs time. The supply chart reminds us of the specific Algo dynamics: the Algo market started with an initial tiny supply, so that subsequent reward flows, represented mainly by participation rewards (paid to all holders) and first-node-runner rewards (paid to the initial supporters that had invested in the project and committed to run relay nodes), had a disproportionate inflationary impact, as one can see from the price chart further below.

This led to the need to introduce some early reforms to the algonomics. First, participation rewards were stabilized compared to the initial distribution trend, until market conditions, almost one year later, allowed them to restart growing.
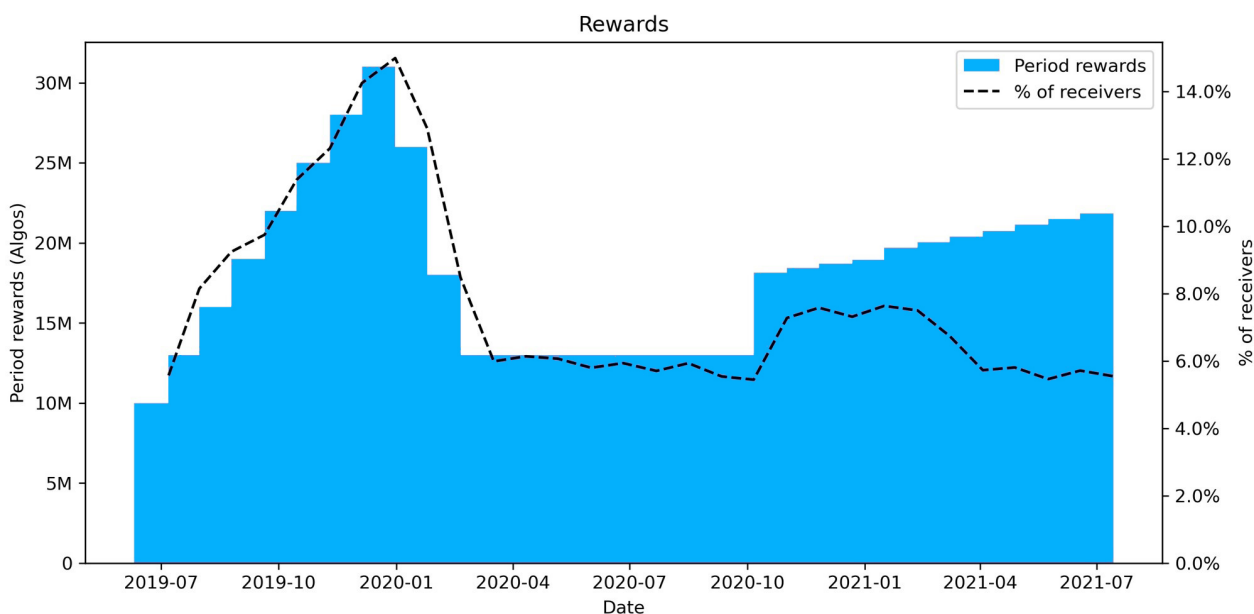
Secondly, the vesting plan was changed, first by pausing vesting for several months (EIP-09092019PC and EIP-10182019), and later (EIP-11252019AF) by introducing a new vesting agreement shifting payments to node runners to the further future and allowing in return a contingent increase and a possible acceleration, but the latter only when the market will be sufficiently mature for smooth absorption. Maturity here is measured mainly by market capitalization. The supply chart below shows how indeed vesting acceleration has been an important part in the growth of supply, particularly in the first half of 2021, so now is the right moment for some empirical analysis of acceleration.
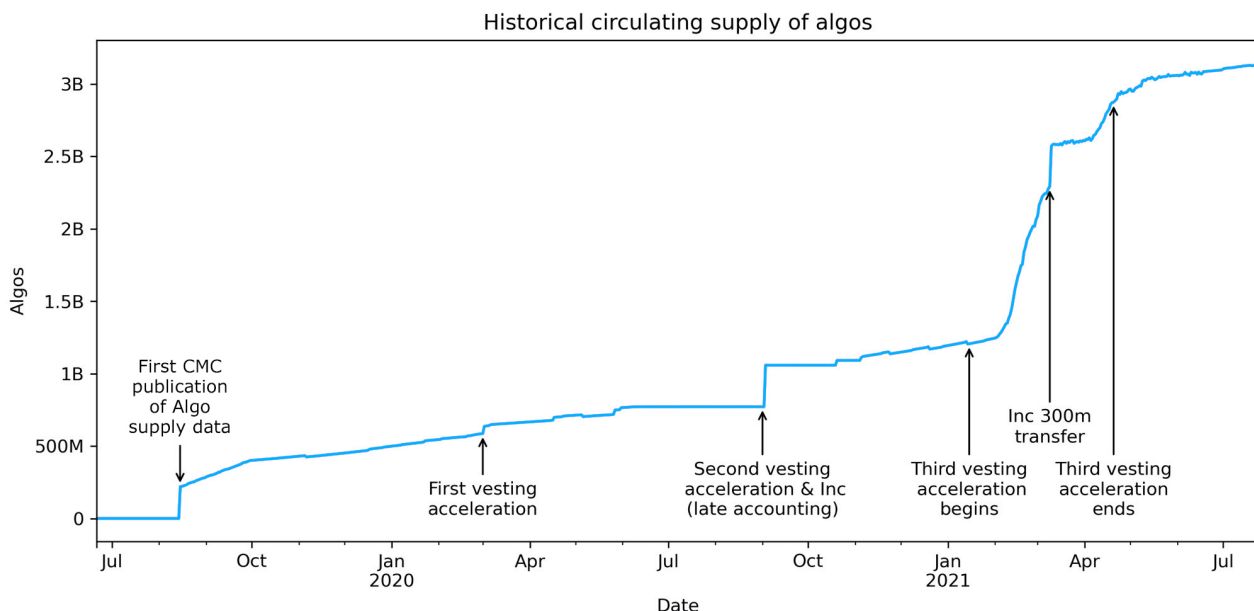
Since acceleration is linked to market cap dynamics, we also report the price chart, market cap being just the product of supply and price. For ease of analysis, we also report in the same chart some important events in the algonomics, comparing the chart with Bitcoin one. The comparison allows us to appreciate the affinity but also the differences: the different trends in 2019 2H–2020 1H, the difference in the timing and nature of the start of trend of 2020 2H–2021 1H.


Historical algo price

Historical bitcoin price
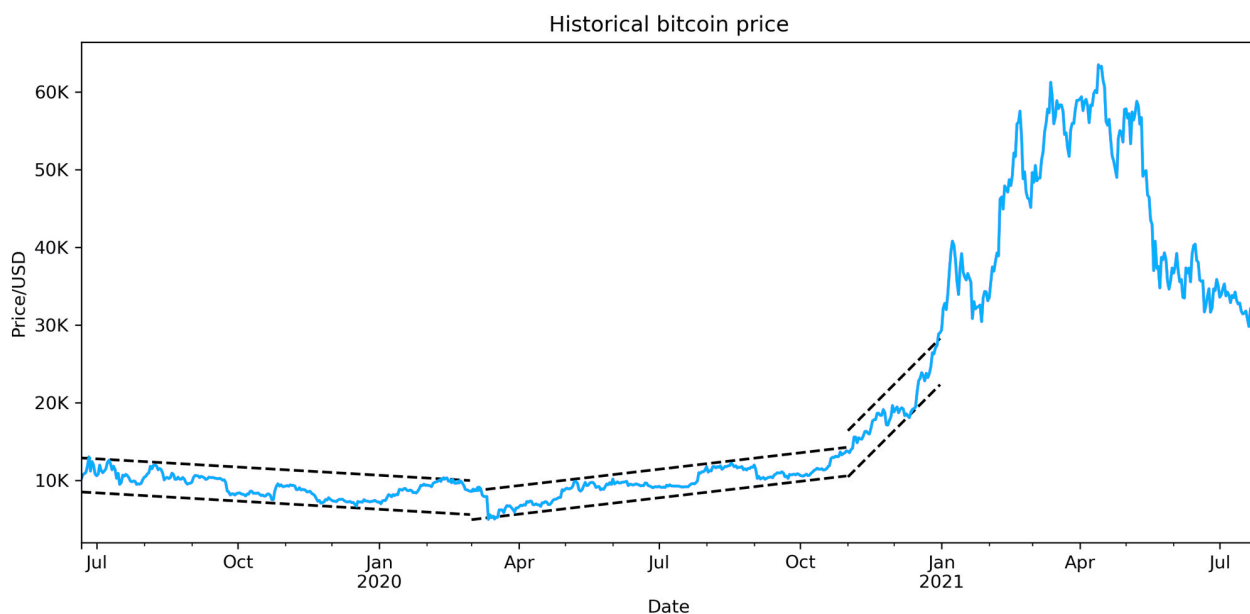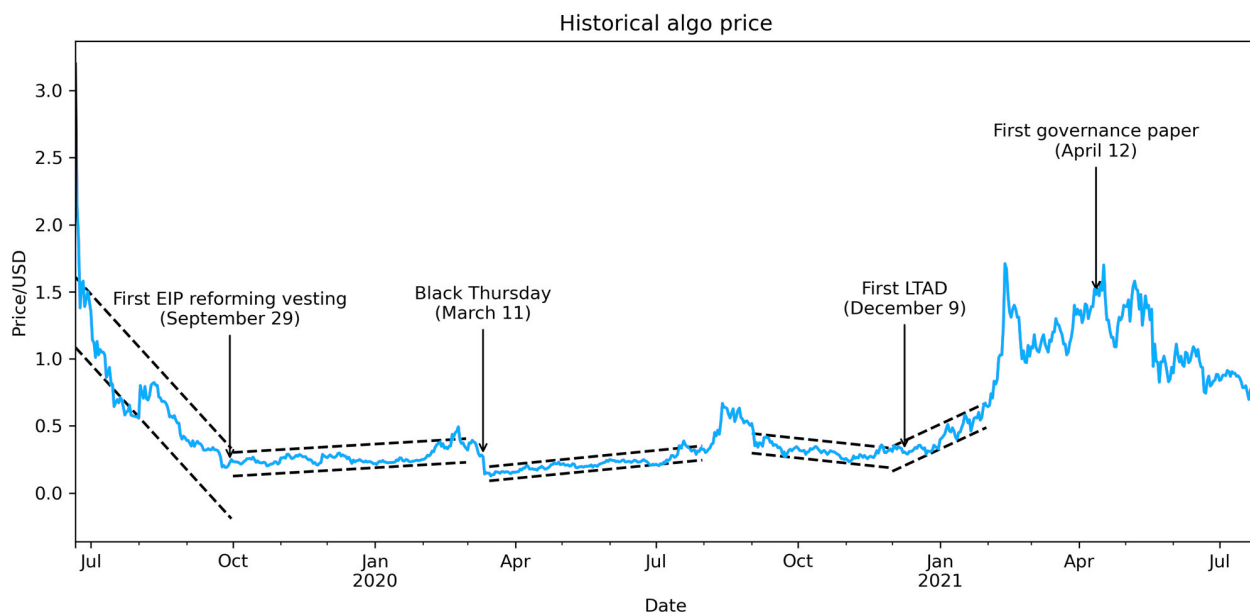
The growth of the Algo market cap seems to have been, compared to the volatility of the initial bootstrap period, relatively smooth and non-inflationary also during vesting acceleration. In fact, the growth was relative and not only absolute: the ranking of the Algo market cap in the first 6 months of 2021, that included 90% of the vesting so far, moved from position 52 to position 32, and if we limited the analysis to blockchains of the kind existing when the network was launched, the market cap would have moved to the first 20s.

Correlation analysis confirms a strong correlation with both BTC and ETH, but also that the price dynamics of the Algo had its own behaviour different from the one of the largest cryptocurrencies. Looking specifically at price correlations from launch, we see this pattern.

3

	S&P	BTC	ETH	ALGO
S&P	100%	29%	28%	26%
BTC	29%	100%	82%	58%
ETH	28%	82%	100%	65%
ALGO	26%	58%	65%	100%

The Algo is more correlated with ETH rather than with BTC, which can be understood considering the importance that smart contracts and DeFi have for both Algorand and Ethereum, and it is not surprising to see that also the correlation with mainstream finance represented by the Standard & Poor index is very low, explaining the Algo role in diversification.

Yet, the fine details in correlation can change, see for example the historical trends of monthly correlations (computed on a 1-month window rolling in time):
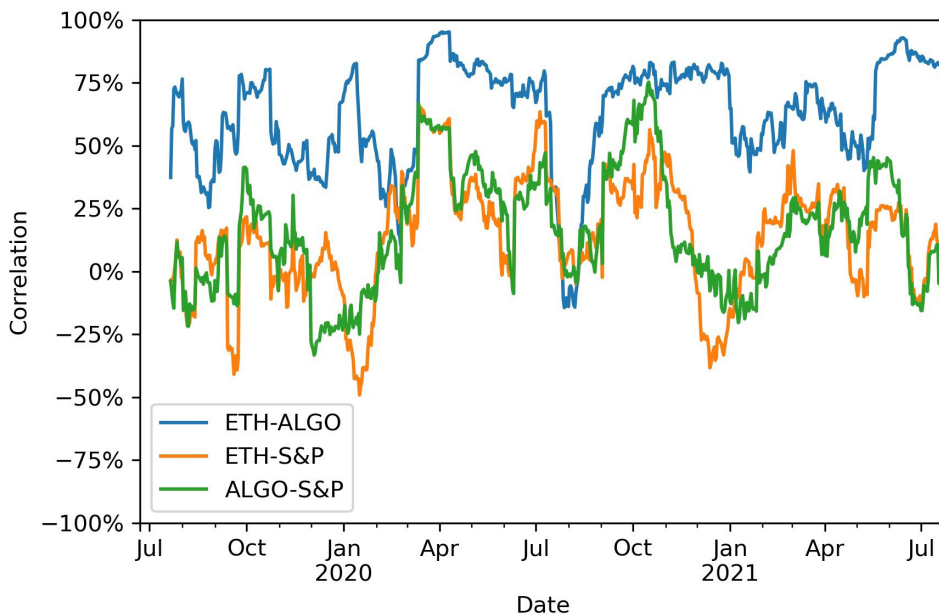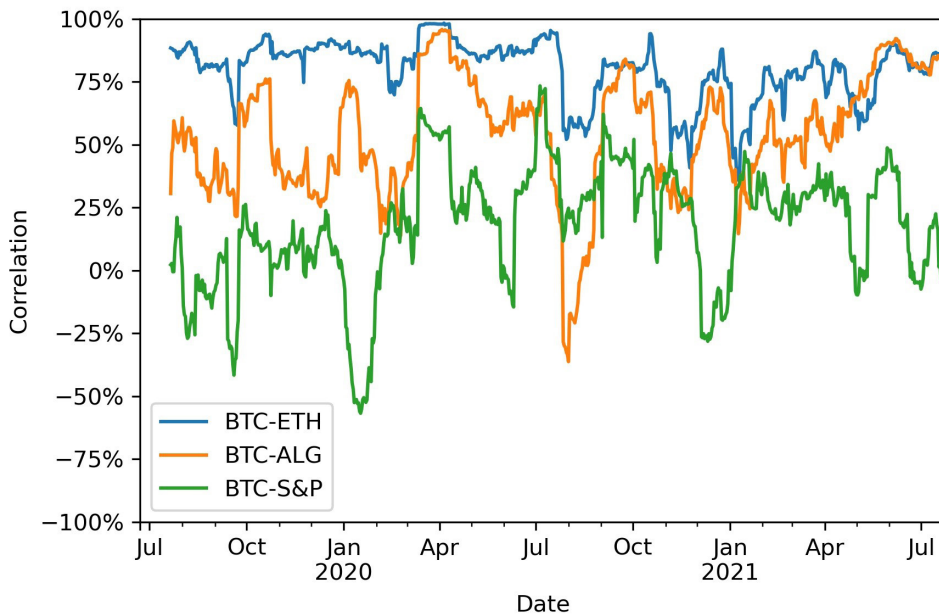
The instabilities we see are quite normal in market time-series when it comes to volatilities and correlations, but we can see that these short-term correlations, while showing more variability, essentially confirm the longer term correlations seen above. Correlation analysis will be important also for analyzing vesting dynamics in the next section.

Algorithmic Acceleration in Practice

In the LTAD, one can see that the initial vesting distribution to Early Backers / Relay Nodes group would have resulted in a significant spike in supply between 2019 and 2021, starting when the market was immature: in fact, all vesting was supposed to happen in the first two years with a flat distribution schedule. As explained in the Transparency Report that followed the most recent acceleration, in the early days of the Algorand Blockchain, market analysis showed that vesting was an important element of inflation. While history is full of thousands of forgotten blockchains who disappeared in the initial days due to excess supply related to the distribution of tokens to initial backers and other structural "whales", the Algorand community recognized the importance in ensuring a future for the platform based on the superior technology introduced by Silvio Micali, and was able to work together to achieve reform.

After EIP-09092019PC and EIP-10182019, suspended vesting were proposed and approved by the Early Backers themselves, EIP-11252019AF reforming vesting for the long term was proposed by the research and economic functions of the Foundation as a reform based on input from the community, and approved with a blockchain vote by the majority of the Early Backers, that accepted a heavy worsening of their conditions: the EIP spread the distribution from 2 years (with 50% vesting in the first year and the remaining 50% in the second year) to 5 years, with the following skewed non-inflationary schedule, where percentages refer to the originally allocated amount of 2.5B Algo, and sum up to 125% where 25% came from contingent rewards.

Year	2020	2021	2022	2023	2024
Vesting %	3%	8%	25%	35%	40%

While the 25% future contingent rewards were devised for compensation of the planned 5 year delay of the backers' rewards, a deeper and forward-looking alignment of the interests of the early backers / relay nodes to those of the ecosystem was both necessary for the agreement and healthy for the ecosystem, and it took the form of Accelerated contingent vesting.

The goal of the percentages in the above table was to make vesting happen only when the market cap was sufficiently large to absorb this supply without destabilizing or inflationary effects. The acceleration mechanism in the EIP reinforced this feature, by providing that, in the case certain market conditions were reached, it would accelerate the vesting of these tokens and bring forward the end date of the early backer program. The purpose of vesting acceleration was to make a faster distribution still possible, as an incentive to the EB/RN to agree to the contractual change, but only if and when the market conditions could allow it without inflationary effects. Consistent with the original purpose, there was a limited acceleration in 2020, and a much more significant acceleration in early 2021, when the Algo market cap was larger and increasing and a sufficiently long time had elapsed since inception. As a result of acceleration, on June 16, essentially 2 years after launch, when the original vesting program was supposed to be completed, around 2BN had actually been distributed, almost 80% of the original predicted amount, but the distribution was not even but dynamically executed following a totally automated algorithmic dynamics.

Historical daily vesting
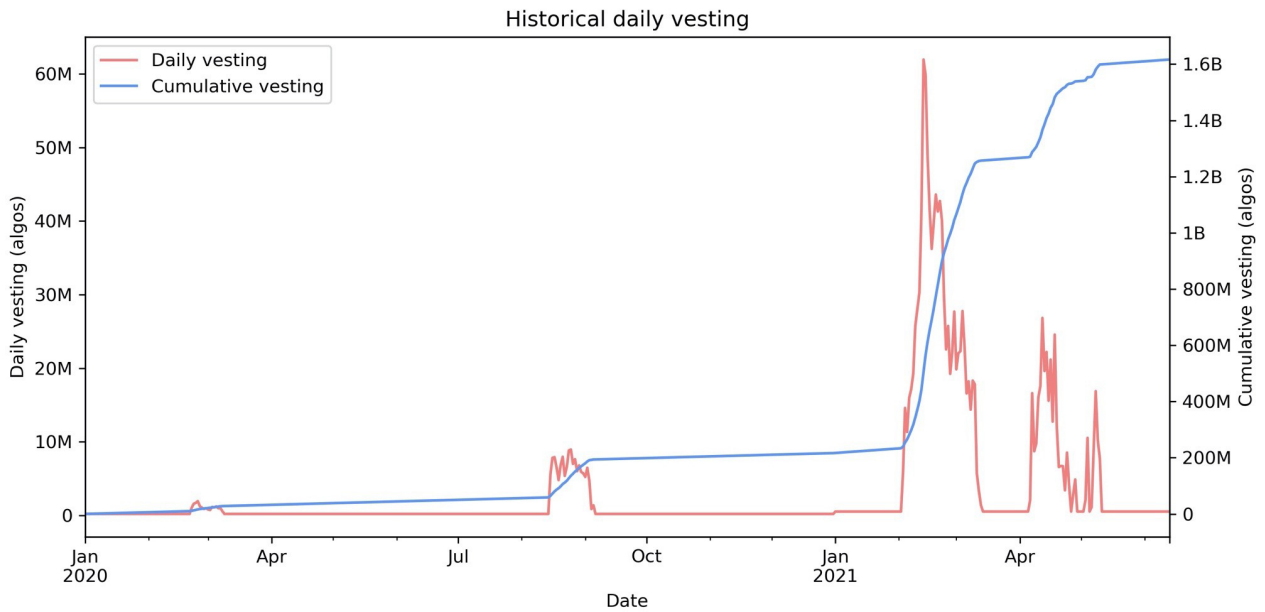
It is possible to see below that volumes have been, in terms of empirical distributions, higher during acceleration periods, yet it is a moderate effect that may potentially only be due to a spurious effect, since both volumes and vesting tend to increase during periods of increasing market cap.

Distribution of volumes under acceleration
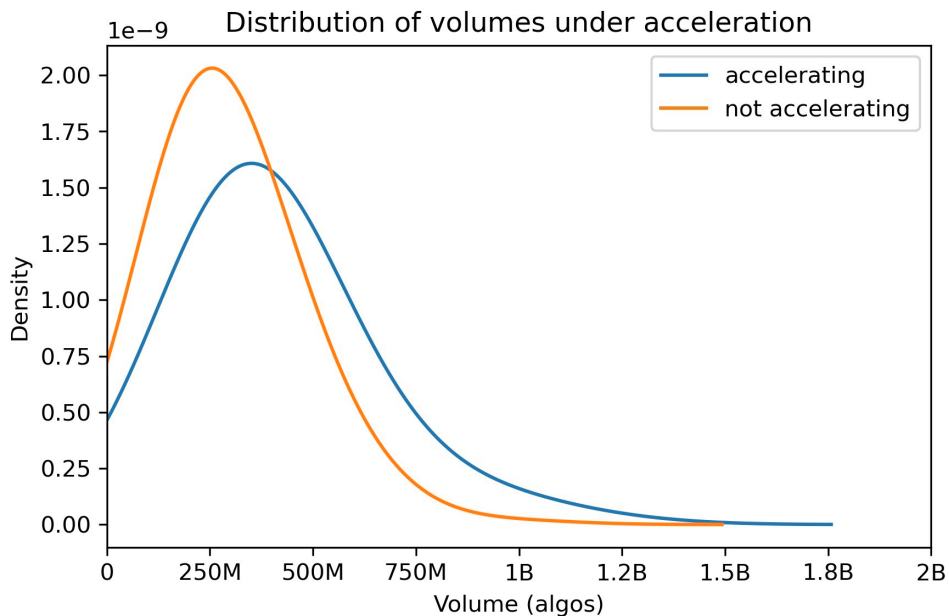
Acceleration, while advancing the early backers program by almost two years and increasing strongly the decentralization of Algo holdings, had a sustainable effect in inflationary terms, as proven not only by the fact that the ranking of the Algo market in the first 6 months of 2021, that included 90% of the vesting, moved from position 52 to position 32, but also from the analysis that follows.

We understand that the growth of the market cap depends both on the increase of supply and on the price dynamics, and that the increase in supply clearly increases the market cap, but we also understand that the increase in ranking has been possible only because the price dynamics also kept healthy, without nullifying the supply increase. This is confirmed by the following result regarding the correlation between the amounts of algo distributed through vesting acceleration and the price.

Cross-correlation between log returns and daily vesting
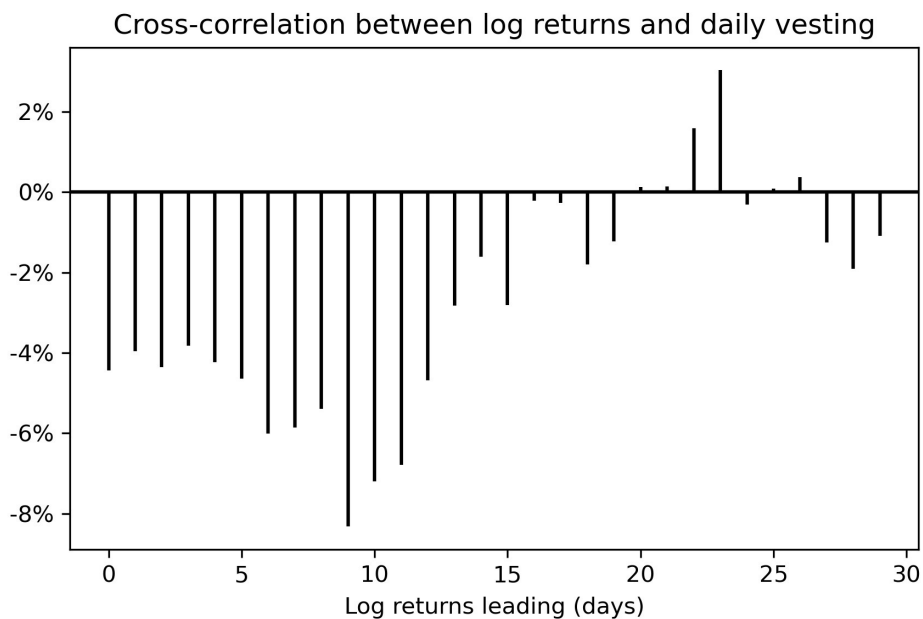
While the happening of vesting does bring the correlation between price and vesting into negative territory, since more supply always means more potential inflationary pressure, this negative correlation remains limited to the range between -5% and -10%, and the effect seems to be limited to the first few days, with correlation going back to be indistinguishable from 0 after around 10 days. Extending the correlation analysis to a longer range risks being dominated by spurious effects. It is not difficult to interpret these dynamics based on the acceleration maths and what we know about basic blockchain economics.

The value of the blockchain progenitor Bitcoin has always been linked both to the attraction that the technological promise exerts on new participants entering the ecosystem by buying the cryptocurrency, and to the loyalty of the existing holders, that are called hodlers, with reference to an episode of extreme loyalty of a holder. Loyalty is based on technical, sentimental and ideological reasons, that are never irrelevant even in traditional finance and probably particularly strong in these days – like the Game Stop case reveals – but also on more genuine economic reasons, that for Bitcoin node runners are even the foundation of the security of the Bitcoin PoW consensus algorithm. In fact, apart from the technical aspects of mining, the economic effect is that miners invest an enormous and ecologically dramatic amount of resources in Bitcoin production, so that the economic sustainability of their activity is preserved only by Bitcoin keeping its value, with the effect that, while being the "whales" that earn all the newly distributed digital BTC units and that could easily dollarize an enormous fortune by dumping Bitcoin in the market, miners tend to remain committed to the currency, both technically by performing correctly their node running role and economically by holding the most part of their gains.

Proof-of-stake itself is built on the same economic, skin-in-the-game incentive logic, but with the crucial innovation of avoiding the enormous waste of resources associated to mining: the largest holders are supposed to have the strongest loyalty and guarantee the best execution of node running services even without introducing an external resource consumption. A meaningful criticism to proof-of-stake is the following: liquidating the token holdings of PoS is relatively easier than liquidating the external hardware investments of PoW, making PoS more subject to node runners turning malicious one instant before liquidating. This potential weakness can be addressed in several ways. First of all, really massive stakes are not easy to liquidate, which exemplifies a fact visible in all blockchains: the importance of a balance between the advantages of granular decentralization and those of the presence of larger and more heavily committed holders. Secondly, various forms of locking commitments can easily be enforced for node runners in the reality of blockchain self-executing smart contracts. In a sense, delaying vesting compensation and skewing it towards the future serves the same purpose, and chaining any anticipation to significant improvements of the global blockchain value can even work as a reinforcement mechanism. A further analogy between this mechanism and other more traditional blockchains is the algorithmic nature, subtracting it from the changing views of human "monetary policies", particularly when an effective decentralization is achieved.

The same fundamental tokenomic topics of decentralization of decisions, sustainable distribution, the balance between LTAD predictability and community and market interaction, and incentives to significant committed holders, are all going to be the center of the next section as well, covering a specific new feature of the Algonomics: Community Governance.

Evolving the LTAD with Governance: the example of Rewards

The LTAD can be considered the beginning of the second phase of Algonomics. After an initial phase when Algonomics had to be reactive to the actual deviations from initial expectations, once a certain maturity was reached it became possible to commit to defining a longer-term precise distribution, at least in terms of expected flows, as done in the LTAD. Algonomics has benefited from this decrease of uncertainty, like most blockchains, starting from Bitcoin, benefit from a partially predictable future distribution, ensuring a certain trend of scarcity rather than inflation, and freeing them, indeed, from the changing views of human "monetary policies". At times, there is a confusion when we speak of the advantages of decentralization in blockchain: in generalist media parlance, decentralization often refers to a system where everyone has the power to decide for the community; in specialized blockchain or regulatory parlance, decentralization often means a system where no one has the power to decide for the community, protecting community resources from being abused by the interests of a single group or entity. Most virtuous realities are often a blend of these two concepts, and this is the path Algorand has set itself upon starting from Silvio Micali's governance blog contribution, one of the elements that sparked the development of the LTAD.

Clearly, the LTAD flows are expected flows. As we explained at the end of the original LTAD plan, some elements influencing future distribution, like vesting algorithmic dynamics or contingent rewards, could not be planned and could alter predictable flows. Additionally, if community Governance was going to be introduced, any defined long-term plan would be subject to potential changes voted by Governors. The first possible deviation became a reality in the first half of 2021, while the second possible deviation has become a reality for the immediate future with the approval of the Governance referendum in June 2021. Balancing between the advantages of a more distributed and transparent decision making system and the advantages of a reliable long term scarcity path is crucial for an evolving blockchain.

We can consider Governance to be the third phase of Algonomics: letting the holders take increasing responsibility. We believe this can improve quality and transparency of decision-making. We also know that, if Governance was designed in such a way that any ephemeral slight majority in Governance could disrupt any reliability in algonomics, with unexpected dumping of community resources, the community would suffer dramatic consequences. The risk of such a moral hazard is highest when the Governors have to take a decision about their own rewards, like in every case when a group can decide their future own personal wealth potentially at the expense of the wealth of the whole community, while having the right to earn freedom from any accountability just by forfeiting a small additional incentive. In order to avoid such a behaviour, Governors need to prove willingness to increase commitment and skin in the game. When Algorand Community governance starts in Q4 2021, the initial economic commitment to be governor is relatively mild, at a level to which we attributed a 10% difficulty score: rather than being locked by smart contracts, they only lose 3 months of rewards in case of early liquidation. However, if the governors want to move to a level of distribution significantly higher than the LTAD long-term sustainable distribution, they will have to show they are even more ready to stand the possible inflationary consequences of their choice.

This allows Governors in Algorand to have the right to decide on their own rewards without the network being put at risk by the potential moral hazard involved in this choice. The announcement of the first governance rewards in June 2021 indicated a path for the preservation of the community AERP structure. Governors will have the option to vote if they want to keep the distribution within a lower bound of the range modelled by the LTAD, while keeping the same mild Governance commitment rules set at inception, or to increase the rewards above what planned by LTAD for that period, but only together with strengthening of the requirements in terms of locking and commitment. Not only this contrasts strongly with the moral hazard risk, it also serves the fundamental anti-inflationary, economic aim of balancing more supply distributed to the Governors with more long term holding commitment on the Governors' side.

From LTAD Curves to LTAD Bands
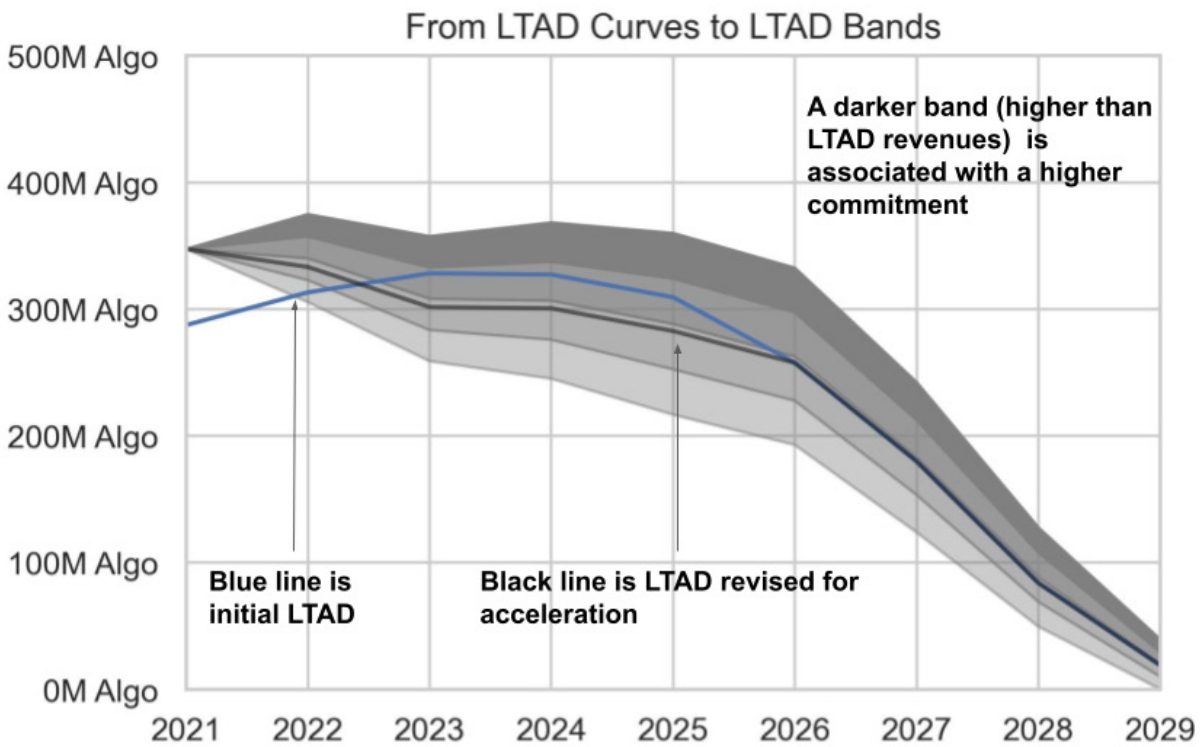
Above we see, specifically for Rewards, an example of what the LTAD curve of expected distribution will become. The blue line is the initial LTAD expected reward distribution published in 2020. The black line is the LTAD distribution revised after 2021's algorithmic acceleration, to align reward growth with supply growth (anticipating scarcity by adding to 2021 and 2022 reward resources taken evenly from the subsequent 3 years). After the Governors vote on Rewards in the fourth quarter of 2021, the line opens to an area of possible scenarios, which, compared to the expected black line, can get to more saving on rewards decided by governors, but also to more distribution if a higher commitment is voted by the Governors at the same time. The plot is a simplifying synthesis of the following simulation of realistic Governor choices about rewards.

Vote Simulation
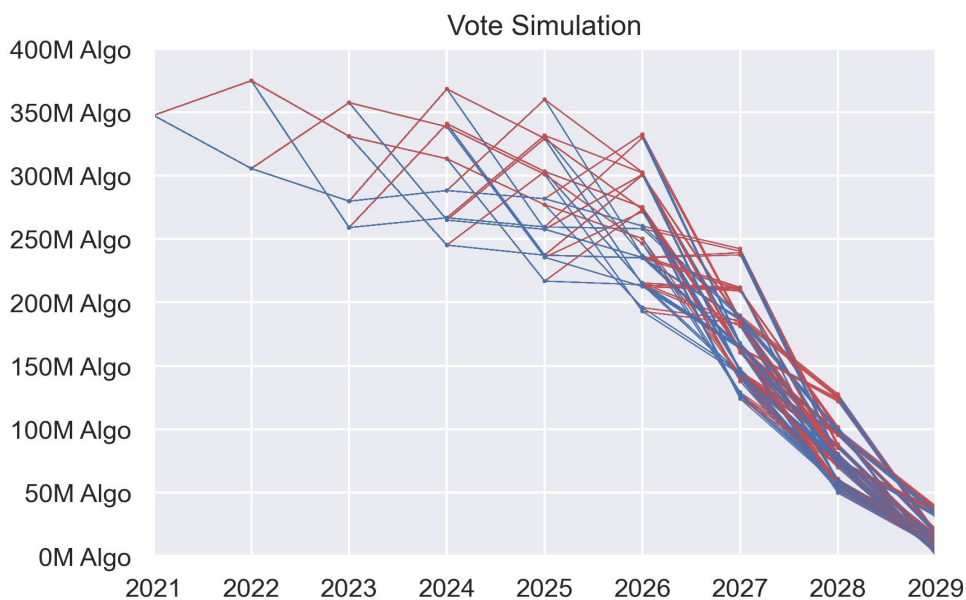
We simulate under the hypothesis that Governors will have binomial choices to increase or reduce rewards, and that the possible increase is higher than the possible decrease. Yet, all choices result in a sustainable evolution. Early reward acceleration will lead to some automatic saving later on, instead early reward savings may even allow the Governors to extend the current rewards system beyond 2029. None of the Governor choices will impact the total supply or the AERP fair distribution in any of the 1024 possible scenarios simulated.

Every choice of increasing rewards will also increase difficulty, so that the future commitment evolution can be simulated by showing the possible difficulty scenarios. The size of the node dots in the chart below indicate how many times a given state can be achieved in the future: larger nodes can be reached by various combinations of future choices, while smaller nodes can only be achieved by extreme choices such as always increasing or always decreasing rewards, within the supply and sustainability constraints.
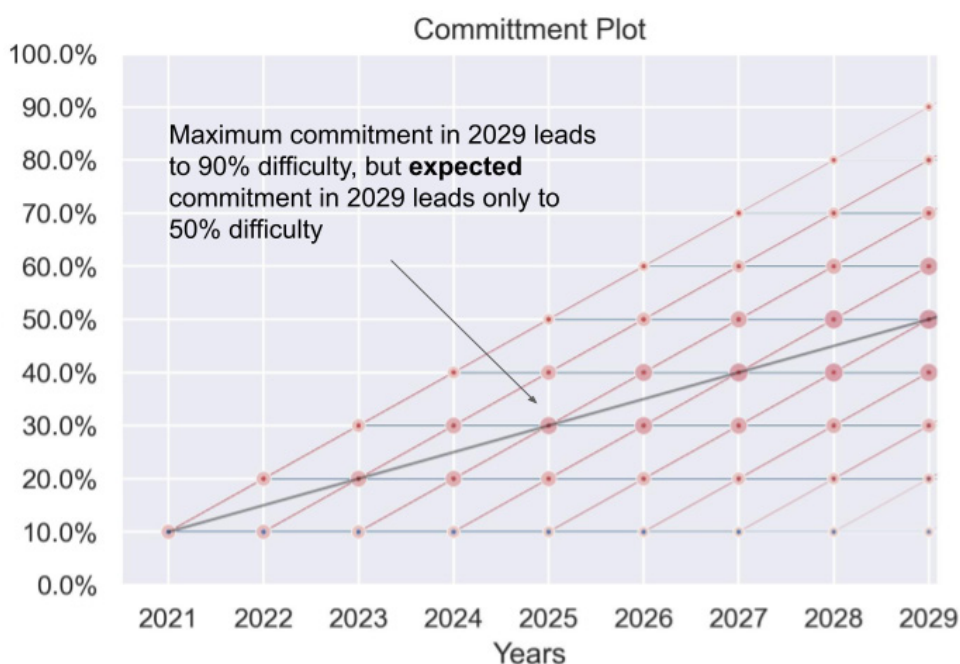
Defining difficulty in the future will also be a Governors responsibility. For the time being, we are working under the minimal hypothesis below regarding commitment and difficulty. It is obvious that different combinations of commitment time or withdrawal restrictions can lead to equivalent sustainable structures, and also that there are several economic improvements, such as introducing overlapping governance periods, which are beyond the list below.

Difficulty Level	Commitment
10%	3m rewards lost upon withdrawals
20%	slashing by an amount = to 3m rewards
30%	slashing by 2×3m rewards
40%	smart contract locking for 3 months
50%	smart contract locking for 6 months
60%	smart contract locking for 9 months
70%	smart contract locking for 1Y
80%	1Y locking + running K nodes
90%	1Y locking + running 2×K nodes

For other categories in the AERP, there is not the same level of moral hazard involved in votes to self-attribute resources, thus Governors will be able to decide on supply without any additional commitment. Yet the same approach to maintain sustainability through mean reversion will apply, so that choice will be within a range from the long term sustainable dynamic originally shown in the LTAD.

The role of Governors commitment as a guarantee that governors are properly incentivized to act in the interest of the community, will emerge also when in the future community proposals will be defined to set votes on potentially mean-diverging deviations from expected distribution. Compared to voting on predefined measures, deciding the measures to vote upon will require a "stronger than usual" commitment and difficulty.

Any decision that can bring a long-term large variation to the algonomics can only be taken by players that ensure an equally long-term commitment to share the economic consequences of Governance choices. The willingness to share the economic consequences of a choice is the only incentive mechanism guaranteeing a decentralization from massive transient attackers. One possible way to balance the power to deviate from a predictable path, is to let this decision-power build along the years for the most loyal and committed governors, recognizing loyalty/commitment in a (probably non-fungible) tokenized form. The guarantee of a long-term commitment will align the interest of the decision maker with the long term interest of the ecosystem. The presence of incentives to long-term locking, together with the above strengthening of commitment, will be very important to reduce further any opportunistic behaviour.

The current structure of Algo supply

In the latest transparency report, which so far has been approximately semiannual but that will become quarterly when governance kicks in (to align with governance periods), we have introduced a few updates to the composition of Algo funds. They were all implemented to achieve the goal of making the Foundation the only autonomous non-profit curator of the Algo ecosystem.

One update given in the transparency report is the transfer of the fund for Protocol Development to Algorand Inc, a final step in severing economic links between the Foundation and Algorand inc. This has allowed the Foundation to be fully fostering a diversified and decentralized contribution to the Algorand protocol, smart contracts and services. In the meanwhile Algorand Inc has developed as a software company aiming to spread the best blockchain technology to different partners, with an enduring focus on the development of the protocol among other core activities that are regularly and transparently reported. A trend that has made Algorand Inc one player among many committed players in the ecosystem, important but equally separate from the many institutional roles of the Foundation.

The institutional roles of foundations are also the reason for the more precise definition of the Foundation 500M Algo resources as separate from the Community AERP 3.2B Algo funds. The AERP funds are locked for the community and their future release outlined in the LTAD plan will be managed by the decisions of Governors within the Governance process. The Foundation 500M Algo Resources will be used for the independence and autonomy of the Foundation and of the Foundation activities, as the steward of the Algo ecosystem, including a sustainable generation of income.

We all know that a blockchain project is not a company that has to "make money", since blockchains have the unique mission of "making money" in a deeper sense: creating, indeed, the money of the future world. Digital currencies which are decentralized and whose working (accounts, transactions, financial agreements) rely on appropriate technology (cryptography, consensus, smart contracts) and not on a plethora of intermediaries (banks, payment processors, lawyers) still implementing a business model designed in the renaissance. In this process, blockchain steward entities can generate the resources for their sustainability, through the smooth, long-term and responsible distribution of a small part of the resources, but the diversification of the funding sources is an element of resilience.

A clear plan for sustainability assures the community that the functions of support to the ecosystem development be available until needed. The Foundation will not participate directly in governance with its own Algo resources, never receiving direct network rewards. The distribution of the AERP funds In Governance can partially contribute to sustainability, by delegation revenues or by the AERP funds themselves generating minimal fees for management and guarantees provided by the Foundation when decision-making is passed to Governors. In order to fully support the Foundation activities, the Foundation 500M own resources will include a fraction of internally managed investments for funding purposes, subject to strict and transparent risk-management requirements, and another part of Algos transferred to external entities that will use these resources for a diversified activity, autonomous but focused on the Algo nascent De-Fi and NFT markets and financial products.

This will maintain and grow resources to support the ecosystem for the remaining part of the full distribution plan outlined in the LTAD, and until Community Governors will be the only governing entities.