

How Blockchain Tokens Are Changing Platform Economics

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Abstract

Blockchain technologies are technologies inspired by Bitcoin, which emerged in 2008. Since then, many cryptocurrencies, altcoins, and other blockchain applications have emerged. For example, Ethereum introduced smart contracts, and with them came tokens, fungible tokens, non-fungible tokens, decentralized finance (DeFi), and decentralized autonomous organizations (DAOs). All these technologies can be grouped under the umbrella term “blockchain technologies.”

Each new generation of blockchain technology promises decentralization, disintermediation, a level playing field for entry, and improved value creation and distribution. However, it is essential to examine to what extent and under what conditions blockchain technologies deliver on these promises. It turns out that sometimes they do, and sometimes they do not. This distinction is essential to apply blockchain technologies effectively for large-scale practical applications.

I focus here on blockchain-based cryptographic tokens and their impact on platform economics. Blockchain-based tokens, in conjunction with smart contracts, allow for new design choices in platforms. Therefore, I explore how these new design choices may help solve old problems in platform economics.

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Category Invited Talk

1 Problems in Platform Economics

The main problems in platform economics come from network effects. Network effects occur when the value of a good or product increases as more people use it. Platforms create value by bringing users together. For example, social media platforms like Facebook bring people together to interact, while Uber brings different types of users, such as drivers and passengers. As more users join the platform, its value increases due to the network effects. This distinct dynamic is not found in other types of goods.

When a platform has no users, potential users are hesitant to join. They will only consider joining if they anticipate that others will also join. This dynamic creates a challenge for new platforms to enter the market with network effects. They must have a significant presence early on, or they risk being unable to enter the market. For example, starting Facebook with just a few users would be difficult. The platform needs a critical mass of users before it can expand.

Once a platform has a large-scale market, network effects create barriers to entry for competitors. These barriers allow the platform to enjoy considerable market power and extract value from the system. For example, Facebook can extract data from its users, while other platforms may charge high prices or impose burdensome conditions on users to extract value. For example, in the past, platforms have charged high prices for long-distance calls.



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Currently, there is ongoing debate about Facebook's ability to extract data. The result of these network effects is the creation of powerful intermediaries that can extract value from the system.

I explore the potential of blockchain-enabled tokens to address these challenges of barriers to entry and value capture. Tokens have been around for a long time, but their use in the context of blockchain is relatively new. Blockchain-enabled tokens offer two key features that traditional tokens do not: commitment and traceability. Commitment refers to the fact that platforms can commit to specific uses, acceptances, or restrictions of tokens, while tradability means that tokens can be traded independently of the platform that issued them. This independence enables tokens to be listed on cryptocurrency exchanges, such as Helium or Filecoin, and traded freely.

I focus here on two types of tokens: utility tokens and governance tokens. Utility tokens enable the platform to issue tokens instead of charging prices directly. This approach can make entry into a market with network effects easier, as it lowers the barriers to entry for new players. However, we also find that utility tokens lower the overall platform's profit and decrease overall welfare, which may limit their usefulness in certain conditions.

Governance tokens, in turn, facilitate voting and thus enable the creation of decentralized autonomous organizations, which can help distribute value more equitably. We find that governance tokens can lead to more value creation and equitable value distribution, but their treatability may also lead to actual re-centralization in equilibrium and value capture by anonymous users. This outcome may be different or even worse than value capture by regulated parties, which can be brought to court.

My research indicates that blockchain-based tokens may help to mitigate the challenges of platform economics, although they may not eliminate them entirely. While tokens present exciting opportunities, it is essential to be aware of potential risks and limitations associated with their use. By understanding the conditions under which tokens can be beneficial, we can evaluate their potential for enhancing economic outcomes.

2 Utility tokens and barriers to entry

Let's start by discussing utility tokens and platform entry. The inspiration for our research comes from great examples like Filecoin and Helium. Filecoin is a peer-to-peer competitor to Dropbox for file storage. It is a peer-to-peer file storage system where users give access to their computer's space to store other people's files. Users need to be willing to pay for this storage, and they pay those who provide storage with Filecoin. Another example, Helium, is a peer-to-peer hotspot network designed for use with IoT devices. Its design relies on people allowing the system to use their hotspots to some capacity, and together they can connect large spaces and allow for connectivity. In both of these services, there are strong network effects. Thus, each system is only attractive if numerous users have already joined the system. The systems are not useful with just a few people offering storage or hotspot capacity.

Both Filecoin and Helium use tokens. Initially, Helium had difficulty getting off the ground and entering the market. However, later it started to use cryptographic tokens, and with those tokens, it successfully took off and is now an active network. In both cases, we have network effects and potential users want to join only if other users join as well. This dependency results in two equilibria, one where everybody adopts and another where nobody adopts. Such multiplicity of equilibria, in turn, leads to a coordination problem. This observation for markets with network effects has a long history going back to Katz and Shapiro (1985) [5] in the case of one-sided networks or Caillaud and Jullien (2001, 2003) [3, 4] and Rochet and Tirole (2003, 2006) [6, 7] in the case of two-sided platforms.

The traditional way to solve this coordination problem is through subsidy, also called a divide-and-conquer strategy. It means subsidizing early users and then profiting from those who join later when it is clear that the platform is successful. Since the platform can charge high prices later when it is successful, it is profitable to subsidize early users so that they join and try the platform. There are many examples of applications of that strategy. Two of my favorite examples are PayPal and Uber because they would give early users a ten-dollar credit for setting up an account and joining the network. It is a very successful strategy, but the problem is that it requires upfront capital, which may be expensive and create barriers to entry.

In *Overcoming the Coordination Problem in New Marketplaces via Cryptographic Tokens* (Bakos and Halaburda 2022 [1]), Yannis Bakos and I build a simple multi-period model analyzing whether blockchain-based utility tokens allow the platform to overcome the barriers to entry without the need for subsidy. Every period, new people arrive at the market and decide whether to join the platform. With the subsidy, the platform sets the access price every period, and the price may be negative. Typically the early users are subsidized. The people arriving at the market may not be fully aware of how much they will like the platform. They only learn that after they join. So if they try it, they may learn that they do not like the platform. If they leave the platform under the subsidy scheme, they get their outside option (which we normalize to 0).

But instead of subsidy, the platform may decide to issue utility tokens. A utility token may allow you to access the platform service, and conversely, you can access the service only with these tokens. This is the case with Helium or Filecoin platforms. The platform can set the price of the tokens in the first period. In the future, however, the platform only decides on the number of additional tokens it issues, and the market determines the price of the tokens by balancing the supply and demand because the tokens are tradable independently of the platform.

If, after experiencing the platform, a user wants to exit, he can sell his token. The price of those tokens is positive (in expectations). This is because even though the platform can issue an arbitrary number of additional tokens, it will never be optimal to issue so many that the price drops to 0 (barred some shock realization in an uncertain environment). Thus, the users expect that they will be able to sell the token at a positive price if they do not like the platform.

Thus, utility tokens may induce agents to try the platform without subsidy. They may even be willing to pay for the token, while without the token, they would need to be paid to join. So the platform's first-period profit is higher with tokens than under the subsidy, and tokens may eliminate the need for subsidy altogether.

However, the platform's future profit is lower with tokens for two reasons. First, the platform will sell fewer tokens in the future because some new users buy tokens from existing early users rather than from the platform directly. Second, the price at which the platform can sell the tokens in the future is lower than the price it could charge under the subsidy. This is because an additional supply of tokens from the existing users puts pressure on the price. But also, the future network is smaller, so less valuable for the new users. The network is smaller under tokens than under subsidy because the positive resale price of the token makes leaving more attractive for early users. Recall that under the subsidy, the leaving users get nothing, but with tokens, they can sell their tokens at a positive price. Hence, some early users who would stay on the platform and provide some network benefit under subsidy are enticed to leave with the token's positive resale price.

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Note that the platform can shut down both forces leading to lower prices in the future by renegeing on accepting old tokens or limiting the trading of tokens. And if the platform realizes higher first-period profit and successfully enters without the need for subsidy, it will have a strong incentive to intervene in this way to increase its future profits. But if agents expect such renegeing, they would refrain from acquiring the tokens in the first place.

Blockchain and smart contracts play a crucial role in this result. With smart contracts, the platform can commit to accepting the tokens in the future. Moreover, the platform cannot interfere with trading because trading occurs on a censorship-resistant blockchain. These two features were not available with pre-blockchain tokens but are crucial to realizing the benefit of overcoming the barrier to entry arising from network effects.

With tokens, there are two competing forces affecting platform profit. The platform earns higher early profits with tokens than under subsidy and lower future profits. It turns out that the second effect is always more prominent, and the platforms' overall profit is lower under tokens. Furthermore, the overall welfare is lower. And this is again because more early users exit with tokens due to the positive resale price, and thus overall network will be smaller in the future, which means that overall network effects generated by the platforms are smaller. Moreover, a bigger part of the welfare goes to the users because they resell the tokens. So tokens redistribute welfare from the platform to the users, but not evenly. The users who exit benefit, but the users who stay are worse off because they don't get to participate in the larger network that would be there under the subsidy.

Overall, blockchain-based cryptographic tokens help overcome the coordination problem for new entrants, and they can make entry possible without a subsidy. They do so by moving the revenue from the future to the entry stage. However, the overall profit and welfare are smaller. So wherever subsidy is (cheaply) available, it would be preferable for the platform. Nonetheless, in many cases, especially for novel technologies, up-front capital needed for a subsidy may come at a high cost or even be unavailable altogether. In such a case, tokens provide a viable entry option. This may explain why we see Heliium and Filecoin successfully entering the market using utility tokens, while it is unlikely an attractive option for more traditional businesses such as Uber or Lyft.

Governance tokens and value distribution

The second type of tokens we considered are the governance tokens and their effect on value creation and distribution?these governance tokens power decentralized autonomous organizations (DAOs). Despite the spectacular failure of The Dao in 2016, many DAOs have been operating quite successfully, like MakerDao or UniSwap. DAOs are set up using smart contracts and governance tokens with the purpose of decentralizing decision-making by allowing a large number of people to vote with their governance tokens. Moreover, other smart contracts can automatically implement those decisions after the vote.

DAOs boast the ability to prevent powerful intermediaries from capturing the value. They aim to achieve this goal by decentralization, much like other blockchain technologies. The argument goes that instead of relying on intermediaries that charge higher prices due to network effects, DAOs offer decision-making power to voters who are also users of the platform. Thus, they will have no incentive to increase the prices and will not extract the value created by the growing network. Furthermore, DAOs typically operate in a permissionless environment to prevent authority figures from excluding users and capturing value. If an agent or entity has the power to exclude others from the DAO, they may extract payments for access.

In *Will Blockchains Disintermediate Platforms? The Problem of Credible Decentralization in DAOs* (Bakos and Halaburda 2023 [2]), Yannis Bakos and I discovered that DAOs could realize the promise of better value creation and distribution, but only under specific circumstances. However, under more general circumstances, DAOs experience strong forces returning to centralization that can hinder this outcome. Hence, it may be challenging or even impossible for platform intermediaries controlled by democratic DAOs to exist in the long run due to these re-centralization forces. Therefore, we suggest that additional measures are required to maintain these intermediaries.

Let me here illustrate our point in a simple example. Imagine there are n potential platform users, and everyone's benefit or "utility" from using the platform ranges from 0 to 1. Those who don't use the platform receive no benefit. This scenario results in a 45-degree demand curve, $1 - p$, often seen in Microeconomics 101 textbooks. Additionally, we will assume that there is no cost to providing the platform. In such a market, the most profitable price for a monopoly platform is $p_m = 1/2$, which generates a monopoly profit of $p_m(1 - p_m) = 1/4n$. However, this also creates a deadweight loss because half of the market cannot benefit from using the platform.

Now, let's explore an alternative approach where the price for accessing the platform is determined by the DAO as a collective decision. We focus here on the pricing decision because this is the most straightforward textbook decision and will easily demonstrate our point. But this approach could be applied to any value-extracting decision, such as selling data or allowing advertising on a platform. In this scenario, there is no central authority controlling pricing. Instead, all potential users have a governance token that allows them to vote on the price. Once the price is set, users can choose to pay it and join the platform or decline and not join. If the price is positive, the DAO earns a profit which is then distributed as a dividend to token holders.

Such a DAO can vote for a price of zero. At this price, everybody would participate in the platform and benefit from its utility, leading to maximum social welfare without any deadweight loss. Next, we examine under what conditions the DAO will ultimately set this price.

First, let's notice that some potential users who do not find much value in joining the platform may prefer to set a higher price and earn more of a dividend rather than setting a lower price and participating in the platform. However, the cost of joining outweighs the dividend for those who plan on using the platform, so they prefer to set the price at zero. Each token can bring a maximum dividend of $\frac{p_m(1-p_m)}{n} = 1/4$ when the monopoly price is set; therefore, those who value joining the platform at less than $1/4$ will vote for the monopoly price, while those who value it higher will vote for zero price. In our example, $3/4$ of token holders vote for the zero price, resulting in the DAO setting the socially-optimal price through a simple majority rule. This is a very encouraging result. Note, however, that until now, we have assumed that all token holders hold at most one token.

It turns out that it is no longer guaranteed that the DAO would set zero access price when users hold multiple tokens. A user with multiple tokens prefers setting a higher access price as his token holdings increase. To see that, note that the net benefit of a user owning t tokens with the access price p_{DAO} is

$$\underbrace{\theta}_{\substack{\in [0, 1] \\ \text{usage utility}}} - \underbrace{p_{DAO}}_{\substack{\text{price} \\ \text{(user pays)}}} + t \underbrace{p_{DAO}(1 - p_{DAO})}_{\substack{\text{dividend} \\ \text{(others pay)}}}.$$

The access price that would maximize the net benefit for a user owning t tokens is $p^*(t) = \frac{t-1}{2t}$, which increases with the user's token holdings. Thus, the more tokens the user holds, the higher price he would prefer to set. For example, even with just two tokens, a user would

rather set a price of $1/4$ than a zero price. This is because, with more tokens, the dividend contributes more to the user's payoff, making a larger dividend more valuable relative to the cost of paying for access themselves.

Moreover, tradeable tokens can lead to a significant level of concentration. If the access price is positive, the governance token will have a positive value due to the expected dividend. As a result, users may choose to purchase more tokens to receive more dividends. However, purchasing a majority of tokens will yield even greater benefits, as it allows the user to influence the price increase, further raising their dividend earnings. We have found that in equilibrium one user will purchase enough tokens to gain a majority. This is another encouraging outcome because it means that although re-centralization may occur, there will be a limit to concentration.

However, this limit to concentration may have little effect on the value capture. Note that if one user holds $\frac{n+1}{2}$ tokens, the dao will set $p_{DAO} = \frac{1}{2} - \frac{1}{n+1}$, which for large n is very close to $1/2$, the monopoly price. As a result, the value is indeed more distributed, as the holders of the remaining tokens also receive high dividends, but the efficiency of the market is only marginally improved.

How can such dynamics be prevented? One possibility is to limit the number of governance tokens that a single person can acquire, but this can be challenging in a permissionless environment where one individual may control multiple wallets. Another option is to restrict or disable the trading of tokens, as seen in the Soulbound token proposal (Weyl, Ohlhaber and Buterin 2022 [8]). However, many DAOs value the transferability of governance tokens and have not yet implemented such restrictions.

3 Conclusions

Blockchain-based cryptographic tokens, like utility and governance tokens, offer new solutions to old problems in platform economics. But they may come at a price or not work as expected. As we have shown, utility tokens may improve the viability of a new platform, but at the cost of its overall profits. So it means that there is still room for banks and VCs alongside the tokens.

The governance tokens may allow for decentralization and an increase in welfare, but they do not remove the tendency to re-centralize and extract surplus. Notice that when the Internet emerged, it also promised decentralization, disintermediation, and democratization. But after the initial years of decentralization, the Internet enabled the rise of intermediaries with more power than ever before – Google, Amazon, or Facebook. As we are looking toward blockchain and DAOs for the new wave of decentralization, it is possible that without changes in design or additional safeguards, we may end up on the same trajectory leading to a new generation of powerful intermediaries.

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