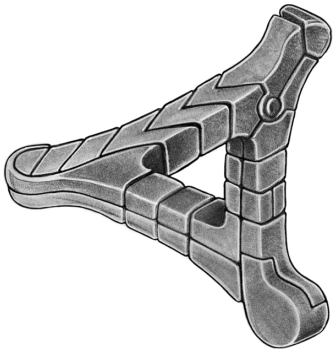


BACKFEED

AN ECONOMIC MODEL FOR BLOCKCHAIN-BASED APPLICATIONS

Recent technological developments are enabling new and mostly unexplored forms of human engagement and coordination. The blockchain is creating a new technological infrastructure for the establishment of *Decentralized Cooperation* (DC)—a term we use to refer to the spontaneous contribution of agents eager to achieve a common goal, with no central coordinating, monitoring or ruling authority. Examples of DC range from decentralized payment systems to decentralized insurance, from distributed social networks to decentralized music labels. However, these examples are only the tip of the iceberg. Our current understanding of the opportunities provided by emergent blockchain technologies can be compared to the early days of the Internet, when no one could predict the success of companies such as Facebook, Google or Airbnb.

Emerging initiatives in the blockchain space pose significant legal, social and political challenges to existing institutions, including traditional law and regulation authorities. Yet, one should not forget the economic opportunities they entail. With the blockchain, new forms of value creation and distribution are possible through the issuance and transfer of digital tokens. Albeit still in their infancy, as new economic models mature, innovative solutions will be needed to understand how these tokens might fit within the traditional categories of the legal system.

Backfeed is at the forefront of research and development in the DC space. The Backfeed protocol includes new methods of value creation and distribution, both internally within a DC community, and externally between the community and third parties. These come along with a new economic model relying upon the formation of digital tokens, coupled to the services the DC provides.

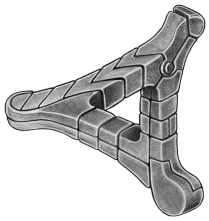
In order to facilitate the deployment of these new blockchain-based applications, we provide here a general overview of the blockchain ecosystem, as envisioned by Backfeed. Most critical in this effort is the task of describing and clarifying the economic model that could potentially be adopted by many communities to bootstrap, manage, coordinate and sustain the operations of decentralized cooperation. This economic model is inherently linked to the lifecycle of a DC's digital token and consists of three main phases, associated to the different phases in the evolution of the DC.

DIGITAL TOKENS AS EQUITY

In line with the Backfeed protocol, upon the initial seeding of a DC by an individual or a group of individuals, a new type of digital tokens automatically comes into existence —which will be used to reward contributors for the value they provide to the DC.

In most of today's decentralized blockchain-based applications (DApps), digital tokens are obtained through an operation described as "mining". Mining refers to the process by which nodes in a decentralized network are contributing to its operation and in return are being rewarded with the network tokens. The network tokens acquire value by also being required for operations on top of the DC network. For example, in the Bitcoin network mining refers to the process of verifying transactions and adding them to the Bitcoin blockchain. The mining process is an ingenious mechanism that enables a DC to operate autonomously, without any third-party support, by providing economic incentives for people to contribute to the DC operations, and it is also the means through which new tokens in the network are released into cycle.

To date, the most tested and widely used consensus protocol is based on the *Proof-of-Work* (PoW) algorithm, which (statistically) rewards nodes in the network according to the amount of computational resources they invest in the network. Given the high costs of PoW, in terms of electricity most notably, alternative consensus protocols are currently being devised, the most promising of which is the *Proof-of-Stake* (PoS) protocol, which rewards individuals according to the stake they have put in the network.Both algorithms rely on economic incentives (or disincentives) to secure consensus in a sybil-resilient way, in that they both require nodes in the network to "invest" (or stake) provable resources in order to affect the consensus. Yet, while they differ in the *modus operandi*, both of these consensus protocols ultimately rely on agents providing *algorithmically-quantifiable* resources necessary to the fundamental operations of the network (*e.g.* validating transactions in the Bitcoin network).



The Backfeed protocol —as a consensus protocol— features an analogous algorithm, *Proof-of-Value* (PoV). However, as opposed to existing consensus protocols, which secure consensus between machines that must agree to an objective measure of value, the Backfeed protocol is designed to secure consensus between people,[1] who can agree to a multiplicity of subjective measures of value. As such, the PoV algorithm distinguishes itself from the former two algorithms insofar as it generalises the process of mining to anything that generates value to a particular network or community. It relies on human attention and judgement in order to reward individuals for actions that extend beyond what is algorithmically measurable by a computer.

Regardless of the consensus protocol adopted, the mining process constitutes a means for a DC to secure an initial burst of contributions by issuing digital tokens whenever new value is created or added. These tokens are distributed within an initial community of contributors, who strongly believe in the long-term success of the DC and are willing to put effort into it. At this stage, the value of these tokens is purely speculative, as they may not have any tangible use yet. This is due either to the lack of infrastructure or technical components (and individuals will thus be rewarded for contributing these missing parts) or to lack of critical mass of participating nodes in the network (and early adopters will thus be rewarded for making the network operation more valuable). Either way, the value of DC tokens ultimately depends on the future success of the DC: if the project succeeds to provide a valuable a product that will attract a sufficient amount of users, then the tokens may obtain actual value (since those are required to enjoy that product); otherwise, they may end up worthless. As such, tokens during this phase are best described as equity —*i.e.* they represent a share in the DC endeavor. Like equity, these tokens carry the potential value of the project and may be purchased by interested investors (either from those early contributors who gained them, or, as we suggest below, directly from the DC itself).

[1] Although outside of the scope of this chapter, it should be noted that PoV (and the Backfeed protocol more generally) is not limited to securing consensus between human beings, rather than machines. The key specificity of the Backfeed protocol is that it allows for multiple value systems to emerge and simultaneously coexist, rather than having to chose amongst pre-defined ones. As such, PoV can be equally be employed for securing the consensus of independent bots or IoT agents encoding different strategies (and thus different value systems).

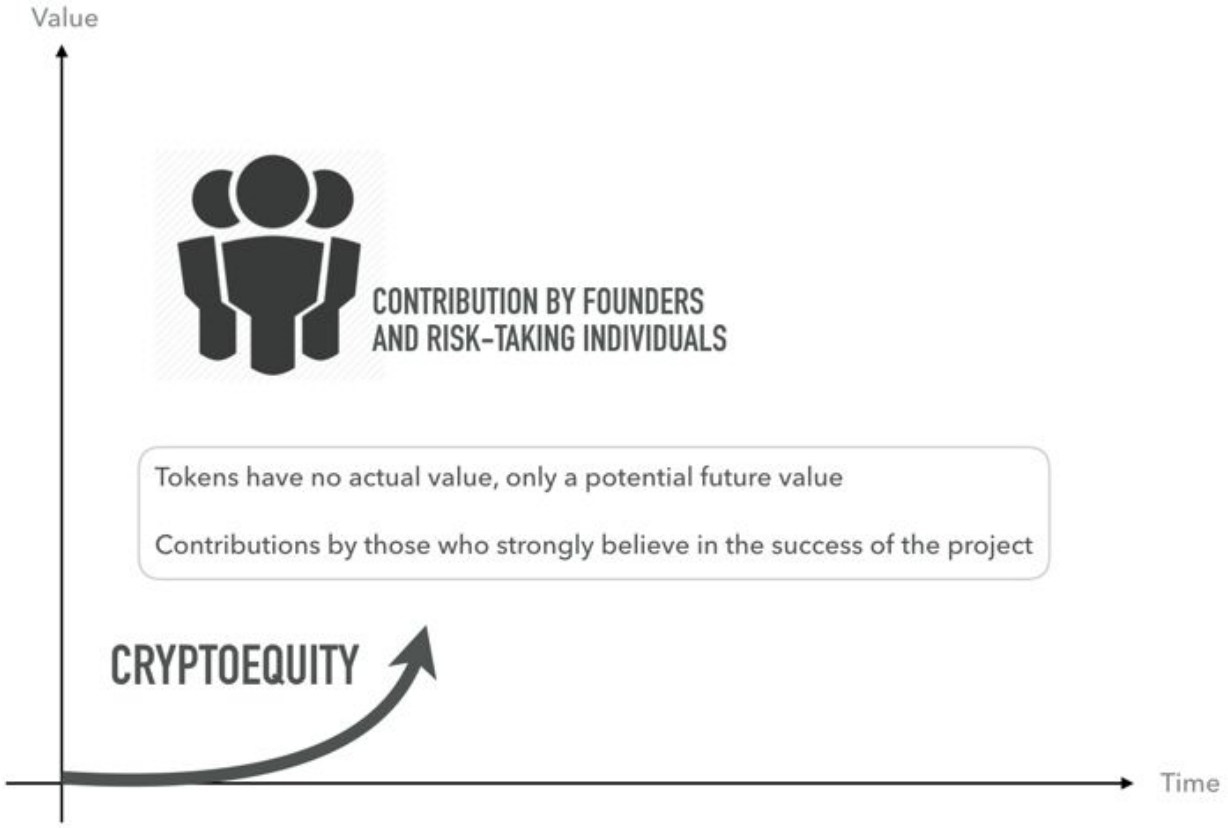


Fig. 1: Illustration of the value of the DC token over time in the equity phase.

As illustrated in *Fig. 1,* at this early phase, the value of DC tokens is relatively low. Starting at zero, when the project is nothing more than an idea, the value gradually rises as the idea materialises into something more tangible through the initial contributions of the founders.

On the one hand, as the project matures, the greater likelihood of success is likely to attract new contributors (other than the founders) who, through their contributions, will gradually increase the likelihood of success —and therefore the perceived value— of the project, thus leading to a progressive growth in the value of the DC tokens.

On the other hand, the increased value of the DC tokens eventually guarantees higher rewards to (mostly earlier) contributors, who can sell these tokens to potential investors eager to speculate on the future tokens' value. This greater opportunity for rewards will attract more contributors, whose contributions is more likely to translate into future economic compensation.

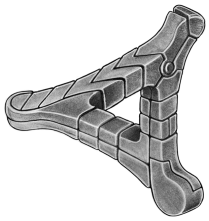
This gives rise to a positive snowball effect, whereby the more people contribute, the greater the perceived value of the project, and the more it becomes attractive for others to contribute as well.

This bootstrap mechanism is somewhat similar to what happens in ordinary startups. In startup companies, early contributors are usually the founders who generally work for months without payment before their efforts can be rewarded —as we often see in the context of DC. Only when the startup matures and profits start being earned can the company begin to compensate its employees —a situation that is akin to the moment in which DC tokens acquire an actual use value, and consequently also a market value.

It is therefore informative to consider the differences between ordinary startups and DC:

- *Bootstrapping*: One important feature that is available to a DC is the ability to bootstrap itself without the need to obtain preliminary fundings. For many startups in the bootstrapping phase, it is difficult to attract people to contribute without any initial fundings (although a startup can always rely on equity-compensation, this mechanism generally only applies to a small number of employees). In the context of a DC, any individual or group of individuals contributing to the project will acquire some kind of equity in the DC. This enables the DC to rapidly scale up, moving from a few founders to hundreds and thousands of dedicated individuals. Such a large group of people can easily undertake a successful project, with much less effort invested per person.
- *Governance*: In addition to the greater scalability of DC in comparison to ordinary startups, a DC is also much more flexible and dynamic in its governance structure: new contributors will trigger an ongoing reallocation of power moving from the initial founders to the new contributors. As time goes by, the DC will thus no longer be controlled solely and exclusively by a small handful of founders, but will rather become subject to the dynamics of the Backfeed protocol.

  On that point, it should be noted that in the context of a DC, there exists an important distinction between governance shares (*reputation*) and financial shares (*tokens*): while both are issued upon positive evaluation of new contributions, only the latter can be transferred to third parties. Hence, in contrast to the situation in regular startup companies, where the founders typically give up control of the company (governance share) in order to get funding from investors, in a DC, investors can only purchase DC tokens. Governance shares can not be purchased, they can only be obtained by active participation in value generating contributions. As a result, the control remains in the hands of contributors *(i.e.* to those who contributed actual value to the DC). This notwithstanding, investors can generate substantial revenues via early token's purchase.



DIGITAL TOKENS AS COMMODITY

The commodity phase begins when the DC reaches a certain degree of maturity and starts offering a service which can be accessed using the DC tokens. While there are potentially many ways for people to pay for these services, there is an important requirement for the DC to benefit from Backfeed's economic model: access to these services must be subject to the payment of DC tokens. In this second phase, from mere equity in a project, DC tokens acquire an actual use value —*i.e.* they are a commodity necessary for people to benefit from the services provided by the DC. Hence, the tokens' value is no longer dependent on the expected success of the DC, but rather on the perceived value of the services it provides. This phase, to some extent, justifies the effort that early contributors have put into the DC at its earlier stages, since they can now enjoy the services of the DC by simply spending the token that they have accumulated. Conversely, those who did not contribute to the DC now have a greater incentive to do so, since they can immediately use the tokens they receive to access the services of the DC.

As the service further matures, it is expected that more and more people (both inside and outside of the DC) will want to access the service. These people can either contribute directly to the DC so as to collect tokens, or they can purchase DC tokens from current token holders —*i.e.* from the contributors who accumulated more tokens than they actually need. Hence, a new market for DC tokens eventually emerges, with exchanges occurring on a peer to peer basis. The token value is highly volatile in this phase, since the market price is ultimately determined by the law of supply and demand: the greater the number of people eager to access the services provided by the DC, and the lower the number of people contributing to the DC, the higher the market price will be (and *vice versa*). Hence, in addition to the ability to access the DC's service in exchange of the tokens accumulated thus far, contributors now have an additional economic incentive to contribute to the DC, as they can gain from the sale of the tokens to third parties.

On that regard, it is worth noting that, overall, the market price of these tokens is likely to increase over time —since, as more people contribute to the DC, the quality of its services will also improve. At the same time, given their greater quality, more people will want to access these services, thereby creating an incentive for them to either contribute directly to the DC (and, by doing so, further improving its services) or purchase tokens from others contributors (thus further encouraging them to contribute, given these new opportunities of economic rewards). A virtuous circle arises, with a growing flow of contributions leading to a growing demand for DC services, which in turn motivates more and more people to contribute to the DC.

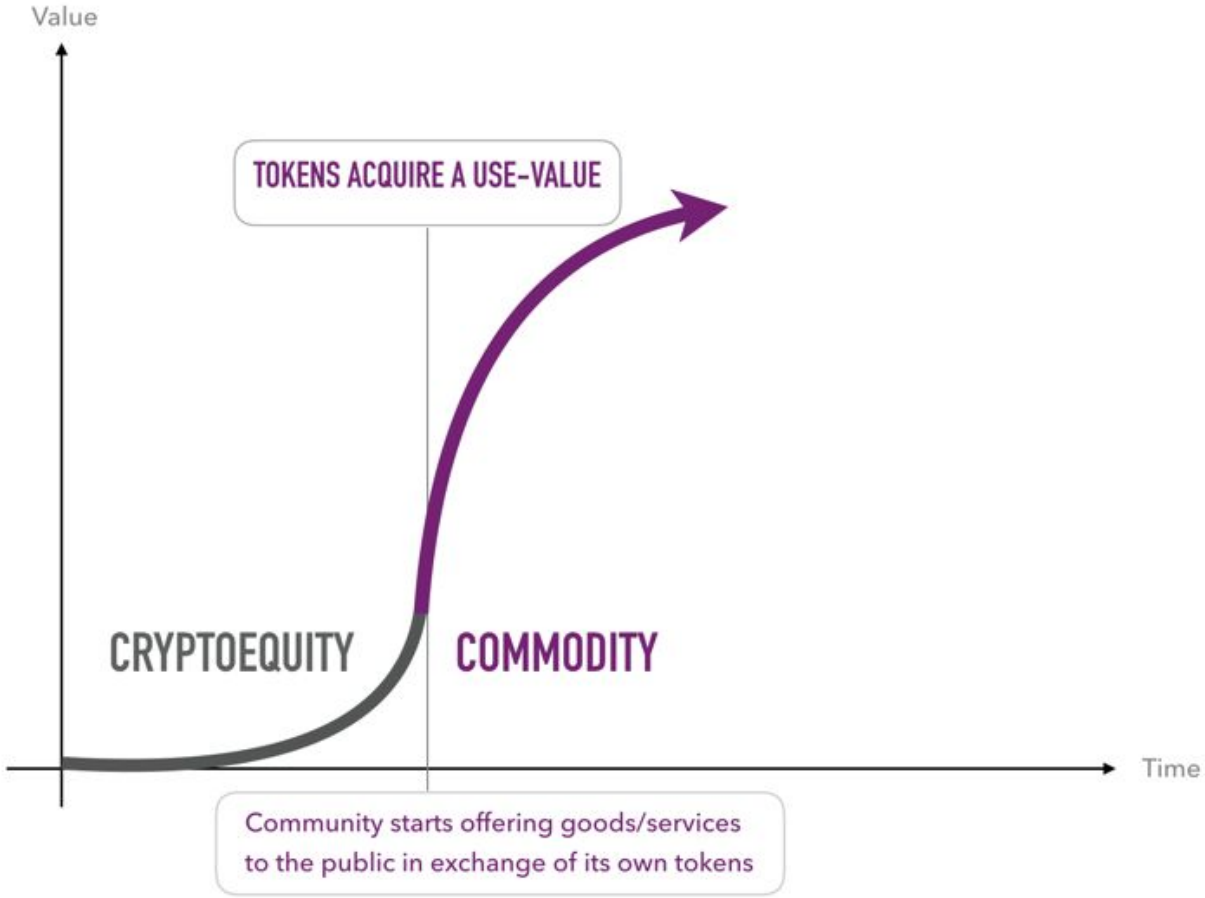


Fig. 2: Illustration of the value of DC tokens over time in the commodity phase.

The exponential growth in the commodity phase comes to an end as the service provided by the DC reaches maturity. At this point, contributions are needed only for maintaining and, eventually, improving the service (*e.g.* through incremental innovations). While the demand for services is likely to grow over time (requiring the expenditure of new DC tokens), the need for contributions progressively decreases, along with the number of new tokens issued by the DC.
This can be problematic to the extent that the price of DC tokens is ultimately determined by the market demand for the DC services and the amount of tokens in circulation. Following the rules of supply and demand, in the saturation phase, the token price is likely to skyrocket, thus making it possible for early contributors to recoup their investment. However, this also makes it really costly for those who did not contribute in the early stage to actually access the service. This is the point where it becomes desirable for a DC to intervene in order to regulate the market price of its tokens, so as to avoid the risk of excessive deflation.

DIGITAL TOKENS AS CURRENCY

At a certain point in time after the DC service has matured, the DC might decide to intervene and regulate the market for its own tokens, so as to further the interests of both DC members and users. As explained above, when the services provided by a DC are properly deployed and reach some kind of steady-state in which there exists a stable user-base, the supply of new tokens to the system becomes very limited, rendering the token's price highly volatile in a deflationary sense.

To stabilize the token's market price, the DC might decide to intervene by becoming an actual issuer of its own tokens, not only in order to reward contributors but also on a purely monetary basis. We present here a model (based on the so-called *partial peg* mechanism) which can drive DC tokens to assume a new function that is closer to that of an actual digital currency:[2]

The DC establishes an upper margin (UM) according to which tokens are offered to the public. Whenever the market price is higher than the specified UM, people will purchase tokens directly from the DC. The DC will issue new DC tokens, thereby increasing the amount of tokens in circulation and therefore progressively lowering the market price, until it falls below the UM.

In addition to capping the market price of digital tokens with the UM, this mechanism also has the advantage of allowing for a lower margin (LM) to emerge organically through the establishment of a growing reserve fund. The funds received by the DC in exchange of its tokens are accumulated in a dedicated fund, which can be used to back existing tokens with regular fiat currencies (or other digital tokens). The fund follows a 100% reserve scheme, so that:

$LM = \frac{F}{T}$, where F is amount of funds and T is the total number of tokens in circulation.

The LM guarantees a minimum conversion rate at which tokens can be redeemed. Whenever new tokens are purchased from the DC, the reserve fund increases according to the UM, whereas, whenever tokens are redeemed against the DC, the reserve fund decreases according to the LM. As long as the UM is higher than the LW, the market price of DC tokens is constrained to fluctuate between these two margins: whenever the market price rises over the UM, people will purchase directly from the DC, whereas, whenever the market price drops under the LM, people will sell (or redeem) their tokens directly against the DC. Besides, the 100% reserve scheme maintained by the DC insures it against a "bank run": redeeming tokens does not affect the LM —which only decreases when contributions are rewarded with newly minted tokens.

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[2] *We discuss here the simplest possible variant of the partial peg mechanism (i.e. a fixed upper margin). Other more elaborate variants of the partial peg mechanism are discussed in the appendix.*

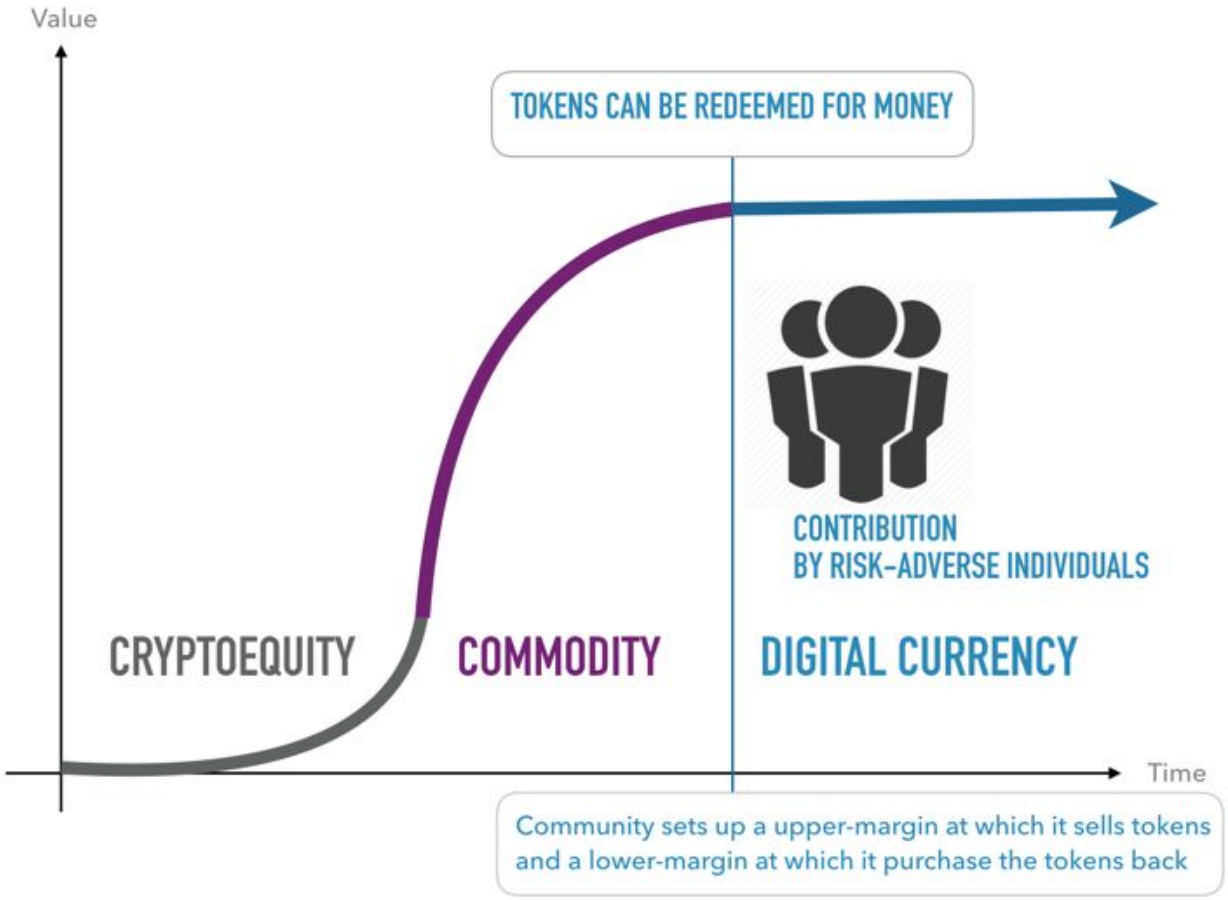
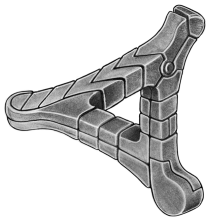


Fig. 3: Illustration of the value of DC tokens over time in the currency phase.

As the product reaches its full maturity, tokens' purchase at the UM becomes the dominant source of new tokens (because less contributions are needed), while token issuance as a result of contributions drops. Over time, as more and more tokens are purchased directly from the DC, the DC accumulates a larger amount of funds within its reserve, and the value of the LM progressively approaches that of the UM. At this point, DC tokens can no longer be used as a speculative investment, as they gradually adopt the properties of a stable digital currency, which can be redeemed at a fixed price.

It should be noted, however, that the economic model presented here is more a suggestion than a general and systematic *modus operandi* for DC. Typically, a DC will start with the equity phase, and will eventually reach the commodity phase, once it starts providing services to the public. Only a few will actually reach a sufficient degree of maturity to enter into the last phase, where the token is turned into a (more or less stable) digital currency.



THE DIVIDEND MECHANISM

In the former section, we have described how the value of DC tokens (as digital currency) can be stabilized and regulated by the DC by virtue of establishing an upper margin (UM) which —in conjunction with the 100% reserve requirement— gives rise to an organically emerging lower margin (LM). This mechanism is used as a means to bound the exchange rate fluctuations. It gradually attenuates the volatility of DC tokens, while increasing the reserve funds of the DC —and therefore the value at which every DC token can be effectively redeemed.

However, this mechanism also comes with a cost to current token holders. To better understand this cost, it is important to distinguish between the two fundamental factors that will lead to the issuance of new coins: contributions and purchase.

- **Token issuance as a result of new contributions,** which contributes to increasing the overall value of the DC —and therefore of its tokens. In this case, token issuance dilutes the DC reserve funds (because of the 100% reserve requirement), but has no effect on the value of each token, whose value will increase in accordance with the overall DC value.
- **Token issuance upon purchase of DC tokens**, which increases the DC reserve fund, but also has the effect of diluting the value of DC tokens —thereby inflicting a loss on current token holders. Moreover, the introduction of a UM (that is lower than the current market price) may impose a limit on the potential profits of current token holders —as the 'would be' market price could otherwise increase far beyond that margin.

Hence, to incentivize participation at early stages, it is therefore desirable to provide a means to compensate token holders for this loss. The Backfeed protocol addresses this issue by way of a 'dividend' mechanism, whereby for every new token generated by the DC (either as a result of the purchase of tokens directly from the DC, or following a new contribution made to the DC) existing token holders will receive a small dividend to compensate for the (potential) dilution in their tokens' value.

In both cases, the amount of dividends is calculated according to a specific interest rate that can be chosen independently by the DC, according to its distinctive needs.

Yet, it is reasonable that, when new tokens are *minted* as a result of a new contribution, the interest rate will be decided by DC members according to the reputation they hold in the DC (as this relates to the perceived added-value that new contributions bring to the DC). Instead, when new tokens are issued due to an actual purchase from the DC, the interest rate will be decided by those who hold a financial stake in the DC (*i.e.* according to their amount of token holdings).

There is no perfect formula to decide upon the actual interest rate. It is a decision that needs to be taken, on a case-by-case basis, by each individual DC, taking account of its own specificities and needs. Yet, it is important to note that there are two competing dynamics at stake: while the dividend mechanism is meant to reduce the loss that current token holders might incur as a result of new tokens being issued by the DC, it is also true that the higher is the interest rate, the greater is the overall dilution in value of these tokens.

In fact, while token's purchase ultimately increases the reserve fund of the DC, this increase is lessened by the fact that additional tokens are created and redistributed to previous token holders, as a form of dividend. Similarly, as new tokens are constantly being issued to reward contributions, any new contribution that is rewarded by the DC will necessarily cause a reduction of the lower margin —given that the same reserve of funds will have to be subdivided into a greater number of tokens, in order to preserve the 100% reserve requirement. And such dilution is stronger if, in addition to the contributors' rewards, new tokens are also being issued as a form of dividend to all current token holders.

Choosing the proper interest rate is, therefore, a delicate decision —which needs to balance, on the one hand, the desire of current token holders to preserve (or even increase) the value of their holding, and, on the other hand, the need for the DC to minimize the inflation of its own tokens.

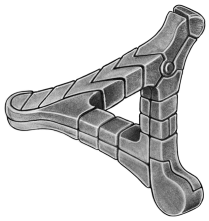
In the case of contributions, it is expected that the profit motive of token holders will be counterbalanced by the reduction in token value due to the inflation created by high interest rates and by the desire of DC members (those who have reputation in the DC, regardless of the amount of tokens they hold) to maintain a fixed or increasing lower margin.

In the token purchase case, we can avoid a decrease in the lower margin if the interest rate is chosen to adhere to the following formula:

$$I < \frac{P}{T} \cdot \left(\frac{UM-LM}{LM}\right) \equiv I_{max}$$

Where I is the interest rate, P is the number of tokens being purchased, T is the total number of tokens and UM and LM are the upper and lower margins respectively. This condition simply states that if more tokens are being issued than what would be issued if the purchase was at lower margin price then the lower margin will decrease.

Needless to say, the instruments presented here are simple tools for a DC to decide how to compensate early contributors and investors. One DC might decide to issue dividends only when tokens are purchased, whereas another may prefer to only issue dividends when new contributions are rewarded —or perhaps not to use any of these options at all.



OVERVIEW OF THE MODEL DYNAMICS

The DC lifecycle emerges from the interrelation of the three phases described above. Yet, these three phases —although distinctive in their nature— actually coexist in a broader ecosystem, where the same token assumes different functions depending on the context in which it is used.

As a general rule, DC tokens can be obtained in three different ways, namely:

(1) those who contribute to a DC will be rewarded in tokens according to the value they add;
(2) those who did not contribute can purchase these tokens from contributors on the market;
(3) or, if the DC is offering tokens at a price, they can purchase tokens directly from the DC.

The value of DC tokens can be related to three different factors, namely:

(1) their actual use value that depends on the perceived value of the services the DC provides
(2) their market price that fluctuates according to current and expected use value of the token
(3) the price at which they can be redeemed against the DC for fiat currency or digital tokens

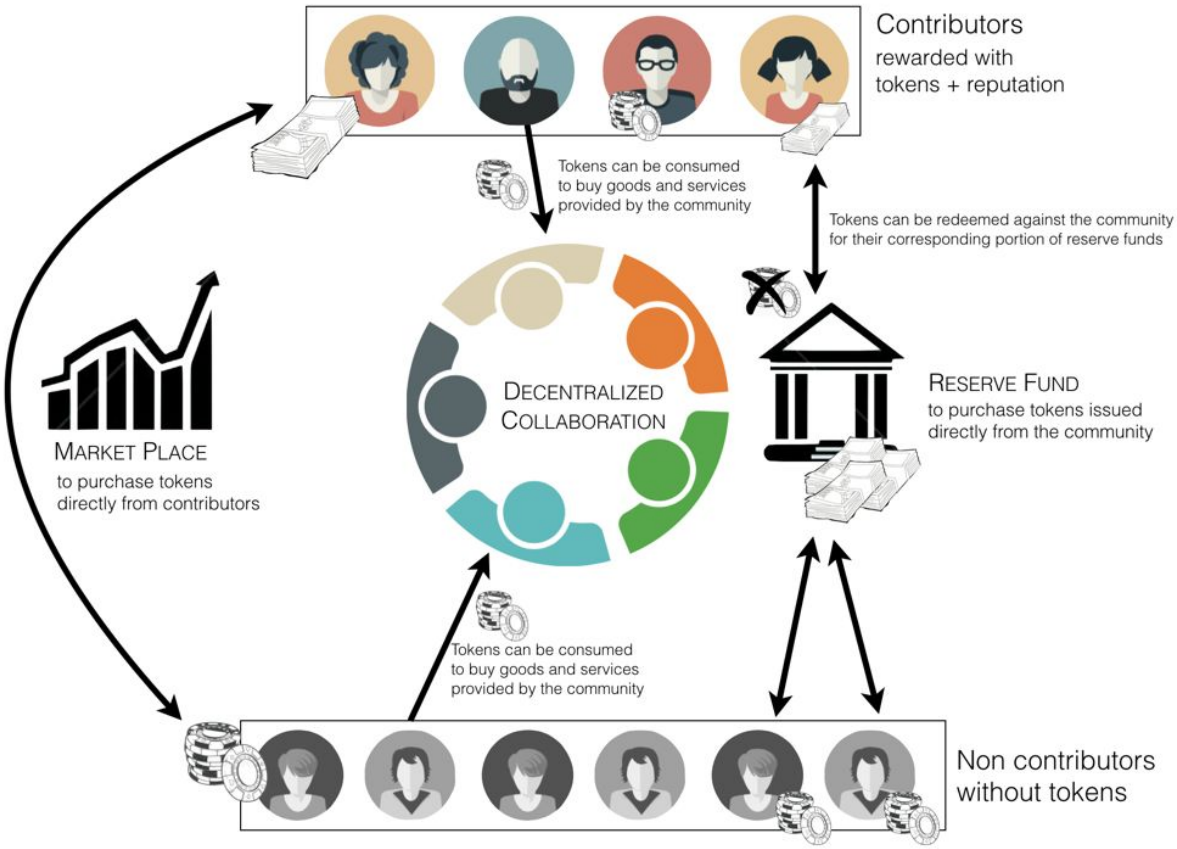


Fig. 4: Flowchart of contributors & non-contributors interacting with a DC

THE DC LIFECYCLE

The most remarkable aspect of this model is that it enables the bootstrapping of new organizations, projects or initiatives without the need for any preliminary funding. In the first phase, the model makes it possible for individual contributors who invest work in a DC to accumulate tokens in direct proportion to the value they contributed to it. Initially, these tokens represent an equity share in the DC, whose value is inherently linked to its likelihood of success. In the second phase, DC tokens acquire an actual market value, which ultimately depends on the perceived (*i.e.* subjective) value of the services the DC provides. In this context, the value of the token is expected to steadily increase, as more people are lured into contributing to the DC, thereby further improving the quality of the services it provides. Finally, in the last phase, the token value can be crystallized into a more objective value, following a decision by the DC to establish a price cap (or upper margin) at which it will start selling tokens.

As time passes, DC tokens eventually become redeemable against a specific amount of fiat currency or other digital tokens, therefore completing the DC lifecycle. This last phase is actually the most innovative and interesting aspect of the model, insofar as it enables digital tokens to be used as an actual store of value, just like any other currency. However, to the best of our knowledge, none of the DCs deployed thus far have experimented with the last phase of the model, which has currently only been tested theoretically.

To complete the description of this model, we must also analyze how these different phases relate to the level of risk that individuals are willing to tolerate. The equity phase is only suitable for the most risk-taking individuals —*i.e.* the founders or pioneers— as it incorporates a high risk of failure, but with possibly high returns in case of success. It is expected that this phase will be taken forward only by a relatively small number of visionary individuals and hard-core contributors. Next, the commodity phase is the most suitable for early adopters, as well as more or less interested users. Here, the level of risk —along with the possible returns— is progressively decreasing over time, as the project gradually materialises into something more concrete, with an actual use value. Lastly, the currency phase resulting from the partial peg mechanism is necessary for the most risk-averse individuals —i.e. to engage with the project, as they would do with a regular job —knowing that they are able to redeem these tokens for regular fiat currency (their salary). The third phase is therefore essential to enable the mainstream expansion of any DC, because only a stable store of value will motivate people to contribute, even if they do not share the vision or simply fail to see it as a successful investment.

TOWARDS A MULTIPLICITY OF VALUE SYSTEMS

In the past few years, we have witnessed a significant amount of innovation in the financial sector, mainly as a result of the rising popularity of Bitcoin, the first decentralized cryptocurrency. The advent of Bitcoin has put into question traditional conceptions of value and has opened the door to a great deal of experimentation in the context of monetary creation and exchange. People began to understand that the monolithic vision of money as a 'creature of the State' might no longer apply, as alternative currencies can now easily be deployed by anyone, and designed to better accommodate their own conception of value.

Bitcoin's innovation over the traditional monetary system was limited to the introduction of a decentralized currency and payment system that is not governed by any State or government. The value system encoded into the Bitcoin network is, however, very similar to that of the traditional market system. In the model we propose, every DC can set up their own tokens to represent the value system that organically emerges as the DC evolves. Some DC may value efficiency over creativity or innovation, others may favor fairness or equality over productivity —though most will feature a mixture of different values, combined in a specific value system. In this sense, every set of DC tokens is an expression of at least two things: (1) the specific conception(s) of value that characterises the DC —which will determine the amount of tokens that the DC will issue, and to whom; and (2) the value provided by the DC within the broader ecosystem —which will determine the exchange rate between the DC token and fiat currency or other digital tokens.

Hence, in a broader perspective, as a multiplicity of value systems emerge out of different DCs, we can envision a whole ecosystem of mutually interacting DCs, each with their own set of tokens which reflect a wide diversity of value systems, backing each other up according to the extent to which they need each other's services.

As the ecosystem evolves, it might even be the case that certain DCs —rather than maintaining their reserve funds in regular fiat currency— may couple to other, possibly more established DCs, whose services are highly demanded or perhaps simply complementary to those of the other DCs. A dynamic exchange rate is therefore established amongst different types of tokens, depending on the relative value of their corresponding DC in the overall ecosystem. This could lead, over time, to the formation of a multilateral market for DC tokens, which might eventually evolve into a self-contained universe of economic transactions —ultimately making it possible for people to bypass fiat currency altogether.