

Anarchy Not Decentralism: Public Goods Under the Status Quo and Exchange in a Post-Archic Society

AJESIROO

ajesiroo@protonmail.com

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ABSTRACT

A primary drawback of existing mechanisms for public goods funding is the degree of uncertainty—grants carry substantial risk for backers, while post factum rewards are subject to arbitrary disbursement. We propose the concept of ternary funding, a trustless mechanism that is contingent on pre-defined deliverables. In its simpler form, stablecoins are locked until attestation of an outcome by validators. In its more elaborate form, an NFT is procedurally generated by mapping the addresses of validators. Successful attestation transforms the latter into an implicit mapping of endorsements as its phenotype is dependent on the aforementioned addresses. To meet today's need, we primarily focus on an implementation on Ethereum, but in later sections explore how the overall locking mechanism can be applied to a theoretical distributed ledger.

1 INTRODUCTION

1.1 Structure

This paper is divided into two main sections. Section 2 describes a funding model for public goods that is implementable today using smart contracts on Ethereum.¹ Section 3, after providing necessary context, describes how the principles in the former can be adapted to a theoretical distributed ledger.

1.2 Not-For-Profit

All mechanisms described herein are not-for-profit. There is no native token and the atypical staking pool described in Section 2.3 has no direct reward for validators.² In order to eliminate the volatility of Ether, a decentralised stablecoin is used for both the pool outlined in Section 2.2 and Section 2.3.

1.3 Public Goods

The term *public good* in the context of this paper refers to goods that are non-excludable, non-rivalrous and include the consideration of externalities.³ The example provided in Section 1.4 is a public good in the form of open data.

1.4 Primary Example

The primary example of a public good that is referenced within this paper is the findings of a team of clinical researchers conducting a small study on the efficacy of a novel immunotherapy. This is used only for illustrative purposes, and the mechanisms described in Section 2 can be applied to any public good that meets the criteria in Section 1.3. The aforementioned example was chosen as it is small in scale and describes research for an underserved cohort that receives insufficient funding under traditional models.

¹Ethereum, and specific EVM-compatible rollups described in later sections, are currently the most suitable candidates for deployment given their ubiquity and level of security without sacrificing decentralisation. The former also exhibits a lower carbon footprint when compared to other major smart-contract-enabled blockchains as a result of the transition to proof-of-stake.

²The social incentives for participating in such a staking pool are described in later subsections.

³See <https://web.archive.org/web/20210702173945/https://otherinter.net/research/positive-sum-worlds/> for discussion on externalities in the context of public goods.

2 UNDER THE STATUS QUO

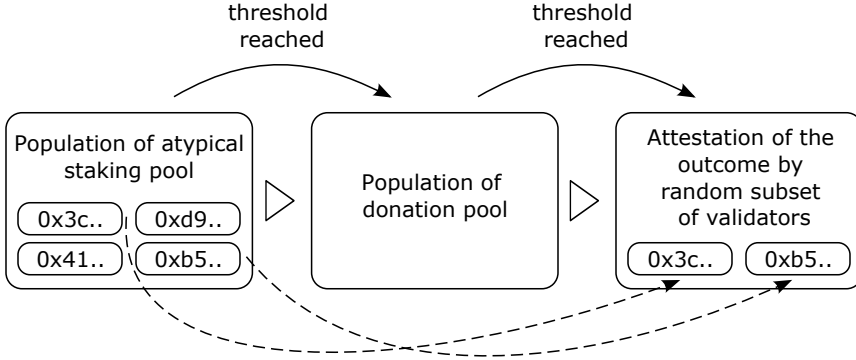
There is a current need to fund public goods that provide benefit to underserved communities such as those described in Section 1.4. That is why there is particular emphasis within this paper on what is implementable today, rather than what is possible on the theoretical distributed ledger described in Section 3.

2.1 Ternary Funding

We introduce a funding mechanism consisting of three primary stages:⁴

- Population of a staking pool,⁵ of which, a minimum number of validators are needed to progress to subsequent stages
- Population of a donation pool, or as described in Section 2.4, the generation of a joint token
- Attestation of the outcome by a random selection of validators, with release of the donation pool or joint token upon delivery of the public good

(Pooled Model)



(Joint Token Model)

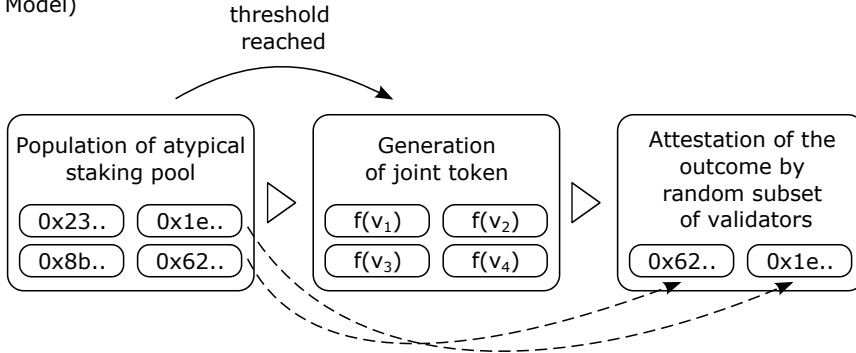


Fig. 1

The cycle is renewed for each funding round and a DAO is not needed to manage subsequent rounds or changes to parameters (see Section 2.3.7).

⁴The term "ternary" is reflective of the three stages. It can alternatively be referred to as "sequent funding" given the similarity of the stages to sequent logic.

⁵"Staking pool" in this context is not equivalent to usage of the term seen in relation to Ethereum PoS. Participants in the pool are the validators themselves, rather than users delegating their stake.

Critically, the staking pool must be populated before the donation pool. This is for several reasons:

- While validators that are randomly chosen to attest to the outcome are pseudonymous, all validators are initially identified (see Section 2.3). This, together with a minimum threshold of validators being reached, provides a degree of legitimacy to the funding round, which is the mechanism that incentivises contributions to the donation pool.
- The threshold of validators being reached is an implicit agreement of the parameters of the funding round, most notably, acceptance of the party developing the public good, and the specific criteria of what constitutes the materialisation of the public good (see Section 2.3.6).

As attestation by the staking pool is the mechanism that either releases or reverses the funds in the donation pool, the amount in the donation pool is capped in order to be within proportion of the staking pool. This is to prevent an attack where the cost of bribing validators, or validators otherwise colluding, is lower than the potential payout of the donation pool (see Section 2.3.2). As also explained in Section 2.3.2, the penalty for attesting outside of the three-fourths majority is the slashing of the entire stake.

Finally, while the contracts are ideally deployed to layer one, gas fees are often prohibitively expensive, and EVM-compatible rollups must also be considered. At present, the only EVM-compatible layer two option that is *deployment-ready* (and provides the full security of the Mainnet) are optimistic rollups.⁶

2.2 Donation Pool

Once the threshold of validators in the staking pool described in Section 2.3 is reached, contributors can populate this pool up until the cap outlined in Section 2.1. It is important to note that contributors are able to participate in both pools.⁷

2.3 Atypical Staking Pool

This is a novel decentralised oracle that determines whether the stablecoins locked in the donation pool, or the newly minted joint token described in Section 2.4, should be released or returned. In the context of a joint token, the latter would amount to it being burned.

Unlike other staking pools, there is no cryptoeconomic incentive to become a validator. The staked tokens are never converted into interest-bearing tokens⁸ and the validator does not receive a direct reward once attestation is undertaken. On the other hand, there are costs involved to become a validator, thus the staking pool is itself a donation pool in the vein described in Section 2.2.

The staking pool is, in effect, donating the following:

- The opportunity cost represented by the risk-free rate (R_f)
- A small but theoretical risk that an honest validator's stake is slashed if it does not attest in line with the three-fourths majority
- The gas fees involved in interacting with the staking contract

It is important to articulate the motivations for participating in such a pool. As described in the overview of Section 2.1, the participants of this pool are not anonymous. The reason for this is threefold. To minimise the risk of various attacks described in later subsections, to allow the

⁶At the time of publication, this includes Arbitrum and Optimism, however EVM-compatible ZK-rollups such as zkSync 2.0 are expected to be deployed to the Mainnet soon.

⁷The pools are not merged as some may want to contribute without the additional burden of attesting.

⁸The version the author is working to implement will not transfer tokens to a lending platform due to the increased counterparty and smart contract risk. Other implementations could use a third-party lending platform so long as all interest earned is provided to the party that delivered the public good (confirmed by attestation) rather than validators.

donation pool to gauge the quality of the funding round, and most pertinently, to provide a social incentive for validators to participate. Validators can publicly post the transaction hash once they have staked the required amount. Thus the incentive is similar to other not-for-profit contributions. The main difference with a simple donation, however, is that an honest validator can expect to receive their staked tokens back,⁹ minus R_f and gas fees.

2.3.1 Sybil Resistance. The inherent properties of the staking pool mitigates this attack. Validators are not anonymous (see Section 2.1) and only during attestation is a random selection of validators pseudonymous (see Section 2.3.5).

2.3.2 Collusion. This is a more complex problem in comparison to Sybil attacks [1, 2]. Nevertheless, this is unlikely to be successful given the inherent design of the various pools. As explained in the overview of Section 2.1, the total amount locked in the donation pool is capped in order to be kept in proportion with the staking pool. In the case of bribing validators, a bad actor would need to ensure that the total expenditure is less than the potential payout of the donation pool. As the random selection of validators that are chosen to attest does not occur until the final stage, and their addresses are obfuscated via zk-SNARKs (see Section 2.3.5), the bad actor would have to bribe the vast majority of validators in order to confidently meet the three-fourths needed to attest to a malicious outcome. If the bad actor was not able to persuade enough validators, the entire stake of all compromised validators is lost during attestation, making collusion prohibitively expensive.

Even in the scenario where the originator of a funding round (who can remain anonymous) is malicious and is associated with all validators in the staking pool, the donation pool would most likely not reach the minimum threshold required to progress to the final stage. As outlined in Section 2.1, the staking pool is populated before the donation pool precisely to allow participants in the latter to assess the quality of validators and the fund originator. An anonymous fund originator, in contrast to a known entity (see example provided in Section 1.4), is unlikely to receive enough funding to allow progression to the final stage. When the minimum threshold in either of the two pools is not reached, all funds are reversed. This also addresses validators simply colluding out of some common interest. In this circumstance, the donation pool can be expected to not receive the minimum threshold if most participants in the staking pool are not trusted.

In the case of a newly minted non-fungible joint token in lieu of donation pool (described in Section 2.4), the joint token would have minimal value but still incur the costs outlined in Section 2.3.

2.3.3 Interval Before Attestation. There is a time-based interval between the delivery of the public good and attestation of the outcome. This is to provide enough time for validators to decide whether the criteria set at the beginning of the funding round have been met. For a typical funding round, this might range from weeks to months, depending on the nature of the funding. For the example outlined in Section 1.4, the interval should be roughly equivalent to the time required for peer review. It is important to note that the actual subset of validators that are randomly chosen to attest are not selected at the beginning of this time-period, but at the end.

2.3.4 Cycling of Validators. A random set of validators are selected to attest to the outcome. This occurs after the interval described in Section 2.3.3. As an anti-collusion measure, the window of time the validator has to attest is short, and if they are not available, a different validator is selected until enough have attested. If the required number of validators do not attest, all funds in the staking pool and donation pool are reverted, and in the case of a joint token, the token is burned.¹⁰

⁹Provided they attest in line with the three-fourths majority.

¹⁰The funding round is considered cancelled, and all funds are returned to their originating addresses.

2.3.5 Attestation. Once a random set of validators are chosen,¹¹ a key is generated and each attester submits a transaction containing the zk-SNARK of this key together with their attestation.¹² The zk-SNARK is needed to ensure only validators that are chosen to attest can call the necessary function. Once enough verified attestations occur, the stablecoins secured by the staking contract are either released or reverted. In the context of a joint token in lieu of a donation pool, the token is either released or burned.

The decision can be shown as:

$$\sum_{i=1}^v \text{attestation}_i \quad (1)$$

where v is the total amount of validators chosen to attest.

It is also theoretically possible to remove the need for an intermediary attestation contract which verifies the zk-SNARK of the key through the use of *private* zk-rollups¹³—that is, zk-rollups that use recursive proofs [3]. In this case only a private transaction would need to be sent to the staking contract, and a proof of the rollup verifies the proof of the underlying transaction.

For a given zk-SNARK (G, P, V) , where G is the generator algorithm that outputs the proving key G_p and verification key G_v , the output of recursive G is (G'_p, G'_v) .

2.3.6 Subjectivity of the Outcome. Validators should be encouraged to only stake in pools where the funding originator has provided a short and highly specific criteria on what constitutes the delivery of the public good. This is to make it as easy as possible to reach the three-fourths consensus during attestation. It is important to reiterate from Section 2.1 that all funds in the staking pool are reversed if the required threshold of validators is not reached to progress to the next stage, therefore it would require the minimum threshold of validators to make this oversight for the funding round to progress.

There will nevertheless be an inherent degree of subjectivity given the nature of the decentralised oracle. Those that attested in line with the three-fourths majority will always receive their stake back, regardless of the decision on the outcome. This also applies for circumstances where no three-fourths majority is reached.

2.3.7 Stigmergic DAO Paradigm. While a permanent DAO can be used to manage the parameters of each funding round, it is not necessary. A new lightweight contract can be deployed for each successive funding round and an interface can be defined that links to a common set of contracts in order to save on the gas fees of deployment. In the context of a joint token, the ERC-721 standard only requires that each address and tokenId form a unique pair, therefore it does not matter if continuity in tokenId is absent so long as a different contract address is used. The advantage of this stigmergic approach is that a governance token can be omitted, and acceptance of the new parameters is contingent on whether or not the new contract receives the necessary threshold of validators.¹⁴ It also negates the ability of a party to spam trivial funding rounds.

2.3.8 Stablecoin. A decentralised stablecoin is used for both the staking pool and the donation pool. The primary requirements are that it is sufficiently decentralised and secure. At present, only several candidates meet these criteria, with Dai being the most notable.

¹¹For example, 16 out of a total pool of 64 validators.

¹²A zk-SNARK for each voting outcome (0,1) should also be considered, although this will use more gas.

¹³An example of a project currently working on this problem is Aztec.

¹⁴This also addresses the funding allocation problem.

2.3.9 *Multiple Known Accounts.* The preferred way to establish identity for the purpose of the staking pool is to adopt a proof of personhood system.¹⁵ Given the infancy of major projects that address this need however, a temporary workaround involves validators posting the transaction hash of their stake from known accounts on multiple unrelated platforms. While this offers a degree of decentralisation, it can nevertheless result in less security than a proof of personhood system.

¹⁵Proof of Humanity and BrightID are two feasible options.

2.4 Joint Token

The donation pool described in Section 2.2 can be replaced entirely with a novel type of non-fungible token introduced herein as a joint token (JT). The token is generated pseudorandomly¹⁶ based on the addresses of all validators, and can only be minted once the staking pool is populated.¹⁷ Validators then decide whether to release or burn the token, in the way described in the overview of Section 2.3.

While an algorithm for generating the token is detailed in Section 2.4.4, it can be summarised as a mapping of each address to an entry, which then collectively form an n^2 grid representing all validators. In a primitive expression, each address can correspond to a colour.

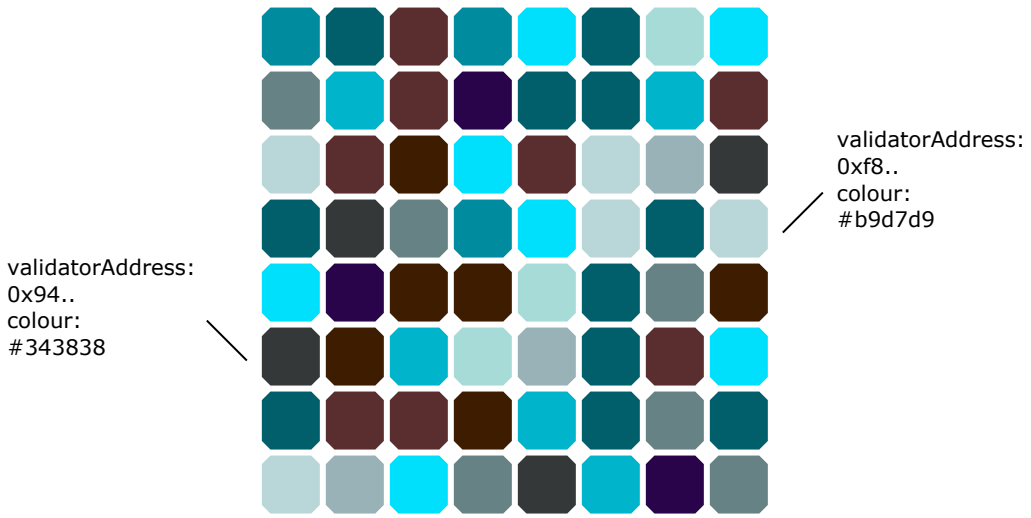


Fig. 2

Crucially, all data relating to the token is stored on-chain. It primarily consists of an array of structs containing each address and corresponding payload. The figure shown above is simply the parsing of this data structure off-chain. The token conforms to the ERC-721 standard, and there is *no* image URI contained in the metadata schema, as only an array of structs containing each pair is necessary to develop a visual representation off-chain.

More complex mappings beyond colours can be used, with gas fees representing the primary bottleneck. For instance, each address can be mapped to an array of integers that define a markup element, culminating in a far more elaborate phenotype.

As only a data structure is stored within the token, a byproduct is composability. Its ultimate form when reconstructed in the browser is dependent on the way it is parsed and augmented. Zone-based interactivity can be enabled by abstracting away some values in tooltips, including the number of times a contributor has participated in previous rounds.¹⁸

¹⁶To prevent coordination of its ultimate appearance.

¹⁷A hybrid funding round containing both a donation pool and joint token is technically possible.

¹⁸In this example, data on previous contributions is derived off-chain.

2.4.1 Value. In the event of a successful funding round,¹⁹ the token can be expected to have a degree of value:

- As its release to the counterparty is contingent on attestation of the public good, the data structure found within it is an implicit mapping of endorsements by validators
- In its visually parsed form, it's possible to ascertain the location of each validator address in the n^2 grid²⁰
- Expenditures outlined in Section 2.3 are also encapsulated as a result of the lack of cryptoeconomic incentives to participate

Ultimately, the released token represents delivery of the public good, endorsement by a set of validators and a series of expenditures.

The recipient can opt to either keep it or trade it in any ERC-721 marketplace.²¹

2.4.2 JT-Specific Incentives. Similar to the staking pool described in Section 2.3, the incentive to generate a joint token is social rather than cryptoeconomic. The validator can publicly post their transaction hash, in the same way an entity can publicly announce any other not-for-profit contribution. As the staking pool can be capped, an additional incentive is scarcity—if the grid is a mapping of 64 validators,²² then a given address can only be associated with the token if the contribution is made before the cap is reached.

2.4.3 Default Funding Vehicle. Given the nominal increase in efficiency, and the reduced risk due to the absence of the donation pool described in Section 2.2, a joint token should be the default mechanism for most rounds.

2.4.4 Procedural Generation. The following is a truncated algorithm in order to illustrate the key components needed to generate a primitive, colour-based joint token.

We first define a struct that will hold the address and colour pair.

```
struct Validator {  
    address validatorAddress;  
    string colour;  
}
```

The string colour corresponds to the hexadecimal code that is ultimately selected, e.g #008b46. For efficiency purposes, this can be represented as a set of integers that form the RGB equivalent, i.e. 0, 139, 70. In order to keep the truncated algorithm simple however, we will use a predefined palette that is represented as an array of strings.

We then initialise an integer representing the total number of validators, and an array of structs, validator addresses and a predefined palette.

```
uint validatorCount;  
  
Validator[] coloursArray;  
address[] validators; // [0x7a..., 0x6B..., 0xb77..., ...]  
string[] palette; // ["#ece5ce", "#424242", "#78c0a8", ...]
```

¹⁹Where the token is released to the party that delivered the public good.

²⁰One way to show each validator address is via tooltips.

²¹The recipient is always the party that delivered the public good.

²²In practice, the value of this parameter should be highly dependent on the funding round.

We define a function that pseudorandomly selects a colour based on the validator address and the current block timestamp. Note that a third-party oracle is not needed as we do not require a more secure source of randomness for this specific application. A hash function that accepts the validator address and `block.timestamp` is sufficient.

```
function rand(address _validator) internal view returns(uint256) {
    uint256 seed = uint256(keccak256(abi.encodePacked(_validator, block.timestamp)));
    return seed % validatorCount;
}
```

We populate the array of structs that contains each pair.

```
function setColoursArray() internal {
    for(uint i=0; i<validatorCount; i++){
        coloursArray.push(
            Validator({
                validatorAddress: validators[i],
                colour: palette[rand(validators[i])]
            })
        );
    }
}
```

We define a function that gets all pairs.

```
function getColoursArray() public view returns (Validator[] memory){
    return coloursArray;
}
```

Table 1. Output

Index	validatorAddress	colour
0	0x3a..	#78c0a8
1	0xc20..	#ece5ce
..

As each funding round is associated with a single token, `coloursArray` is the token itself, not an array of tokens. `coloursArray` needs to be transferred to an address, per the ERC-721 standard, and the `tokenId` is the index of the array containing all `coloursArray`'s.

Once the array is parsed off-chain, we can build the grid that can be presented in the browser.²³

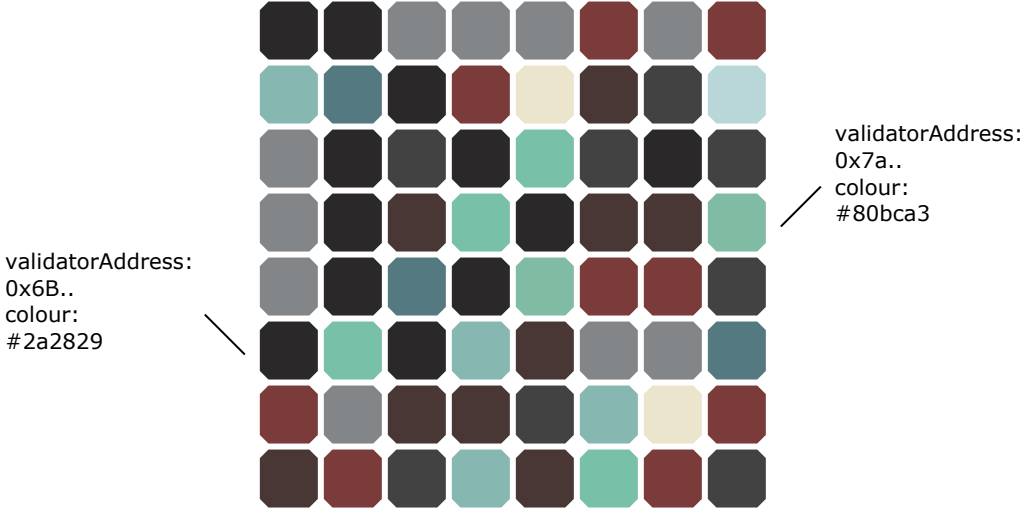


Fig. 3

2.4.5 Colour Permutations. For simplicity, we assume a funding round of 64 validators v and a palette of 64 colours c . When colours are able to be reused in the same funding round, we observe $c^v = 3.94 \times 10^{115}$ permutations. In the case that colours can only be selected once, we observe $\frac{c!}{(c-v)!} = 1.27 \times 10^{89}$ permutations. With either approach, it is highly unlikely that any two parsed tokens will have the same presentation.

²³ENS name can also be displayed if reverse resolution is enabled.

3 UNDER ANARCHY

Anarchy is a fundamental intolerance towards hierarchy. It does not limit itself to dismantling the state and private property.

The most common criticism of anarchy as a form of social organisation centred on anti-hierarchy is that it's unobtainable.²⁴ Yet its primary precursor will be a change in the zeitgeist itself; hierarchy must be viewed as an impediment to individuality rather than an imperfect means that facilitates it. The latter would only be true in a world void of interdependence, not only in ways that are immediately obvious, but in subtle ways that ultimately affect our wellbeing; a privileged person might think they've completely escaped the consequences of hierarchy, until they're in need of a life-saving treatment that was never developed because of the very same hierarchy they helped to reinforce. Similarly, a powerful individual might think they've escaped the consequences of hierarchy, until they're confronted by our lagging research into longevity.²⁵

Those that are adamant that anarchy is untenable should not be able to default to appeal-to-nature fallacies such as human nature. For reasons that have already been touched upon, anarchy aims to be the self-interested organisation of society.²⁶ As Malatesta put it:

Solidarity is therefore the state of being in which man attains the greatest degree of wellbeing; and therefore egoism itself [...] impels man and human society towards solidarity; or it would be better to say that egoism and altruism [...] become fused into a single sentiment just as the interests of the individual and those of society coincide [4].

Not only is anarchy not built upon a vague sense of altruism, but a society that used this as its foundation would be non-resilient as it would quickly lead to alienation and emergence of a quasi-state. For the same reason, an anarchistic society would need to remain conscious of the abstraction of community ultimately being a means to enable individuality, rather than an end in itself.

Nevertheless, it is undeniable that some can gain temporary advantage through hierarchy, as Malatesta emphasised:

Man discovered that he could, at least up to a certain point [...], achieve the advantages of cooperation by subjecting other men to his will instead of joining with them; and in view of the fact that the fierce and anti-social instincts inherited from his animal ancestry were still strong in him, he obliged the weakest to work for him, preferring domination to association [5].

For this reason, anarchy must not only dismantle hierarchy, but remain cognizant of those that wish to re-establish it.²⁷

Even in the face of widespread decentralisation and a plethora of horizontal associations, without an aversion towards hierarchy in the broader sense, the result is tantamount to a rudderless ship. Paradoxically, social organisation could take a form that is more hierarchical than the status quo; decentralism is not synonymous with non-hierarchical outcomes.

²⁴Anarchy does not assume perfection, or a utopian realisation—it only requires a broad aversion to hierarchy.

²⁵The assertion is not that hierarchy never provides us with any kind of short-sighted advantage, it's that its implications in a highly interconnected world are counterintuitive. The latter is likely a result of the recency of a status quo, relative to overall human history, not consisting of largely isolated localities.

²⁶Self-interest is not always equivalent to narrow self-interest; even if for argument's sake we assumed that we can completely isolate ourselves from the consequences of hierarchy, few would be satisfied with all the ramifications of a hierarchical society. The latter has the implication that self-interest, in itself, is more nuanced than direct benefit.

²⁷It should be noted that an absence of hierarchy is not synonymous with equality of outcome. This is self-evident in the context of non-essential goods. An absence of hierarchy also doesn't translate into allowing an incompetent individual to perform brain surgery.

3.1 Hierarchy as the Nexus

A post-scarcity²⁸ society that's averse to hierarchy would necessitate an economy based on mutual aid for essential needs. The only other non-hierarchical economic relation under the three-tier paradigm introduced by Graeber²⁹—exchange—cannot definitionally meet the basic needs of those unable to reciprocate. Crucially, this does not exclude exchange; it's the observation that it cannot be relied upon for essentials.^{30 31}

3.1.1 Private Property. Private property—but obviously not personal property—is inherently hierarchical. This extends also to the modified form³² advocated by some “individualist” anarchists of the 19th century, most notably Tucker, but excluding mutualists such as Proudhon.

“Individualist anarchism” and “social anarchism” are used herein for historical context, but are misnomers that should ultimately be made obsolete. There is only anarchy; a society that's fundamentally intolerant towards hierarchy. “Social anarchy” has the connotation that a collective abstraction is being emphasised, when in actuality, as Kropotkin, Malatesta, Bakunin and many other anarchists have detailed, social organisation is just a means for achieving maximum individuality. Similarly, “individualist anarchy” has the loaded implication that there is some other, non-individualist form of anarchy.

Tucker, in particular, still features prominently in contemporary “individualist” works, despite a vision of anarchy largely limited to decentralism rather than anti-hierarchy, and despite fundamentally misrepresenting his two largest influences, namely Proudhon and Stirner.

A central thesis of Proudhon's thought was that the coercive nature of private property rendered wage labour incompatible with anarchism. Tucker, who frequently cited Proudhon as foundational to his conception of private property, was nevertheless in favour of wages so long as the worker received the “full product” of their labour. Ultimately Tucker saw wages as a “form of voluntary exchange” as both parties had entered into a contract [6]. In actuality, this not only contradicted Tucker's own principles on “occupancy and use”, but led to exploitation as workers would have little choice but to enter into these agreements in an economy where wage labour—rather the cooperatives Proudhon had advocated—was ubiquitous. The issue is further compounded by the equivocation of the “full product” of labour; the collective output of a workplace is greater than the sum of its parts, and where an employer is incentivised to minimise expenditure on wages, this obfuscation serves the interests of the latter.

²⁸Post-scarcity does not refer to the total absence of scarcity.

²⁹In *Debt: The First 5000 Years*, Graeber describes three primary economic relations; communism (referred to herein as mutual aid), exchange and hierarchy.

³⁰If there was a way to enable a fundamentally non-hierarchical society without relying non-reciprocity, then that would of course also be consistent with anarchy as the latter only concerns itself with hierarchy. For the same reason, essentials provided on the basis of non-reciprocity should not be equated to a prescriptive formulation of anarchy, as, in the context that it's necessary to avoid hierarchy, it's fundamental to its realisation.

³¹Anarchy is a never-ending project that doesn't naively assume a point where every instance of hierarchy ceases to exist. Anarchy is opposed to all hierarchy—there is no such thing as “justified” hierarchy—and part of this involves being cognizant that new hierarchies are constantly emerging after the old, likely with increasing degrees of subtlety. There is no point where proactivity can be dropped.

³²Namely, the justification of wage labour under the pretext that its “full product” is passed on.

More consequential was his misrepresentation of Stirner. Despite helping to provide one of the first translations of his works, his characterisations of his views were not accurate. Tucker applied Stirner's ideas in relation to power prescriptively, whereas *The Ego*³³ articulated them descriptively; the later chapters of the aforementioned work were not a schematic for social organisation.³⁴

For Stirner, power, or *right of might* in Tuckerite terms, was whatever that actualised. In this respect, it can take unintuitive forms, as he illustrated when describing a society that assists the disadvantaged:

[...] it also supports, for example, sick people, children, the elderly, in short, those unable to work? [...] To one who exercised no power at all over you, you would grant nothing [7].³⁵

This purely descriptive, rather than prescriptive, nature of power was not reflected in Tucker's works. In his many references to *right of might* throughout his periodical *Liberty*, he misguidedly coupled it with conventional notions of strength and saw contracts formed on an individual basis as a way to compensate for the disparity:

If the strongest is to exercise his right, then he need stop at nothing but the impossible; if, on the other hand, he contracts with the weaker on a basis of equal liberty [...] [8]

For Tucker, without a contract in place, the right of might takes precedence, something he tied with strength rather than actualisation.³⁶

His misunderstanding of Stirner's conception of power and his synthesis of this with contract rights likely reached its culmination in the September 1895 edition in *Liberty*. He describes a situation where anyone trying to prevent a parent from harming a child should be "[arrested] for assault" [9]. The child, according to Tucker, was the property of the parent as they were not yet able to contract. In a non-dystopian realisation of anarchy however, the parent's actions would be viewed as hierarchical and anyone intervening would not face negative consequences.

Stirner was agnostic of the form of social organisation as it was relative only to his own benefit:

Egoism [...] is no enemy of intimate warmth, but it is also no enemy of critique, nor of socialism, nor, in short, of any actual interest. It doesn't exclude any interest. It is directed [...] not against thought, but against sacred thought, not against socialists, but against sacred socialists [10].

Unlike Tucker, he also implicitly acknowledged the role of positive freedom, that is, not only being free to do something, but actually having the means of doing so:

Is "free competition" then actually free? [...] There a rich manufacturer does splendid business, and I want to compete with him. "At any rate," says the state, "I have no objection to make to your person as competitor." Yes, I reply, but for that I need a space for buildings, I need money! "That's bad; but if you have no money, you can't compete. You aren't allowed to take anything from anyone, because I protect and privilege property." Free competition is not "free," because I lack the things for competition [11].

³³ Although *The Ego and Its Own* is referenced given its relevance to Tucker, quotes herein are generally sourced from *The Unique and its Property*. It should also be noted that there are sections of either translation that are particularly problematic when not considered in their context. These sections are widely regarded as satirical references to Hegelianism.

³⁴ This includes concepts in *My Intercourse*, which is clarified in *Stirner's Critics*.

³⁵ The full context of the quote is a reference to communistic society, something that Stirner did not advocate for, but nevertheless provides it as a hypothetical in order to illustrate his conception of power.

³⁶ One example of actualisation versus conventional notions of strength is if there was a desire to collectively form a non-hierarchical society.

Further expanding on competition in *Stirner's Critics*:

Of course, in competition everyone stands alone; but if competition disappeared because people see that cooperation is more useful than isolation, wouldn't everyone still be an egoist in association and seek his own advantage? [12]

For Stirner, conscious egoism was the discarding of fixed ideas, effectively making them his property. If an idea was undissolvable, in other words sacred, then the reverse was true; he was the property of the idea. Social organisation was no exception to this, as he emphasised when he stated that he was “not against socialists, but against sacred socialists” [13]. Anarchy—a society fundamentally intolerant of hierarchy—should also not be held as a higher purpose. Counterintuitively, this only makes anarchism more resilient as the anarchist acting out of self-interest is less likely to be alienated.³⁷ Ultimately, anarchy is a means, not an end.

3.1.2 Hierarchy is Inescapable Under the Status Quo. Even the most advantaged are not completely escaping hierarchy.

Malatesta briefly alludes to this in a largely overlooked section of *At The Café*:

Perhaps, liberty and the possibility of developing one's own individuality exist for you, for a small caste of privileged people... and perhaps not even for them. These same privileged persons are victims of the struggle between one human being and another that pollutes all social life, and they would gain substantially if they were able to live in a society of mutual trust [...] [14]

Our lagging medical breakthroughs, relative to our overall technological advancement, is to a large extent a consequence of hierarchy,³⁸ and this impacts everyone, including those who nevertheless largely escape hierarchy, in the form of inadequate research into longevity and a wide range of pathological processes.

³⁷Self-interest should not be synonymised with narrow self-interest or machiavellianism. Stirner addresses the former in *Stirner's Critics*: “[The egoist that thinks only of themselves] would be someone who doesn't know and relish all the joys that come from [...] thinking of others as well, someone who lack countless pleasures”. And in *The Unique*: “All that they do is egoistic, but it is one-sided, close-minded, bigoted egoism; it is being possessed”. Further elaborating in the chapter *My Intercourse*: “Am I perhaps to have no lively interest in the person of another, should his joys and his well-being not lie at my heart, should the enjoyment that I prepare for him not be more to me than other enjoyments of my own? On the contrary, I can sacrifice numberless enjoyments to him with joy, I can deny myself countless things to heighten his pleasure, and I can risk for him what would be dearest to me without him, my life, my welfare, my freedom. Indeed, it forms my pleasure and happiness to feast on his pleasure and happiness.”

³⁸For instance, due to the lack of free association as a result of the skewed incentives under the status quo.

3.1.3 *Mutual Aid*. A fundamentally non-hierarchical society would quickly default to an arrangement of indirect reciprocity, that is, mutual aid, as the basis for essential needs. Exchange, in the context of the three-tier paradigm introduced by Graeber, cannot form this basis as it necessitates direct reciprocity.

Denying the basic needs of those unable to reciprocate is hierarchical, and in a post-scarcity society, not providing these same needs to those who simply opt out of reciprocity also risks the formation of hierarchy with little to actually gain.³⁹

Therefore, anarchy necessitates positive freedom in addition to negative freedom. Allowing the pursuance of basic needs is insufficient; they must be actively met regardless of direct reciprocity.

The counterargument that an anarchistic society should be free to not provide these needs implicitly justifies the freedom to establish hierarchy. As Malatesta put it:

[Some] seem almost to believe that after having brought down government and private property we would allow both to be quietly built up again, because of respect for the freedom of those who might feel the need to be rulers and property owners.

A truly curious way of interpreting our ideas [15].

Kevin Carson is one of the most cited contemporary anarchists that doesn't hold this view of positive freedom. Specifically, he doesn't hold the view that anarchy—a broad aversion to hierarchy—would necessitate essential needs being provided on the basis of non-reciprocity.

While no longer identifying with anarchist adjectives, his position on mutual aid largely echo his earlier, market-anarchist-based works; its role in anarchistic society is auxiliary, rather than inevitably forming the most fundamental economic relation. His most recent book at the time of publication, *Exodus*, continues to reflect a form of social organisation where the delivery of basic needs, outside of associations, is contingent on circumstances:

[...] the renaissance of the commons and expansion of the commons circuit presuppose reuniting productive property with commoners, and reincorporation of the means of production into the commons. The commons, as the locus of direct production of use-value, and for insurance against risk and mutual aid in time of need [...] [16]⁴⁰

Carson has written extensively on healthcare over several decades, and his preference towards reciprocal models has been consistent, noting very early:

Workers organizations for self-help and mutual aid included collections for charity, and “friendly societies” organized on a subscription basis to insure members against funerals and sickness [17].

³⁹ Given the fundamentally different nature of work under anarchism, those who choose to opt out entirely are unlikely to be in numbers that prove to be detrimental. If this weren't the case, and so few were willing to meaningfully contribute to their community that it was no longer able to function, then it would be reflective of a deeply alienated society. The underlying problems should be addressed rather than resorting to coercion.

⁴⁰ The context of this quote is on the post-capitalist transition, but nevertheless summarises views elsewhere in the aforementioned work on mutual aid under anarchy.

He expands on this significantly about a decade later in *Organisation Theory*, where he first floats the idea of resurrecting membership-driven guilds to meet this need [18], and then proposes price tiers for different levels of care:

In contrast, here's my vision of one possible alternative healthcare system, as it might exist in a genuinely free market. The lowest tier of service is a cooperative clinic at the neighborhood level, perhaps organized on a subscription basis by a fraternal order or mutual society, on the old lodge practice model [19].

The next tier would be an intermediate insurance policy. If the G.P. or nurse practitioner recommended a test or treatment that was beyond his competency, or the resources of the facility, the second tier of insurance would kick in. For example, the woman with the inflamed eye in the example above might be advised to get an MRI just in case [20]

The third tier would provide coverage only against catastrophic illnesses [21].

[The] provision of such health insurance plans would likely be a standard benefit of membership in a guild or a community association [22]

Reaffirming his favourability towards this type of guild more recently in *The Desktop Regulatory State*, where we draws parallels to not-for-profit organisations that offer health insurance at lower prices:

One possibility is the resurrection of the guild as a basis for organizing mutual aid [...] A good example [of associations that attract memberships on an individual basis is] the Healthy Workers medical plan, organized by Working Partnerships USA and the Santa Clara Valley Health and Hospital System, which provides health insurance with no deductible at half the price of competing commercial plans [23]

Throughout various works, he bolsters the argument for membership-driven associations to meet healthcare needs by implying that anarchist communists such as Kropotkin were in favour of this model:

[There] have been important anarchist thinkers like Kropotkin who emphasized mutual aid and other mutual organizations, without in any strict sense being mutualists [24].

Writers like Kropotkin and E.P. Thompson describe elaborate self-organized safety nets—cooperatives, mutuals, friendly societies, etc.—created by workers for themselves [25].

I'm a strong advocate of cooperative models of health care finance, like the Ithaca Health Alliance [...] or the friendly societies and mutuals of the nineteenth century described by writers like Pyotr Kropotkin and E. P. Thompson [26].

However the work Carson cites for this, *Mutual Aid*, was providing a historical account of self-organisation under the status quo. Kropotkin, an anarchist communist, advocated for a society where all basic needs were provided on the basis of indirect reciprocity, in other words, on the

basis of mutual aid.⁴¹ He was not in favour of these needs being contingent on membership within friendly societies or other associations. Where Kropotkin did support associations, was for the distribution of luxuries.

In more recent years, Carson has moved away from his earlier Tuckerite focus and devoted several works to the post-capitalist transition, specifically, the role of counter-institutions, stigmergic organisation and other forms of horizontalism. Central to this is the concept of interstitial development—that crevices outside of the state’s reach present an opportunity to erode its power.

Carson emphasises that the counter-institutions that develop within these interstices are not only catalytic, but reflective of an anarchistic society:

Marx saw revolution as the culmination of a long process of interstitial development by which the preconditions of communism were created within the capitalist system [...] We, on the other hand, see a fully functioning post-capitalist system developing here and now, as more and more cooperative or commons-based institutions arise and coalesce into a whole [27].

[...]‘interstitial’ suggests actually building the new society here and now rather than just prefiguring it [28]

However the horizontal counter-institutions described in *Exodus*, or the stigmergic organisation detailed in both the former and in *The Desktop Regulatory State*, do not amount to a fundamentally non-hierarchical society. It is not a point of pedantry; decentralism is not synonymous with non-hierarchical outcomes.

To illustrate this, consider a society consisting of an expansive mesh of non-hierarchical cooperatives, mutual aid associations and DAOs, with much of the coordination taking place stigmergically, rather than directly. Essential needs under this model is inherently not guaranteed—apart from reciprocity or membership within associations, it is up to the whims of these structures to provide these needs. A mutual aid association will *probably* step in to assist an individual that is unable to reciprocate. A cooperative *might* waive its requirements for membership. This is why anarchy must be defined as an aversion to hierarchy rather than simply a constellation of non-hierarchical associations; if the societal phenotype is fundamentally hierarchical, it’s of little consolation if each of its individual components are horizontal, or if their development took place in a way that was stigmergic and permissionless.

In both *Exodus* and *Desktop*, Carson frequently contrasts hierarchies with networks:

In a hierarchy, all communications between members or between local nodes must pass through a limited number of central nodes. The only communications allowed to pass from one member or local node to another are those which meet the standards for distribution of those who control the central nodes [...] But in a distributed network, every node has the power to transmit as well as receive, and any two nodes can communicate directly with each other without passing through a central node or obtaining the approval of whoever controls that node [29].

But in every instance, Carson is referring to horizontalism at the componental rather than societal level. The permissionless nature of distributed networks is of little relevance to hierarchical outcomes. In other words, permissionlessness has little bearing on enabling a non-hierarchical society.

⁴¹For those who wished to be a part of an anarchist communist society, not for those who wished to live outside of it.

Later in *Exodus*, Carson states the following:

We're not simply adopting more decentralized production technologies or organizational forms, but coalescing all these building blocks into a fundamentally different economic paradigm [30].

However the aforementioned work doesn't go beyond proposing a more decentralised form of social organisation.

As outlined previously, Carson frequently misrepresents Kropotkin, and this is no different in *Exodus*, where he describes the conclusion of the post-capitalist transition:

[The outcome of the transition] bears a more than passing resemblance to the libertarian communist future Pyotr Kropotkin described in *The Conquest of Bread and Fields, Factories and Workshops* [...] [31]

This ignores the most distinct facet of anarchist communism—that a non-hierarchical society *necessitates* basic needs to be provided on the basis of mutual aid, which is in contrast to its auxiliary nature detailed throughout Carson's most recent works.

3.1.4 Solidarity. Solidarity is simply collective action towards our end of maximum individuality. It does not require amiability.⁴²

3.1.5 Subjectivity. Hierarchies are complex, interconnected and fluid, and while an anarchistic society would quickly identify major hierarchies, many others are subtle or entrenched. Constructive empiricism⁴³ might be particularly useful, but ultimately epistemological anarchism⁴⁴—the rejection of universal methodologies—ensures we do not limit ourselves to any single approach.⁴⁵

3.1.6 Exchange. As expanded on previously, exchange, under the paradigm introduced by Graeber, is distinct from hierarchy. Naturally an anarchistic society would exhibit everything from barter to more elaborate exchange mechanisms.

The principles of marginalism can also be adapted to exchange value, even in a moneyless society. Nevertheless, there have been various attempts to synthesise the labour theory of value (LTV) with marginalist concepts, albeit lacking in rigour. The most cited contemporary example is likely Carson's subjective LTV, which was detailed in *Studies in Mutualist Political Economy*. Carson asserts that, in the long-run, equilibrium price will trend towards the cost of production, which in turn is largely reflective of the disutility of labour. The rationale is that a producer will seek compensation that at least factors in this inherently subjective disutility and competition will in many cases prevent them from charging above this amount.

This however shares the same deficiencies as classical interpretations of LTV; even when focusing only on the long-run, its plausibility requires an extensive amount of exceptions to specific circumstances. In addition to this, Carson doesn't formalise his subjective LTV in either *Mutualist Political Economy* or in subsequent works, addressing this in the former by stating that "[such] statements require no verification beyond an a priori understanding of human nature" [32].

⁴²Nor does it make any naive assumptions regarding human nature. Ultimately a society averse to hierarchy is cognizant of this.

⁴³Epistemologically, that something widely accepted is empirically adequate rather than anchored in a definitive reality.

⁴⁴Proposed by Paul Feyerabend.

⁴⁵For clarity purposes, the subsection *Subjectivity* is in reference to the academic deconstruction of hierarchy, not direct application.

3.1.7 Transition. Without a widespread understanding that it's hierarchy in itself that inhibits maximum individuality, any manifestation of anarchy will be short-lived; even if through sheer luck the major apparatus of the status quo were somehow overcome, a form of state will quickly emerge. For this reason, decentralism is insufficient and a general aversion to hierarchy is necessary.

Counter-economics, in the broader definition, will be a key part of the transition. The locking mechanism of ternary funding introduces trustlessness, which in turn enables anonymous development as funding is contingent on delivery.⁴⁶

Those with the greatest capability are often the least able to forgo anonymity. Trustlessness encourages the development of projects that challenge the boundaries of the status quo.

⁴⁶In this context, the mechanism is not limited to public goods. It should also be noted that in its modified form, both the pool of backers and the recipient can remain anonymous. Nevertheless, fully anonymous transactions on Ethereum are more difficult than some other blockchains, despite ultimately being possible.

3.2 Mutual Tokens

Mutual tokens are a way to facilitate some forms of exchange where a decentralised oracle is advantageous. Non-fungible items⁴⁷ are pooled, and a random subset of participants attest to an outcome.⁴⁸ If attestation is successful, the tokenised pool is transferred to the counterparty and deconstructed back to its individual components.

In addition to broader exchange, they are useful to incentivise development towards uncommon needs that were otherwise not being met. An anarchistic society based upon mutual aid would already address most of this need, but would nevertheless fall short in some circumstances, for instance when research only directly affects a very small cohort.

Under Graeber's three-tier paradigm, mutual tokens generally fall under exchange, although the decentralised oracle can still be useful when direct reciprocity is not expected.⁴⁹

3.2.1 Simple Mutual Tokens. Each token consists of a pool of non-fungible items and corresponding addresses. From the pool, a random subset of validators are chosen and attestation of an outcome is undertaken. Slashing of individual addresses occurs when attesting outside the consensus, the latter of which is a threshold set by participants at the beginning of the round. If consensus cannot be reached, each item is reverted to its original address.

In order to prevent collusion between validators, zero-knowledge proofs can be used to obfuscate individual attestations.

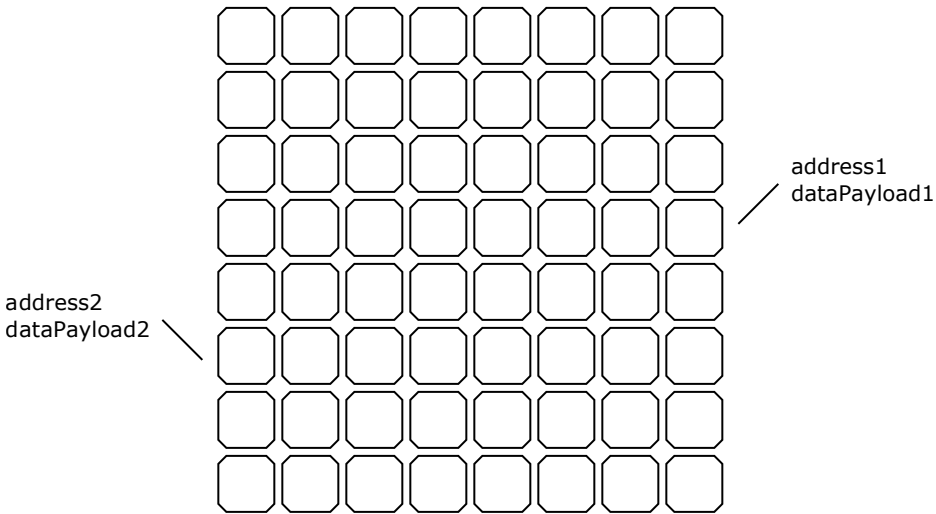


Fig. 4

When the token is transferred to the counterparty, the pool is deconstructed back to its individual components, thus losing its transferability.

⁴⁷Even wholly digital non-fungible items do not need to be confined to simple payloads of data; they can amount to mechanisms within themselves. Their only distinguishing feature is a unique identifier.

⁴⁸The threshold that constitutes as consensus is flexible depending on the preferences of the pool. Furthermore, the subset chosen to attest is random in order to minimise the risk of collusion.

⁴⁹Put differently, items can be pooled and a collective decision can be made to transfer the token to a counterparty on the basis of mutual aid, i.e without direct reciprocity. It should also be noted that a previous version of this paper did not use Graeber's distinct economic relation paradigm.

3.2.2 Complex Mutual Tokens. In contrast to simple mutual tokens, which are wholly digital, complex mutual tokens correspond to a pool of physical goods or services. As the items that constitute a pool are off-chain, the theoretical ledger distributed is useful insofar as enabling the round and associated attestation, rather than the tracking of items on-chain.⁵⁰ A by-product of this is the elimination of the slashing mechanism during attestation.

At the end of a round, the counterparty's address records only the outcome, without regular transaction data.

3.2.3 Alternative Uses. Mutual tokens do not need to be limited to instances where direct reciprocity is expected. In the case of mutual aid, where there isn't a need to attest to an outcome, the decentralised oracle simply votes on whether or not to transfer the token to the counterparty. The advantage of mutual tokens in this scenario, over a direct transfer, is the facilitation of a voting mechanism.

Alternatively, they can incentivise outcomes by expressly taking the form of recognising an achievement. Here attestation amounts to an acknowledgement, something that can carry greater weight depending on the participants of the pool.

3.2.4 Consensus Mechanism. Even with the absence of a cryptocurrency,⁵¹ consensus on a theoretical distributed ledger can be reached. For instance, proof-of-stake can be implemented with non-fungible digital items. These would be subject to slashing during attestation in order to address the nothing-at-stake problem, but would nevertheless be limited to non-essential goods.

3.2.5 Prescriptiveness. An anarchistic society would realise a diverse economy with innumerable methods of exchange; its phenotype is open-ended and much will depend on trial and error. Only economic relations which are hierarchical should not be tolerated, as anarchy only concerns itself with hierarchy. Mutual tokens are a suggested mechanism to facilitate some forms of exchange where smart contracts are beneficial, particularly when attestation is needed.⁵² The theoretical distributed ledger described herein is not indispensable to an anarchistic society and is unrelated to the meeting of basic needs; its primary relevance is with subjective needs.⁵³

3.2.6 Representative Nature of Attestation. Anarchy is the opposition to hierarchy, and as Malatesta, Kropotkin, Proudhon, de Cleyre, Goldman, Bakunin, Berkman, Gelderloos and others have articulated, it is not the advocacy of democracy as an overarching system [33][34][35][36][37][38][39][40].

The former having summarised:

This is why we are neither for a majority nor for a minority government; neither for democracy nor for dictatorship [...] We are for the freedom of all and for free agreement [...] [41]

Nevertheless, the attestation mechanism of mutual tokens can be described as democratic;⁵⁴ a subset of participants are chosen to vote on the token's release.⁵⁵ This is consistent with anarchism because the pool is a voluntary association engaging in non-essential exchange. As emphasised previously, basic needs in a non-hierarchical society are provided on the basis of non-reciprocity

⁵⁰Convolved mechanisms can be implemented in an attempt to address this, but are unlikely to be particularly useful as the items are ultimately off-chain.

⁵¹An absence of cryptocurrency does not necessarily exclude distributed-ledger-based mutual credit systems.

⁵²Put differently, suggesting how a non-essential facet of anarchy could work does not amount to a prescription.

⁵³One of the earliest usages of the term was by surrealist Andre Breton. More contemporaneously, it was referenced on Angie Speaks.

⁵⁴More specifically, a form of sortition or aleatory democracy.

⁵⁵To reiterate, participants of the pool can also opt to require complete consensus rather than defaulting to a subset.

and thus have little relevance in this context. Additionally, while mutual tokens can be used in circumstances where reciprocity is not expected, they are most useful to facilitate exchange.

3.2.7 *Code is Not Law.* The smart contracts on our theoretical distributed ledger are not law.⁵⁶ The aim is to abolish hierarchy, not recreate it in newer forms. Under the paradigm used throughout this paper, hierarchy is by definition not exchange, and in a society averse to the former, its presence in this context would lead to damaged reputation or sanctions.

Immutability does not take precedence over anti-hierarchy; when a systemic issue arises on existing blockchains, hard forks are contemplated, and there is no difference in this respect.⁵⁷ They are nevertheless non-trivial, with agreement amongst a large number of nodes required.

Ultimately, if smart contracts were a viable way to circumvent the opposition to hierarchy, then the result is a techno-dystopia rather than anarchy.

⁵⁶The term “contacts” in this context is also a misnomer because they are not contracts in the traditional sense, but rather stored procedures, and in the absence of an external oracle introducing randomness, are deterministic in nature. Nevertheless, unfettered use can lead to hierarchical implications.

⁵⁷The history of existing blockchains demonstrates that immutability has never been absolute. There has always been a trade-off between the drawbacks of a hard fork and the need to resolve critical issues.

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