Content/Bounty Coin

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Abstract

The utility of cryptographic tokens and their appropriate use has become a highly contested issue in light of the recent ICO phenomenon. This paper begins by proposing a framework for assessing whether a token adds value to an economy based on basic economic principles. Based on this value framework, this paper examines the markets for user-generated goods and explores two key challenges which can be improved in order to add value to these markets: profitability and allocation of productive resources. An abstract token type called a Content/Bounty Coin is proposed to address these challenges and add value to markets for user-generated goods by rewarding producers of popular goods with tokens and creating a tokenized bounty system which gives consumers greater influence over allocation of productive resources. There is already a successful tokenized rewards platform for Reddit-like content called Steemit. However, a tokenized bounty system has yet to be seen. Some of the key challenges to implementing a tokenized bounty system are discussed in this paper. The paper concludes with a brief exploration of potential use-cases for Content/Bounty Coins.

Contents

1 Introduction

A Content/Bounty Coin is an abstract type of cryptographic token which adds value by improving markets for user-generated goods.[1]

    The market for user-generated goods has two major problems: profitability and allocation. It is difficult to profitably produce many kinds of user-generated goods, because it is difficult or impossible for the producers to directly monetize them. At best, they can

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[1]In this paper, the term "goods" is used to refer to both goods and services. The term "user-generated goods" is used broadly to mean user-generated content and other goods which are generally made available to consumers for free online—*e.g.*, blogs, webcomics, YouTube videos, FOSS and mobile apps.

monetize these goods *indirectly* through ad revenue or donations or *partially* through a freemium revenue model, but these methods are sub-optimal, because they are less sustainable or create deadweight loss relative to direct monetization. Furthermore, indirect monetization makes it more difficult for consumer demand to influence the allocation of productive resources to their most valuable outputs, since consumers do not have a "dollar vote" on allocation. However, even dollar voting is a sub-optimal solution to the allocation problem, both in markets for user-generated goods and in the wider economy.

A Content/Bounty Coin addresses the problems of profitability and allocation with two key features:

1. **Content-rewarding**—Producers of goods are rewarded with tokens, resulting in direct monetization of goods and increased profitability.

2. **Bounty-setting**—Consumers of goods can use the tokens to set bounties for the producers, improving the allocation of productive resources.

This paper will start by presenting a framework for assessing the value of tokens based on fundamental economic principles. Then, this paper will explore the profitability and allocation problems affecting markets for user-generated goods and how a Content/Bounty Coin can add value by solving these problems. Next, some design considerations regarding implementation will be discussed. Finally, the paper concludes with a brief exploration of a few potential use-cases for Content/Bounty Coins.

2 Value framework for cryptographic tokens

Let's begin by building a framework for assessing whether a cryptographic token adds value to an economy. The utility of tokens and their appropriate application has become a highly contested issue in light of the recent ICO phenomenon. Taking a step back and looking at the issue from an elementary economic perspective, a token adds value if and only if the following two conditions are met:

1. **Productiveness**—It increases the total value of production of an economy.

2. **Uniqueness**—The same economic benefits cannot be achieved using other existing currency (whether crypto or fiat) or non-currency solutions for the same or lower cost.

By definition, a token adds value to an economy only if it increases the total value of production. However, if the same benefits can be achieved with another solution at a lower cost, then use of the token would result in deadweight loss versus use of the cheaper solution. In this case, pursuing the tokenized solution would actually destroy potential value by diverting productive resources to an inefficient use. If the cost of the solution based on the token versus other solutions is the same, then use of the token is value-neutral. If a token increases the total value of production of an economy and the same benefits cannot be obtained with an equal-cost or cheaper alternative, then the token adds value to the economy.

3 Further analysis of productiveness

To understand the value proposition of a Content/Bounty Coin, it is helpful to further analyze the factors which determine productiveness.

The total value of production in an economy is a simple function [16] of input and productivity:

$$Y = A \times I$$

where:

Y = total value of output,
A = productivity, and
I = total value of productive inputs (labor and capital).

From this, it follows that productivity is a simple ratio of total output to total input:

$$A = Y/I$$

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There are two ways to increase the total value of production:

1. Increase I by employing more or more valuable labor and capital in production.

2. Increase A by increasing the efficiency of production or the quality of goods produced.

In other words: produce *more goods* by increasing I or A (efficiency), or produce *more valuable goods* by increasing A (quality).

In a market economy, I depends on *profitability*. If producers can obtain benefits from producing goods which outweigh the cost of their inputs, they will employ these inputs towards producing more goods.

A is determined by two factors: *technology* and *allocation*. Advances in technology mean that more, or more valuable, output can be produced. More output can be produced when production technology is improved, making production more efficient (*i.e.*, cheaper). More valuable output can be produced when product technology is improved—*i.e.*, when new or improved products come to market. Improvements in allocation mean that production is diverted from lower-value output to higher-value output. In a perfect economy, each marginal unit I would be allocated towards production of the highest marginal value unit Y.

Many economic models focus only on the technology aspect of productivity, because perfect allocation is taken for granted (since it is a consequence of a perfectly competitive economy with perfect information, two common simplifying assumptions for the development of economic theories). In the real world, however, there are no perfectly competitive economies with perfect information, and allocation is imperfect. Hence, we can increase the value of productive output by improving allocation.

4 Problems facing markets for user-generated goods

In this section, we will explore in more detail the problems of profitability and allocation that affect the markets for many user-generated goods.

4.1 Profitability

Profitability is one of the major problems affecting the markets for many user-generated goods. This is because it is difficult or impossible for the producers to monetize them, *i.e.*, to receive money from their consumption.

When a good is monitized, its producers benefit when it is consumed. These benefits incentivize the producers to produce more of the good. If a good is not monetized, people may still produce it for free, given that there are often some non-monetary benefits from producing it (*e.g.*, people enjoy making it, or see it as an opportunity to improve professional skills), but it is likely that fewer resources will be allocated to its production (since the producers also have to make time for their "day jobs"). This makes production less sustainable and results in the production of a lower quantity of the good overall.

The most common existing, non-token solution to the profitability/monetization problem is *indirect* monetization through ads or donations or *partial* direct monetization through a freemium revenue model. While these options improve profitability for producers, they are sub-optimal solutions.

Ads can be a reliable source of revenue to producers of free goods. However, ad-based revenue creates deadweight loss in two ways:

1. The ad clutter gets in the way of usability and frustrates consumers, making the good worse.

2. The producer do not monetize the value of *the good itself*, only the value of the viewership of the ads (monetization of which is itself a highly inefficient process [6, section 2.2]). Even if the producer offers a paid ad-free option, as many do, the producer is still not monetizing the value of the good itself, only the incremental value to consumers of the good with versus without ads.

Ideally, producers should have a way to, at their option, monetize the full value of the goods they produce (*i.e.*, the good itself *plus* the value of the viewership or the paid ad-free option). For some producers, monetizing the good would be a more efficient way to have it reach consumers, given that there are consumers who are strongly averse to ads/consumer culture and are angered by having to pay to remove ads. This may not be a problem in a large market, but in niche markets (*i.e.*, the "long tail" of user-generated goods), this can be a bigger problem. Furthermore, ads are a less viable source of revenue for some goods, because effective monetization requires the producers to control the platform on which the ads are published. This works well in standalone apps or websites, but not so well for goods distributed on public platforms, like videos posted on YouTube, where producers must rely on the platform to share the ad revenue with them (and the platform generally takes a cut). Also, the rise of ad blockers reduces the

viability of all ad-based revenue models. This is not to say that all producers should seek to monetize the full value of their goods—for some, a pure ad-based option might be best—but giving producers the option is itself valuable.

Donations are also a form of indirect monetization, as it is not the good itself which is monetized, but rather the consumers' philanthropic feelings and desire for the producers to continue producing the good. Donation-based monetization is sub-optimal, because it tends to be a less reliable revenue source than direct monetization or even ad-based monetization, and therefore production is less sustainable. Like ad-based revenue, donation-based revenue is also more viable for standalone apps and websites where producers can place a "donate" button in the sidebar. It is less viable for content posted on public platforms, where producers do not have as much control.

Freemium models, while a form of direct monetization, only monetize a portion of the good—*i.e.*, the incremental value of the paid features. This is sub-optimal compared to providing the producer a means to monetize the full value of the good. Furthermore, freemium models reduce the value of the good to consumers using the free version, and in many cases can frustrate consumers, generating negative reactions to the good.

Thus, neither ads, donations nor freemium models are the best solution to the monetization problem. In an ideal market, producers would be able to directly monetize the full value of the goods they produce, making production more profitable and therefore more sustainable, thereby increasing total productive output.

4.2 Allocation

Producers are only one side of the economic equation. In a market economy, productive resource are allocated to their most valuable outputs according to *consumer demand*. In markets for goods which are directly monetized, consumers "vote with their dollars" on which goods get produced and in what quantity. This is, of course, impossible where goods are not directly monetized.

Where goods are monetized through ad revenue, consumers still influence allocation by "voting" with their views. The number of views determines how much ad revenue is generated, so producers are incentivized to produce goods they believe to be in high demand in order to maximize viewership. There are a few problems with view voting, however. One problem is that there is no good way to ascertain how much the good is actually worth to the viewer. So, a good worth a million dollars to one viewer could receive less viewership than a good worth ten dollars to a hundred viewers. Another problem is that due to the indirectness and the inefficiencies in ad revenue generation, not to mention the distorting effect of click fraud [15], a change in actual viewership is likely to have less impact on the producer's revenues than dollar voting. Overall, this makes view voting a less effective allocation mechanism than dollar voting.

Freemium revenue models, being a form of direct monetization, are responsive to dollar voting. However, even dollar voting is a sub-optimal solution to the allocation problem, because:

1. Consumers' dollar votes provide information only on the past.

2. Consumers can only buy goods which already exist (or which are at least already developed to a certain stage, in the case of pre-sales).

When a producer analyzes historical spending data, the best she can learn is this: "Of the set of goods already available, consumers in the past preferred this." This backwards-looking data is not the most decision-useful for *future* production. It does not provide the producer with any data on what *new* types of goods consumers want, or what types (new or existing) of goods consumers want in the future. To gauge future demand, producers are left with:

- analyzing past trends, which can be misinterpreted and are not guaranteed to hold in any case,

- relying on consumer surveys, but voting for a good on paper is no guarantee that the consumer will actually spend money to buy it when it is made, or

- just guessing.

This is sub-optimal for consumers as well, since they cannot voice what they would like to see produced in the future. Imagine being asked "What kind of TV show would you like to see this Fall?" and all you could say was "I liked Game of Thrones this Summer". While this may be true, you probably would *not* like seeing 15 clones of Game of Thrones air this Fall.

Donations are somewhat better than normal dollar voting or view voting, as donations can be both backwards-looking (the consumer wishes to reward the producer for goods they have already consumed) and forward-looking (the consumer wishes to provide capital for the production of more goods). Furthermore, consumers can often donate to specific initiatives, or at least include a message of their intent with their donation, which can include the development and production of new types of goods.

The key shortcoming with donations as an allocation mechanism is that it is unreliable. For consumers who intend their donations to support future production, there is typically no guarantee that the money will actually be used by the producers for this purpose. Excluding tokenized solutions, the best consumers could do is to bind the producer with a legal agreement requiring her to use the donated funds in accordance with the stated purpose and sue her if she use the funds otherwise. This is a very expensive solution. It is not guaranteed to work, either—if the producer wastes all of the funds, there is nothing left for the consumers to claw back. There is also deadweight loss due to opportunity costs. Even if the consumers do eventually claw back the funds from the fraudster, if these funds had been donated to an honest producer from the start, she would have produced the desired goods long before the law suit was finished.

As an allocation mechanism, donations are potentially better than dollar voting or view voting, but still not an ideal solution. The ideal market would give consumers a direct, reliable vote on future production, thereby improving the allocation of productive resources and increasing the value of productive output.

5 How a Content/Bounty Coin can improve markets for user-generated goods

5.1 Key productive features

A Content/Bounty Coin has two key features which improve productiveness in markets for user-generated goods:

1. **Content-rewarding**—Producers of goods are rewarded with tokens.

2. **Bounty-setting**—Consumers of goods can use the tokens to set bounties for producers.

The first feature addresses profitability, and the second feature addresses allocation. These features can provide unique solutions to the problems they address, thereby adding value to the markets in which a Content/Bounty Coin is introduced.

5.2 Content-rewarding

The content-rewarding feature improves profitability by providing a solution for directly monetizing user-generated goods. The ability of a token to monetize previously non-monetized/non-monetizable user-generated goods has already been demonstrated by Steemit (`https://steemit.com`), a Reddit-like content posting/upvoting platform powered by the Steem blockchain and tokens [5]. The following case study explores Steemit's solution in more detail.

5.2.1 Case study: Steemit

The best existing example of a successful implementation of the content-rewarding feature to a market for user-generated goods is Steemit, a Reddit-like content posting/upvoting platform powered by the Steem blockchain and token. Steem provides a way to directly monetize user-generated content such as social media, social news, blog posts and anything else that could be posted on Reddit. Readers are encouraged to visit Steemit.com and to read through the explanatory materials available on Steem.io to get a better idea of what the platform is and how it works.

Steem:

- rewards content creators whose posts are upvoted, and

- rewards content curators who are among the first to upvote popular posts (*i.e.*, who upvoted the posts before they got popular).

The rewards are newly minted tokens.[2] The fact that the reward tokens are newly minted is important, because this means users do not have to give up any of their own

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[2]There are actually three different kinds of Steem tokens with different uses and economics, but distinguishing between them is not necessary for the present discussion.

tokens in order to access or promote the content of others—it is as free as reading and upvoting posts on Reddit.

The type of content posted on Steemit is very difficult to monetize directly without a token. The only way to do so is to put the content behind a paywall, which is not viable unless the author has already established a very strong reputation or is writing for a commercial publication (but in this case, the publication usually gets most of the revenue, rather than the author). ad revenue and donations are for most the only viable non-token revenue sources, but for the reasons discussed in section 4, monetization through these revenue sources is particularly difficult for this type of content, because the authors typically post it on public platforms. Again, unless the author has already established a reputation, it is not feasible to attract readers to a private platform. Overall, most authors are unable to monetize much of their content using non-token solutions, and certainly not enough to make writing it a full-time job. Monetization of comments and curation with a non-token solution is even more difficult.

With Steem, users receive a *direct* reward for producing upworthy content and comments and for curating this content for other users on a *public* platform. Producers do not need to sacrifice readership or frustrate readers with ads in order to generate sustainable revenue. This makes posting, commenting and curating more profitable and therefore more sustainable, which should result in a greater amount thereof.

The Steem tokens are valuable to their holders because of their uses, which are primarily:

- **Influence**—The more tokens a user holds, the more influential her upvotes are [1].

- **Rewards**—The more tokens a user holds, the more rewards she can earn from curating content [1].

- **Payments**—The tokens can be used for secure, trustless payments, just like bitcoins and most other cyptocurrencies [5].

The tokens are traded on exchanges, allowing producers to cash out their rewards for fiat currencies they can use to pay their rent and buy groceries, making "professional poster/upvoter" a more viable profession.

Readers should examine the Steem white paper [5] and user documentation [2] to get a better understanding of how the reward system works and how the Steem tokens derive their value.

5.3 Bounty-setting

Perfect allocation requires perfect responsiveness of supply to demand. Thus, to achieve perfect allocation, consumers must have a direct, reliable vote on future production.

Dollar voting falls short, because consumer spending data is historical and therefore not the best indicator of future demand. Upvotes on Steemit fall short for the same reason. Just because a travel blog on Thailand gets a lot of likes one week does not mean readers want to see 15 more travel blogs on Thailand next week.

View voting on goods which are monetized through ad revenue also falls short for the same reason. Furthermore, the correlation between views and ad revenue is likely lower than dollars/upvotes and revenue due to inefficiencies and distortions like ad blockers and click-bots.

Donations are better in terms of communicating consumer demand, since consumers making donations often have a chance to communicate future demand to the recipient producers. However, donations still fall short as an allocation mechanism, because it is very difficult to guarantee that producers will actually use the funds according to consumers' demands. Since the producers receive the funds before the goods are produced, their incentives to actually produce the goods are reduced.

A better solution to the allocation problem is a bounty system for production, in which consumers can place a bounty on a good they would like to be produced in the future. The first producer to satisfy the demand would receive the bounty. Individual consumers who want the same good can pool their bounties together to create large bounty pools. This way, even if the amount each individual is willing to pay for a good is small, the collective pool may be large enough to incentivize production.

An effective bounty system should have the following features:

- **Specificity**—Consumers can specify the exact type and quantity of goods they want produced and place additional demands on production, such as deadlines. Producers know exactly what consumers want; they no longer have to guess.

- **Breadth**—Consumers are not limited to signaling which existing goods they wanted in the past. They can set bounties for anything, even goods that do not exist yet. Allocation thus becomes forward-looking.

- **Guarantee**—If the content a consumer specifies is not produced, then no one takes the bounty. It either remains in place until some producer delivers the specified good, or else it is returned to the consumer. On the other hand, a producer who does produce the specified good is guaranteed to receive the reward.

Bounties should become a very influential force on future production when introduced into a market, since they take the guess-work out of production and provide a guaranteed reward. Bounties, therefore, both increase efficiency and reduce the risk of production, thereby both increasing profitability and improving allocation. This should increase both the quantity and quality of productive output.

A tokenized solution is well suited to implementing a bounty system because of the requirement of guarantee. A smart contract could be used to keep an immutable, public record of the bounty specifications, pool bounties from a large number of consumers, hold the funds in escrow and automatically release them to the first producer who delivers the specified goods or return them to the consumers if the bounty expires unfulfilled. A smart contract would provide a greater level of guarantee than a legal agreement, which falls short for the reasons discussed in section 4.2. Greater guarantee means lower risk for all parties, making the bounty system more effective.

5.4 Uniqueness of a Content/Bounty Coin's productive features

Whether a Content/Bounty Coin presents unique benefits to a given market for user-generated goods must be evaluated on a case-by-case basis. Generally speaking, the content-rewarding feature will be most unique in markets for goods which are not directly monetized/monetizable, while the bounty-setting feature can potentially improve allocation in the markets for many goods, even where the good is already directly monetized. The key unique advantages of implementing these features through a token are the ability to:

- leverage the benefits of blockchain technology,

- mint tokens, and

- leverage the positive value feedback loop between content-rewarding and bounty-setting.

These advantages are discussed below.

5.4.1 Blockchain

Successful implementation of a content-rewarding feature requires a reliable record of consumer feedback (*e.g.*, upvotes) to the good distributed on the platform. Otherwise, the risk of being cheated by the platform will reduce production levels. A blockchain is arguably the best available tool for providing certainty in the validity of a record. A tokenized solution can also be effective in reducing feedback abuse by making abuse more expensive [5].

The major advantage of blockchain technology for bounty-setting is the ability to use smart contracts to keep an immutable record of bounty specification criteria, pool bounties for the same good from a large number of consumers, automate payment/refund of bounties and potentially achieve trustless consensus on bounty fulfillment. These features increase the level of guarantee provided by bounties. There are many conceivable cases where a smart contract can provide a better and/or cheaper solution for guaranteeing bounties than non-tokenized alternatives, such as traditional legal agreements.

It must be noted that currently, high transaction costs and low transaction throughput are a major problem for Ethereum, the most popular platform for tokens and smart contracts. However, planned upgrades to the Ethereum protocol [7] and new blockchain protocols like EOS [3] and Tezos [8] promise to resolve these issues in the near future.

The benefits of blockchain technology can be leveraged by any tokenized platform, with or without issuing its own native token.

5.4.2 Minting

A *native* token can often be the cheapest way to reward producers on a platform, because the platform controls the minting of the tokens. This makes rewarding content cheaper in two ways:

1. It is much cheaper for a platform to reward its producer with a token it can mint than with another currency/token. Imagine how expensive it would be to operate Steemit if it rewarded content producers with USD or BTC instead of Steem tokens.

2. If the platform rewards producers with newly minted tokens, then consumers do not have to spend any tokens to reward producers. Producers are rewarded, but the goods are free!

The latter has profound transformative potential in many markets for user-generated goods, as will be discussed in section 7. Furthermore, if new tokens are minted exclusively through the content-rewarding feature, the result is a currency backed by *proof of useful production*. This is perhaps more socially desirable than a currency backed by trust in the issuer (*i.e.*, fiat), proof of collateral (*e.g.*, gold standard) or proof of (otherwise useless) work (*e.g.*, BTC).

5.4.3 Positive value feedback loop

In order for content-rewarding and bounty-setting to have any effect on production, the reward token must have some value to the receiving producers. Holders of the token must either be able to do something useful with it, or else sell it for another currency or token with which they can do something useful (like pay their rent and buy groceries). To maximize the token's value to holders, they should be able to do both.

Tokens can have two types of uses: internal and external. Internal uses are uses within the native platform. External uses are uses for the token outside of the native platform. Returning to our discussion of Steem tokens from section 5.2.1, increasing influence and rewards from curation are both internal uses, and using the tokens for payments is an external use.

The value of influence depends on network effects within the native platform. The more Steemit is used, the more valuable upvotes are. The value of Steem tokens for payments also depends on network effects, but outside of the native platform—*i.e.*, what percentage of the global economy is willing accept these tokens as payment. Holding the tokens to earn more rewards does not give tokens value in itself (what good is it to earn more useless tokens?), but to the extent that tokens have other valuable uses, this use can make them even more valuable.

Steemit does not have a bounty system, but a bounty-setting feature would be an additional source of value to token-holders, as it gives holders more influence over which goods are produced. This is another internal use, and like upvoting influence, its value depends on network effects within the native platform.

The combination of the content-rewarding and bounty-setting features in a single token generates a *positive value feedback loop*:[3]

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[3]This can also be accomplished with multiple tokens, provided that the tokens are linked in a way which incentivizes people who want to use the bounty-setting feature to buy the content-rewarding tokens from producers—*i.e.*, there must be some sort of value transfer from bounty-setting to content-rewarding.

1. If the platform's bounty-setting features are restricted to (or work better with) the token, then the ability to set bounties will make the tokens valuable for holders.

2. The more people want to set bounties, the more valuable the tokens will be, making production more profitable. Since this token is also earned from general (non-bountied) production, this will increase production levels both by drawing new producers to the platform and by incentivizing existing producers to produce more. Furthermore, the increased value of the tokens might make the general production of certain goods profitable, whereas it would not have been when the reward tokens had a lower value. Overall, the productive capacity of the platform will increase.

3. As the platform's productive capacity increases, the bounty-setting feature becomes more valuable, since bounties are likely to be fulfilled quicker and as more producers participate, the cumulative abilities of the platform's producers are likely increased, allowing a wider range of goods to be bountied. The increased value of the tokens makes general production more profitable, and steps 2 and 3 repeat in a loop.

This positive feedback loop might generate enough value in some markets to allow sustainable production of fully free goods without the need for any ads or donations. In such case, the entire output of the platform (both general and bountied production) would effectively be paid for by the bounty-setters, while passive consumers get the goods free of charge. Conceptually, this is very similar to ad-based monetization—*e.g.*, how a relatively small group of advertisers pay for an internet search engine that the whole world uses for free [11].

However, developers must beware of *value diversion*—increasing the value of the Content/Bounty Coin to its holders at the expense of decreasing the overall value that the Content/Bounty Coin adds to the economy. This is discussed further in the next section.

5.4.4 Value diversion

To distribute the maximum amount of the platform's value (*i.e.*, from its productive features and network effects) to the holders of its native token, the use of platform features can be restricted to native-token-holders. This is ubiquitous across platforms with a native token. This also creates a market for the tokens, since it creates a demand to purchase the tokens in order to access the platform's useful features. This allows holders to sell their tokens for other currencies/tokens. Some platforms restrict their secondary uses to native-token-holders as well—*e.g.*, purchasing ad space on the platform [14]—in order to further increase value to native-token-holders.

However, if the platform's features could just as well be accessed with another existing token or currency requiring users to buy the native token to use the platform's features creates deadweight loss. The restrictions increase value to token-holders at the expense of decreasing the overall value that the token adds to the economy.

Value distribution is not straightforward. Suppose you are building a new platform for distributing user-generated goods on Ethereum with content-rewarding and

bounty-setting features. You calculate that the cheapest way to implement the content-rewarding feature is to rewarded producers with newly minted tokens. This requires using a native token for content-rewarding. The bounty system is implemented through a smart contract, which can just as well be used with ether as with the native token. On one hand, restricting bounty-setting to native-token-holders will make the native token more valuable to holders by taking advantage of the positive value feedback loop, which makes both content-rewarding and bounty-setting more effective. This increases the value that the token adds to the economy. On the other hand, restricting bounty-setting to native-token-holders creates deadweight loss, decreasing the value that the token adds to the economy. Should bounty-setting be restricted to native-token-holders? The answers to questions like these will need to be determined on a case-by-case basis.

Restricting platform usage is not the only way to make a native token valuable to its holders or to create market demand for it. Even if other currencies/tokens can be used to access platform features, there will still be demand for the native token if it has better features than the alternatives for either internal or external use. Using BTC is not the only way to make payments. It is just a better way than fiat in some aspects.

6 Challenges to implementing a bounty system

There are a number of potential ways in which a Content/Bounty Coin can be implemented. The best implementation will need to be determined on a case-by-case basis, depending on the market in with the Content/Bounty Coin is being introduced. The case study on Steemit in section 5.2.1 presented one successful implementation of a Content/Bounty Coin's content-rewarding feature in the market for Reddit-type content. However, a robust, useful tokenized bounty system for user-generated goods has not yet been developed. There are a number of challenges which will need to be addressed in order to successfully implement a bounty system. Some of the key challenges—consensus, private bounties, dispute resolution, price volatility and spamming—are discussed below.

6.1 Consensus

As discussed in section 5.3, bounty systems are more effective the greater the degree of guarantee they provide, both to consumers and producers. If producers are not guaranteed to receive the bounty, they are less likely to produce the desired good. If consumers are not guaranteed the specified good or their money back, they are less likely to set bounties. Smart contracts are an attractive solution in this respect, since they can guarantee automatic payment/refund if the specified good is/is not delivered before the bounty expires. The key difficulty, however, is reaching consensus as to whether or not the specified good was delivered.

Reaching consensus on the validity of financial transaction is relatively simple. The criteria for validity is entirely objective and can be evaluated quickly and cheaply by machines without any human input. On the other hand, a much wider range of criteria may be required to specify a desired good, making consensus a much more difficult

problem in certain cases. Consensus will be easiest when the specified criteria is entirely objective and can be efficiently evaluated entirely by machines. Consensus will be more difficult where:

- **Criteria is subjective**—One honest validator cannot be certain how another honest validator will evaluate the criteria, making validators less likely to participate and reducing the reliability of the system for users. Producer and consumer cannot be certain that validators will evaluate the criteria the same way that they do. This reduces the degree of guarantee provided by the system. Subjective criteria also requires human evaluation, leading to further problems.

- **Human evaluation is required**—This can either be because the criteria is subjective, or because it is objective but inefficient to evaluate with machines. Human evaluation is more error-prone than machine evaluation, reducing the degree of guarantee provided by the system. It also generally tends to be more time-consuming and expensive and less scalable than machine evaluation.

- **Evaluation is time-consuming and/or expensive**—This makes the system less practical to use and more difficult to scale.

- **Specialized knowledge or hardware is required**—If specialized knowledge (for humans) or hardware (for machines) is required to evaluate the criteria, then the pool of potential validators is smaller. This results in longer, possibly uncertain wait-times for validation, which makes the system less reliable for users. It also makes scaling more difficult and tends to be more expensive. Furthermore, to the extent the consensus algorithm is vulnerable to collusion among validators (*e.g.*, a "51% attack") a smaller validator pool increases the security risk, reducing the degree of guarantee provided by the system.

One potentially suitable consensus mechanism for a bounty system is *staked voting*. Conceptually, this is similar to the proof-of-stake consensus algorithm for blockchain protocols [4]. A simple implementation would look something like this:

1. Consumers set a bounty with specified criteria for the desired good.

2. A producer claims she has delivered the desired good.

3. A set of validators is somehow selected.

4. Each validator stakes something of value (*e.g.*, by depositing tokens into the bounty smart contract).

5. Each validator votes `true` or `false` on whether all of the criteria are satisfied.

6. If the number of `true` votes or the number of `false` votes exceeds the threshold for consensus, then consensus is achieved. If the consensus is `true`, the producer receives the bounty. If the consensus is `false`, the producer does not receive the bounty.

7. Validators who voted along with the consensus receive a reward.

8. Validators who voted against the consensus are punished by losing their deposit.

9. If there are not enough `true` or `false` votes to exceed the consensus threshold, a tie-breaking mechanism is applied (*e.g.*, a new set of validators is selected and the process is repeated).

The strength of staked voting on bounty criteria is that it can tolerate both human and machine evaluation and both objective and subjective criteria. For example, Indorse, which aims to be a decentralized LinkedIn, plans to implement a staked voting system for human validation of professional skills claimed by users [14, ch. 2]. The claims can be objective or subjective [14, ch. 2]. That said, a staked voting system is still affected by the difficulties posed by the above-mentioned factors.

The question of how to select validators for staked voting bounty consensus can be difficult. Since staked voting is vulnerable to collusion among validators, random selection from a wide pool of validators is ideal for minimizing the security risk. On the other hand, where the criteria is subjective, both consumers and producers benefit in terms of guarantee by choosing validators only from a certain subset of the pool who they believe will evaluate the criteria similarly to how they would (*e.g.*, validators from a certain community). Where specialized knowledge/hardware is required to evaluate the criteria, the pool is reduced by necessity.

Given the number of possible considerations, the best solution may be to allow bounty-setters to set the parameters for consensus on a bounty-by-bounty basis. If the chosen parameters reduce the guarantee to producers, a larger bounty will be required to incentivize production. If the validation criteria or consensus parameters create uncertainty for validators or result in a small validator pool, the bounty-setters may need to pay a transaction fee to validators in order to have their bounty validated. The bounty-setters can choose how much risk they are willing to bear in terms of guarantee, security, speed and reliability and how much they are willing to pay to offset.

6.2 Private bounties

A platform may want to allow consumers to set bounties for goods which the consumers do not want shared with the public. These goods would be delivered by producers only to the bounty-setter instead of being distributed on the public platform. For example, a paywalled publication may want to set bounties on a blogging platform for articles it wants to publish on its own platform (*i.e.*, bounties for freelance journalism). If the bountied articles were posted on a public platform, they would lose value for the paywalled publication, since readers could get the articles for free.

Selecting validators for private bounties is a difficult problem. From the consumer's perspective, the ideal solution would be to have the consumer herself evaluate the product, as this maximizes both privacy and guarantee to the consumer. From the producer's perspective, this is the worst solution, since it minimizes guarantee to the producer. The likely result is that producers will have to bear the risk, meaning private bounties will

need to be larger than public bounties for the same goods in order to incentivize production.

There are a number of other issues which may affect private bounties from both a producer and consumer perspective, depending on the nature of the specified goods. There is the issue of confidentiality from the producer's perspective and return of the good to the producer if it does not satisfy the bounty criteria. Another issue is the transfer of intellectual property rights in the product from the producer to the consumer. This should happen *after* the good is validated, but *before* the bounty is paid out, which may be difficult to design.

Smart contracts can still be valuable for private bounties for pooling bounties and automating payment once consensus is reached, but consensus might have to rely on trust, and some of the other issues raised may require off-chain solutions (*e.g.*, traditional legal agreements).

6.3 Dispute resolution

There is a risk of disputes arising between producers and consumers over the correctness of bounty validation results, especially where:

- the validation criteria is subjective,

- the validator pool is small (raising concerns of collusion), or

- the validators have conflicting interests, because they are connected to (or they in fact are) the bounty-setters.

This risk will likely be higher for private bounties than public bounties.

Accordingly, a formal dispute resolution mechanism may be a useful feature. Dispute resolution may rely on on-chain or off-chain solutions (or a mix of both). For example, Aragon, a tool for managing decentralized organizations powered by Ethereum, proposes an on-chain solution for dispute resolution based on staked voting [9].[4]

6.4 Price volatility

Volatility in the price of the bounty-setting token creates risk for both producers and consumers. As price volatility increases:

- Producers are less certain of the bounty payout and risk sinking costs into production which becomes unprofitable due to downward price movement.

- Consumers are uncertain how much money they are committing to a bounty and risk overpaying for the goods.

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[4]This may not add much value to dispute resolution if the primary consensus mechanism is already based on staked voting.

These risks disincentivize consumers/producers from setting/fulfilling bounties. The risk increases for producers as the cost of producing the bountied good increases. The risk increases for each individual bounty-setter as the size of her contribution to the bounty pool increases. The risk increases for everyone as the expected time to bounty fulfillment increases.

The risk of price volatility can potentially be offset in a number of ways. The platform could try to stabilize bounty payouts by stabilizing the price of the bounty-setting token, either through built-in features, like Steem does [5], or through market intervention [17]. Alternatively, the platform could peg bounty payouts to a more stable currency (*e.g.*, USD). Market manipulation is expensive because it requires the platform to hold reserves in another currency and engage in active trading. Pegging the bounty pool to another currency can be logistically difficult, because it requires accounting for amounts added to the pool at different times at different exchange rates and constantly reading from a price feed oracle. Storing all of this data on a blockchain and calling the oracle can get very expensive, depending on the protocol. It might also require bounty-setters to contribute more tokens to the bounty to offset downwards price movement, which may not be feasible. Built-in stabilization features may be the easiest way to reduce price volatility. However, any attempt to reduce price volatility would also reduce the positive price impacts of the positive value feedback loop discussed in section 5.4.3.

Alternatively, the platform could do nothing and rely on market forces to correct the problems posed by price volatility. Consumers and producers who are putting enough money/resources into setting/fulfilling bounties to make the risk significant are likely sophisticated enough to hedge their exposure the bounty-setting token in the open market, just like commercial firms that do business in multiple currencies do. Consumers might take a cautious approach to bounty-setting to offset the risk of positive price movements, committing small amounts at a time and increasing their contribution if it looks like the bounty is not getting enough interest from producers. Similarly, if there is a downward price movement that chills interest from producers, the bounty-setters can increase their contributions until the pool is large enough to generate interest.

There is no perfect solution which both minimizes the risk of price volatility and maximizes the benefits of the positive value feedback loop. The best approach will likely vary from market to market. On the whole, markets where production costs are low and production time is short will be least-affected by price volatility and therefore easiest to implement a bounty system in. Markets with high production costs, long production times and high contributions from individual bounty-setters will be most-affected and therefore more difficult to implement a bounty system in.

6.5 Spamming

Bounty systems are vulnerable to spamming. When producers claim to deliver a product, network resources will be applied towards validating these claims. False claims prevent true claims from being validated, since network resources are tied up validating the false claims. These false claims may be purposeful (a DoS attack) or just frivolous (*i.e.*, the producer is not confident that the product meets the bounty's specifications, but

submits it anyways because "why not?"). One potential solution may be to require producers to stake their claims, with false claimants losing their stake. The downside is that it increases risk for producers, especially where the validation criteria is subjective. Therefore, larger bounties will be required to incentivize production.

6.6 Conclusion

Overall, bounty systems seeking to provide robust and elegant solutions might limit their features to public bounties for low-cost goods with short production times that can be specified with objective criteria that can be verified efficiently by machines—at least until further advances in trustless validation are made and good solutions to other problems are developed.

The crypto community is already aware of the value of bounties. Many ICO promoters use bounties as a means of crowd-sourcing promotion, rewarding tokens to people for tasks such as posting about the ICO on social media and translating promotional materials (google "ICO bounties" to see some examples). The tasks are typically easy to verify, like the ones just mentioned (even though there are no smart contract guaranteeing these bounties; validation and payment are entirely within the ICO promoter's discretion).

A platform seeking to offer more flexibility/features will likely need to resort to less robust/elegant solutions. That said, the metric should not be whether or not the features are perfect, but whether or not they add value to the market in which they are introduced.

7 Use-cases

As discussed in section 5.4, a Content/Bounty Coin's content-rewarding feature is most valuable to markets for goods which are not directly monetized/monetizable. The bounty-setting feature is valuable in many markets, included both markets for goods which are and are not monetized/monetizable. The following sections briefly explore a few markets for user-generated goods where both the content-rewarding and bounty-setting features can add value.

7.1 GitHub — Free and open-source software

Free and open-source software (FOSS) is inherently difficult to monetize directly. This means that a large portion of this software is produced as a hobby, and there is a significant risk that developers stop maintaining software which consumers rely on. This also makes it difficult for passive consumers to influence the direction of software development

A content-rewarding feature similar to Steemit's could be implemented on GitHub (or a similar platform) to reward developers based on the number of forks, stars or downloads their repository gets. This will make FOSS development more profitable and

reduce the risk that useful projects are abandoned, while still allowing the full software to be used by consumers free of charge (and without any ads).

A bounty-setting feature would give consumers a greater influence over software development. It is true that, without a bounty system, consumers could still get the software they want by hiring someone to develop it. However, unless there is significant benefit to the consumer from keeping the software propriety, then setting a public bounty is better, because:

- Many consumers may need the same software, so pooling together to pay for the development of one free and open-source copy would be more efficient than duplicating efforts individually. Furthermore, the developed software could be used freely by anyone in the future, not just the bounty-setters. Thus, the value added by the software to the economy would likely be much greater than if it were proprietary.

- It may be difficult to find someone with the skills required to produce the desired software without crowd-sourcing the development.

- It incentivizes collaborative development by producers, which is likely to result in better software.

7.2 App Store and Play Store — Mobile apps

A Content/Bounty Coin could have a big impact how mobile apps are monetized. Mobile apps are primarily monetized through ad-based or freemium revenue models, both of which tend to frustrate consumers and reduce the value of the apps to them. Furthermore, neither is a direct monetization of the app itself. A content-rewarding feature in the Android and iOS app stores (or other mobile app repositories) could allow developers to make profitable apps which are fully free of charge while remaining ad-free.

Another issue with mobile apps is that many are developed as a hobby and therefore have a higher risk of being abandoned by their developers. A content-rewarding feature can make development more profitable, reducing the risk of abandonment of useful apps.

A bounty system is valuable for mobile apps for the same reasons it is valuable for FOSS. It may be even more valuable for mobile app users, because the average mobile app user is likely less knowledgeable about mobile app development than the average GitHub user is about software development, making it even more difficult for average mobile app users to hire proprietary app developers for apps that they want to use.

7.3 Reddit, Twitter, YouTube, Facebook and Instagram — Blogs, vlogs, photos, social news, etc.

Steemit has already demonstrated the successful introduction of a tokenized content-rewarding feature for Reddit-like content. A bounty-setting feature could also be introduced, giving consumers greater influence over content production and making produc-

tion more profitable for writers due to extra revenues from bounties and less effort spent guessing what readers will like.

Very similar content-rewarding and bounty-setting features could be applied to Twitter, YouTube, Facebook, Instagram and other platforms for user-generated content. The results could be profound. For instance:

- Rather than passively reading the news, readers could set bounties for news stories they care about. Freelance journalists could work directly for the readers, cutting traditional news publications out of the picture and increasing value for both the readers and the writers.

- Advertisers could set bounties for Instagram photos of their products. Even casual users could potentially earn ad revenue from using Instagram, not just large influencers. This can be very beneficial to advertisers as well. If a lot of users participate, the total viewership through bountied product placement will likely be much greater than placement with a few influencers.

Similar architecture could also be used to implement at Content/Bounty Coin for social review sites like Yelp and TripAdvisor.

7.4 Stack Overflow — Help

Help is extremely difficult to monetize on public Q&A forums. Yet, it is essential to the modern economy. Taking Stack Overflow as an example, amateur and professional developers alike rely heavily on the platform. Imagine how much time and effort would be wasted if everyone trying to figure out a problem had to reinvent the wheel themselves. Many projects would likely fail altogether, because the developers would be unable to find a solution.

Help on these platforms is given freely, which is a nice thought on one hand, but on the other hand, it means that giving help is always a net cost to the helper. By necessity, it will tend to be prioritized less than profit-generating activity. Furthermore, because help is not monetized, it is difficult to prioritize a question. Questions can be bumped by other people to whom they are relevant, but a bump is only an indicator of the number of people to whom an answer is valuable, not the value of the answer to them. There is no effective way to signal that your question is a million dollar question, even if you are the only one who needs an answer. A Content/Bounty Coin could potentially solve both issues by rewarding answers (while keeping them free) and allowing askers to prioritize their questions based on value, rather than number of people affected.

A bounty-setting feature for Stack Overflow (or a similar platform) could be transformative to the economy. Given the amount of knowledge which exists today and the rate at which new knowledge is developed, it is impossible to staff a team that knows everything. Without an effective way to draw attention to valuable questions on public forums, the only option for enterprises whose questions go unanswered is to hire experts to answer the questions. However, it can be very difficult to find someone who knows

what you need to know (especially if you do not even know what exactly it is you need to know). Crowd-sourcing an answer is much more efficient. Furthermore, if there is no value to the asker in keeping the answer confidential, then the answer will likely be posted publicly. Then, the next enterprise which runs into the same problem will not need to re-invent the wheel to find an answer, increasing the efficiency of the economy overall.

7.5 Beyond user-generated goods

A Content/Bounty Coin can potentially add value to markets beyond those for user-generated goods. There are markets for commercial goods in which direct monetization is difficult and allocation is sub-optimal. The latter problem is ubiquitous. Any such markets could benefit from introduction of a Content/Bounty Coin. Introduction of a Content/Bounty Coin in some markets could even transform commercial goods into user-generated goods by lowering barriers to entry for producers. This could turn centralized markets for paid goods into decentralized markets for free goods.

7.5.1 Music

Monetization of recorded music has become very difficult over the past two decades, first due to piracy and now due to legal streaming services like Spotify and YouTube, whose payouts to artists are criticized for being unfairly low [10, 13]. Furthermore, given the background threat of piracy and the years-long trend of declining legal downloads, Spotify and YouTube must monetize the music indirectly through ad-based revenue models.[5] Recording industry revenues in 2016 were roughly half of what they were in 1999 [10].

A Content/Bounty Coin could be transformative in this industry. As with user-generated goods, the content-rewarding feature provides a means of direct monetization. Assuming the rewards would be newly minted token and the music would be free of charge to consumers, this counteracts the threat of piracy, since streaming the music through the Content/Bounty Coin platform would become the quicker, easier and safer way to listen to music.

A bounty system for recorded music could further counteract the effects of piracy and also legal streaming services. Rather than recording the music and seeking to monetize it afterwards, artists could create music in response to bounties. This way, artists would receive the revenue the moment the recording is distributed, and neither pirates nor steaming services could reduce this revenue. Listeners would also have more input on the music produced. They could set a bounty for new music by a specific artist or a bounty which could be fulfilled by any artist.

Introduction of a Content/Bounty Coin could open up the market more to indie artists by leveling the playing field against mainstream artists. The content-rewarding feature would generally make music production more profitable, which means that smaller artists

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[5]While Spotify pays artists directly per stream, the fact it then monetizes the music indirectly means that ultimately the music is monetized only indirectly.

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could produce music profitably, not just those with tens of millions of fans. The rewards would be available to all artists on the same terms, and non-artist-specific bounties would be as well.

It is true that without a Content/Bounty Coin, artists can still monetize their music through live performances. However, not all music is meant to be played live. Giving artists a way to directly monetize their recorded music while counteracting the negative effects of piracy yet keeping the music free for listeners is a valuable proposition for the music industry.

7.5.2 R&D

Research and development is very difficult to monetize. Basic research is difficult to monetize, because it does not have an immediate application. Applied R&D is monetized through patents—*i.e.*, legally enforced monopolies—over the developed products. In the absence of patents, it would not be profitable for companies to spend money on R&D, since their competitors could just reverse engineer the product once released and cut into their profits, without having spent the money on R&D themselves. These factors lead to several major problems.

Since basic research is difficult to monetize, it is funded through grants. Grants are sub-optimal in terms of allocation and effectiveness.

In terms of allocation, the general public has very little influence over which specific projects are funded with grants, even though many of these grants are made up of public funds, *e.g.*, grants from government organizations and public universities. At best, the public has some indirect influence through the election of representatives to governments and public universities who can influence the type of research that gets funded. Ideally, however, the public would have a direct vote on which projects get funded, and funding would be allocated to the research which the public believes to be the most valuable.

There are also major barriers to members of the general public *receiving* research grants. Grant recipients must typically be affiliated with established research institutions. A capable team seeking to carry out valuable research may fail to receive funding just because they lack such affiliation.

There are two problems with the effectiveness of grants. One is that grants are received before the research is done. This makes grants risky, since the grants could be misused. Grants can be staged so that interim results must be demonstrated in order to receive further funding. However, at each stage of funding, there is risk of misuse.

The second problem is that, since making grants to fund basic research is not profitable, there is not enough investment in basic research, creating a deficit of innovation. [12] presents several case studies which illustrates this problem in the U.S.

Turning to applied R&D, the patent system is designed to make large commercial expenditure on R&D profitable. There are two key problems here. The obvious problem is the deadweight loss and higher prices resulting from the developer's monopoly over the patented product. This is not only uneconomical, but for products such as lifesaving pharmaceuticals, it is unethical.

The less obvious problem is that, because patents can make siloed R&D profitable,

multiple companies might spend billions conducting the same R&D in isolation for years, until finally one of them finishes first and receives the patent. This creates significant deadweight loss in the economy.

A Content/Bounty Coin could transform R&D. Both the content-rewarding and bounty-setting features would give the public a way to allocate funds to research projects believe to be valuable, giving the public a stronger voice in the direction of research. Anyone could receive funding through the Content/Bounty Coin; no particular affiliations would be required.

While this would not give the public direct influence over the allocation of grants for basic research, there would likely be increased indirect influence. Since public sentiment towards research projects would be evident through the number of upvotes and the size of bounties addressing the topic, this would create pressure on grant-makers to apply public funds in the direction of public sentiment. Furthermore, since basic research would become profitable through the Content/Bounty Coin, this would attract profit-seeking capital to supplement grants in funding basic research, helping to resolve the investment deficit.

The bounty-setting feature in particular could transform applied R&D. Rather than carry out redundant R&D in isolation, companies could pool R&D spending into bounties for the desired products. The research itself could be conducted by specialist R&D firms, rather than the companies which manufacture the resulting products. Guaranteed bounties would allow the R&D firms to raise capital from financial investors to fund their projects, who are able to bear the risk of financing R&D better than product manufacturers. The product manufacturers would then pay only for successful R&D. Overall, this would make R&D cheaper, reducing the justification for patents. This would hopefully cause governments to reassess their patent systems and decrease patent durations, if not get rid of them altogether.

8 Conclusion

This paper has demonstrated how a Content/Bounty Coin—a token which is used *a*) to reward producers based on consumer feedback and *b*) to set bounties for the production of goods—can add value to both producers and consumers in markets for goods by making production more profitable, increasing the amount of resources applied towards production, and by improving the allocation of productive resources to the goods which consumers value the most. While this paper focused primarily on the application of a Content/Bounty Coin to markets for user-generated goods, a Content/Bounty Coin can potentially add value to any market where profitability or allocation are problematic (the latter problem is ubiquitous across markets).

Based on the framework applied by this paper, a token adds value to an economy if and only if it increases the total value of the economy's output and the same result cannot be achieved with an equal- or lower-cost solution. Thus, in addition to presenting a Content/Bounty Coin's output-increasing features, we have also examined its uniqueness compared to other solutions. One of the major sources of uniqueness is the positive value

feedback loop between its bounty-setting and content-rewarding features.

Developers are encouraged to apply the principles discussed in this paper towards instantiating Content/Bounty Coin type tokens in markets where they believe they can add value.The use-cases discussed in section 7 may provide some inspiration.

The case study on Steemit presented one existing, successful implementation of a tokenized content-rewarding feature. Developers are encouraged to learn from Steemit's example when implementing Content/Bounty Coins. There has not yet been a successful implementation of a tokenized bounty-setting feature, which is more difficult to implement for a number of reasons. The most difficult part will be developing a robust system for consensus on bounty fulfillment. This is particularly difficult where goods are specified with subjective or otherwise difficult to evaluate criteria or where the pool of validators is small. Early Content/Bounty Coin implementations might choose to focus on markets for goods where specification criteria is easy to validate and the pool of validators is expected to be large.

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References

[1] Steem: Curation Rewards. `https://steem.io/getinvolved/paid-to-curate/`. [Online; accessed 31-August-2017].

[2] Steem: User Documentation. `https://steem.io/documentation/`. [Online; accessed 31-August-2017].

[3] EOS.IO Technical White Paper. White Paper, block.one, June 2017. [Available at: `https://github.com/EOSIO/Documentation/blob/master/TechnicalWhitePaper.md`].

[4] Proof of Stake FAQ. `https://github.com/ethereum/wiki/wiki/Proof-of-Stake-FAQ`, 2017. [Online; accessed 7-September-2017].

[5] Steem: An incentivized, blockchain-based, public content platform. White Paper, August 2017. [Available at: `https://steem.io/SteemWhitePaper.pdf`].

[6] Brave Software. Basic Attention Token (BAT): Blockchain Based Digital Advertising. White Paper, Brave Software Inc., May 2017. [Available at: `https://basicattentiontoken.org/BasicAttentionTokenWhitePaper-4.pdf`].

[7] V. Buterin. Casper the Friendly Finality Gadget. [Work-in-progress; available at: `https://github.com/ethereum/research/blob/master/papers/casper-basics/casper_basics.pdf`], September 2017.

[8] L. M. Goodman. Tezos: A Self-Amending Crypto-Ledger—Position Paper. White Paper, August 2014. [Available at: `https://www.tezos.com/static/papers/position_paper.pdf`].

[9] T. Kärki. Aragon Network Jurisdiction Part 1: Decentralized Court. `https://blog.aragon.one/aragon-network-jurisdiction-part-1-decentralized-court-c8ab2a675e82`, July 2017. [Online; accessed 7-September-2017].

[10] A. Kharpal. YouTube 'exploits legal loopholes' to pay artists poorly, US music body claims, as streaming revenues hit record high. `https://www.cnbc.com/2017/03/31/youtube-artists-pay-streaming-revenues-riaa.html`, March 2017. [Online; accessed 11-September-2017].

[11] G. McFarlane. How Does Google Make Its Money? — Investopedia. `http://www.investopedia.com/stock-analysis/2012/what-does-google-actually-make-money-from-goog1121.aspx`, November 2012. [Online; accessed 11-September-2017].

[12] MIT Committee to Evaluate the Innovation Deficit. The Future Postponed: Why Declining Investment in Basic Research Threatens a U.S. Innovation Deficit. Report, Massachusetts Institute of Technology, Cambridge, Massachusetts, April 2015. [Available at: `dc.mit.edu/innovation-deficit`].

[13] D. Sanchez. Exclusive Report: Spotify Artist Payments Are Declining In 2017, Data Shows. `https://www.digitalmusicnews.com/2017/05/16/spotify-audiam-low-rates/`, May 2017. [Online; accessed 11-September-2017].

[14] G. Torvekar and D. Moskowitz. Indorse. White Paper, Indorse Pte. Ltd., August 2017. [Version 1.1; available at: `https://indorse.io/whitepaper`].

[15] Wikipedia. Click fraud — Wikipedia, The Free Encyclopedia. `https://en.wikipedia.org/w/index.php?title=Click_fraud&oldid=798755772`, 2017. [Online; accessed 4-September-2017].

[16] Wikipedia. Cobb-Douglas production function — Wikipedia, The Free Encyclopedia. `https://en.wikipedia.org/w/index.php?title=Cobb%E2%80%93Douglas_production_function&oldid=796829778`, 2017. [Online; accessed 1-September-2017].

[17] Wikipedia. Currency intervention — Wikipedia, The Free Encyclopedia. `https://en.wikipedia.org/w/index.php?title=Currency_intervention&oldid=799673903`, 2017. [Online; accessed 12-September-2017].