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Sustainable Growth and Token Economy Design: The Case of Steemit

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Abstract: Cryptocurrency blockchain technology is attracting worldwide attention, and the number of initial coin offerings (ICOs) is increasing rapidly. This new economic trend, called cryptoeconomics, can program human behavior through incentive design. A cryptocurrency-based incentive system is not only transparent, but also allows businesses to substitute initial investment costs with cryptocurrency tokens until they are on a sustainable growth trajectory in terms of network effects. This study aims to propose a process for building a desirable model of a token economy, based on the case of Steemit—a blogging and social networking website that is creating high values due to its efficient token economy model. We suggest the following design process of a token economy model: (1) Determine token-business fit, (2) determine the chance of success, (3) determine the properties of token, (4) give tokens intrinsic value, (5) establish strategies to raise token value, (6) establish operational strategies of token economy system, (7) establish strategies for token liquidation, and (8) continue modifying the operational base. Considering cryptoeconomics is still at an early stage, it is expected that the guidelines on the token economy model suggested in this paper will lay a significant foundation for the development of cryptoeconomics research.

Keywords: cryptocurrency; blockchain; cryptoeconomics; ICO; token economy; Steemit

1. Introduction

Cryptocurrency blockchain technology is attracting worldwide attention. An initial coin offering (ICO) is a type of funding using cryptocurrencies, and the number of ICOs has been increasing since Vitalik Buterin, who made groundbreaking contributions to the development of cryptocurrencies, created the Ethereum platform in 2014 [1]. Specifically, more than 30 ICOs took place in 2016, their number reaching 800 in 2017 [2,3]. Many countries recognize cryptocurrencies as a type of asset and are preparing standards and regulations in this respect [4]. Recently, leading global corporations joined in ICOs, raising expectations that cryptocurrencies can complement the conventional corporation system. A number of ICOs, however, failed to achieve the desired purposes due to poor design of their economic models. This study aims to propose a process for building a desirable model for ICOs based on case analysis. ICOs with a well-designed economic models will achieve high market value and sustainable growth with voluntary activities of participants who may pursue their own interests.

The key to a successful ICO is the design of a token economy model. Despite the significant interest in the business field on this topic, academic research is scarce and still emerging [5]. As such, to respond to the urgent demand for research on token economies with blockchain technology, this study analyzes an exemplary token economy model, Steemit. The research question is, how should a community design its token economy model for self-sustainable growth? While most studies on token economy models come from economics or computer science viewpoints [6,7], this study contributes

to the literature by suggesting a process for building a token economy model from the strategic management perspective. Specifically, we focus on a mechanism design that enables sustainable business growth with de-centralized governance and an incentivized user base. The results will also provide managerial insights for managers and entrepreneurs to develop their businesses using cryptocurrency tokens.

To explain the new economic trends of cryptocurrencies, we need to understand the concept of crypto-economics. Crypto-economics is different from conventional economics in three ways. First, it is also referred to as a programmable economy, as it can program an economic system that reflects complexity and volatility based on blockchain technology [8]. Such a system can earn high trust from participants. A blockchain technology-based system has no central server and the original data are stored in distributed servers, making them less vulnerable to hacking and more difficult to change data once they are registered, guaranteeing non-reversible trust [9]. Second, a user participation incentive system can be established [9]. In crypto-economics, the property of currency can be programmed and human behavior controlled within a predictable range by programming incentives. For instance, incentives can be designed to make users participate in activities to raise the value of the currency and enhance system efficiency. Finally, a crypto-economic system is transnational [10]. Taking Bitcoin as an example, it can be liquidated in most countries with just a wallet address and used to make payments with QR codes (Quick Response codes), while carrying the wallet address cannot be regarded as an illegal transfer of foreign currency.

Crypto-economics can program human behavior through incentive design and solve a range of problems related to sustainability. For instance, it is necessary to obtain and measure an extensive amount of data to address climate change or energy problems, as well as the active participation of people worldwide to such issues [11]. With a crypto-economic system, it is possible to collect highly reliable data with technologies such as the Internet of things (IoT), big data, and blockchain technology and design incentives for participants to produce and consume energy more efficiently, thus inducing global participation. When incentives are designed with conventional currencies or points, instead of a cryptocurrency, the system is not free from manipulation, hacking, or abuse, and financial resources to provide incentives should be prepared. On the other hand, a cryptocurrency-based incentive system is not only transparent and accurate in handling data, but also allows businesses to substitute initial investment costs with cryptocurrency tokens until they are on a sustainable growth trajectory in terms of network effects [12]. Metcalfe's law states that the effect of a network is proportional to the square number of connected users in the system [13]. In the system of crypto-economics, the value of the network is linked to that of the token and, as the network expands, the value of token incentives—distributed to initial participants—increases, making it possible to provide sufficient benefits to participants. In the energy sector, various cryptocurrency projects are in operation at initial stages.

The essence of crypto-economics lies in the design of a token economy model [12]. Here, a token is a medium for exchange and also has value and functionality. For the sustainable growth of crypto-economics, it should be modeled so that the properties and management strategies of the token are linked to user incentives, motivating users to voluntarily contribute to the development of the system [12]. Token economy is a discipline developed for the systematic reinforcement of target behaviors among students or patients [14]. Research on token economy is however required to systematically manage user behavior in de-centralized crypto-economics, but there exist few studies on token economy that specialize in cryptocurrencies.

This study thus proposes a process for building an adequate model of a token economy based on the case of Steemit, a blogging and social networking website that is creating high value due to its efficient token economy model, laying the foundation for the future development of crypto-economics research.

2. Theoretical Background

2.1. Token Economy

A token economy is a management system that reinforces target behavior and has been widely used as a methodology to change the behaviors of students and patients [14–17]. It is assumed to induce desirable behaviors by providing tokens, which can be converted into other items or privileges. The possibility of building a model with programmable incentives lies at the core of the token economy. More importantly, the terms for providing and exchanging a token should be clear [18]. In other words, the designer of the system should define "desirable behaviors" and provide fair rewards for each behavior, while also presenting what participants can do with the token. If designed well, desirable behaviors will then be reinforced [18].

In a token economy specialized in cryptocurrency, rewards should be determined fairly and provided transparently for all community users. These rewards can be classified into three categories and the Swiss Financial Market Supervisory Authority categorizes tokens into three types in its ICO guidelines as well: Payment tokens can be used as a means of payment or transfer, utility tokens are intended to provide digital access to an application or service based on blockchain, and asset tokens represent assets that substitute stocks and are used as an entitlement to dividends [19]. Patrick Byrne, the CEO of the Internet retailer Overstock.com, which was the first worldwide to accept Bitcoin as payment, insisted that everyone who participates in creating a token economy system can enjoy the share, and prospected that all assets will be tokenized someday [20].

As aforementioned, crypto-economics enables programmable incentives, which are the core of the traditional token economy, through cryptocurrency blockchain technology. In crypto-economics, created value, which used to be monopolized by a few giant firms, can now be distributed to individual community users, thus combining their social incentives and financial value [21]. Tokens facilitate transactions among users and contribute to the growth of communities. The value of a token depends on the user base and quality of the platform [22]. De-centralized and autonomous communities are enabled by tokens and their policies and rules are affected by community users [23]. A token is the key to sustainable growth and balance of crypto-economics, inducing participants' desirable behaviors [5].

2.2. Mechanism Design

Mechanism design, first proposed by Leonid Hurwicz and subsequently developed by Eric Maskin and Roger Myerson, assumes market participants with different interests put their own interests first over others', and explains how to design an optimal policy or institution to achieve socially desirable goals with minimal conflicts of interests [24–26]. Unlike game theory, which focuses on how participants would behave given a set of rules, mechanism design sets desirable behavioral goals first and then focuses on establishing the game rules to accomplish those goals [27]. Mechanism theory implies that an economic system should be established to have incentive compatibility, which induces participants towards truthful reports and behaviors, while they act by putting their own interests first [28,29].

Mechanism design is also applied in crypto-economics. For instance, Satoshi Nakamoto modeled Bitcoin using the concept of mechanism design. Specifically, Bitcoin was created with the goal of de-centralization, and "rewards" have been introduced as a substitute for a central organization that would maintain, manage, and expand the system [9]. Allowing the behaviors of individuals following their personal interests to also benefit the community they belong to, mechanism design is an extremely important concept to maintain and expand cryptocurrencies by blockchain technology. If the mechanism that deals with situation when a problem occurs is not properly designed, crypto-economics, devoid of any central organization, will easily collapse. Further, when the value of the network is not linked to that of the token or services do not work, a crypto-economic system can be considered to fail.

3. Methodology

This paper analyzes the token economy model of Steemit, a lucrative business model using cryptocurrency. Specializing in cryptocurrency, token economy is in its early stages and, thus, an in-depth case analysis of a real-life, successful token economic model can provide significant implications for future theory-building [30]. To this end, the design process of a token economy model is proposed here based on the Steemit case and other related studies. The Steemit model of token economy is then described in detail according to this process. Materials on the token economy of Steemit were gathered from the Steem white papers, other reading materials, and an interview (The interview was conducted in the form of private seminar with Steemit users in Seoul, Korea on 2 May 2018. The seminar was hosted by IT Chosun with the title of "Ned's Talk: The Future and Opportunity of the Steem Blockchain." One of the authors participated in the seminar and talked with Ned Scott [31].) with one of its co-founders, Net Scott. We chose a case analysis to develop the design process of a token economy model, due to the lack of extant studies and other reference materials.

We also analyzed the relationship between token value and users' posting activity on Steemit. We accessed the user data on steemsql.com, a publicly available database, and STEEM price data on coinmarketcap.com. Daily data from 1 May 2017 to 18 November 2018 were gathered. We discuss the results in the "Conclusion and Discussion" section.

When designing a token economy model, the following should be considered. From a strategic management perspective, corporations need to use tokens to remain competitive. To this end, the fit between the market and the proposed token business model should be high [11]. High technical skills may not lead to business success if the product-market fit is low. Sustainable value creation can be achieved through a good fit between the product and the market [32,33]. At the same time, the incentives given to participants based on tokens should help create business value and, ultimately, corporate performance. The token economy model can then be introduced to existing businesses, and also used to create new ones [12]. If it is believed that tokens can be useful in securing a competitive advantage, the terms of providing and exchanging tokens should be defined for the businesses to remain competitive. Specifically, how tokens can be used, and the strategies to operate and increase the value of tokens, should be established, along with a mechanism for measuring the value of tokens realistically while steadily increasing the number of users [12]. For sustainable growth or the stability of token value, encouraging users' long-term participation is required to create token demand and design an incentive system for users' desirable behaviors and long-term possession of tokens [34]. Against this backdrop, this study suggests the following design process of a token economy model: (1) Determine token-business fit, (2) determine the chance of success, (3) determine the properties of token, (4) give tokens intrinsic value, (5) establish strategies to raise token value, (6) establish operational strategies of token economy system, (7) establish strategies for token liquidation, and (8) continue modifying the operational base.

4. Steemit Case Analysis

4.1. Steemit

Steemit has emerged in the context of crypto-economics with the announcement of a sophisticated reward system for issuing cryptocurrencies to users, and criticized existing social media giants such as Facebook for raking profits for shareholders only, even if they mainly owe their growth to the dedicated participation of users. For instance, Reddit suggested in 2014 that, if it can distribute its shares to contributing users, it will ultimately help raise the corporate value of Reddit [35]. Steemit is regarded as a representative new business structure using cryptocurrencies, along with complementing the structure of the traditional stock companies with its incentive system, which induces user participation and shares benefits.

Steemit is the first blockchain-based database that supports the creation of communities and cryptocurrency transactions with the goal of rewarding the personal contributions of community

members accurately and transparently [35]. Specifically, when users post a comment, they are given STEEM, a cryptocurrency. This model is receiving great responses from users, as the readers up-vote comments—similar to Facebook users liking a post—are rewarded along with the writers. Since it launched the service in 2016, Steemit has provided more than USD 40 million in rewards until October 2018 and 1.5 million comments are posted monthly [36]. The characteristics of Steemit, which make the steady growth of its user base possible, will be analyzed in the subsequent section.

4.2. Token Economy Design of Steemit

4.2.1. Token-Business Fit

As previously discussed, the first thing to be considered in designing a token economy model is the token-business fit. If you start a new business, it should be decided whether this is feasible using tokens. If you introduce tokens into an existing business, whether there are business assets to be tokenized and the business can grow with the issuance of tokens, should be considered [11]. Steemit was a new type of project launched to "give fair rewards for contents" [35].

> "As a major of psychology and economics, I have always been interested if people can have a new behavior pattern. I started to conceive this project to give good influence on people with cryptocurrencies. I thought you need to have users, traders, and a community for them to create value for a cryptocurrency."
>
> Excerpt from an interview with Ned Scott, the co-founder of Steemit

For the sustainable growth of a decentralized community, participants should be induced to make choices that contribute to the community while adopting self-interest behaviors. Ned Scott believed this can be realized through an "incentivized, blockchain-based, public content platform" [35]. The assets, which can be tokenized in the business model of Steemit, include content posted by users, activities such as curation, and the resulting ranking and rewards for their posts. Steemit has created a token economy model that incentivizes "individuals" who participate in the creation of such assets. Given that it is users that actually create traffic and contribute to community growth, Steemit can be regarded as having a high token-business fit. If the community grows, and the value of incentives for participation increases through an effective token economy model, it is possible to ensure the sustainable growth of a community with minimum ads and operational costs, as the system allows a steady inflow of newcomers, as well as retaining the old users.

4.2.2. Determining the Chance of Business Success

Second, it should be considered whether the use of tokens will secure business competition. If so, it is possible to create new sales, increase market share, or gain first-mover advantages. Steemit was able to lead the market through a synergy of cryptocurrency and social media as the first de-centralized, distributed social platform. Unlike other social media platforms, Steemit offers an opportunity for contents providers and readers to make profits from cryptocurrency, which rewards ensure sustainable, stable profits for STEEM holders [35]. Steemit applies the principle of sweat equity [37]. This means that those who contribute their scarce time and attention toward producing and curating content for others should be rewarded as much as those who contribute with cash resources during business growth [35]. Steemit distances itself from other cryptocurrencies or social media by quantifying and rewarding all contribution types. Content, once created, is stored in blockchains and managed to enable accurate and transparent rewarding. The types of activities rewarded, according to the principle of sweat equity, and the reward system will be explained in the subsequent section. Based on first-mover advantage and its distinctive characteristics, Steemit has been able to successfully attract users, surpassing other centralized communities, as shown in Figure 1. Given the rapid growth of Steemit, corporations were quick to create official Steemit accounts to carry aggressive marketing campaigns.
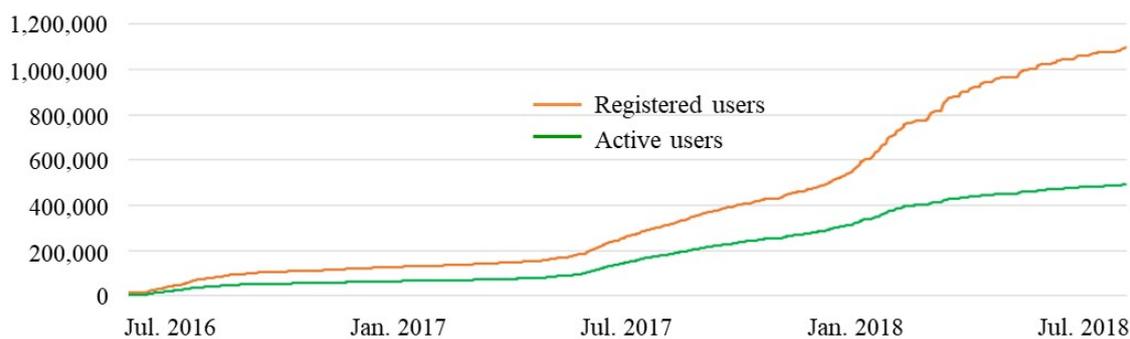
Figure 1. Number of Steemit users [38].

4.2.3. Determining Token Properties

Tokens can have a wide range of properties depending on their use [12]. For example, platform tokens are used on specific crypto-economic platforms and service tokens can be used to buy services or get discounts. On the other hand, reward tokens are given when users make designated activities or purchases as rewards, while membership tokens allow the participation of users possessing or paying a certain amount of tokens and, as users have more tokens, they become more influential in a community [12,19,39]. Tokens can be designed to have one or more properties from the above, according to a mechanism design that seeks the incentive compatibility of each player's behaviors in accordance with the purpose of a crypto-economic ecosystem.

Steemit has reward and membership tokens. Before explaining each of their properties, let us introduce the three currencies Steemit's token economy depends on: STEEM, Steem Power (SP), and Steem Dollar (SBD) [35]. STEEM is the fundamental unit of account and can be exchanged into other cryptocurrencies, SP has the function of inducing long-term investments by giving privileges to its holders, and SBD provides the stability of rewards. Each currency will be further explained in Section 4.2.6.

Steemit has reward tokens, which assess all members by their contributions and reward them accordingly based on the principle of sweat equity [35]. Therefore, it is critical to develop an evaluation algorithm to measure individual contributions in a way considered fair by members. Steemit distributes 75% of the cryptocurrencies issued every year to users who created, recommended, or posted comments in order to encourage constructive discussions [35]. The contribution of each content is evaluated by Zipf's law, which says that, if we order some large collection by size or popularity, the *k*th ranked item will generally measure about 1/k of the first one in terms of influence [40]. Therefore, if contents are evaluated and rewarded for their contributions according to this law, they are actually rewarded according to their relative popularity. Voters, who "upvote/downvote" contents, are also rewarded proportionally to the ultimate reward paid to the content creator. Besides content creation-related activities, Steemit rewards "proof of work" and supply of liquidity, among others [35]. Witnesses, elected by the worldwide community of SP holders, are involved in creating blocks and proof of work activities. As all user activities are open on blockchains, it is possible to verify them directly. Steemit witnesses are playing a crucial role in making rewards accurate, transparent, and fair in the community. When witnesses process block creation and proof of work as scheduled, they are paid in SP. The supply of liquidity means providing liquidity for the demand- and supply-side through selling and buying STEEM and SBD on the market, and is evaluated and rewarded based on an algorithm. A market maker earns points any time an order of theirs is filled after being on the books for more than 1 min. Points are calculated based upon the volume of STEEM on both sides of the book. Every hour, the accounts gaining the most points are given 1200 STEEM and the liquidity point is reset to 0 [35].

Steemit also has the property of membership tokens. If anyone wants to join Steemit, he or she must buy STEEM and be in possession of SP to vote for contents. Furthermore, for voting to assess and allocate dividends, users have one vote for one STEEM, so those with more STEEM who have made higher contributions to the community are more influential in decision-making. As suggested by

mechanism design, it is best to predict and be prepared for situations where people act by prioritizing personal interests [12]. One of the opportunistic behaviors that can be seen in evaluation by voting is collusion. However, Steemit prevents collusion through the addition of negative-voting, making it possible for many smaller stakeholders to nullify the voting power of collusive groups or defecting large stakeholders. Moreover, Steemit prevents voting abuse by allowing the voting rights of individual users to fall every time they vote and then be recovered during the period of non-voting. To further prevent abuse, all payouts are delayed a stake-weighted average of 24 h from the time each vote was cast. This ensures large stakeholders cannot snipe payouts by voting at the last second before other voters have a chance to negate potential abuse [35].

4.2.4. Giving Tokens Intrinsic Value

The intrinsic value of a token is a mechanism through which the value of the token as a cryptocurrency can be realistically evaluated. By linking it with the value of the legal tender, it is possible to give intrinsic value to tokens and it is best to do it as quickly as possible after token issuance. Steemit designed SBD to always be pegged to the USD, giving a security of rewards to users [35]. In effect, feed producers are responsible for proposing a monetary policy, such as the adjustment of interest rates, for maintaining a stable peg against the USD. The exchange rate can be maintained by stopping interest payments if SBD is continuously traded at more than USD 1.00 and by increasing the interest rate if SBD is continuously traded at less than USD 1.00. Feed producers are elected by SP holders. To prevent abuse of this power, SP holders should vote for witnesses who can be counted on. Under Steemit, the conversion between SBD, STEEM, and SP is possible so that pegging SBD to the USD will effectively give STEEM or SP intrinsic value as well. Steemit factors out short-term price fluctuations by using the median price over a period of a week. The median published feed is sampled every hour, on the hour. In the event that the feed is corrupted, network participants will have the opportunity to vote out corrupt feed producers before the corrupted feed can affect actual conversion price. Additionally, Steemit stabilizes the market by requiring all conversion requests to be delayed for a week [35].

4.2.5. Strategies to Raise Token Value

If token value rises steadily, it is possible to retain existing users while attracting new ones and the community will be able to grow sustainably. Token price is determined by the supply and demand of the token on the cryptocurrency market. If token holders keep the tokens for a long period, the supply of tokens will decrease and its price will increase. Therefore, it is desirable to hold the tokens for a long time to reduce their velocity and increase their value [41–43]. However, if you hold tokens for too long, the transactional volume collapses to 0, which is not desirable. Therefore, it is important to induce users to hold tokens for an appropriate amount of time.

Steemit put strategies in place to establish a community whose members have a long-term perspective by reducing token velocity. Under the Steemit model, it is STEEM that drives token value. The values of SP and SBD do not need to be increased because they cannot be exchanged with other cryptocurrencies or traditional currencies. Steemit's first strategy to lower the velocity of token circulation is rewarding community activities. As mentioned in Section 4.2.3, users must buy STEEM and be in possession of SP to join Steemit and participate in the activities to be rewarded. When profit-seeking investors buy and hold tokens, token velocity decreases. The second strategy is the vesting schedule. When a post receives a payout, it takes the form of SBD and SP, which take 13 weeks and 3.5 days to be converted into STEEM, respectively [35]. This makes users hold tokens for a certain amount of time and slows down token velocity. The third strategy is about raising community value. Under Steemit, STEEM and SP serve as equity and STEEM and SP holders can expect an increase in the value of their shares as the community value increases. Therefore, they tend to hold tokens for a long-time in the expectation of sustainable growth and increase the value of the Steemit community, slowing down token velocity. This will be explained in more detail in the next section.

4.2.6. Management Strategies of the Token Economic System

Generally, token management strategies can be classified into business growth-linked, burning, and dividend types, depending on the business purpose. A growth-linked strategy uses network effects, meaning the bigger the network, the higher the incentives for participation [13]. The burning strategy involves increasing token value by burning the cryptocurrency [44] and the dividend strategy is about distributing newly issued currencies to existing token holders. As the number of participants increase, the more likely to have quality contents posted and shared on the Steemit platform and this is why the business growth-linked strategy, which takes advantage of the network effect, has been adopted. At the same time, the dividend strategy is used consistently to offer benefits to token holders.

There are two funding methods for organizations: Investment of shares and loans. Steemit classifies holding shares into "liquidation" and "earning rights" [35]. They correspond to the three types of assets in Steemit's token economy model. STEEM is to hold liquidity, SP is to gain rights, and SBD is a form of loan that can be transferred into equity. The relationship among these assets can be illustrated as in Figure 2.
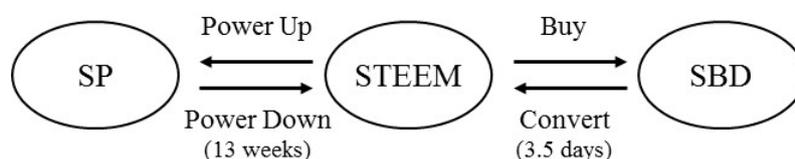

Figure 2. Assets in Steemit token economy [35].

STEEM is the fundamental unit of account in the Steem blockchain, and can be used as a form of payment, and is the only token that can be used for cryptocurrency exchanges, which makes it correspond to an equity with liquidity. Steemit creates new tokens at an annual inflation rate of 9.5% and allocates them to users. When users move from STEEM to SP, they can have more influence over the distribution of the reward pool. As users with more SP have more influence on the distribution of rewards, it can be regarded as an equity or a stock option to gain rights [45]. SP holders are given access to servers, allowing them to participate in the community activities more easily and lend or transfer SP to other participants. Additionally, SP holders are paid 15% of the yearly inflation, making it an appropriate long-term investment. Users can always transfer from STEEM to SP ("powering up") or from SP to STEEM ("powering down") according to the ratio of STEEM they hold to the total SP amount. SBD provides stability to users by maintaining a stable peg to the USD. As investors are paid 10% annual interest, which can be transferred into STEEM, SBD has a similar structure as a convertible bond. How, when, and to whom SBD should be issued is decided by the blockchain as to maintain a stable rate of SBD issuance. As previously mentioned, SP and SBD are designed to take 13 weeks and 5.5 days to be transferred to STEEM, respectively, partly to prevent opportunistic behavior related to timing. As such, Steemit has a number of devices in place to prevent misuse, distortion, and abuse [35].

4.2.7. Strategies for Token Liquidation

Token liquidation strategy means increasing the token value by making it easier to be exchanged with other cryptocurrencies, conventional currencies, or commodities through private sales and listing on exchange markets according to the growth stage of the crypto-economic ecosystem [46]. Generally, it proceeds in the following order: Private sales, listing on the open exchange, on the small and medium DEX (decentralized exchange), on the medium CEX (centralized exchange), and on the large exchanges, gradually increasing listing cost and liquidity. As its founders' abilities were highly appreciated, Steemit was able to be listed on large-scale exchanges from the beginning and its tokens traded on a range of exchanges.

4.2.8. Continuous Modification of the Operational Base

Continuous improvement and management efforts are required to operate a token economy model [34]. As such, since it published the Steem Whitepaper in 2016 to introduce the token economy, Steemit has updated it every year. Community users influence the modification of the algorithm [47]. In 2017, for example, the high rate of inflation emerged as a problem and the annual amount of issuance of STEEM was reduced to lower the inflation rate. Another criticism was the long period it takes for transfers between different token types to take place. To deal with this problem, a "power down cycle," where SP is transferred into STEEM, was shortened from 2 years to 13 weeks, and the cycle of transferring SBD to STEEM from 7 to 3.5 days [35]. It is important to constantly observe whether the token economy model is being operated as it was intended: To deal with potential but un-predicted problems.

5. Conclusions and Discussion

Sustainability, such as energy, the environment, and climate change, is frequently mentioned as an area where blockchain technology can be applied [11]. By doing so, accurate and transparent incentives can be offered to corporations or individuals, inducing them to voluntarily participate in activities that produce and consume energy more effectively and protect the environment. While corporations and individuals act in their own interest, they can help solve environmental global problems at the same time. To build such an ecosystem in a sustainable manner, the number of participants should be large enough to create a network effect, which will make the utility of each participant higher than the cost of participating in the ecosystem. However, utility is hitherto assumed to be lower than cost, it is thus necessary to make significant investments to attract participants to the ecosystem. In areas with large potential profits—such as Facebook and Uber—traditional venture capital played the role of an initial investor and reaped the majority of gains from ecosystem growth. However, there have been no subjects to date that can cover the initial investment cost and risks in the public domain, in areas such as energy, the environment, and the climate. At a more general level, sustainability deals with, not only environmental effects, but also social issues. Sustainable development of a business involves the achievement of economic, environmental, and social sustainability objectives, satisfying diverse interests of stakeholders [48,49]. From this point of view, the business model of Steemit can better achieve social sustainability by sharing value with community participants, compared to established social media giants that share profits only with shareholders. With the introduction of cryptocurrencies and the token economy, it has become possible to issue and distribute financial rewards to initial participants, allowing the results of the growth of the ecosystem to be shared among participants [12]. To spread this trend, it is necessary to have a better understanding of cryptoeconomics in relation to blockchain-based cryptocurrencies.

As such, this paper introduced a method to design a token economy model, the essence of crypto-economics, and analyzed the case of Steemit, a fast-growing token economy. The first step in building a token economy model is judging token-business fit [11]. In other words, it should be decided whether a business can be newly implemented and grown by the introduction of tokens. Second, it needs to be assessed whether a business can have a competitive edge. That is, a business should be able to provide differentiated values to users, leading to tangible results, including creating new sales, expanding market share, and having first-mover advantage. Third, token properties should be determined [12]. Depending on their use, tokens can be used as platform, service token, reward, or membership tokens. Multiple properties can be given simultaneously and considered differently from the user perspective. Fourth, it is possible to secure system stability by giving intrinsic value to tokens. This means pegging tokens to a legal tender at a fixed exchange rate. Fifth, a strategy to raise token value is needed. Token velocity should be appropriate to enhance token value [41–43]. To induce users to hold tokens for longer, they can be allowed to share profits, require transaction requests to be delayed for a certain amount of time, or raise the expectation of the future growth of the community. Sixth, operations strategies for the token economy need to be established. Generally,

strategies can be classified into business growth-linked type to use network effect, burning type to increase token value, and dividend type to allocate newly issued currencies to token holders. Seventh, token liquidation should also be considered, and can be considered an exit strategy by allowing token holders to realize the value of their tokens by listing them on an exchange [46]. Finally, it is important to make continuous efforts to improve and manage such a system based on its operation.

Tokens have significant influence on the growth of communities [22]. Chohan [47] argues that the value of Steemit is likely closely related to the value of social networking and sharing rather than that of speculative investment. In other words, token value will be correlated with the fundamental function of the content platform, that is, sharing the content. We collected STEEM price and Steemit user data to analyze the correlation between the number of postings on Steemit and STEEM price. Analysis of the daily data from 1 May 2017 to 18 November 2018 shows that the correlation coefficient is 0.82, with a significance level of 0.01. The result confirms that the value of Steemit is highly correlated with users' activities of sharing the content, which could be attributed to the sound token economy model.

However, Steemit has several limitations. Token price is determined by supply and demand of the token, so there should be enough sources of token demand for a sustainable token economy design. Steemit has an innovative design for paying tokens to users, but there are not enough sources to spend tokens on. Another limitation is that a few wealthy users with a lot of SPs may monopolize the power in the community [47]. Additionally, there might be problems of self-voting and power abuse [7]. Steemit pursues a decentralized community model, but the strong influence of heavy users may undermine this vision.

This paper brings significant implications by presenting the design process of the token economy model, the essence of crypto-economics, using a case study. While most studies on the token economy model are from the perspectives of economics or computer science [6,7], this study was conducted from a strategic management perspective, focusing on sustainable business growth with an incentivized user base. Considering crypto-economics is still at an early stage, it is expected that the guidelines on the token economy model suggested in this paper will contribute to the development of future research. Additionally, it also provides practical implications for corporations to use cryptocurrencies in their operations. Given that numerous corporations worldwide are using cryptocurrencies and ICOs, studies on a token economy model in diverse areas will be beneficial. There are some limitations pertaining to this study. First, there is the issue of external validity due to the number of cases it analyzed. Steemit is one of the few communities with crypto-economics that have grown over the years, so the number of real business cases is still small. Second, there are few extant studies on the topic of crypto-economics, so we had to rely on the business case to propose the token economy model. As such, our results should be cautiously generalized. As the number of successful models of token economy accumulates in the future, empirical studies with statistical analyses will present more generalizable results. Also, analyses of token economy models that directly deal with environmental or social sustainability issues will yield significant implications.

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