On the Effectiveness of Multi-Token Economies

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***Abstract*—Even though a token economy is the core part of a blockchain-based project, it is still in the early stage of academic exploration. Moreover, recent projects adopt multi-token economies to encourage the participants to stay longer in their economic systems, which are more complicated than single token economies. This paper addresses the token classification, the reason for adopting multi-token economies and the effectiveness of them. We analyze the Steemit as a representative example of multi-token economies. We describe how the multi-token economy has been working and show the distinctive features of multi-token economies. We also propose the evaluation criteria for multi-token economies.**

***Index Terms*—blockchain, token economy, multi-token economy**

I. Introduction

Recently, a token economy is attracting attention from both blockchain research communities and industries. A token economy, a core element of a blockchain-based project, is a broad term including monetary policies, service models, agents interactions, and more. This paper mainly focuses on the design and effectiveness of multi-token economies for blockchain-based projects where more than two tokens are adopted in a blockchain token economy.

In the early stage, most of blockchain-based projects adopted single token economies. For example, the most famous project adopting a single token economy was Bitcoin [1]. Bitcoin has only one coin (token) in its economy which is mainly functioning as a currency. On the other hand, many recent blockchain-based projects are adopting multiple tokens in their economies. For example, Steemit, one of the representative multi-token projects, introduces three different tokens [2]. Other projects also employ multi-token economies. Then why do some blockchain-based projects build multi-token economies, and others not? This is the point where the research questions begin. This paper also tries to answer whether those multi-token economies are working properly according to their original design intentions.

In this paper, we first review the theoretical background of blockchain tokens and exchange rates. We analyze the structures and the needs of multi-token economies. Then, we discuss deeply on the multi-token economies with the Steemit project as a representative example. We trace the historical price changes of the Steemit tokens and analyze whether the original design purpose works well or not. After suggesting evaluation criteria for multi-token economies, we conclude this paper with future work.

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II. Background

A. Token Classification in Blockchain-based Projects

There have been efforts to classify the blockchain tokens according to their attributes. FINMA (Swiss Financial Market Supervisory Authority) classifies blockchain tokens into the three categories payment token, utility token, and asset token according to their economic function and purpose [3]. The payment token is synonymous with the crypto-currency which is used as a means of payment. The utility token is a token used for the application usage while asset token is for tokenized security. Although FINMA provides a good groundwork for token classification, it is mainly for the regulation and hence not enough for explaining the usage of multiple tokens in a blockchain economy.

Mougayar describes role, features, and purpose as factors affecting the usage and value of tokens [4]. Also, a recent study suggests the eight archetypes of tokens including cryptocurrency, equity token, funding token, consensus token, work token, voting token, asset token, and payment token [5]. Even though those propose a thorough description on the detailed role of tokens, it is too complex. We suggest that a right can penetrate the utility or the roles of tokens since a role or utility can represent a right to do something such as voting, possesing, exchanging, or getting a reward. We also assert that the virtue of multi-token economies should be how to plan the delicate division and allocation of rights in order to operate the economy more sophisticatedly than a single token economy.

B. Exchange Rates and Impossible Trinity (Trilemma)

If there are more than two tokens in a blockchain economy, it is inevitable to exchange between the tokens whether directly or indirectly. In the case of exchanging the tokens, it leads to the matter of exchange rates. The impossible trinity or trilemma is an international economics concept which explains that it is impossible to have all three of the following, simultaneously [6].

- Independent monetary policy
- Fixed exchange rate
- Free capital flow

Most of the countries select independent monetary policies and free capital flows at the cost of floating exchange rates. However, some countries such as China choose a stable exchange rate and an independent monetary policy, but not free capital flows. On the other hand, Hong Kong has taken a

stable exchange rate and free capital movement, while giving up its monetary autonomy.

This also applies to multi-token economies of blockchain-based projects. However, in the case of designing a multi-token economy, the tokens in the blockchain economy are generally interrelated to a certain extent. They are not the different currencies of different countries. It is similar that a country has two different currencies such as Cuba. The exchange rate part is relatively clear. There can be multiple exchange rates between the tokens, and between each token and fiat money respectively. Besides, measuring the degree of freedom of capital flows and the monetary autonomy is more complicated.

III. Multi-Token Economy

A. Token Classification for Multi-Token Economy

This paper reclassifies the purposes of tokens into the three groups payment, right, and asset ownership. In most of multi-token blockchain economies, one token usually acts as a base currency (i.e. payment) while the other tokens represent various types of rights or the ownership of assets. A right can include asset ownership in a broad term. However, we separated the asset ownership from rights since (i) the asset ownership can be regarded as securities and (ii) it is different from the other type of rights such as voting and reward.

When representing asset ownership, the tokens are valued and exchanged at the prices based on the underlying assets each token represents. The valuation of the tokens carrying the ownership of the specific assets is out of scope for this paper.

B. Necessity of Multi-Token Economy

The fundamental reason for adopting a multi-token economy is to separate a base currency from other purposes and to make the other tokens facilitate economic activities more delicately. Since we rule out the valuation of the asset-backed tokens from this research, the remaining question is the reason why a blockchain economy needs to split its token into a base currency and the other types of rights. One possible answer can be that multi-token economies can capture more value from permission-less innovation, creating more open, trustless and valuable economies [7].

Recalling the goal of the token economy, adopting multiple tokens should incentivize the participants more and lead to more desirable behaviors than using a single token. Then what are the desirable behaviors for blockchain economies?

By analyzing the white papers of the various blockchain-based projects, we have found that the most desirable behavior for the blockchain economies is for the participants to stay and play longer in their economic systems. It is primarily because the entry and exit of blockchain economies are extremely easier compared to the real world economies. Though we cannot change from a country to another country easily, we can change from a blockchain economy to another blockchain economy with virtually no friction.

Naturally, many tokens are distributed as rewards in result of incentivization. However, what if the participants rush to the external exchanges and sell off their tokens? If then, the blockchain economy would not maintain and could collapse eventually. Therefore, some blockchain economies prevent their second token from being exchanged on the external markets [8]. Also some token economies put barriers between the base currency (mostly listed on the external exchanges) and the second token by raising converting costs and time [2], [9]–[11].

IV. Case Study of Multi-Token Economy

In this section, we discuss the effectiveness of multi-token economy with a concrete example. We select Steemit as a representative example due to its sophisticated design.

A. Steemit Multi-Token Economy

Steemit is a public content platform based on blockchain, launched in June, 2016 [2]. Steemit is one of the most famous and successful blockchain-based projects and also renowned for its sophisticated token economy design. The economic activities in Steemit include contents creation and curation. The participants get rewarded by tokens based on their economic activities. Steemit employs the three different tokens Steem, Steem Power, and Steem Dollars. Among these, Steem and Steem Dollars are listed and exchanged on the external exchanges while Steem Power is not.

Steem Power is carrying voting rights, while Steem Dollars are used for incentivizing the contents creators and the curators. Steemit elaborates that Steem Dollars are like debts for Seemit since Steem Dollars are carrying the right to convert to Steem.

At the same time, Steemit wants Steem Dollars to be stable rewards for the participants. Therefore, Steemit implements its pegging mechanism to support the price of Steem Dollars above at least US$ 1. Unlike the typical real world exchange rates pegging system such as Hong Kong, the upside potential is open.

Steem is acting as a coordinator between Steem Power and Steem Dollars. There is no way to convert directly between Steem Power and Steem Dollars. Steemit explains that Steem is like the short-term capital which can be converted to the long-term capital (Steem Power) and also exchanged with the debt obligation (Steem Dollars).

Figure 1 shows the relation and the exchange scheme of the Steemit tokens. Steemit implements many frictions which restrict free capital flows among the three tokens in its economy. While Steem Power is not exchanged on the external markets, Steem and Steem Dollars are listed and exchanged freely, which means Steemit adopts the floating exchange rate system. In terms of monetary policy, Steem and Steem Dollars have each monetary policy, but they are linked under the debt-to-ownership ratio. If the total value of Steem Dollars in the market exceeds 10% of the total market capitalization of Steem, Steemit stops issuing new Steem Dollars and changes

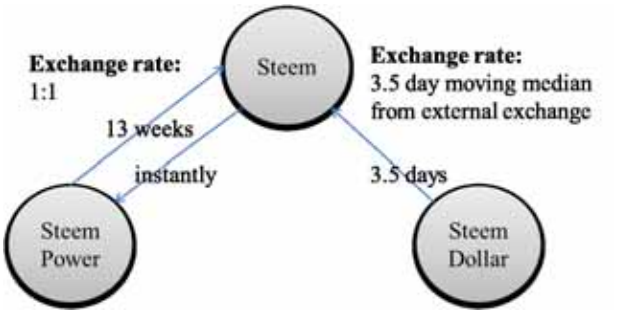

Fig. 1: Exchange policy among Steem, Steem Power, and Steem Dollar.

the internal exchange rate of converting Steem Dollars to Steem.

To sum up, Steemit choose the floating exchange rates between its two tokens and fiat money, and the modified floating exchange rate between Steem and Steem Dollars with the pegging system supporting the minimum price level of Steem Dollars above US$ 1. In terms of money flows, Steemit adopts restricted capital flows among its tokens, but free capital flow between its token economy and the outside economy. When it comes to monetary policy, each token has its own monetary policies but they are correlated under the debt-to-ownership ratio management plan and the converting time delay.

B. Steemit Price Level Effect Analysis

We analyze the cause and effect of the level of prices of Steem and Steem Dollars. The most desirable levels of prices are low Steem Dollars (around US$ 1) and high Steem. In that case, the debt level maintains low and the participants prefer holding capital than debt, which means a healthy and robust economy. Even if the prices of Steem and Steem Dollars are both high, as long as the market capitalization of Steem Dollars to that of Steem is kept low, the economy is overheated but still sustainable.

However, if the demand for Steem Dollar increases and the price of Steem goes down, it can be interpreted as a precursor for an economic crisis. Because the fact that the participants prefer holding debt to capital means the participants see the future of the economy negatively. Furthermore, if the prices of Steem and Steem Dollars both fall, it would cause an economic crisis. It means the Steemit economy is not attractive anymore and some participants would begin to escape from the economy.

In order to investigate whether the Steemit token economy has been working well according to its design intention, we traced the historical prices of Steem and Steem Dollars. As of Dec 6th, 2018, the prices of Steem and Steem Dollar are US$ 0.29 and US$ 0.76 respectively.

The price of Steem has fluctuated over time. For example, it peaked around US$ 4 in Jul 2016 and above US$ 7 in Jan 2018 (Fig. 2). Until May 2017 after the first peak, the price of Steem stayed stably low under US$ 1. The price of Steem

TABLE I: Analysis of Price Level Effects to Steemit Economy

Price Level		Steem Dollar	
		High	***Low***
Steem	***High***	**Overheated.** (sustainable as long as debt-to-ownership ratio managed under 10%)	**Stable growth.** (desirable, because capital is preferred to debt while debt ratio managed low)
	Low	**Stagnation, or infancy.** (possibly precursor for crisis, debt is preferred to capital)	**Recession, or economic crisis.**

Dollars had been stable around US$ 1 until Apr 2017. It rose up to US$ 2 in Jun 2017 and got back to around US$ 1 again. It made a peak in Dec 2017 and recently moves under US$ 1.

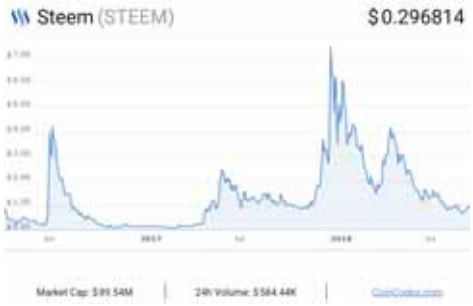

Fig. 2: Historical prices of Steem. (retrieved from CoinCodex.com) [12]

Fig. 3: Historical prices of Steem Dollars. (retrieved from CoinCodex.com) [13]

Now we put the prices and the number of active users together and analyzed how the Steemit economy has been doing in particular time periods.

1) From Aug 2016 to May 2017: Steem Dollars stirred around US$ 1 most of the time. Steem was also stable, but moved below US$ 1. In this period, right after Steemit was launched, a small number of users participated in the Steemit community. Although the price of Steem was lower than Steem Dollars, the total market capitalization of Steem was far greater than that of Steem Dollars and Steem Dollars were stable. Also the Steemit communitys economic activities slightly grew during the period (Fig. 5). Therefore, Steemit economy was also working well.

2) From May 2017 to Dec 2017: This is the growth period of Steemit. The number of active users increased, and the amount of economic activities measured by the number of blockchain transactions grew as well. As a result, the price level of Steem jumped up above US$ 1, while Steem Dollars were quite stable around US$ 1. The exchange rates and the pegging mechanism worked well. Steemit achieved a stable economic growth in this period.

3) From Dec 2017 to Feb 2018: In this period, Steem and Steem Dollars both spiked and showed a sign of overheating. The amount of economic activities also peaked in this period. To prevent the debt-to-ownership ratio from rising too much, Steemit tried to cool down the price of Steem Dollars with the implied market operations by aggressively buying Steem Dollars on the internal and the external exchanges.

4) From Feb 2018 to Dec 2018: This period shows the decline of the economy. The amount of economic activities decreased as well as the number of active users. The economy has been losing its vigor. The prices of Steem and Steem Dollars have fallen sharply, and the debt-to-ownership ratio also broke 10%. The price of Steem Dollars is around US$ 0.76 which is much less than US$ 1 the supporting target of its pegging system. The pegging mechanism did not worked well as intended since the price of Steem dropped much sharper than Steem Dollars.

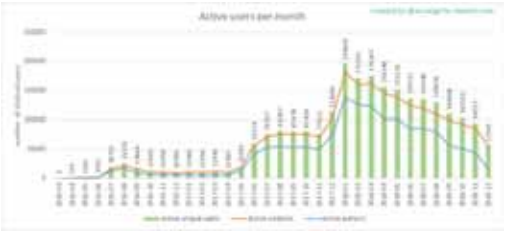

Fig. 4: Steemit montly active users. (retrieved from https://steemkr.com/statistics/@arcange/steem-statistics-20181204-en)

Fig. 5: Steemit the numnber of daily transactions. (retrieved from https://steemkr.com/statistics/@arcange/steem-statistics-20181204-en)

C. Discussions

The history of the Steemit economy demonstrates the various stages of an economic cycle. Steemit adopted a sophisticated multi-token economy, and it worked quite nicely during the growing phase. However, we have found that the token economy is not functioning well in a crisis as its original design intended. It is still unclear whether the shrinking economic activities caused the crisis, or the falling token prices triggered the crisis. We reason that the cause of its malfunctioning is that Steem Dollars are carrying the right to convert to Steem, not the other rights such as voting. This means Steem and Steem Dollars are fundamentally not so different. Steemit tried to make Steem Dollars as a more stable version of Steem, but the economic demands for the two tokens are not very sophisticatedly distinct.

Besides Steemit, many projects including MediBloc [8], MVL(Mass Vehicle Ledger) [9], Carry Protocol [10], and CoinUs [11] introduce multi-token economies. The main purpose of their multi-token economies is also to make the undesirable transactions harder and to promote the users to stay and work in its economy as long as possible. Their multi-token economies have unique features and worth to analyze. However, those projects are newly initiated and we do not have enough data yet, compared to Steemit. We will analyze those projects in our future work.

The more token a blockchain economy has, the more flexibility the economy will have and the more complicated predicting the agents behaviors and interactions will be. Also, the design of a multi-token economy requires that each token carries a specific and distinct role in its economy. Otherwise, the effectiveness of a multi-token economy could be seriously compromised. The selection of whether a multi-token economy or a single token economy is a difficult question. In terms of measuring the effectiveness of a multi-token economy, we suggest the following evaluation criteria.

- How the exchange rates and the monetary policies facilitate and foster the internal economic activities.
- Whether the exchange rates and the monetary policies work sophisticatedly as a defensive mechanism in an economic crisis.

To analyze and evaluate the effectiveness of a multi-token economy, we need to accumulate the sufficient price history of the tokens, the internal transactions between the tokens if any of them is exchanged only internally, and the data for the amount of economic activities.

V. Conslusion

In this paper, we propose a new classification of token types and analyze the necessity of multi-token economies. Even with its complicated attributes, multi-token economies are widely adopted to recent blockchain-based projects for encouraging the participants to stay longer in their economic systems. With the analysis of Steemit case, we reveal that the multi-token economy works well during the growing phase and does not function well in a recession. With the analysis result, we propose the evaluation criteria to evaluate the effectiveness of multi-token economies. As our future work, we will gather more information about multi-token economies of blockchain-based projects and analyze the data to draw general criteria.

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