



Is a Blockchain-Based Game a Game for Fun, or Is It a Tool for Speculation? An Empirical Analysis of Player Behavior in Cryptokitties

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Abstract. The market growth and popularity of Blockchain technology in various fields has been astonishing. The gaming industry is one of the prominent industries that applies Blockchain technology. However, there is some concern about the speculative aspect of Blockchain-based games. Therefore, this paper examines the effects of speculative and enjoyable aspects on users' playing behavior in Blockchain-based games. For this, we developed a web crawler and collected data from Cryptokitties, one of very first successful Blockchain-based games. To analyze our dataset, we conducted fixed panel regression. The results indicate that the external aspects of the game are negatively related to item selling, whereas the internal aspects of the game are positively related to item selling in the Blockchain-based game. This result suggests that playing Blockchain-based games is a mix of behavior with enjoyable and speculative aspects. As such, it remains unclear whether users play Blockchain-based games just for fun or as a form of speculation.

Keywords: Blockchain · Blockchain-based game · Cryptokitties

1 Introduction

Cryptocurrency has become more than a digital asset. In the early stages of cryptocurrency, people handled it as a kind of digital currency that could only be used via the Internet. However, as people have come to understand its unique characteristics, which allows for a decentralized payment system, it started to attract massive public attention. There are now more than 1,600 types of cryptocurrency including Bitcoin, Ethereum, EOS, etc. [6]. Cryptocurrency is also garnering academic interests and scholars have examined its viability as currency [8], its speculative characteristics [1, 4], determinants or trend of cryptocurrency price [2, 11, 15].

Blockchain technology is one of the key cryptocurrency technologies that allows the decentralized payment system [14]. The market size of Blockchain technology is estimated to be about 1 trillion in valuation and growing [3]. Blockchain technology is not used just for cryptocurrency, but for diverse applications such as trading, ecosystem, security, social service [19]. In various fields, the gaming industry is prominent. There are now more than 300 Blockchain-based games and more continue to be

launched [7]. Users of Blockchain-based games can spend and earn cryptocurrency during their gameplay.

As the Blockchain-based game industry continues to grow, people are becoming concerned with the speculative or addictive features of Blockchain-based games [9]. These kinds of worries existed at the beginning of cryptocurrency and many researchers have investigated different aspects of cryptocurrency. However, there is a lack of academic research on the enjoyable or speculative aspects of Blockchain-based games. Therefore, this paper investigates the effect of enjoyable and speculative aspects on users' playing behavior in Blockchain-based games. To do this, we developed a web crawler to gather users' transactions in their open ledger related to Cryptokitties (www.cryptokitties.co), an early Blockchain-based game that was released in March 2017 and was one of the very first Blockchain-based games to experience success [10].

The remainder of this paper is organized as follows. In Sect. 2, a research model and relevant hypotheses are suggested. Section 3 explains the data gathered from Cryptokitties and the analyzing method used to consider the features of our data. Section 4 shares and discusses preliminary results. Finally, Sect. 5 presents the conclusions of this research and directions for future research.

2 Research Hypothesis

Blockchain-based games are different from traditional games in several aspects. The main difference is the interoperability across games. Traditional games allow their assets to be used only in their own game, but the assets of Blockchain-based games are interoperable across Blockchain-based games. Unlike traditional games, Blockchain technology allows high asset security and open trading among users even across games. It is possible for users to profit because users can earn additional cryptocurrency by getting or receiving game items in Blockchain-based games.

In addition, the price of game items can go up in price regardless of cryptocurrency price, so users can earn extra cryptocurrency in the game. Therefore, users who have speculative purpose are likely to play games to gain extra profit by converting game items into cryptocurrency. These users pay attention to the price and the total volume of cryptocurrency for buying or selling game items. Speculative users try to achieve the maximum benefits from market fluctuations, so when the price is high and the trade volume is huge, they are willing to wait for potential bigger benefits. Therefore, the hypotheses are as follows.

Hypothesis 1: The price of cryptocurrency is negatively related to the number of items selling in Blockchain-based games.

Hypothesis 2: The total volume of cryptocurrency is negatively related to the number of items selling in Blockchain-based games.

In addition, to distinguish speculative and enjoyable behaviors in the blockchain-based game, we assume the behaviors related to the game itself are related to enjoyable behaviors such as in-game purchases, special functions in the game, interactions between users, etc. These in-game behaviors make the game enjoyable for users and keeps them playing. Selling in-game items also relates to in-game aspects, so the internal aspect of games will be related to item selling. The frequency or amount of

item purchase presents the degree of immersion [12, 13, 17]. Highly immersed users will spontaneously play the game more using in-game functions. Accordingly, our hypothesis is as follows.

Hypothesis 3: Item purchase is positively related to item selling in Blockchain-based games.

Furthermore, users who use unique functions of the game will be more likely to feel satisfaction [16]. Users who are satisfied with unique features of the game will be more likely to use in-game functions. Thus, the hypothesis is formulated as follows:

Hypothesis 4: Unique game functions are positively related to item selling in Blockchain-based games.

As people enjoy the game for its social-interaction activities, many games set several items to encourage interaction with other players [18]. Accordingly, social-interaction playing behaviors can be described as playing behaviors in which users enjoy the game through interactions with others. Therefore, the relationship between social-interaction playing behaviors and item-selling behavior is investigated as follows.

Hypothesis 5: Social interactions are positively related to item selling in Blockchain-based games.

3 Research Method

3.1 Blockchain-Based Game

The dataset used in this paper is user-level transaction log data collected from the Cryptokitties website (www.cryptokitties.co). Cryptokitties is one of the very first blockchain-based games; it was released in March 2017. Using Ethereum blockchain, users are able to buy, collect, breed, present, and sell digital cats with unique characteristics made by a combination of certain attributes, or “cattributes.” Figure 1 shows the main page of Cryptokitties.

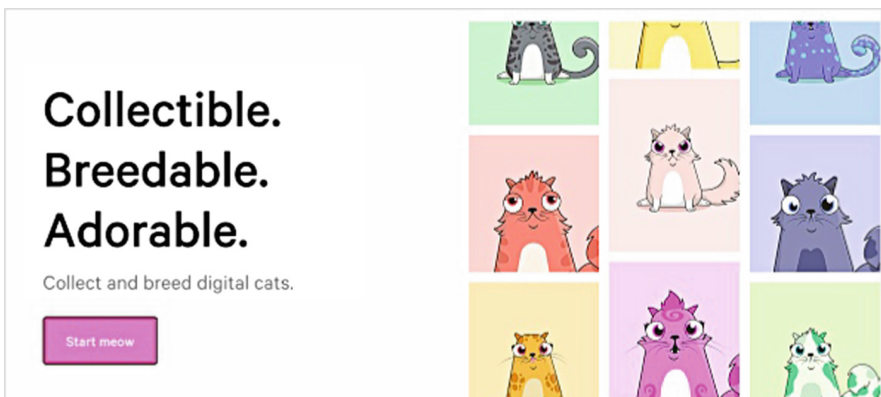


Fig. 1. Main page of Cryptokitties

There are 4 billion possible variations of Cryptokitties, and a new Cryptokitty was released every 15 min until November 2018. Because all Cryptokitties are linked to the Ethereum, each new cat is assigned a generation. A limited number of highly desirable early - generation kitties had the highest sales prices. The total trading amount for Cryptokitty purchases was about 6.7 billion dollars until December 2017. Due to the rocketing number of Cryptokitties users, the Ethereum network experienced delays in 2018 [5]. Figure 2 presents screenshots of an individual user's web page and a kitty in Cryptokitties. Users can see their own kitties and their cattributes in the individual kitty page.

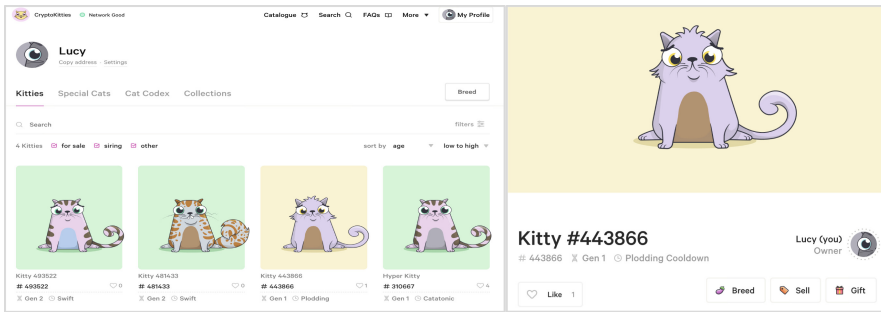


Fig. 2. User page and kitty page in Cryptokitties

3.2 Variables

We developed a web crawler using Python to collect all transactional records from 1 December 2017 till 31 July 2018. The raw dataset contains all Ethereum transaction behaviors of 60,000 users. Among these datasets, we selected the data related to Cryptokitties transactions and analyzed these data, which numbered more than 100,000 rows. The key variables are as follows (Table 1).

Table 1. Summary of key variables

Variable			Definition
Dependent variable	$SellKitties_{i,t}$		The number of Cryptokitties that a player i sells at time t
Independent variable	External	$EtherPrice_t$	The price of Ethereum at time t
		$EtherVlm_t$	The total volume of Ethereum at time t
	Internal	$Purchase_{i,t}$	The number of Cryptokitties that a player i buys at time t <i>Immersion</i>
		$Siring_{i,t}$	The Number of Cryptokitties that a player i sires at time t <i>Unique game function</i>
		$Gifting_{i,t}$	The Number of Cryptokitties that a player i presents at time t , <i>Social interaction</i>

To investigate the effects of enjoyable and speculative aspects on users' playing behavior in Cryptokitties, we considered the effect of external and internal factors. We assumed that users who consider speculative features of Cryptokitties as important are likely to pay attention to the price or the total volume of Ethereum. The price and total volume of Ethereum are considered external aspects. Figure 3 depicts the price trend of Ethereum within our data time window. The Ethereum price fluctuated dramatically.



Fig. 3. Price of Ethereum

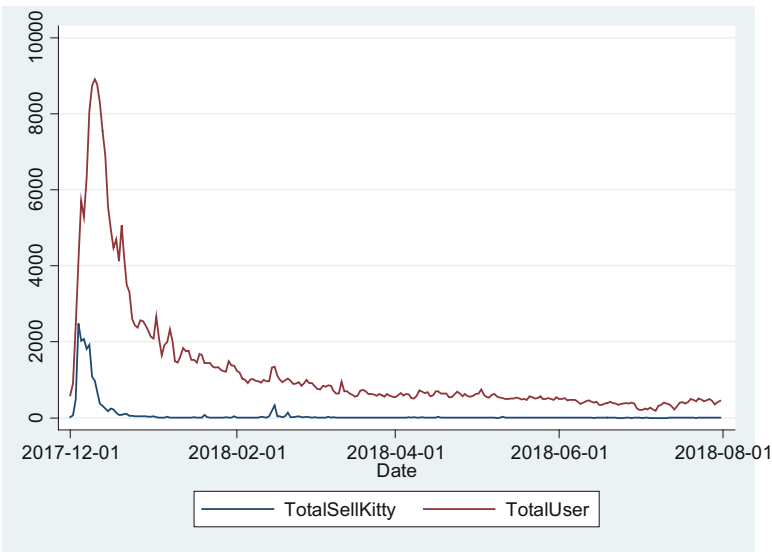


Fig. 4. The number of item selling and players in Cryptokitties

To investigate the effect of enjoyable aspects of Cryptokitties, we assumed that users who consider the game enjoyable are likely to use game functions often to play. Therefore, the game functions are considered internal aspects—the numbers of Cryptokitties a player buys, sires, and presents. Figure 4 illustrates the number of users and Cryptokitties that users sold. The numbers soared around the end of December 2017 and plummeted soon after.

4 Empirical Analysis

4.1 Research Model

To estimate the suggested factors, panel data models were conducted. We formally tested using techniques of the fixed effect model and the random effect model. To check whether the random effect model or the fixed effect model was suitable for our dataset, the Hausman test was carried out and its result indicated that the regressors are not correlated with the error terms. Therefore, our estimation incorporates fixed effects for users to consider unobserved characteristics of individual users. The following equation captures our econometric model. In this equation, users are indexed by i , and time is indexed by t . β_i is coefficients' estimates for the number of Cryptokitties selling at time t . μ_i is for the individual cross-sectional effect, and the error term $\varepsilon_{i,t}$ controls for the idiosyncratic effects.

$$\begin{aligned} SellKitties_{i,t} = & \beta_1 EtherPrice_{i,t} + \beta_2 EtherVlm_{i,t} + \beta_3 Purchase_{i,t} + \beta_4 tSiring_{i,t} \\ & + \beta_5 Gifting_{i,t} + \mu_i + \varepsilon_{i,t} \end{aligned}$$

4.2 Preliminary Result

The result of our main model is demonstrated in Table 2. Our finding suggests that the external aspects (the price and the total volume of Ethereum) are negatively related to item selling (Hypotheses 1 and 2 are supported). In addition, the internal aspects (the number of item purchase, siring, and gifting) are positively related to item selling (Hypotheses 3, 4, and 5 are supported). The results indicate that users play Blockchain-based games for fun as well as speculation. Therefore, it is difficult to say whether a Blockchain-based game is just a game for fun or a tool for speculation.

Table 2. Main results from fixed effect analysis

Dependent variable		$SellKitties_{i,t}$
Independent variables	$EtherPrice_t$	$-0.0006^{***} (0.0000)$
	$EtherVlm_t$	$-3.12e-11^{***} (0.0000)$
	$Purchase_{i,t}$	$0.0669^{***} (0.0032)$
	$Siring_{i,t}$	$2.5421^{***} (0.0811)$
	$Gifting_{i,t}$	$0.0124^{***} (0.0014)$
Observation		301,591
Number of users		34,723

5 Conclusion and Future Plan

This study investigated the effects of enjoyable and speculative aspects on users' playing behavior in blockchain-based games. We crawled playing behaviors of Cryptokitties and analyzed these behaviors by conducting a fixed-effect panel regression model. We found that the external aspects (i.e., the price and the total volume of Cryptocurrency) are negatively related to item-selling behavior in Blockchain-based games. In addition, the internal aspects (i.e., item purchasing, siring, gifting) are positively related to item selling. Thus, it is hard to say whether a Blockchain-based game is just a game for fun or a tool for speculation. Playing behaviors in Blockchain-based games mix enjoyable and speculative aspects. We anticipate that these findings will not only contribute to the extant literature on the speculative aspects of Blockchain-based games, but also aid game developers by suggesting how to make users continue to use the game for long-term success.

This research has some limitations. First, the characteristics of players could differ according to the time when they joined the game. For example, players who joined the game in the early stages may be more likely to be risk-takers. Unlike early adopters, players who join the game in the latter stages could be followers. Additionally, this paper does not consider the lag variables of each suggested variable. For example, the price of cryptocurrency last week could affect item selling in a Blockchain-based game this week. A later version of this paper will address these issues.

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