Spillover Effects of Airdrops: Evidence from Tokenization Platforms

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Abstract

The emergence of tokenization platforms based on blockchain technology has led to the use of free airdrop to replace traditional expensive financial incentives to enhance user engagement. However, critics argue that such incentives may devalue tokens and prompt nonrecipients to panic sell. To investigate the impact of airdrops, we conducted a quasi-experiment on Axie Infinity. Our findings indicate that airdrops significantly enhance engagement among both recipients and nonrecipients. Mechanism analysis shows that cross group spillover effects stems from expectation of another airdrop program and increased market liquidity. While recipients tend to immediately sell tokens and often sell more tokens than received, we did not find evidence of nonrecipients panic selling tokens. Furthermore, we investigated the heterogeneous effects of airdrops. Our work contributes to the ongoing debate of the effectiveness of airdrops and provide insights into the study of tokenization platforms.

Keywords: Airdrops, Spillover Effects, Tokenization Platforms, User Engagement

Introduction

In recent years, tokenization platforms utilizing blockchain technology have emerged, with the primary objective of creating democratic and decentralized systems via *tokens*. Tokenization platforms, as defined by Chod et al. (2022a), encompass two defining attributes: 1) utilization of proprietary digital currency to settle transactions via smart contracts; and 2) establishment of decentralized or peer-to-peer governance frameworks. Compared with traditional platforms, tokenization platforms can alleviate moral hazard issues (Chod et al. 2022b) and overcome coordination problems (Bakos and Halaburda 2022) in traditional markets. An example of such a platform is the play-to-earn games, where players can obtain tokens by investing time in gameplay and exchange in-game assets with other participants. Yahoo Finance reports that the global Play-to-Earn non-fungible tokens (NFTs) Games market was valued at USD 3,292.73 million in 2022 and is projected to reach USD 8,856.95 million by 2028[1].

However, platform growth is never easy and the main challenge lies in enhancing user engagement, especially for emerging markets. Conventional platforms commonly rely on financial incentives to boost user participation (Kuang et al. 2019; Sun et al. 2017), albeit at considerable expense. For example, Uber

[1] https://finance.yahoo.com/news/play-earn-nft-games-market-150700399.html

Sign Up Bonus provide one driver with up to $2500[2]. In contrast, blockchain-based platforms have pioneered innovative methods for implementing alternative financial incentives, known as *Airdrop*. These incentives are regarded as being totally free for platform developers, thus supplanting conventional financial incentives. Airdrops have emerged as one of the most prevalent marketing strategies to enhance user engagement. Airdrop is a discretionary distribution of cryptocurrency tokens or digital currencies, typically free of cost, to numerous wallet addresses. This process entails transferring a specific quantity of cryptocurrency to wallets of qualified participants, often based on predefined criteria such as registering with the tokenization platform prior to a designated date or holding a predetermined amount of cryptocurrency. According to *CoinMarketCap*, there are more than 400 airdrop projects of the tokenization platforms[3].

However, the effectiveness of Airdrop is controversial. The primary objective of Airdrops is to enhance the visibility and adoption of the project while also rewarding early adopters and supporters. Advocates contend that airdrop marketing costs are low, and tokens can be disseminated to a wider user base. When executed effectively, an airdrop can incentivize recipients to familiarize themselves with the token and improve the user engagement. However, opponents argue that airdrops will create an inflationary effect, resulting in the depreciation of tokens held by non-recipients. Nonrecipients will therefore sell a large number of tokens, affecting the user engagement of the platform.

Despite airdrop's widespread adoption in the industry, there has been a limited amount of research conducted to understand its impact. Liebi (2021) suggests that the distribution of airdrop results in an immediate decrease of the parent coin's prices by 4.65%. Cong et al. (2023) demonstrate that airdrops can enhance users' transaction volume. Furthermore, Makridis et al. (2023) report that while airdrops may not significantly increase market capitalization, decentralized exchanges and governance token airdrops tend to have a positive impact on market capitalization. Recently, Chen et al. (2023) investigate how token price volatility influence users' contribution. However, existing literature has predominantly focused on the effects of airdrops on token value and market capitalization, neglecting the impact of airdrops on user engagement, which is crucial for the long-term development of tokenization platforms. Tokenization platforms are often considered to be speculative markets (White et al. 2022) lacking of user loyalty and continuous engagement, which makes it essential for them to prioritize long-term user engagement over short-term gains. Secondly, individuals are both users and investors of the tokenization platforms but existing research mainly focus on the trading behaviors while ignore the personal investment decisions, which is important for measuring the degree of decentralization.

To fill this gap, we utilize a quasi-natural experiment wherein the platform implements an airdrop project. In this study, we seek to answer the following four research questions about the airdrops: (1) What are the impacts of Airdrop on the liquidity of related tokens on tokenization platform? (2) What are the impacts of Airdrop on the recipients and nonrecipients engagement? (3) What is the potential mechanism of Airdrop impacts on user engagement? (4) What are the impacts of Airdrop on the recipients and nonrecipients token holding decision? (5) How does the balance holdings moderate the impacts of Airdrop?

Our study reveals both noteworthy cross-category and cross-group spillover effect. Both the dropped tokens' liquidity and related tokens' liquidity improved a lot. What's more, both incentivized and non-incentivized users exhibit heightened engagement on tokenization platforms. Mechanism analysis shows that non-recipients become more effective because of their expectation for new Airdrop program and improvement of market liquidity. Our empirical investigation reveals that, following an airdrop, users exhibit a tendency to decrease their token holdings. Additionally, our analysis did not reveal any evidence of non-incentive users selling their tokens due to the dilution of token value. Importantly, our analysis indicates that Airdrops on large token holders do not increase of decrease their user engagement while large holders sell more tokens after receiving Airdrop. Our results suggest that airdrop is an effective tool for increasing market liquidity and user engagement, even if users sell tokens immediately upon receipt.

Our study makes several noteworthy practical contributions. Firstly, our findings shed light on the ongoing controversy surrounding airdrops on tokenization platforms and their effectiveness. We investigate the overall impacts of Airdrops and we find great positive spillover effects with little negative spillover effects, which assures the effectiveness of airdrops as a free incentive approach. Secondly, our results have revealed

[2] https://gigworker.com/uber-invite-code-drivers/
[3] https://coinmarketcap.com/airdrop/

that airdrops, which provides valuable insights for token platforms in the design and implementation of airdrop projects.

This paper presents several theoretical contributions to the study of token economy. Firstly, it identifies a gap in prior literature, which primarily focuses on the financial implications of airdrops and neglects the crucial aspect of user engagement. Taking a long-term perspective, the study reveals that airdrops have significant cross-category and cross-group spillover effects on tokenization platforms. Secondly, the study examines the personal investment decisions of individuals on tokenization platforms, which differ from those on traditional platforms. Intriguingly, the findings indicate that users tend to increase their usage of the platform while investing less in tokenization platforms. This discovery contributes to the existing literature on platform adoption.

The remainder of this paper is structured as follows. Section 2 summarizes the related literature. Section 3 lays out the theoretical underpinnings of our study and posits our hypotheses. Section 4 illustrates the industrial background and describes the dataset that we employ to test our hypotheses. In Section 5, we detail our empirical methodologies and present our findings. Finally, Section 6 summarizing our main findings and their implications for the field.

Related Literature

Tokenization Platforms

Tokenization platforms leveraging blockchain technology have garnered substantial interest in recent years (Bakos and Halaburda 2022; Chod et al. 2022b; Gryglewicz et al. 2021; Sockin and Xiong 2023a; Sockin and Xiong 2023b). One strand of the literature has concentrated on the advantages of tokenization, such as mitigating moral hazard (Chod et al. 2022b), resolving coordination challenges (Bakos and Halaburda 2022) within novel marketplaces, and tackling the platform's time-inconsistency problem(Cong et al. 2022).

Another branch of research has directed its attention toward initial coin offerings (ICOs), an innovative fundraising mechanism for blockchain-based platforms, associated with tokenization platforms (Davydiuk et al. 2023; Gan et al. 2021; Holden and Malani 2022; Lyandres et al. 2022; Xu et al. 2021). For instance, Davydiuk et al. (2023) discovered that ICO issuers retaining a more considerable portion of their tokens experience greater success in fundraising endeavors and demonstrate a higher likelihood of developing a functional product. Lyandres et al. (2022) posited that post-ICO operational performance has financial implications. Xu et al. (2021) investigated the influence of heterogeneous effect, like team knowledge, on ICO success.

Notwithstanding the existing research predominantly focusing on ICOs' impact on the operational management of platforms, the impact of token supply on users' behavior, a critical aspect of tokenization platform development, remains largely unexplored. In the present study, we explore the effect of airdrops on tokenization platforms, aiming to elucidate whether airdrops serve as an efficacious instrument for blockchain-based platform managers.

User Engagement in Online Platforms

User engagement has emerged as a vital area of inquiry within the domain of academic information systems. Extensive research on this subject has been conducted across several platforms, including knowledge sharing (Chen et al. 2010; Khansa et al. 2015; Zhao et al. 2016), health management (Bao et al. 2020; Bardhan et al. 2020; Zhou et al. 2022), online learning(Leung et al. 2022), and social media (Lee et al. 2018). Of particular interest, the video game industry represents a relevant field for the investigation of user engagement. Within this domain, Wiebe et al. (2014) suggest that user engagement in video games is influenced by several factors, such as focus attention, perceived usability, aesthetics, and satisfaction. Fang et al. (2019) examine the relationship between players' paying behaviors and their social networks, highlighting the positive impact of players' direct connections on their willingness to pay. Gu et al. (2022) reveal the significant influence of crowdsourcing features on user engagement in video games. Kwon et al. (2016) explore the evolution of player engagement post-purchase, while Huang et al. (2019) propose a novel two-stage Hidden Markov Model approach to optimize customer game-play experiences. Following Huang et al. (2019), we mainly leverage participation level and game-play outcomes as two measures of user engagement.

Despite the prevalence of financial incentives as a means of promoting user engagement in the video game industry, limited research has focused on the impact of airdrops. This research seeks to address this gap by using on-chain data to estimate the effect of airdrops on player engagement, as well as the spillover effect of airdrops on those who do not receive them. The findings of this study can provide valuable insights for video game platforms seeking to design effective token incentive plans to promote user engagement.

Financial Incentives

Financial incentives are common tools used by platforms managers to motivate desired behaviors (Tang et al. 2012). Previous studies have investigated the effectiveness of financial incentives in promoting desired behaviors targeted by such incentives. Overall, these studies have found that financial incentives can enhance user engagement in online communities (Burtch et al. 2018a; Lu et al. 2018; Shriver et al. 2013). However, some findings suggest that monetary rewards can also lead to a decrease in users' online contributions (Khern-am-nuai et al. 2018; Sun et al. 2017). Gneezy et al. (2011) argue that the effectiveness of financial incentives is contingent on the specific behavior being targeted and the amount of the incentive offered. Furthermore, spillover effects of financial incentives have been observed in knowledge sharing platforms (Kuang et al. 2019; Wang et al. 2022). Specifically, these studies report that the introduction of monetary incentives by knowledge sharing platforms can influence non-rewarded knowledge activity on the platform.

Despite the widespread use of airdrops in various contexts, a paucity of research exists on their impact on user behavior. While Gao and Leung (2022) have reported that airdrops can significantly enhance user trading behavior, their study solely focuses on user engagement behavior, without accounting for the potential spillover effects of airdrops. To address this gap in the literature, the present research endeavors to investigate the multifaceted impact of airdrops on play-to-earn markets. Specifically, this study seeks to deepen our understanding of the implications of airdrops for user behavior in these emerging markets.

Theoretical Foundation and Hypothesis Development

Cross Category Spillover Effects

The spillover effect is a well-established phenomenon whereby a party benefits from the actions of another party without significant costs (Han et al. 2012). This effect has been widely studied in various contexts, including editor-curated recommendations (Liang et al. 2019), advertising (Garthwaite 2014; Lewis and Nguyen 2015), and promotion (Erdem and Sun 2002; Parshakov et al. 2020; Zhang et al. 2020). Of particular relevance to this study is the research on the spillover effect of product promotion, which has been the subject of numerous empirical studies. For example, Erdem and Sun (2002) identified advertising and sales promotion spillover effects for umbrella brands, while Garthwaite (2014) found that advertisements had a positive impact on the sales of other books by the endorsed authors. Liang et al. (2019) discovered a positive spillover effect of editor recommendations on related apps, and Zhang et al. (2020) established the unintended long-term consequences of promotion, where there is a negative spillover effect on sellers who did not offer promotions.

Another related stream of literature is the spillover effect of financial incentives. Mochon et al. (2017) found no negative spillover effect on exercise and customer loyalty of health interventions, while Kuang et al. (2019) investigated the impact of financial incentives on non-financial user engagement, such as social engagement in the platform. According to Wang et al. (2022), the utilization of monetary incentives may serve as an effective means of fostering user participation across both compensated and uncompensated endeavors. However, it is imperative that platform proprietors exercise prudence with respect to the potential adverse repercussions that may arise subsequent to user disengagement from the remunerated activity. Therefore, based on the existing literature, users tend to participate in other related market activities in the tokenization platform when they receive the airdrop. Formally, we posit the following hypothesis:

Hypothesis 1: The implementation of a specific Airdrop will lead to increased market activity of other related tokens of the tokenization platform.

Cross Group Spillover Effects

Three underlying factors can contribute to the occurrence of cross-group spillover effects. Initially, individuals who have not received airdrops may anticipate the possibility of subsequent airdrop initiatives, prompting them to enhance their engagement in order to qualify for future airdrop distributions. This phenomenon arises from the fact that the quantity of airdropped tokens an individual obtains is contingent upon their level of engagement. Subsequently, heightened market liquidity might serve as a catalyst for non-recipients to increase their participation. The augmented market liquidity could potentially incentivize non-recipients to engage in token trading activities, thereby fostering a heightened degree of engagement within the broader market. Lastly, the influence of social dynamics could also be instrumental in stimulating non-recipients to elevate their engagement levels. Social interactions have been established as an essential factor in shaping spillover effects. The impact of social interaction have been studied in different work settings, including local labor markets (Cornelissen et al. 2017), teachers (Jackson and Bruegmann 2009), academic scientists (Waldinger 2012), supermarket workers (Mas and Moretti 2009), and call center workers (De Grip and Sauermann 2012). Notably, Cornelissen et al. (2017) found substantial peer effects in the wages of low-skilled workers, while Frakes and Wasserman (2021) established strong evidence of peer influence in patent examiners' granting behaviors. Tokenization platforms, by enabling users to engage in trading and interact with others, have the potential to generate significant spillover effects of recipients and nonrecipients. These effects are expected to benefit not only individuals who receive airdrops but also those who do not. Therefore, we propose the following hypothesis:

Hypothesis 2: Users, including those who receive the Airdrop and those who do not(H2b), will increase the market activity if there is an Airdrop activity (e.g., free cryptocurrency) on tokenization platform.

Investment Decision

Participants on tokenization platforms serve as both users and investors, underscoring their multifaceted role in these platforms (Chod et al. 2022b). Pertinent literature in this area has focused on users' investment decisions in crowdfunding platforms (Burtch et al. 2016; Burtch et al. 2018b; Jiang et al. 2018). Jiang et al. (2020) have posited that individuals strive to strike a balance between profitability and associated risks when making investment decisions. In the context of tokenization platforms, the risk of holding tokens may increase due to concerns that an airdrop could dilute token value. Accordingly, we contend that individuals who receive an airdrop may prioritize the immediate sale of the airdropped tokens for fiat currency. Furthermore, we anticipate that those individuals who do not receive an airdrop will also opt to sell their tokens following the airdrop project due to potential risks associated with the airdrop. In light of these considerations, we advance the hypothesis that both airdrop recipients and non-recipients will choose to sell their tokens:

Hypothesis 3: Users, including those who receive the Airdrop(H3a) and those who do not(H3b), will decrease their cryptocurrency balance if there is an Airdrop activity on tokenization platform.

Research Context and Data

Industrial Background of Play-to-earn Games

Play-to-earn (P2E) is a game mechanic that utilizes blockchain technology, whereby players are incentivized to complete various tasks, engage in battles with other players, or progress through different levels within a game with the aim of receiving cryptocurrency tokens as rewards. The underlying principle that governs P2E games is straightforward: the amount of time and effort that a player devotes to the game is directly proportional to their likelihood of obtaining rewards that possess tangible value, primarily in the form of cryptocurrency tokens.

Figure 1 presents a comparative analysis of traditional games and play-to-earn games, highlighting their principal distinctions. In traditional games, players typically acquire game assets, such as character skins and in-game items, from the platform through purchase. In contrast, blockchain games enable players to exchange earned tokens or assets for fiat currency. This facilitates the ability of players to sell game assets to other players or purchase desired assets from others, thereby affording greater flexibility to players of blockchain games who may opt to liquidate their game assets and exit the game. Furthermore, while traditional game developers rely on income generated by selling game assets, play-to-earn game developers generate revenue through the distribution of tokens governed by smart contracts. These tokens may also be sold for real money. Lastly, players of play-to-earn games occupy the dual role of users and investors.

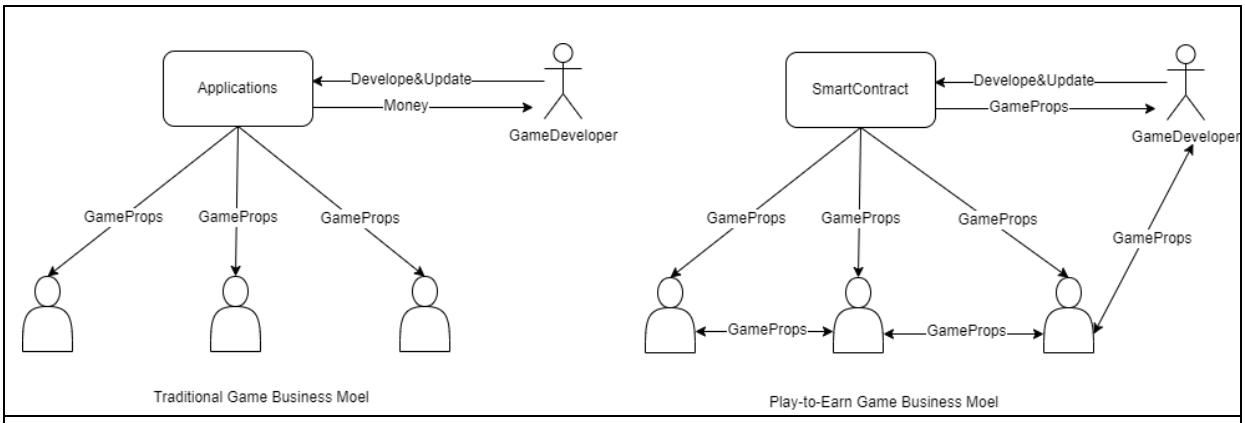

Figure 1. Traditional games vs. Play-to-Earn games business model

Axie Infinity and The Sandbox present captivating platforms for empirical inquiry into the effects of token-based incentives on user participation, owing to their prominent roles as leading play-to-earn ecosystems. As two of the foremost and accomplished initiatives within this realm, they furnish extensive data for analyzing the interplay between token-based rewards and user engagement. The Axie Infinity airdrop has garnered the attention of a substantial user base, and its airdrop initiative stands out as an early and recognizable endeavor within the web3 landscape. To establish a comparative framework, we select The Sandbox as the control group, given the shared characteristics of early creation time, and popularity with Axie Infinity.

Axie Infinity is a renowned blockchain-based game that incorporates the "play-to-earn" mechanics, which enables participants to acquire cryptocurrency tokens by participating in battles with other players. In this game, players can procure their own virtual pets referred to as axies, which exist within the Axie Infinity universe, and their ownership is registered on the blockchain as non-fungible tokens. Each axie consists of six distinctive body parts, determined by a unique genetic code, with the attributes of the axies derived from these body parts. Additionally, the game includes two forms of fungible tokens, Axie Infinity Shards (AXS) and Smooth Love Potion (SLP). AXS serves as a fungible governance token for the Axie Universe, enabling players to engage in the game, participate in critical governance votes, and breed new axies using AXS.

On September 30, 2021, Axie Infinity unveiled an airdrop initiative wherein 800,000 AXS were disseminated to players who engaged in the game before October 26th, 2020, constituting a value of over 60 million dollars. The primary objective of this airdrop program is to acknowledge the users' persistent dedication towards Axie Infinity. The amount of AXS allocated to each participant is contingent on their wallet activity.

The Sandbox is a play-to-earn game that bears similarities to Axie Infinity. As a blockchain-based game, it shares commonalities with the traditional game, Minecraft. The fungible tokens in Sandbox, known as Sand, are comparable to the AXS tokens used in Axie Infinity. The game permits players to engage in the exchange of in-game assets, such as lands and Sand, with other players. In our research study, the Sandbox game serves as the control group to identify the impact of airdrop.

Data

We have constructed a dataset that amalgamates data from both Axie Infinity and Sandbox games to identify the impact of airdrops on Axie Infinity. Utilizing the Covalent application programming interface (API), we have gathered players' historical transactions and balances for both games. Our data processing procedure is as follows. First, we normalize the number of Sand by multiplying the number of sandbox tokens by the ratio of the mean amount of AXS to the mean amount of the Sand. Second, to ensure the exclusion of fake addresses, we have discarded those who have only made a single transaction during the observation period. Additionally, we have excluded addresses that have executed more than 500 transactions since many exchange addresses, such as Binance, are solely utilized for token transactions. Consequently, we contend that our approach has enabled the identification of genuine players of play-to-earn games. Due to the limited capacity of the API, we have randomly selected 100 addresses that have

received the airdrop and 100 addresses that have not received it, to carry out our empirical research. Table 1 reports the summary statistics of the variables. Axie Infinity players accounts for about 18% in our data and individual players publish 1.41 transactions on blockchain on average. What's more, players received 1268 AXS during the airdrop project and user hold 1201 tokens in their wallet on September 1st.

	Definition	Mean	Std.Dev.	Min	Max
Transactions	Individual published transactions on Chain on a specific week	1.41	6.53	0	388
Game-Play Outcome	SLP, Axie mint transactions	3.897	19.70	0	368
Balance	Average amount of AXS in personal wallet of a specific week	1294.17	33134.16	0	1195403
SLP Transactions	Another kind of tokens in Axie Infinity	1.90	11.63	0	388
Treat	Axie Infinity player or not	0.18	0.39	0	1
TransactionCountBefore	Address published Transactions on Chain between August 1st ,2021 and September 1st ,2021	4.92	8.29	0	30
BalanceBefore	Amount of AXS in personal wallet on September 1st ,2021	1201.01	30294.77	0	994342.62
TokenAmountBefore	Amount of AXS that one address exchange before September 1st ,2021	1305.47	9628.34	0	165942
Experience	Number of days for users to join the game as of September 1st,2021	82.79	62.51	3	212
AirdropAmount	Airdrop received from the airdrop project	1268.06	3297.40	0	26452.109

Table 1. Descriptive Statistics

Empirical Methodology

We use a quasi-experimental difference-in-differences to approach to estimate the influence of airdrop, wherein change in the outcome variable (Transactions, Game Play Outcomes and balance) of the treatment groups is compared with that in the control groups. Here, we first discuss the choice of treatment group and control group. We then specify the regression that will be used to test the main theoretical predictions.

Treatment and Control Groups. It is a common idea for scholars to use those who do not receive airdrop as control group(Cong et al. 2023). However, within the context of tokenization platforms, the tradability of airdrops between users can give rise to spill-over effects that may impact non-airdrop recipients. Furthermore, it is argued by some that the distribution of airdrops may result in the dilution of value for non-airdrop recipients. In this regard, it is pertinent to explore alternative control groups, such as the Sandbox token market, which is another play-to-earn game. The Sandbox token market is deemed suitable to be the control group because of the co-movement of tokens.

Coarsened Exact Matching. Our primary objective is to employ **Coarsened Exact Matching** (CEM) methodology to construct a dataset that emulates a randomized experiment. Specifically, we utilize CEM to establish a pair of play-to-earn users who possess comparable characteristics. We consider the users of the Axie Infinity game as the treatment group, while the users of the Sandbox game are regarded as the control group.

The purpose of our study is to identify a set of users whose observable characteristics closely resemble those of users who received the Axie Infinity Airdrop. To this end, we employ Coarsened Exact Matching (Liu et al. 2022; Wang et al. 2022), where we utilize four matching variables: transactions between August 1st and September 1st, balance on September 1st, token transfer amount between Aug 1st,2021 and number of days from the users' first transation to September 1st,2021.

Difference-in-Difference. After matching, we can get a panel data set such that each observation corresponds to a user. Meanwhile the unit of time is defined as weekly. Hence, we have a total of 9 weeks, namely 4 weeks before and 5 weeks after the Axie Infinity airdrop. The dependent variables of our model are the number of transactions of each address published each week and average number of token holdings of each address. We employ difference-in-difference regression to analyze the impact of airdrop on Axie Infinity users. The difference-in-difference regression specification is as follows:

$$\boldsymbol{DV_{it} = \gamma(\mathbf{Treatment_i} \times \mathbf{After_t}) + \beta \mathbf{X_{it}} + \alpha_i + \delta_t + \varepsilon_{it}} \quad (\mathbf{1})$$

In Equation (1), subscript i denotes the address and t denotes the week. DV_{it} represents the dependent variables, which will be specified later. Meanwhile, α_i capture address individual fixed effects and δ_t capture time fixed effects. For example, the price of AXS and SAND will impact the transactions on chain and it can be captured by δ_t. $Treatment_i$ is an indicator variable that represents whether the user is treated. In our data sample, all users of Axie Infinity are considered as treatment group but we conduct our difference-in-difference separately. $\mathrm{After_t}$ indicates whether it is post-treatment period. Finally, $\mathrm{X_{it}}$ is a vector that represents time-varying control variables. We use $\mathrm{TransactionCount_{t-1}}$ and $balance_{t-1}$ in this research.

Aside from the effect of airdrop on market, we explore the heterogenous treatment effect. Particularly, we examine how the airdrop amount and personal balance of individual players moderate the effect that airdrop has on gameplayer engagement. We include these variables, denoted by $Moderator_i$, as an interaction term that moderates the effect of $Treatment_i \times After_t$ in our specification. Formally, our second mode specification is

$$\begin{aligned}\boldsymbol{DV_{it}} &= \boldsymbol{\gamma(\mathbf{Treatment_i} \times \mathbf{After_t}) + \beta \mathbf{X_{it}}} \\ &\quad \boldsymbol{+\eta(\mathbf{Treatment_i} \times \mathbf{After_t} \times Moderator_i) + \alpha_i + \delta_t + \varepsilon_{it}} \quad (\mathbf{2})\end{aligned}$$

Main Results

In this section, we first verify our Hypothesis 1 to explore the impact of airdrops on the number of Transactions and Activity. We first sought to examine the potential cross-category spillover effect of Airdrops in the context of tokenization platforms. To this end, empirical analyses were conducted, and the results are presented in Table 2. The findings provide consistent support for Hypothesis 1. Specifically, the analysis reveals a statistically significant increase in both the number of transactions and market activity of AXS related tokens, SLP, subsequent to the Axie Infinity airdrop. This outcome lends support to the contention that cross-category spillover effects are discernible in the context of tokenization platforms.

	Log-SLP Transactions		SLP Activity	
Variable	(1)	(2)	(3)	(4)
Treatment×After	6.3663*** (1.8439)	8.6550** (2.2382)	0.1420 *** (0.0408)	0.1900 *** (0.04751)
Lag transaction/balance	No	Yes	No	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	1710	1520	1710	1510
R-square	0.0078	0.0171	0.0079	0.0133

Table 2. DID estimation of the Effects on related Token

Table 3 present the empirical test for Hypothesis 2a results. The results of our analysis provide consistent support for Hypothesis 2a. Specifically, we find that following the Axie Infinity airdrop, there is a statistically significant ($p<0.01$) increase in the number of transactions among those who received the airdrop, with an average increase of nearly 100% in the subsequent month (column (1) and column (2)). In addition, we also observe a statistically significant ($p<0.01$) increase in game play outcome, as measured by whether users publish transactions, with an average increase of approximately 90% in the subsequent month.

Table 4 presents the empirical analysis of users of Axie Infinity who did not receive an airdrop, which is consistent with our Hypothesis 2b. Our findings reveal a statistically significant rise in the number of transactions among this group in the following month, as reflected in column (1) and column (2), with a nearly 50% transaction increase. This increase is comparatively smaller than that of those who did receive the airdrop. Moreover, the game play outcome average effect for those who did not receive the airdrop is approximately 20%. These results provide support for Hypothesis 2.

	Log-AXS Transactions		Game-Play Outcome	
Variable	(1)	(2)	(3)	(4)
Treatment×After	1.2242*** (0.0695)	1.0992 *** (0.8181)	0.9392*** (0.3110)	0.8362 *** (0.3711)
Lag transaction/balance	No	Yes	No	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	1710	1520	90	80
R-square	0.1702	0.1715	0.1138	0.1483

Table3. DID estimation of the Effects on users who receive Airdrop

	Log-AXS Transactions		Game-Play Outcome	
Variable	(1)	(2)	(3)	(4)
Treatment×After	0.5205*** (0.0351)	0.4652 *** (0.0387)	0.1690*** (0.0384)	0.1833*** (0.0418)
Lag transaction/balance	No	Yes	No	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	4986	4432	3978	3536
R-square	0.0473	0.0485	0.0054	0.0178

Table 4. DID estimation of the Effects on users who do not receive airdrop

Mechanism Analysis

In order to find out why cross group spillover effects occur, moderators are introduced for differentiation. Concerning expectation for another airdrop program, the influence of game experience on the relationship is examined using it as a moderator. In the case of Axie Infinity's airdrop design, a designated cutoff date of October 26th, 2020 is established, entitling platform entrants before this date to receive the airdrop. If non-recipients anticipate subsequent airdrops, those with greater experience are more inclined to be airdrop beneficiaries. Consequently, we anticipate heightened post-airdrop activity among nonrecipients with more substantial experience. Estimation outcomes are presented in Table 5. Table 5 shows that users with more experience are more active. These findings substantiate the proposition that individuals who did not receive the initial airdrop exhibit heightened activity, potentially attributed to their anticipation of forthcoming airdrop initiatives.

	Log-AXS Transactions		AXS Activity	
Variable	(1)	(2)	(3)	(4)
Treatment×After	0.4572 *** (0.0383)	0.420*** (0.042)	0.3098*** (0.261)	0.2946 *** (0.0283)
Treatment×After× Experience	0.0013*** (0.0003)	0.0010*** (0.0004)	0.0009*** (0.0002)	0.0007*** (0.0002)
Lag transaction/balance	No	Yes	No	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	4986	4432	4986	4432
R-square	0.0508	0.0504	0.0507	0.0506

Table 5. Experience Moderating Effect on the Impact

Regarding increased market liquidity, it's important to note that market liquidity is a macro-level attribute that defies individual-level identification. To illustrate the amplified market liquidity, we furnish aggregated market-level statistics. Figure 1 vividly illustrates fluctuations in mean market liquidity, computed as the ratio of Transfers to Addresses. The demarcation of the airdrop event is indicated by the red line. Evidently,

Axie Infinity's market liquidity has experienced significant enhancement. This augmentation in market liquidity potentially contributes to the heightened engagement of non-recipient users.

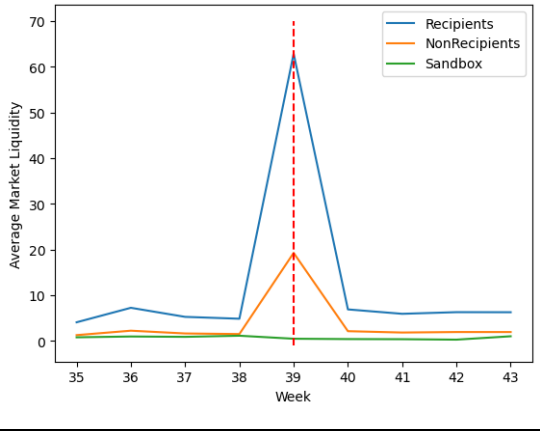

Figure 2. Market Liquidity

Regarding social influence of recipients, we perform a subsample analysis to ascertain the presence of social influence. Specifically, we examine nonrecipients who exchange tokens with recipients to determine their activity levels relative to non-traders. The results are presented in Table 6, indicating that trading nonrecipients do not exhibit higher activity compared to their non-trading counterparts. Consequently, these findings imply the absence of social influence within tokenization platforms.

In summary, cross-group spillover effects emerge due to expectations of future airdrops and market liquidity. However, insufficient evidence is found to support the notion that nonrecipients become active due to social influence.

	Log-AXS Transactions		AXS Activity	
Variable	(1)	(2)	(3)	(4)
Treatment×After	0.3737 * (0.2177)	0.5268* (0.2767)	0.3142* (0.1746)	0.3989* (0.2262)
Lag transaction/balance	No	Yes	No	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	224	198	224	198
R-square	0.0154	0.0265	0.0169	0.0232

Table 6. Nonrecipients who trade with recipients

Subsequently, we conducted an analysis on the impact of the airdrop on the users' balance. The results indicate a noteworthy decrease in the token holdings of those who received the Axie Infinity airdrop and those who do not receive the Axie Infinity airdrop. On average, their balance reduced by over 200 AXS. These findings provide compelling evidence in support of Hypothesis 3a. As per Hypothesis 3b, we anticipated observing a decrease in their balance. However, our results fail to provide significant support for Hypothesis 3b. In other words, we did not observe any significant evidence indicating that the users of Axie Infinity who did not receive the airdrop decreased their token balance in the subsequent month.

	AXS balance	
Variable	(1)	(2)
Treatment×After	-260.12** (123.13)	-185.69 (2260.20)
Individual FE	Yes	Yes
Time FE	Yes	Yes
Observations	1710	4986
R-square	0.00294	1.526e-6

Table 7. DID estimation of the Effects on AXS holding

Heterogeneity

Our analysis investigates the differential impact of airdrop on transactions among users holding varying balances. Table 8 shows that airdrop on large holders would not increase their engagement while motivate them to sell more tokens. These results suggest that airdrop on small token holders is beneficial for platforms development.

	AXS Transactions		Balance	
Variable	(2)	(2)	(3)	(4)
Treatment×After	1.2232*** (0.0695)	1.1051 (0.0819)	-248.20** (119.19)	7.2494 (115.56)
Treatment×After× BalanceBefore	0.0006 (0.0004)	0.0003 (0.0005)	-7.610*** (0.7508)	-3.7859*** (0.6966)
Lag transaction/balance	No	Yes	No	Yes
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	1710	1520	1710	1520
R-square	0.1711	0.173	0.0665	0.3183

Table 8. Heterogeneous effect of Airdrop Treatment

Robustness Checks

To verify that the differential effect of airdrop in the preceding are not driven by systematic differences between the two types of tokens before the Axie Infinity airdrop, we analyze the pre-airdrop dynamics of our estimate. As shown in Table 9, no significant pre-trends are observed. We believe this result provide us further evidence to support our findings.

	Log-Recipient A Transactions	Log-Recipient AXS Transactions	Log-Recipient AXS Balance	Log-Non-Recipient AXS Transactions
Variable	(1)	(2)	(3)	(4)
Treatment × pre 2W	2.0370 l(3.3648)	0.0634 (0.1270)	118.28 (224.92)	0.7323 (0.7173)
Treatment × pre 1W	4.2694 (3.8853)	0.078 (0.1466)	-181.39 (259.71)	0.7528 (0.8283)
Treatment × Afer	2.1457 (3.0095)	1.250 *** (0.1136)	-183.22 (201.17)	-0.0158 (0.6415)
Individual FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	1710	1710	1710	4986
R-square	0.0101	0.17038	0.0022	0.0022

Table 9. Pre-Trend Analysis

Discussion and Conclusion

The proliferation of blockchain technology has led to the emergence of platform tokenization. To augment user engagement and broaden their user base, numerous tokenization platforms have turned to airdrop as a marketing strategy. By utilizing airdrop, these platforms aim to stimulate interest among users and entice new users to participate in their platform. Despite the increasing popularity of airdrop as a marketing strategy for tokenization platforms, its effectiveness in promoting the development of these platforms remains a controversial issue within the industry. Moreover, research investigating the impact of airdrop, which is a novel financial incentive, on user engagement and behavior is limited. Recognizing this gap, this study explores the economic implications of airdrop on user behavior, aiming to contribute to the literature on the effectiveness of airdrop as a marketing tool on the tokenization platforms.

To formulate our research hypotheses, we drew upon prior literature in the areas of spill-over effects and psychology. Our theoretical development posits that airdrop initiatives may enhance user engagement but could also prompt users to sell their token holdings. Moreover, we argue that the magnitude of t individual user balances can moderate the impact of airdrop on user behavior. To test these hypotheses, we collected a dataset consisting of user transaction records and personal token holdings. Using Coarsened Exact Matching and difference-in-differences regression analysis, we conducted empirical investigations into the impact of airdrop initiatives on user behaviors. Specifically, we analyzed the effects of airdrop projects on user activity levels and their decisions regarding personal token holdings.

The results obtained through empirical analysis corroborate our first hypothesis, which suggests that airdrops not only augment the engagement levels of the beneficiaries, but also positively impact the involvement of non-recipients. Our mechanism analysis shows that cross group spillover effects stems from expectation for another airdrop program and increased market liquidity. s. Furthermore, our findings demonstrate that upon receiving airdrops, players are inclined to decrease their token holdings. We did not observe a significant reduction in the token holdings of players who did not receive the airdrop. Notably, our investigation reveals that the influence of the airdrop on token holding decisions is contingent on the personal token holdings of the players, while airdrop impact on user engagement is not moderated by personal token holdings.

Our study constitutes a substantial contribution to both academic research and practical applications. Theoretically, our paper presents compelling evidence of the spillover effect of airdrops, which is a new way of financial incentives on decentralized tokenization platforms. Existing research mainly focus on token value and token market activity while this paper focus on the impact of airdrops on user engagement. We find both cross category and cross group spillover effect of the airdrops on tokenization platforms. What's more, we conduct a mechanism analysis to find out the mechanism of cross group spillover effects, which contribute the source of spillover effects.

Furthermore, the present study significantly expands upon the existing body of knowledge pertaining to individual investment decision-making processes on peer-to-peer tokenization platforms. Distinct from traditional platforms, tokenization platforms witness individuals assuming dual roles, as both users and investors. Our investigation reveals that, subsequent to receiving airdrops, individuals exhibit a predilection for reducing their token holdings.

In practice, our comprehensive empirical analysis demonstrates that airdrops serve as an efficacious instrument for augmenting user engagement. Importantly, the potential adverse effects of airdrops, as postulated by some, do not manifest in the context of our study, which is set against the backdrop of a thriving cryptocurrency market. Although airdrop recipients display a propensity to liquidate their tokens, this behavior neither incites market panic nor prompts non-recipients to divest their holdings. In light of these findings, we advocate for tokenization platforms to strategically employ airdrops as a means of capitalizing on their potential, particularly within burgeoning markets.

In addition, we demonstrate that the impact of airdrops on user engagement is not influenced by personal token holdings while large holders tend to sell more tokens after receiving airdrop. These results suggest that airdrop on small token holders is more beneficial for platform growth without causing market panic. Our research shed lights on airdrop program design.

Our research is not without limitations, which also represent avenues for future research. Firstly, our analysis was conducted within the context of a cryptocurrency bull market. Given that the Axie Infinity airdrop occurred during a period of bullish market sentiment, coinciding with an upsurge in Bitcoin's value, it remains unclear whether our findings are transferable to other market scenarios. Secondly, with the evolution of airdrop projects, new types of airdrops have emerged that incentivize users to complete specific tasks in order to receive the airdrop. Our investigation focused solely on basic airdrop methods and their empirical impact, neglecting to explore other varieties of airdrops. Nonetheless, our research offers a promising methodology for discerning the influence of different airdrop types across diverse market scenarios. Future research could explore the impact of these other airdrop types in different market contexts to provide a more comprehensive understanding of the efficacy of these mechanisms.

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