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Emerging Trends in Play-to-Earn (P2E) Games

Andreea Raluca Duguleană [1], Cristina Roxana Tănăsescu [1] and Mihai Duguleană [2,*]

[1] Department of Management, Marketing, Business Administration, Faculty of Economics, "Lucian Blaga" University of Sibiu, 550324 Sibiu, Romania; andreearaluca.farcasel@ulbsibiu.ro (A.R.D.); cristina.tanasescu@ulbsibiu.ro (C.R.T.)
[2] Department of Automotive and Transport Engineering, Faculty of Mechanical Engineering, "Transilvania" University of Brasov, 500036 Brasov, Romania
* Correspondence: mihai.duguleana@unitbv.ro

Abstract: This research aims to establish the primary drivers influencing the development and consumers' decision-making process in web3 games—decentralized games that function according to the play-to-earn paradigm. We observe several types of micro-economies developed within five play-to-earn games and highlight four roles consumers play at any given time. Our study offers a different perspective on rational consumer behaviour in cryptocurrency-based games and paves the way to better understanding their dynamics and evolution. Results shed light on the construction of in-game economies and how individuals of a given type engage in different playing activities. Furthermore, we compare the key features of web3 games with those similar to classic online games and assess if the play-and-earn implementations represent an evolution from previous revenue models. Using our proposed methodology, researchers can compare and classify any P2E games. We conclude by establishing a set of actions that enable consumers to benefit from this new phenomenon.

Keywords: play-to-earn; consumer behaviour; blockchain; web3 games; non-fungible tokens

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1. Introduction

Depending on the context, the gaming industry uses several types of revenue models to sustain itself. Historically, the entertainment companies that produced the first games monetized them by using the buy-to-play (B2P) model [1], which presumed a one-time fee paid prior to playing, while the digital game would have been available physically on a medium such as a floppy disk or CD [2].

As the technology evolved, so did the revenue models. In the late 1990s, taking advantage of the emergence of the internet, video game companies could apply other monetization strategies [3]. One of the most common was by subscription (also called pay-to-play—P2P), a method that requires users to pay a recurring fee to continue accessing the game. One of the most successful implementations of this model was achieved in Activision Blizzard's World of Warcraft (WoW), a massively multiplayer online role-playing game that had, at its peak, over 12 million active players, and which still retained over 4.7 million players in 2021, although the original version was released in 2004 [4,5]. Blizzard's idea of using the P2P model originated not only from financial considerations but also from the development point of view, as WoW received continuous improvements over the last decade, including eight expansion packs which deeply expanded the original universe and functionality. Companies use the subscription business model in cases where the goods or the services offered are continuously improved, thus giving their customers a reason to keep paying the recurring fee [6].

By 2010, with the emergence of smartphones, another revenue model knew a rapid adoption: free-to-play (F2P). F2P games offer some of their content for free, but players must pay to enhance their in-game experience [7]. One of the most dominant forms of F2P revenue models at the moment uses in-game ads, which appear as, e.g., footer banners

visible throughout the entire gameplay experience or as videos that require watching to obtain an in-game advantage or to move over to superior levels. With this particular revenue model, users pay with their time and with their exposure to commercials about new goods and services, usually new games or mobile applications related to the ones they are using [8].

Another form of F2P games is linked to the freemium concept. Freemium pricing strategy allows users to access basic functionality but requires payment to access additional content or to use additional digital goods—which may even increase the chances of success, in which case the revenue model transforms into a pay-to-win paradigm [9]. Free-to-play, and more specifically, freemium, is the most rapidly growing segment of the video game industry in terms of revenue generation. Unlike the traditional B2P model, where the game's success is measured by the number of units sold, F2P's most important factor is the number of active players, followed by the number of spending venues. Depending on their engagement, players can spend different amounts of money. In some cases, 1% of the players or even less may account for more than 50% of revenue [10]. About 10% of the users spend large amounts, 40% spend average amounts, and the rest spend the minimum amount necessary to maintain the playing activity [11]. One of the most successful games that uses the F2P model is Candy Crush Saga. Although the game was launched more than a decade ago, the latest financial reports from its current owner, Activision Blizzard, show that the game still produces more than USD 1 billion per year, while other sources show that only 2% of its users make an in-game purchase [12,13].

Although the revenue models presented above satisfy the purpose of gathering the funds from users and distributing them to the producing companies, for some of the games and depending on the context, a functionality that could allow users to share or trade in-game assets was missing. Several attempts have been made to solve this issue. For example, several third-party entities created forum-like marketplaces for successful multiplayer games, where players could list their items or participate in auctions with real currency. At the same time, the trading process would be completed inside the actual games. This process was laborious and not entirely safe, but it could, for the first time, allow players to earn from playing. For example, a digital good from the renowned game Second Life was sold on eBay for USD 50,000 in 2007 [14]. Most of the time, however, the makers of the games were not happy with trading digital goods outside the game itself. Many auctions and trades resulted in user bans. Following this turn of events, in some cases, the companies producing the games started to offer marketplace sections, some even making use of an in-game currency [15]. However, the problem of transporting the value produced inside the game to the outside world was not solved, as in most cases, the primary beneficiary remained the entity who created and owned the game, mainly due to financial reasons. For example, buying and selling digital goods inside a game is a thriving revenue venue for Activision Blizzard, as microtransactions (in-game transactions) amounted to USD 5.1 billion in 2021 [13]. It is also worth mentioning additional ways of earning revenue from classic online games, such as competitions, tournaments, or other types of events. Although we acknowledge their financial potential (e.g., in the latest Dota competition, the prize pool was USD 19 mil) [16], these are not connected to the in-game economy, and are in most cases used as a marketing vehicle.

Based on the new development of blockchain technologies, one of the most recent advancements pushes for a new revenue paradigm titled play-to-earn (P2E). In a decentralized manner, P2E allows both companies to receive revenue and players to trade their earned digital goods and thus earn an income. However, P2E has become highly sought after by consumers for several compelling reasons besides the economic incentives. P2E players enjoy having complete ownership over their in-game assets. Moreover, P2E games offer transparent and secure transactions, not to mention elevated financial inclusion—individuals who might not have access to traditional financial systems can participate and earn income through gaming.

The most common term for applying decentralization to the internet is Web3. Web3 seeks to apply blockchain principles (immutability, security, transparency) and other distributed ledger technologies to the existing web infrastructure, thus enabling developers to create in-game economies and users to trade digital goods and tokens more effectively. Investigating the motivations, actions, and behaviours of the different player types in P2E web3 games is an emerging area of inquiry with limited contributions available. Therefore, the objective of this study is to conduct exploratory research using ethnographic methods [17] to closely engage with the research context through in-depth fieldwork and gain new insights into the types of consumers who prefer this paradigm. The research aims to understand how these players engage with P2E games, what motivates them to participate, and how financial decisions are made. Our purpose is to advance the understanding of the different player types in P2E games and their role in shaping the in-game economy. This can help game developers and marketers to better cater to the needs of different players and maximize their potential. Additionally, this research can help players make more informed decisions about which types of games to play and how to approach earning rewards within those games.

In this rapidly evolving landscape, our study focuses on trends that are reshaping the intersection of gaming, finance, and blockchain technology. Our research is motivated by the way P2E games alter gaming dynamics and offer new economic paradigms, making it an essential area for contemporary research. In Section 2, we present the prerequisites of our study: the introduction of smart contracts and the emergence of automated market makers. Based on these two breakthroughs, web3 evolved and eventually produced the first P2E ecosystems. We then analyse classic online game elements and make a connection with their web3 counterparts, while presenting the methodology and the experiment design. In Section 3, we discuss the results, the limitations, and future work.

2. Materials and Methods

2.1. The New Paradigm

2.1.1. Smart Contracts and Non-Fungible Tokens

One of the key elements that allowed an evolution in blockchain was the introduction of smart contracts (SCs). SCs appeared as an extra layer over the value-storing attribute brought by Bitcoin. Vitalik Buterin, the creator of Ethereum, the first network that introduced SCs, envisioned them as pieces of code stored on the blockchain that can be run by users and can automate specific processes based on a set of conditions coming from inside the network, or from the outside world [18].

The possibilities brought by SCs are endless. Several financial products would benefit from the immutability and transparency characteristics of SCs, such as loans, futures and forward contracts, insurances, deposits, and others [19,20]. Entire companies could be run by the paradigm of the decentralized autonomous organization (DAO), where a central authority does not influence the decisions, owners can vote online and see results without any time loss, and the entire management of the organization can be done within the limits of the financial involvement of each investor [21].

Nevertheless, the utility of SCs travels outside finance. Imagine a world where autonomous cars could rely on the micro-transactions implemented inside an SC that would allow faster movement for people who need higher mobility and are willing to pay the price and passive income for those willing to give up their seats in traffic. Another example could be recycling—people could be automatically rewarded for recycling plastic, metal, or glass. Virtually any multi-user application that needs transparency, immutability, and flexibility is a good candidate for a web3 application that uses SCs.

All examples presented above could use the cryptocurrency of the network (e.g., the cryptocurrency for the Ethereum Network is ETH), or they could use an SC to develop their own token. Ethereum Virtual Machine (EVM) is a decentralized computation engine initially built for the Ethereum Network that can support smart contracts [22]. For EVM networks, the SC standard used to create proprietary tokens (fungible coins) is called

Ethereum Request for Comments 20 (ERC-20). ERC-20 is ideal for representing tokenized units. Implementing a standard means that all fungible tokens created under ERC-20 share minimal similar attributes and functionality [23]. Any SC that implements a specific set of functions meets the ERC-20 standard and thus is considered to implement a fungible token. Fungible tokens can be seen as a useful tool, but one of the main problems they initially faced was the lack of an environment where people could buy and sell these without constraints. Listing an ERC-20 token on a centralized exchange such as Binance, one of the biggest centralized exchanges in the world [24] would require much time and substantial financial resources. Thus, a decentralized exchange that could facilitate fungible token listing and trading was needed.

NFTs, or Non-Fungible Tokens, represent just a fraction of the vast capabilities of blockchain technology and smart contracts. For example, the implementation of NFTs is represented by the standard ERC-721 in and EVM network. NFTs have garnered significant attention for their role in digital ownership and unique asset representation. NFTs are in fact a part of the blockchain, and they are essentially a smart contract. All P2E games analysed in this paper are based on these secure, transparent, and decentralized assets.

2.1.2. Automated Market Makers

Automated Market Makers (AMMs) have played a pivotal role in the integration of cryptocurrency P2E games. These decentralized exchanges facilitate liquidity provision, enabling players to trade in-game assets and cryptocurrencies seamlessly. AMMs have not only enhanced the liquidity of in-game tokens but have also allowed players to convert their earnings from P2E games into tradable assets. This bridges the gap between the gaming and financial worlds, empowering gamers to utilize their in-game coins outside the gaming ecosystem, whether for investment, trading, or other financial activities. AMMs have unlocked the full economic potential of in-game currencies, adding a layer of real-world utility to P2E gaming economies.

Uniswap is the company that created the Uniswap protocol, the first AMM, an open-source SC that uses liquidity pools to ensure that users can exchange tokens [25]. A simple explanation of the protocol is that liquidity providers act as the main entities, providing the tokens (in pairs) to the SC and earning a commission from each trade. Supposing that an SC holds a quantity of tokens A and B at a point in time, each new trade would automatically modify the amounts inside the SC, as presented in Figure 1.

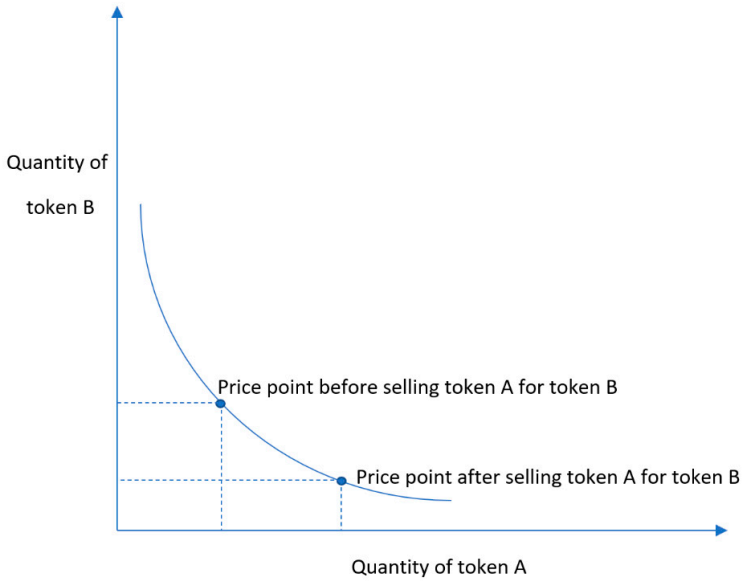

Figure 1. Uniswap bounding curve, before and after a trade.

The less token A is present in the SC, the more it costs in token B units, and vice-versa. As presented on Uniswap's knowledge base [26], the pairs are the automated market makers, as they can accept at any time a token for the other, using the following swapping formula:

$$x \times y = k \quad (1)$$

where k is the product of a pair's x and y balances for tokens A and B. Given the constant nature of k, larger trades relative to the number of tokens present in the pool will be processed at much higher rates than smaller ones, thus preserving the exponential nature of the curve.

2.2. Game Elements

The successful implementation of Web3 games requires transferring various game elements from traditional games to their blockchain counterpart. One such element is achieving "the flow", which describes the optimal state of immersion in a game. Another element is player profiling, which is the process of understanding player behaviour and preferences in order to tailor the gaming experience to their needs. Finally, monetization techniques play a crucial role in the success of Web3 games, as they determine how players can earn rewards and how the game itself can generate revenue.

2.2.1. Flow Theory

Mihaly Csikszentmihalyi was one of the first scientists to evaluate the cognitive flow of a user engaged in an activity [27]. He conceded that "the flow" refers to finding pleasure and lasting satisfaction in an activity and that it is a subjective process that appears during total immersion, supported by both the mental and emotional states of the user, which should be entirely centred on the said activity. The flow depends on the user's abilities, the difficulty of a task, and the degree of success [28]. Based on current literature, we present below a non-exhaustive list of the key elements that influence the flow of video games [29]. We linked each of these elements to their potential application in P2E applications.

Rewards

Rewards are an important element that motivates players and keeps them engaged in the game. These rewards can come in various forms, including in-game currency, items, and virtual goods that enhance the player's gaming experience. The rewards offered in P2E games can be either intrinsic or extrinsic. Intrinsic rewards are inherent to the game, such as the satisfaction of completing a difficult task or the excitement of discovering a new game mechanic. On the other hand, extrinsic rewards are external to the game, such as monetary compensation or other tangible items [30]. In the context of Web3 games, the use of blockchain technology potentially allows for secure and transparent reward distribution. This means that players can be more confident that they will receive their rewards and that the reward system is fair and unbiased. This can increase player motivation and engagement and make the game more attractive to a wider audience [31].

Clearly Defined Goals

Clearly defined goals are an essential aspect of video games as they help guide players towards a specific objective and give them a sense of purpose and direction. Having clear goals helps players understand what they need to do to progress and succeed in the game. This clarity can also increase motivation and engagement, as players have a clear understanding of what they need to do and what rewards they will receive for their efforts. Goals can be tied to specific tasks or challenges, such as completing a level, reaching a certain score, or acquiring a specific item. They can also be related to the player's progress within the game, such as levelling up, unlocking new content, or advancing to higher difficulty levels.

In addition to providing structure and direction to the gameplay, clearly defined goals can also help players track their progress and assess their performance. This can

be particularly important in P2E games, where real-world rewards are tied to in-game achievements. It is common to see P2E players running game simulators to see which strategy maximizes their return on investment (ROI). For example, for stepN [32], a Web3 game based on a walk-to-earn paradigm, tens of online calculators were created in the first months of its release as users were trying to maximize their earnings potential.

Loss of Self-Consciousness and Sense of Time

One key element that enables players to achieve the flow state in video games is when they are fully immersed in the gameplay and do not have to think about their actions consciously. This is a state where action and awareness merge [33]. When players experience flow, they are fully absorbed in the game, and their actions become automatic and intuitive, allowing them to perform at their highest level without conscious effort.

In P2E games, this element is particularly hard to achieve since the real-world linked rewards obstruct one of the main contributing factors, the suspension of disbelief. When fully immersed in a game, players are more likely to accept and embrace its fictional world and forget about the real world. To achieve a high level of suspension of disbelief, game designers and developers must carefully craft the game's world, narrative, and gameplay mechanics. For example, creating a believable and consistent world, designing engaging characters and storylines, and providing smooth and intuitive gameplay can all contribute to the suspension of disbelief and help players become fully immersed in the game [34].

The loss of sense of time is an important factor in P2E, as it allows players to become fully absorbed in the game and to continue playing for extended periods. When players lose track of time, they become more invested in the game and are more likely to continue playing, even if they had originally intended to stop.

In classic video games, the loss of sense of time is often achieved by creating a game that is engaging, enjoyable, and provides instant feedback to players. For P2E games, achieving the loss of sense of time is achievable by providing clear goals and creating a believable ecosystem. For example, in walk-to-earn Web3 applications such as Walken [35], players need to walk to create some of the resources needed inside the game economy.

Immediate Feedback

Immediate and direct feedback is critical in video games, as it provides players with the information they need to progress and succeed. When players receive immediate and direct feedback, they can understand how they are performing, what they are doing well, and what needs to be improved [36]. This information is essential for players to make informed decisions and keep playing the game.

In P2E games, as in classic video games, immediate and direct feedback is often achieved through a combination of visual and auditory cues, such as animations, sound effects, and on-screen text. These cues inform players of their progress, reward them for their actions, and guide them on what they need to do next. Immediate and direct feedback increases player engagement by creating a sense of satisfaction and accomplishment. When players receive immediate feedback, they can see the results of their actions in real-time, increasing their sense of control and autonomy in the game.

Since P2E games provide some form of monetary reward, this factor is often more decisive than others—e.g., players see in real time their virtual wallet having a higher amount of tokens than it did before completing an action.

Balancing Player Skills and Challenges

Balancing player skills and challenges is a critical flow element in P2E games. This balance refers to ensuring that the game's challenges are neither too easy nor too difficult for the player. If the challenges are easy enough, players may become bored or disengaged, as they feel they need to be more energized to continue playing. On the other hand, if the challenges are too difficult, players may become frustrated or overwhelmed as they struggle to progress in the game. When the challenge is well-balanced with the player's

skills, it creates an optimal state of flow in which the player is fully engaged and focused on the game [37].

Balancing player skills and challenges can be achieved in several ways, such as adjusting the game's difficulty level based on player performance, providing incremental challenges that increase in difficulty over time, or offering different levels of difficulty for different skill levels [38]. Additionally, most P2E games offer dynamic difficulty adjustment, as many require an initial investment, which could be bigger or smaller depending on the financial capabilities of each payer. One of the most sensitive areas of P2E game development is finding the most suitable competitive advantage between these different types of players.

Player Control

Player control is a crucial element of flow in play-to-earn games, as it refers to the feeling that the player has control over the game and its challenges. When the player feels in control, they are more likely to be engaged, motivated, and focused on the game.

In video games, player control can be achieved in several ways, such as providing clear goals and objectives, allowing the player to make decisions and choices within the game, or providing a clear and intuitive user interface (UI). UIs play a crucial role in creating an engaging and enjoyable experience. A well-designed UI facilitates player control by providing clear and intuitive navigation, as well as allowing players to access and manage their game assets and information quickly [39].

In P2E games, UIs can help players understand their goals, progress, and rewards. For example, through clear and concise metrics, players can easily track their progress and assess their performance within the game. This type of feedback can increase motivation and engagement by allowing players to see their progress and understand the steps they need to take to achieve their goals. Additionally, UIs can facilitate player control by allowing players to personalize their gaming experience. Various customization options can help players tailor the look and feel of their game environment to better reflect their personal preferences and play styles [40].

Microflow vs. Macroflow

Game design works with two types of flow: the microflow and the macroflow. The microflow is a state of mind where the player experiences intense and focused enjoyment and fulfilment through a series of successful achievements. The microflow has three key elements: gameplay rhythm, the virtuous circle effect, and positive feedback. The gameplay rhythm refers to the relationship between player inputs and a rhythm pattern. The idea is to allow users to give a sequence of inputs unconsciously, thus encouraging dopamine secretion. The virtuous circle effect involves having gameplay mechanics that encourage players' continuous success, keeping them in the perception loop that reassures them they are better than expected. Lastly, positive feedback and rewards maintain player engagement by providing intrinsic reinforcement for their actions. The microflow lasts for a short period but can repeat over time. In video games played on desktop computers, microflow can last about 10–15 min, whereas in mobile apps, microflow was measured to 3–4 min [41]. Over a game-playing session, microflow looks as presented in Figure 2 (left). When referring to P2E games, the peaks of the microflow function may, e.g., coincide with the time frames when users obtain token rewards.

The macroflow is an important concept in game design as it determines the overall progression of the game's difficulty. If microflow refers to single game sessions, macroflow can spread throughout the entire length of the game-playing period, sometimes lasting years. The goal of the macroflow is to keep players engaged by finding the balance between anxiety and boredom. A player who is too challenged may experience anxiety, while a player who is not challenged enough may become bored. The key is to keep the player in the flow zone, where the challenge follows their skills progression and motivation [42].

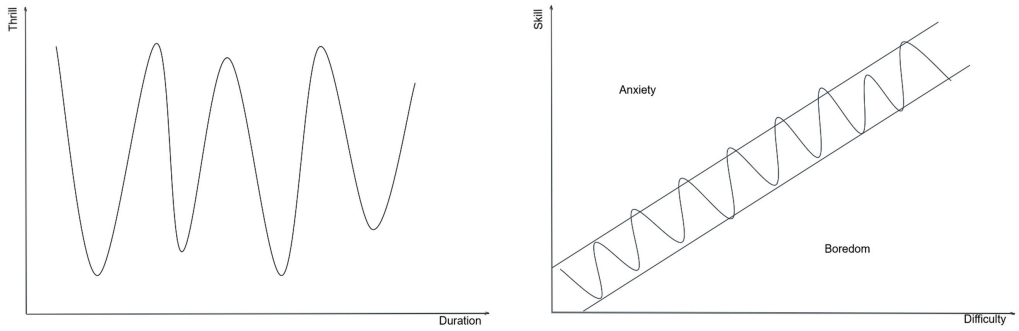

Figure 2. Microflow representation (**left**) vs. macroflow representation (**right**).

Playtesting is a common practice for game designers to find the right balance between challenge and player skills. However, developers must be careful to keep the challenge manageable based on playtest results, as this could increase the potential boredom zone and lead to less player engagement. A representation of the macroflow is presented in Figure 2 (right). When considering P2E applications, macroflow refers, e.g., to the process of choosing and following a long-term strategy able to maximize the earnings from the game.

2.2.2. Player Profiling

In the context of Web3 player profiling and based on previous studies related to classic video games [43,44], we distinguish among four types of players, which are defined as follows:

- Achievers: These players focus on the convenience of progress and making their in-game numbers bigger through means such as acquiring unique items and speed-up enhancements. They may also buy buffs, auras, daily passes or any other metaphor that helps them further advance their in-game progress.
- Socializers: These players are driven by customization and social status. They enjoy buying cosmetics and upgrading their in-game items to get better-looking armour and other decorative items. These players value the game's social aspect.
- Killers: These players are competitive and focus on gaining a competitive advantage. They are willing to buy power to become the top player on the leaderboards in PvP (player versus player) battles. Money is the driving force for these players, as they aim to achieve a competitive edge over others.
- Explorers: These players are driven by content. They enjoy exploring the in-game world and discovering new things. They are the weakest category from a financial viewpoint and the least well-defined, as they are largely immune to monetization. Content for these players is more expensive to create in comparison with the one created for the previous categories since game developers need to provide bigger worlds and better activities.

2.2.3. Monetization Techniques

In-game monetization can be implemented through various techniques, such as free daily rewards, intro bundles, and high-value battle passes. These tactics emotionally engage players with the game, making them perceive themselves as spenders. The *self-perception theory* states that people develop their attitudes by observing their behaviour and concluding what attitudes must have caused it [45]. This is exploited in most standard desktop and mobile apps, and it is an element that can also be considered when building or engaging in a Web3 game. In the case of a P2E game, players obviously perceive themselves as involved financially in their endeavour. This feeling can be in some cases emphasized by additional elements, such as the *foot-in-the-door theory* [46], which suggests that players can develop a habit by ensuring progress, such as daily or weekly chores/tasks/missions targeting a progression. To further incentivize spending, games can offer new bundles after

completing an event. With enough time and engagement, players will identify themselves as loyal fans of the game, leading to more investments in terms of time and money [47].

Randomness is another monetization technique with a high potential in P2E games. Randomness not only attracts players but also has the potential to drive monetization [48]. Players are drawn to the excitement and unpredictability of random gameplay elements, which can increase player engagement and retention. Additionally, game developers can utilize randomized features such as loot boxes, gacha systems, or in-game rewards to monetize their games by encouraging players to make purchases for the chance to receive rare or valuable items. Many successful P2E games use randomness in one way or another but have a hard time identifying the financial potency of their consumers. According to both older [49] and more actual [50] research in game analytics, the behaviour of players who spend large amounts of money on games is an essential factor to consider. On the other hand, consumers who spend small amounts of money must also be considered. While individual players may only contribute a small amount of revenue, the cumulative effect can be substantial. When deciding on a monetization strategy, there is a balance between appealing to invested players who spend large amounts of money versus catering to a larger base of casual players. For example, a game that appeals to a wide range of players may be better served by focusing on smaller, more frequent transactions. In contrast, a game that appeals to a smaller, dedicated player base may be better suited to offer larger, more expensive transactions.

Daniel Kahneman's book "Thinking, Fast and Slow" describes two systems of thinking [51]. System 1 is fast, automatic, and intuitive, while System 2 is slow, deliberative, and effortful. In the context of P2E games, keeping players in a "*hot state*" activates System 1 thinking, generating an automatic and intuitive response to the game. This state is characterized by heightened emotions, anticipation, and engagement with the game. System 1 thinking is influenced by emotions, instincts, and heuristics, which can lead players to engage in impulsive and irrational behaviour, such as spending large amounts of money on in-game items or upgrades.

The "*Ikea effect*" is a psychological phenomenon where people place a high value on products or experiences they have personally invested time and effort in creating [52]. In P2E games, this effect can be observed in how players become attached to their in-game creations or achievements due to the time and effort they have invested in them. This attachment can lead players to perceive their in-game items as more valuable and this increases their motivation to continue playing the game to enhance their creations. Game developers can utilize the Ikea effect to boost player engagement and monetization by providing customization options, personalizing the gaming experience, and offering opportunities for players to create unique in-game content.

Another important monetization technique is setting up a *socially acceptable way* to play P2E games by mixing spending and non-spending players. This idea includes creating cosmetics, allowing the inspection of other players' items, and accessing leaderboards [53].

Having too much freedom in a game can overwhelm and make players anxious. Game developers can *limit choices* and use guiding activities to ease decision-making. Subtle changes, such as bundling purchases into regular and special categories, can reduce the number of choices available and potentially increase the game's revenue [54].

Keeping the game's core loop through the store section can be used to increase monetization. The idea is always to keep the store within reach, making it easy for players to spend money [55]. Free daily rewards placed inside the store encourage players to visit it daily. Having the option to spend real money next to free rewards for completing achievements or quests makes it more tempting for players to consider purchases.

In the context of the monetization of P2E games, cognitive biases can influence player behaviour in various ways. The sunk cost fallacy can lead players to continue playing or spending money on the game even if it no longer provides enjoyment. The effort justification bias can make players feel more attached to their in-game items or achievements due to their invested effort. Fear of missing out can lead players to make impulsive

purchases before offers expire. Gambler's fallacy and optimistic bias can cause players to believe they are more likely to succeed in the game, leading them to spend more time or money. Finally, restraint bias can lead players to believe they can control their spending in the game, even if they end up spending more than they intended [56,57].

2.3. Methodology

The introduction of Web3 technology can produce a considerable shift in the gaming business. Although we are still in their infancy, blockchain technology and cryptocurrencies have created new possibilities for in-game economy.

2.3.1. Research Objective

In this study, we investigate how Web3 games' economic systems affect the gaming business. Our goal is to provide a nuanced and comprehensive picture of the in-game economies of the five Web3 games (Axie Infinity, Crypto Kitties, The Sandbox, Cryptomines, and Walken), and evaluate their impact on the gaming industry and beyond. We chose these specific five P2E games because at the moment of writing, besides being the largest functional P2E games, authors had experience and interacted with the community of these applications. We look at the distinctive characteristics of in-game economies developed by Web3 games and evaluate their capacity for expansion and scalability. This exploratory study uncovers the unique features and dynamics of crypto-currency communities within the gaming industry, and assesses the percent of each player type, for each of the games in focus.

2.3.2. Ethnographic Research

We decided to use ethnographic research as this is a reliable method for collecting data in the context of social and behavioural sciences. Ethnographic research is a qualitative approach used to study people and cultures in their natural settings. It involves immersing researchers in the context of the study, often for an extended period, to gain a deep understanding of the culture, behaviors, beliefs, and social interactions of the participants. This kind of research typically employs a variety of data collection techniques, including participant observation, interviews, field notes, and artifacts analysis.

Ethnographic research is a good match for player profiling because it allows for a deep and nuanced understanding of the motivation of players in their natural environment [58]. This type of research is particularly useful when studying emerging phenomena or exploring previously uncharted areas of inquiry, such as the intersection of gaming and cryptocurrency. Through in-depth fieldwork and observation, ethnographic research can uncover insights that may not be apparent through other research methods, such as surveys or experiments. It can also contextualize the market-shaping phenomenon by allowing researchers to explore the perspectives of the different actors involved in shaping the cryptocurrency markets, including players, developers, and investors. Another advantage of ethnographic studies is that they do not require a large amount of test subjects to achieve their purpose. Ethnographic research has been used before in appropriate contexts, e.g., for determining the gender difference in playing video games, the influence of interactivity in games, or for analysing player's social activity [59–61].

The main methods that can be used within an ethnographic study are participant observation (actively engaging with the community and participating in their events), structured/semi-structured/unstructured interviews (gathering information, perspectives, and experiences related to the research topic), and field notes (recording observations, interactions, experiences, and behaviours).

2.3.3. Data Collection

In this study, data were collected by attending cryptocurrency events in Romania and using social media channels (Twitter, Telegram and Discord) to document the emergence and evolution of P2E crypto games. We adopted the role of active participants and collected

data through observations, on-site interviews, and secondary sources. We attended seven P2E-related events between September 2019 and October 2022 (see Table 1), conducted 24 unstructured ethnographic interviews with 24 participants (19 males and 5 females, all ages between 18 and 42, all of Romanian nationality), and collected secondary data. All users were informed of the participation in our study according to the regulations posed by the Commissions of Ethics from our organisations, more specifically according to the code of ethics for scientific research with human participants.

Table 1. Events where data were collected.

Event	Location	Date
Romanian Cryptology Days	Bucharest	16–18 September 2019
Transylvania Crypto Conference	Cluj	10–13 October 2019
SecITC	Bucharest	14–15 November 2019
Bitcoin Romania Chess Open	Bucharest	5–6 June 2021
Bitcoin Bucharest	Bucharest	30–31 May 2022
CRYPTODATA Decentralized Connectivity Redefined	Bucharest	19 March 2022
consolid8	Brasov	7–9 October 2022

2.3.4. Data Analysis

Ethnographic data analysis involves organizing, interpreting, and making sense of the collected data to identify patterns, themes, and insights. Researchers may use various qualitative analysis techniques, such as thematic coding, narrative analysis, and grounded theory, to analyze the data and generate meaningful interpretations. This is an iterative process that involves constant comparison, reflection, and validation of findings to ensure validity. Moreover, this needs to be done while respecting the cultural norms, values, and traditions of the community being studied.

The data obtained during the collection phase were analysed using processes outlined by Miles et al. to identify the type of microeconomies, the game elements, and the roles of the individuals from the social collectives studied [62]. In particular, each of the interviews contained various unstructured questions, but also a common branch which we used to infer the type of player we interviewed ("What is your favourite action?" or "What is the most efficient strategy?"), the in-game system as it was seen by him/her ("How do you use your tokens?"), and strategy adopted in various situations (sometimes having an in-situ hands-on gaming session, or an online screen share).

In order to develop constructs from empirical evidence, we collected, refined, and organized all of the data into a repository. After that, we dissected and rebuilt the text corpus to analyse the data. We then used descriptive coding to structure data and used the participants' language to limit the number of properties. The result was transformed into categories and then filtered by several patterns to focus on the properties of the games and the behaviour of their players. The variable-oriented strategy showed that some members used cryptocurrency-related vocabulary during the attended events or on social channels. In contrast, others were more used to the gaming terminology and did not show a particular preference for the cryptocurrency dialect. Based on the work of Eisenhardt et al. [63] and on the common questions related to their activity preference and token usage, we summarized the roles of the participants and their assessment of each of the five games.

3. Results

One of our first results is the theoretical categorization of the main types of financial systems of P2E games. Web3 in-game economies model how players participate in various in-game activities in order to earn digital assets with real-world value. These assets can come in various forms, including but not limited to in-game items, in-game tokens, and even cryptocurrency. The key feature of Web3 economies is that the value of the assets earned by players is determined by the market, allowing for the creation of new revenue streams for gamers.

In Web3 economies, the value of the assets is often determined by supply and demand, which creates a market for these assets to be traded or sold. This creates a "micro-economy" within the game that operates similarly to the real world, where players can earn income through their in-game activities. Additionally, these digital assets can be used to purchase in-game items, further driving the economy and increasing their overall value. Based on our analysis of P2E games and as an initial result of the interviews, we identified three types of game economies, which we present below as the first contribution of this paper.

3.1. Single-Token Systems

In single-token play-to-earn economies, the game uses one token as both the in-game currency and the reward for players. This token can be used to purchase items, do upgrades, buy buffs and other types of enhancements. It can also be used for player-to-player trading and converted to real-world currency. Examples of games with single token play-to-earn economies include The Sandbox and Cryptomines. In Figure 3, we present a basic architecture for a single-token economy with four types of stakeholders: players, traders, investors, and stakers.

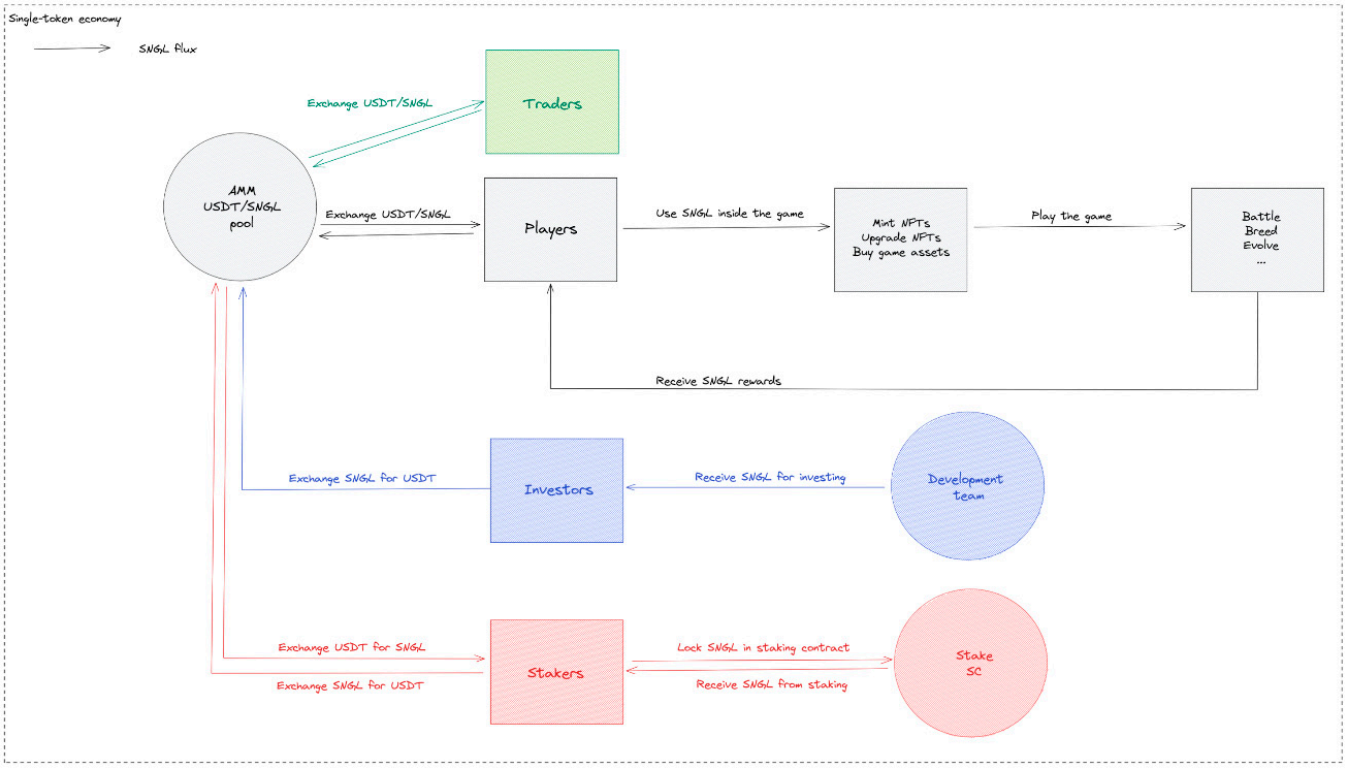

Figure 3. Standard micro-economy of single-token a web3 game (named SNGL).

Except for investors, who usually obtain the token before the actual start of the game during a single or multiple rounds of private sale, the others need to purchase it from the AMM or a decentralized crypto exchange (DEX). AMM pools are created by mixing the token of the game either with a tether coin (e.g., USDT), or with the cryptocurrency of the blockchain used to host the SCs. Investors aim to sell their tokens at a value higher than what they have spent but usually have their tokens linearly vested over larger timeframes (e.g., six months, a year, or even more). Stakers aim to earn a return on their investment by locking their tokens for determined periods in exchange for high interest rates. Players are looking to maximize their ROI by optimizing their in-game strategies. Traders do not interact at all with the game ecosystem and only use the dynamic market evaluation of the token as a means of generating income.

3.2. Dual-Token Systems

In dual-token P2E economies, games use two tokens, each with its distinct purpose. One token usually serves as the in-game currency and is used to purchase items and trade with other players, while the other token serves as a reward for players, often through staking or participating in governance. An example of a game with a dual token play-to-earn economy is Axie Infinity, where players can earn Axie Infinity Shards (AXS) and Small Love Potions (SLP). Generally speaking, and depending on the game mechanics, dual-token systems are more stable than single-token applications because they can isolate the inflation factor. Within single-token games, as the ecosystem matures, more tokens are produced from rewards and staking than are spent inside the game. The nature of the P2E concept is that, at some point, players will earn more than they have invested in the game. This means that an inflation vector that grows with time is continuously pressuring over a zero-sum system. In dual-token systems, one token can take all the inflation pressure while the other can have a fixed supply that circulates inside the game.

In Figure 4, we present the fluxes of the tokens from a standard dual-token P2E economy. For simplicity, we removed from stakeholders the staker and the trader types, as they have the same activities and follow the same objectives as in single-token economies.

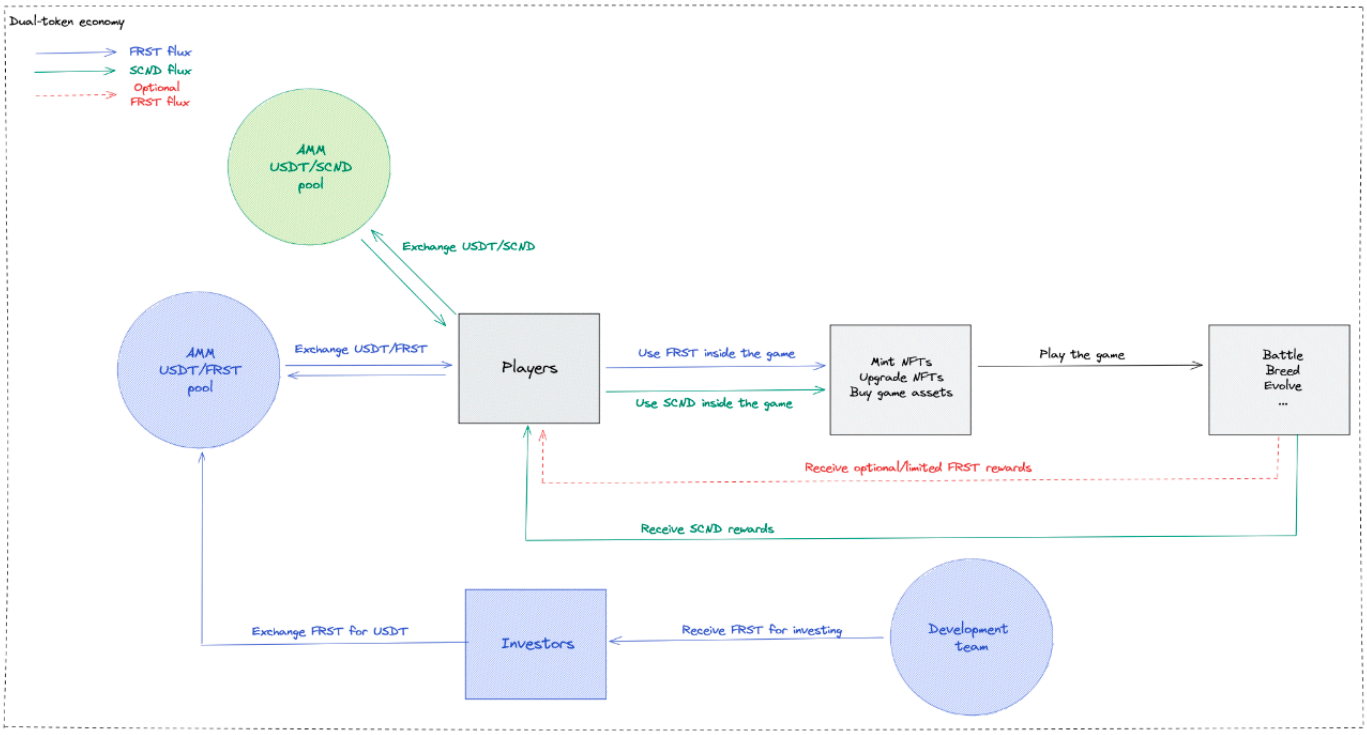

Figure 4. Dual-token micro-economy of a web3 game.

FRST is thought to be the in-game currency used to mint new NFTs, upgrade stats, buy add-ons and gear, or govern the ecosystem. FRST has a fixed supply and was used in private sales to incentivize investors. SCND is the token produced inside the game. SCND does not have a limited supply, and it can also be used to upgrade NFT stats, buy buffs, or unlock levels. As long as the flux of FRST that enters the game is larger than the flux of FRST rewards that exist in the game, the game remains balanced. As soon as the reserve of FRST depletes, the game cannot offer any more FRST rewards. This usually is the end for most Web3 games since players are no longer incentivized to play.

3.3. Hybrid Systems

Hybrid schemes are a type of in-game financial ecosystem that incorporates both centralized and decentralized elements. These economies are designed to provide players

with a blend of the benefits of both Web3 and regular systems, offering a unique and diverse gaming experience. In a Hybrid Economy, players may earn decentralized digital assets of real-world value through their in-game activities. At the same time, they may also participate in a centralized, traditional game economy. This allows designers to overcome some of the limitations of working with SCs. Such an example is Walken, where GEM tokens are directly connected to the number of steps the owner takes, while WLKN is the unique token linked to the blockchain.

Given these three types of game economies, one of the most important aspects is which one is the best for game business developers. The answer depends on the purpose and the mechanics of the game which needs to be implemented. Determining the "best" game economy system among single-token, dual-token, and hybrid systems for game business developers depends on various factors, including the specific goals of the game, the target audience, technical considerations, and the developers' resources and preferences. Each system has its advantages and challenges.

Single-token systems offer a simplified ecosystem. Using a single token makes the economy easier to understand and manage for both developers and players. Players only need to deal with one token type for all in-game activities. However, single-token systems may face inflationary pressures over time as more tokens are produced through rewards and staking. Another drawback of single-token economies is the limited flexibility, as developers would find it difficult to effectively separate the functions of currency and rewards.

On the other hand, dual-token systems can isolate inflationary pressures by separating the functions of currency and rewards, potentially leading to a more stable economy. Developers have more control over the monetary policies of each token, allowing for better balance and adjustment. Unfortunately, these benefits come with an increased complexity to the game economy, both for developers and players.

Hybrid systems combine the advantages of both centralized and decentralized elements, offering a diverse gaming experience. They can overcome some of the limitations of fully decentralized systems, allowing for more flexibility. However, from the point of view of game developers, they would require additional development resources.

Ultimately, the choice of a game economy system depends on the specific requirements, goals, and constraints of the game project. Developers may also consider user experience, economic stability, scalability, and regulatory compliance when designing the game economy. Conducting market research and analyzing player preferences can expedite the decision-making process.

4. Discussion

According to data offered by blockchain explorers such as ETHscan or BSCscan, the SCs of these games were accessed by hundreds of thousands of users. Figure 5 presents the timeline series of transaction amount and transaction count indicators for the SCs for tokens AXS, SAND, ETERNAL and the Cryptokitties NFT. ETHscan.io and BSCscan.io are the main transaction explorers of the Ethereum Mainnet and Binance Smart Chain.

The first graphic from Figure 5 shows the evolution of transfers of the AXS token and their cumulated amount. It is noticeable that the most intense trading period was during July–September 2021. For comparison, the activity of SAND tokens spiked between November 2021–April 2022. Cryptomines ETERNAL had the most transactions between October–December 2021. The follow-up periods differ for each of these games, as their game mechanics are fairly different. For instance, Axie transactions gradually decreased after the initial boom, but maintained an appeal that generated a new surge of transactions at the beginning of June 2022. SAND players reached a critical mass—the transactions are self-sustained and continue on an ascendent trend, even after the main acceleration period, while Cryptomines activity completely stopped at the end of 2021, denoting that its game mechanics presumed a complete termination. The last graph presents the number of NFT transactions for the Cryptokitties SC. As we can see, it diminished continuously after January 2018, as the public lost interest in the game activities.

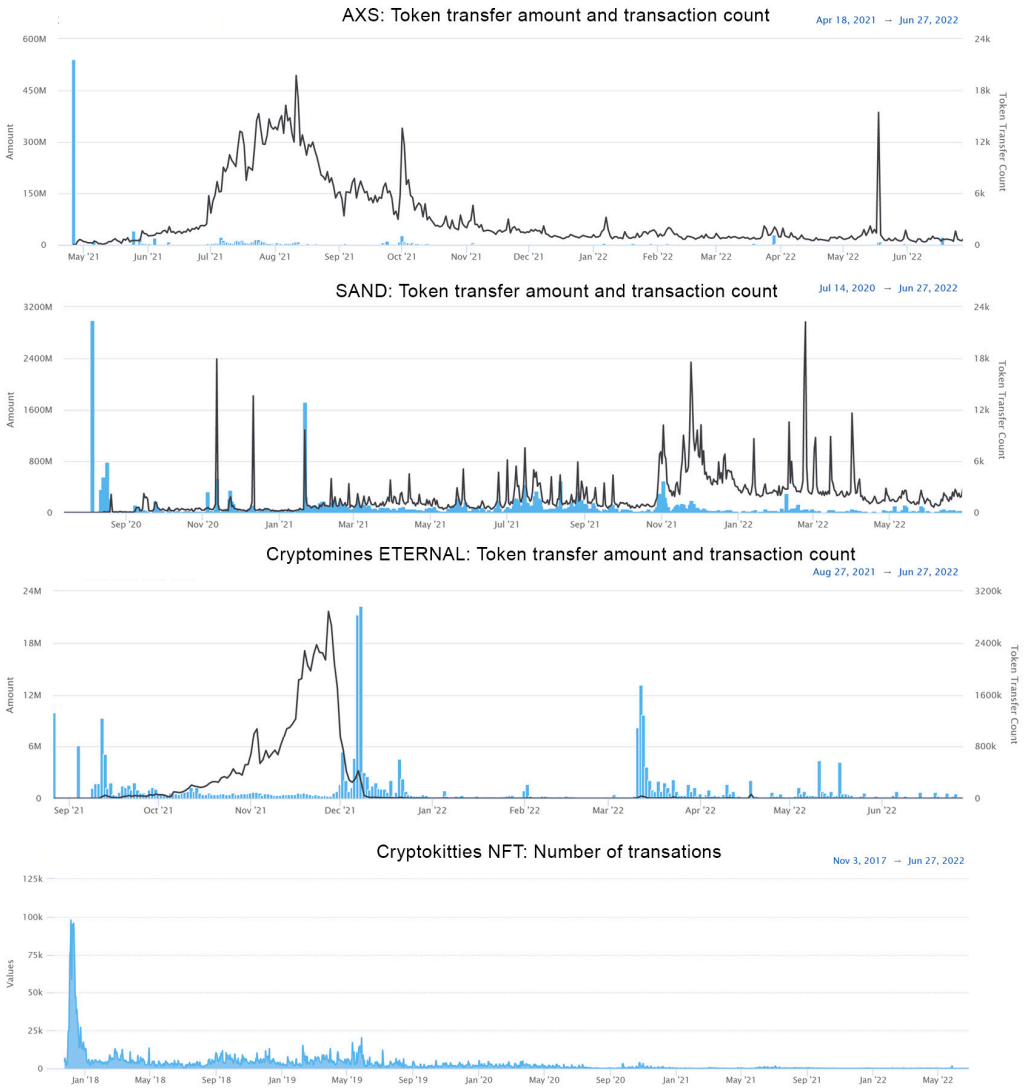

Figure 5. Timeline series for token amount (blue) and transfer count (black)—data obtained using https://etherscan.io, accessed on 27 June 2022; https://bscscan.com, accessed on 27 June 2022.

Interview results revealed that participants assumed different roles when shaping the web3 gaming market. Specifically, we identified the proportion of the four distinct roles among individual members of P2E web3 gaming communities (Achievers, Socializers, Killers, and Explorers). These roles are illustrated in Figure 6, which also shows the relative distribution of each role in the studied communities for each of the five games (Axie Infinity, Crypto Kitties, The Sandbox, Cryptomines, and Walken).

Figure 6 shows that Killers frequent Axie Infinity, Crypto Kitties is used mostly by Socializers and Achievers, Explorers and Socializers play the Sandbox, Cryptomines is appealing to Achievers and Walken is enjoyed by Killers and Socializers.

One of the variables that deeply influenced the distribution above is the type of game economy used by each of them (single-token, dual-token or hybrid, as presented above). Table 2 shows the difference between their token systems and the all-time-high number of users, transaction count, and market capitalization.

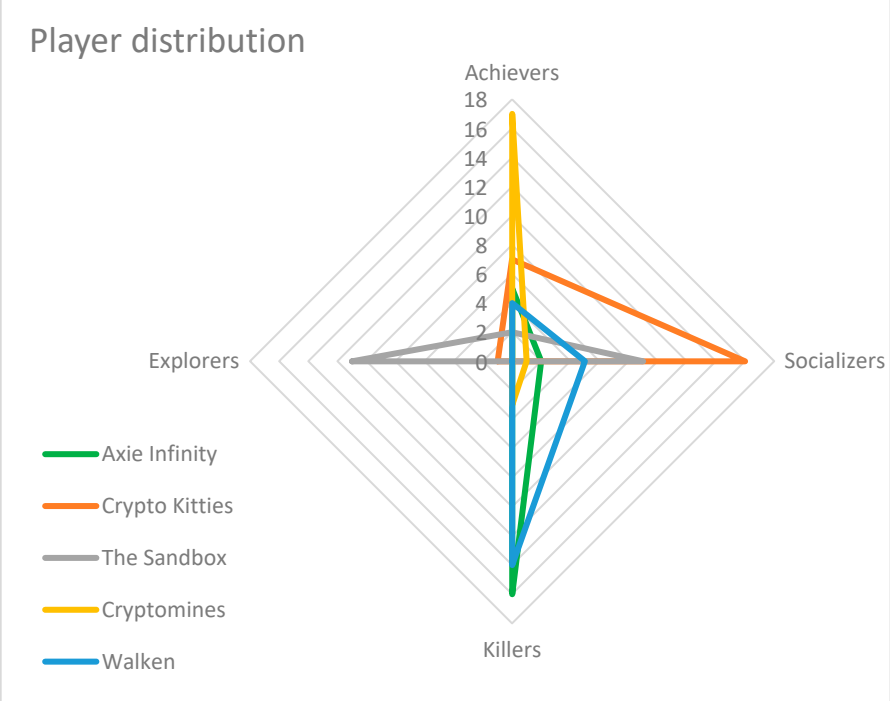

Figure 6. Player profile distribution in analysed web3 games.

Table 2. Type of game economy.

Game	Token	Type of Micro-Economy	ATH No. of Users	ATH Transaction Count	ATH Market Cap
Axie Infinity	AXS, SLP	Dual-token	2,700,000	19,740	USD 10b
Crypto Kitties	-	-	120,000	97,891	-
The Sandbox	SAND	Single-token	220,000	22,246	USD 4.5b
Cryptomines	ETERNAL	Single-token	150,000	2,886,095	USD 3.8b
Walken	WLKN, GEMS	Hybrid	400,000	-	USD 0.3b

To assess the game elements presented in Section 2, participants were observed and interviewed while playing P2E web3 games. We used a combination of qualitative and quantitative methods to measure these elements in percent. Figure 7 shows the data for each of the web3 games. This graphic shows the constructive difference among the analysed P2E games. Using this methodology, we can thus compare among any P2E games.

After averaging the percentages, we observe that Cryptomines addresses most game elements with success, obtaining a total average of 89.05%, as opposed to Crypto Kitties, which obtains 71.61%. This result shows that the game economy proposed by Cryptomines, with their ETERNAL token pegged to the real-world US dollar, fulfils most of the requirements of a web3 game built to monetize its player base efficiently. On the other hand, the main drawback of Crypto Kitties is that it does not have an in-game token—the main reason its scores are lower on some of the features.

The game elements with the best scores for all five games are Social acceptance, Ikea effect, Limited choices, Clear goals, and Self-perception. This shows that the intrinsic nature of the P2E web3 games translates into higher values for these features, based on the concept of earning from playing. Social acceptance refers to the degree to which a player feels accepted and included within a gaming community. All five games have highly effervescent communities on social media, with tens of thousands of active players. The Ikea effect describes how players may develop a stronger attachment to in-game items or progress they have created or earned themselves. All P2E games presume players will use a progressive strategy to ensure progressive financial rewards. Limited choices can

also be important, forcing players to make strategic decisions and invest more deeply in their gameplay. All the applications have turn-based gameplay with limited options. Clear goals give players a sense of direction and purpose, which helps to keep them engaged and motivated. In all analysed P2E web3 games, the final purpose of players is to obtain a profit. Finally, self-perception refers to the degree to which players view themselves as game spenders—almost all games require an initial financial commitment.

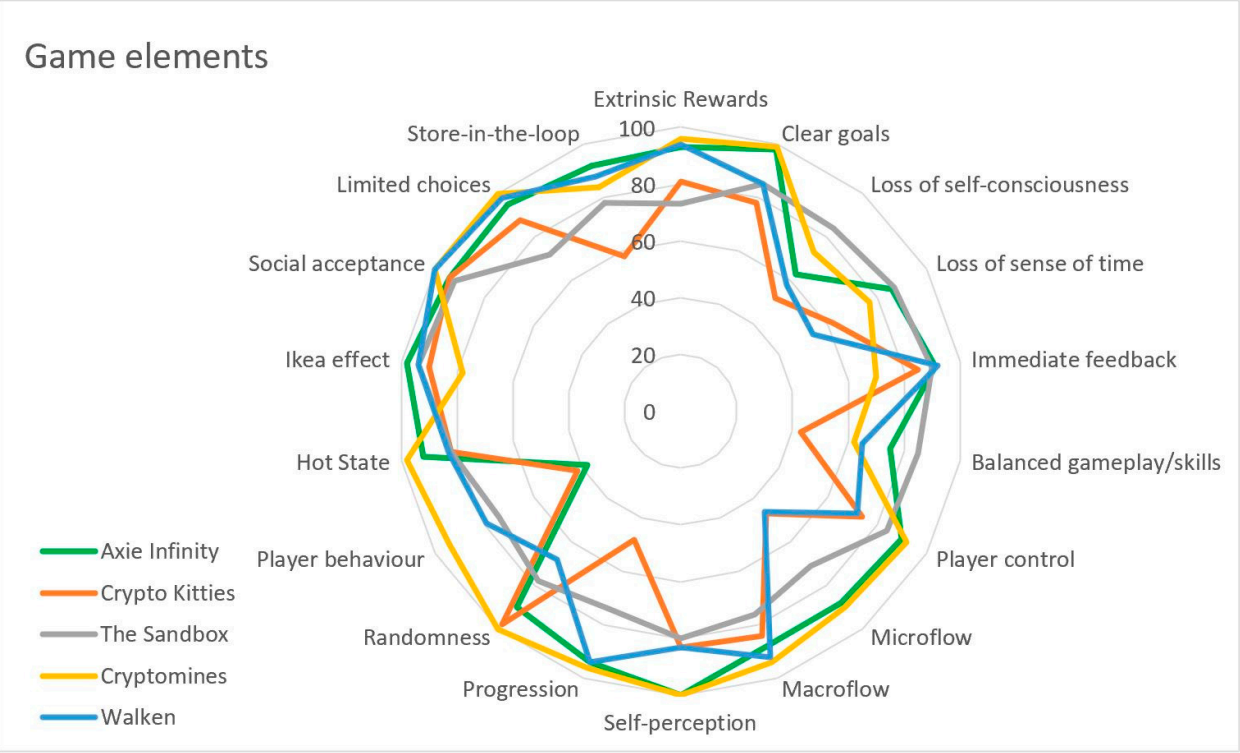

Figure 7. Game elements assessment (in percent) for analysed web3 games.

The worst-performing elements of all five games are Loss of self-consciousness, Balanced gameplay/skills, Microflow, and Player behaviour. Although subjective (it may be possible that these features may not be crucial for some, while they may be for others), this result shows that for the moment, P2E web3 games need to create a better context, to improve their gameplay by allowing small spenders to receive balanced rewards in comparison with large spenders, and to provide a more immersive experience.

According to the data collected and based on the individual profiles, we clustered user actions (that members of the analysed crypto-currency communities have engaged in) into six classes:

1. Trading: Members bought and sold in-game assets or currency through official marketplaces or peer-to-peer transactions.
2. Collecting: Members accumulated rare or valuable in-game items as a form of investment or to demonstrate their status within the community.
3. Gaming: Members engaged in the game's actual gameplay, using in-game currency and assets to advance their progress and gain an advantage over other players.
4. Investing: Members bought and held cryptocurrency or in-game assets as a form of investment, hoping to realize gains as the value of these assets appreciated over time.
5. Staking: Members held and locked up a certain amount of cryptocurrency to support the underlying blockchain and earn rewards in return.
6. Speculation: Members bought and sold in-game assets or currency to profit from short-term price fluctuations.

As presented above, these actions depend heavily on each game's mechanics, as their rules and structure influence them. Players select web3 games based on a variety of interconnected factors, some of which are highly dependent on individual preferences—one of the most important is monetary incentives (opportunities for earning real or virtual currency). As presented above, various web3 game activities attract multiple types of individuals. Other critical drivers include game mechanics (players are often drawn to games with engaging and well-designed mechanics that offer enjoyable gameplay experiences), game features (such as immersive storytelling, challenging quests, strategic decision-making, and rewarding progression systems), game genres (action, adventure, role-playing, simulation, or strategy), game community (opportunities for social interaction, collaboration and competition), reviews (recommendations from friends, reputation of a game studio, word-of-mouth endorsements), and accessibility (compatibility across different platforms). By comparison, the most important driver for web3 game developers is financial success. P2E games are easier to market, as players tend to invest more time and energy into a system that can also output some form of financial incentives. Moving on, we can also mention other factors such as cultural impact, passion for game development, artistic expression, technical innovation, player engagement, community feedback, and general recognition for their contributions to game development.

5. Conclusions

The use of blockchain and cryptocurrency in gaming has given rise to a new type of in-game economy that operates on decentralized principles. This exploratory study aimed to uncover the unique features of the most played P2E web3 games and the dynamics of cryptocurrency communities within the gaming industry. Our investigation allows a deeper understanding of the opportunities and challenges posed by in-game economies based on cryptocurrency. Using the presented methodology, any P2E game can be associated with one of the three identified in-game economies, while its target group can be easily understood. Added value and possible challenges were presented for each of these.

As with any exploratory research, there are some limitations and future research opportunities that need to be addressed to gain a better understanding of the topic. One of the limitations of this study is that it was conducted on a small sample size and only focused on five specific games. Future research could expand the scope and sample size to investigate other P2E games and compare the results across different genres. The study focused on both players' and developers' perspectives. However, it would be interesting to explore the perspective of other stakeholders (e.g., investors and local authorities) to gain a more comprehensive understanding of the P2E game ecosystem.

We conclude that players select web3 games based on several factors, including monetary incentives, game mechanics, features, genres, community engagement, reviews, and accessibility. Web3 game developers prioritize financial success, leveraging play-to-earn models for easier marketing. Other factors driving developers include cultural impact, passion for game development, artistic expression, technical innovation, player engagement, community feedback, and recognition.

Classifying users within the four types of stakeholders was performed based on the common questions related to their preferred in-game activities. One might easily argue that the same person could possess more than one of these roles and enact them on different occasions. However, we tried to make the true distinction on the spot, during or immediately after the interview. Nevertheless, we agree that the process may be prone to errors, some of which may appear due to the very nature of the subject—some subjects could be reluctant to share complete information about activities with financial implications.

Regulatory issues may arise as P2E games continue to evolve and gain popularity. Future research could investigate the role of regulators and governments in the P2E game ecosystem and explore how they can promote fair gameplay and protect players' rights.

Overall, this study on P2E games represents a significant step forward in understanding the blockchain gaming ecosystem. Still, numerous research opportunities exist to

expand the knowledge base and explore new areas that arise as the industry continues to develop.

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Data Availability Statement: Qualitative interview data supporting the findings of this study are available on request from the corresponding author. Some interview data are not publicly available due to restrictions that could compromise privacy of the participants.

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Abbreviations

SC	smart contract
B2P	buy-to-play
P2P	pay-to-play
F2P	free-to-play
P2E	play-to-earn
EVM	Ethereum Virtual Machine
ERC	Ethereum Request for Comments
AMM	automated market maker
DAO	decentralized autonomous organization
NFT	non-fungible token
IPFS	InterPlanetary File System
UI	user interface
ROI	return of investment
DEX	decentralized crypto exchange
PvP	player versus player

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