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REVIEW ARTICLE

Understanding the mechanics and consumer risks associated with play-to-earn (P2E) gaming

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ABSTRACT

Background and aims: Play-to-earn (P2E) gaming is a newly emerging form of gaming increasingly based on blockchain technology. In this paper, we examine the mechanics and business model of these games and their potential benefits and risks for players. *Methods:* The paper draws upon and critically synthesises the developing published literature on predatory monetization in gaming as well as objective market data drawn from credible online sources. *Results:* P2E gaming blurs the boundaries between gaming and trading and may not yield many of the benefits promoted to consumers or otherwise conveyed through marketing and social media messaging. Particular risks include the deflationary nature of reward currencies and the asymmetric reward structures that heavily favour early investors and exploit late adopters. *Discussion and conclusions:* This paper highlights the need for greater consumer awareness of the mechanics and risks of these new gaming models. It will be important for business models to be more transparent and designed so as to encourage more equitable game outcomes, sustainable returns, a balance between intrinsic and extrinsic rewards, and protection for potentially vulnerable players.

KEYWORDS

play-to-earn gaming, crypto-currency, trading, risk factors, harm, consumer protection

INTRODUCTION

Over the last two decades, there has been a significant transformation in the nature of commercial gaming. In the 1990s through to the 2000s most gaming was based on a 'pay-to-own' (P2O) model. In P2O, consumers would outlay money for consoles, handheld devices or computer software (e.g., CDs) that could be installed. There was usually a single (often larger initial financial outlay), but then all games and game options were largely owned. Player access to gaming features or levels was predominantly based on natural game progression and playing skill. In the 2000s, as broadband Internet spread around the world, new models began to emerge (King & Delfabbro, 2019a, 2019b). These included: (a) free-to-play (F2P) models in which people could gain access to entire games, but which required them to pay for additional content such as gaining access to certain levels or content or pay for in-game assets; (b) subscription models in which whole games are sold in stages; or (c) 'Freemium models' in which limited versions of games are made available, but the person has to pay to obtain full access to all the functionality of the game. Broader terms such as play-to-play (P2P) are often applied to any games which require an outlay to gain access to games or game functionality, with the term 'play-to-win' (P2W) referring to games which advantages in the game are afforded by paying money (e.g., to get better in-game assets) rather than through just skillful play. In each case, the trend has been towards the greater monetization of games, with an increasing focus of encouraging the use of ongoing micro-transactions and repeat purchases to provide additional streams of revenue for the gaming industry (King, Delfabbro, Gainsbury et al., 2019).

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According to Davidovici-Nora (2013) and Hamari and Lehdonvirta (2010), new F2P business models involving in-game micro-transactions emerged within the Asian region as a result of problems with real money transactions, the use of bots and cheating software, piracy and other criminal activities in the late 1990s and 2000s. In essence, when some massive multiplayer online (MMO) games became popular, the only way to trade in-game assets was on third party sites. Concerns arose when this created disparities between different players (traders and non-traders of assets), copyright violations, and the involvement of unscrupulous operators. The internalization of in-game assets, in-game currencies (i.e., a more internalized market-place) gave platforms more control over their own copyright and the gaming ecosystem. F2P, as Davidovici-Nora points out, also afforded many marketing advantages and game flexibility including: the ability to attract new players who could try the game for free and new sources of value for longer-term players. This new model appears to have been commercially successful with the global online microtransaction market estimated to have attracted about $59 billion in 2021 and is projected to reach $67 billion in 2022 (The Business Research Company, 2022).

Despite their many commercial benefits to the industry, F2P features such as microtransactions[1] have attracted some criticism and have sometimes been described as 'predatory' (King & Delfabbro, 2018; Petrovskaya & Zendle, 2021). Predatory, in this context, refers to situations in which the cost of games to consumers are often unclear or where gamers may feel increasingly compelled to make purchases to retain their position in the game. Some monetization features have also been likened to a form of 'gamblification' of gaming. Discussed in detail by Macey and Hamari (2022), this term refers to contexts in which gambling context becomes increasingly present in activities. This process can either occur at an affective level (e.g., gambling is more normalized or the term is used) or more structurally when realistic or partially realistic (e.g., chance games for prizes) are made available in gaming activities. A particularly well publicized example of this are loot boxes (Garea, Drummond, Sauer, Hall, & Williams, 2021; King & Delfabbro, 2020; King, Delfabbro, Gainsbury et al., 2019) which are features (e.g., treasure chests or card packs) that can be purchased or earned and which deliver outcomes based on chance-based algorithms (Drummond & Sauer, 2018; Drummond, Sauer, & Hall, 2019; Griffiths, 2018; Macey & Hamari, 2022). Loot boxes have attracted regulatory attention because they appear to share some features with gambling: the purchase of a stake in an outcome governed by chance (Derevensky & Griffiths, 2019; Zendle & Cairns, 2018).

Although most research into 'Pay-to-Play' (P2P) has shown that only a minority of gamers purchase loot boxes and tend to spend only a modest amount (Zendle, Cairns, Barnett, & McCall, 2020), these features appear to be attractive to higher risk gamblers. For example, studies consistently show that those who purchase loot boxes are more likely to be high intensity gamers (e.g., people who play 30+ hours per week) who score higher on measures of Internet Gaming Disorder (Gibson, Griffiths, Calado, & Harris, 2022; Zendle & Cairns, 2018; Zendle, Meyer, & Over, 2019; Zendle et al., 2020). Purchasers of loot boxes also tend to score higher on measures of problem gambling (Brooks & Clark, 2019; Li, Mills, & Nower, 2019) which suggests that those who engage in other forms of monetary risk-taking may be more attracted to these features. This gives rise to concerns that some young people under the age of 18 years are being exposed to gambling-like content in games, and that loot boxes might impose an additional source of financial harm (Carey, Delfabbro, & King, 2021; Delfabbro, King, & Carey, 2021). The transition from loot boxes to gambling has been referred to as the "gateway hypothesis" and gambling to loot boxes as the "reverse gateway hypothesis" (Close et al., 2021; Spicer et al., 2022). Spicer et al. showed that most people report a transition from gambling to loot boxes, but that around 20% reported using loot boxes first before gambling. It is not clear, however, whether this reported impact of loot boxes on gambling might be amongst young people who already had an interest in gambling, but had not yet participated in gambling because they were under-aged. Delfabbro and King (2020) favored the view that loot boxes were likely to be attractive to those who were already interested in gambling and preferred this style of activity (a 'selection effect').

THE RISE OF PAY-TO-EARN (P2E) GAMING

In addition to concerns about the increasing monetary cost of games, another narrative within the gaming community has been that gaming, in general, has not been a well-rewarded activity (De Jesus et al., 2022; Francisco, Rodelas, & Ubaldo, 2022). Despite the emergence of a growing and multi-billion-dollar esports industry that benefits a small elite percentage of gamers, most people who engage in intensive (and often competitive gaming) usually have little to show for all their effort. Players may play games for 30 h per week, earn many in-game assets or solve complex games, but obtain little tangible compensation. For this reason, there has been growing interest in the potential merits of so-called 'Play-to-Earn' or P2E games, which could reward players for their gaming (Jiang & Liu, 2021; Serada, 2020; Serada, Sihvonen, & Harviainen, 2021). The idea here is that players might earn tokens or rewards for their game-play as well as assets which they definitively own and which can be converted into fiat currency.[2] In other words, the model extends beyond existing largely in-game and within closed

[1]The cost of micro-transactions can vary. Loot boxes can cost as little as $2, but access to premium content on some games can entail expenditures of $20–50.

[2]A fiat currency is a form of exchange and store of value backed by executive governments. It is not backed by gold or silver or other independent store of value.

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economy currencies or point systems and assets, to one that more strongly resembles an open trading market in which in-game success can translate into real-world financial outcomes. The concept of P2E games has existed for some time in the form of the development of virtual in-game currencies (e.g., Diablo series), the trading of in-game assets for real world currency (Davidovici-Nora, 2013; Hamari & Lehdonvirta, 2010), which includes skins-trading that has enabled players to buy and sell cosmetic features of games on trading platforms or other third party sites. More recently, this technology has evolved to encompass blockchain technology.

OVERVIEW OF BLOCKCHAIN TECHNOLOGY

Blockchain is a distributed ledger system that stores transactions or events in a sequence using cryptographic technology (Ammous, 2018; Narayanan, Bonneau, Felten, Miller, & Goldfeder, 2016). This event sequence has the qualities of being largely immutable once the transactions are recorded, transparent (i.e., they can be viewed 'on chain') and the records of the transactions are usually decentralised or not stored in a single location. Blockchains use algorithmic or consensus systems to ensure that the sequence of transactions remains valid (e.g., to avoid the double-spending problem resolved through the Bitcoin algorithm) (Casey & Vigna, 2019). This can be achieved using 'proof of work' systems that involve multiple computers trying to solve complex numerical sequences to ensure that transactions are ordered into sequential blocks that occur in a set order and interval (e.g., Bitcoin, Litecoin) (Ferdous, Chowdbury, & Hoque, 2021). Alternatively, there can be other mechanisms such as 'proof-of-stake' consensus which involve the use of validators (usually parties who have large holding of governance tokens) to 'agree' that each transaction is processed validly and fairly in a way that does not allow any party to game the system or gain unfair advantage (e.g., Cardano, Solana, Polkadot) (Milunovich, 2022). In either case, blockchain provides a way of enabling the development of decentralised finance systems, whereby tokens can be created, bought and sold on exchanges, sent peer to peer, and used to make purchases without the involvement of central organisations such as banks (Casey & Vigna, 2019).[3]

Blockchain can be used to secure the value and transfer of currencies or digital assets. Blockchain based currencies are commonly referred to as 'crypto-currencies', although a distinction is drawn between 'coins' produced through mining and 'tokens' issued without this process (Charfeddine, Benlagha, & Khediri, 2022). Crypto-currencies are usually defined by their tokenomics: (a) whether they have a finite or infinite supply; (b) how many tokens are circulating at a given time relative to total supply; (c) their market value per coin; (d) total market capitalization (total coins in circulation × current market price) and (e) fully diluted market cap (current market price × total potential market supply). Blockchain can also be used to validate the ownership and transfer of other digital assets such as non-fungible tokens (or NFTs) which can be in-game assets, artworks, animations, or documents (Nadini et al., 2021).[4] The potential benefit to gamers is that blockchain can provide a system to validate the earnings and assets of gamers. For example, it gives rise to the possibility that gamers could own in-game currencies as well as assets in the form of NFTs that are validated on a blockchain. As with crypto-currencies, ownership is determined using asymmetric algorithms that create a private code or key that is possessed by the owner (e.g., in a wallet), but which generates a public key (in a pair) that is recognized by the blockchain. Only the person who owns the associated private key in that pair has access to (and effectively) 'owns' the asset or crypto-currency (Ammous, 2018; Casey & Vigna, 2019).

BLOCKCHAIN TECHNOLOGY APPLIED TO P2E GAMES

P2E gaming does not necessarily have to use blockchain technology. However, the above advantages of this technology have meant that many games are being developed using leading Layer 1 blockchains,[5] which have the scale (and also the speed) to provide the monetized features that are desired. In effect, this technology makes it possible for players to earn a form of currency that could be converted into fiat currency; to own their own gaming assets; and the ability to buy and sell gaming assets for currency. One of the first examples of the use of blockchain-based assets were VGO skins (Abarbanel & Macey, 2019), whereas the first popular game to utilize the full functionality of NFTs and cryptocurrency with P2E benefits was Cryptokitties, an Ethereum-based game that was popular in 2017–18 (Jiang & Liu, 2021; Scholten et al., 2019). Cryptokitties involved the purchase of NFTs (kitties) which were used in competition between players to earn in-game currency. The game had only a relatively short period of popularity at around the peak of the 2017 cryptocurrency "bull-run" of 2017. As Jiang

[3]Decentralised finance refers to systems based on blockchain and which allow the transfer of value between different parties based on smart contracts. Earnings can occur in several ways. Examples include: staking (allowing tokens or coins to be locked into contracts that return interest in return) or by providing liquidity to markets (people receive a cut of the transactions fees on the exchange)

[4]Non-fungible tokens are digital assets which are assigned to blockchains (minting) so that they can be transferred between parties as based on public-private key system. They are usually priced in the units of the crypto-currency on which they are based (the layer 1). Non-fungible means that they are unique, whereas crypto-currency or any other money is fungible (no dollar is unique-each can be exchanged for another).

[5]A layer 1 blockchain is the blockchain that provides the functionality to run smart contact that power applications based on that blockchain. Examples include: Ethereum, Solana or Cardano. Smart contracts involve the transfer of value from one party to another which is recorded on a blockchain ledger.

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and Liu (2021) show using on-chain data from the Ethereum network, this game declined in popularity because of an over-supply of players and 'kitties' on the market; a decrease in returns and increasingly disparity between player outcomes; the increasing NFT entry cost; and, increasing congestion on the Ethereum network. However, it set the scene for a model of gaming that brings together the mechanics of crypto-currency technology and modern gaming that is now being replicated on multiple blockchains (e.g., Polygon, Solana). A summary of how many emerging blockchain gaming projects and technology are incorporated into gaming is provided in Fig. 1. Not all people may engage with games exactly this way (e.g., people may load in currency into platforms from hard-wallets: Trezors or Ledgers); however, the example given should provide readers who are unfamiliar with crypto-currency processes how gaming might be undertaken and how this can be integrated with decentralized finance applications.

As Fig. 1 shows, most people will start the financial process with a centralized transaction. They will use their bank or credit card to send money to a centralized crypto-exchange (e.g., Coinbase, Binance). They would then usually purchase the principal Layer 1 currency on which the game is based (e.g., Ethereum, Solana or Harmony are three leading Layer 1s with popular games). The person would then usually have to set up a browser or mobile extension (e.g., Metamask) and configure it to the respective mainnet (e.g., Harmony) or add a browser wallet (e.g., Phantom for Solana). Cryptocurrency (e.g., Solana) is then sent from the central exchange to the decentralised wallet using the target receipt address. Once it has arrived (for a small fee), the person then has money to pay for 'gas fees' for transactions. The person may also (in some cases) purchase governance tokens which provide voting rights in the game (not all games will have this) and/or they may need to purchase some amount of the in-game currency to get started. To take part in the game, they connect their decentralised wallet or ledger if they want to use a hard wallet. This gives the game access to the currencies which the person holds. Some games or gaming ecosystems will have a governance or game token and in-game utility token (e.g., *Defi Land* has the DFL token which can be used to make purchases and which can be staked for interest and also Goldy which is the "in-game" currency which is used to make simple in-game transactions). Others (e.g., Synesis One has just the one single token which fulfils both purposes).

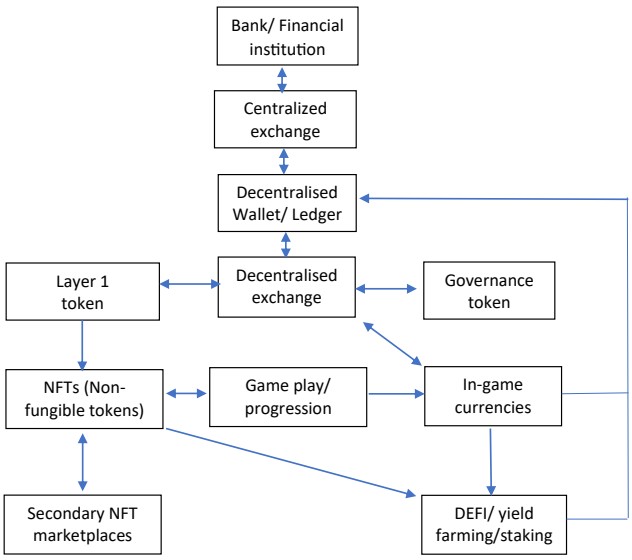


Fig. 1. Mechanics and elements of blockchain play-to-earn gaming

In most of these emerging games, successful participation involves the purchase of in-game assets (NFTs). These are usually purchased using the Layer 1 currency (e.g., Solana) that can be obtained on open markets or via 'drops',[6] which usually means that people have to register, be engaged in various social media groups or sign up processes to be eligible. Drops are often time limited and highly competitive. Once these NFTs (the first and valuable ones are termed 'GEN0 or genesis NFTs) are obtained at a relatively low price in the drop, they can then be purchased at a much higher price in marketplaces (e.g., Magic Eden on Solana). Without these NFTs, it may be difficult to do very well in the game, so that the small number of people who acquire these assets early will have a significant advantage over late-comers (Aguila, Bartolata, & Estrañero, 2022). Even if games are not fully developed or released, quite vigorous and lucrative markets can be developed for game NFTs. Examples of this include *Solchicks* or *Star Atlas* on the Solana blockchain.

The value proposition or benefit for players is that, if they own these NFTs, and engage in the game then they can receive many potential benefits. These can include: the capacity to earn in-game currency which can be converted into fiat currency; the ability to earn additional NFTs; possible capital gains on the original NFTs; enjoyment and challenges from playing; and, the kudos of winning competitions or advancing on leader-boards. Other potential benefits, if the game is integrated into decentralised finance protocols (DEFI) is the ability to stake the token rewards for additional tokens for larger financial gains.

The example of Axie Infinity

So far, only relatively few games have attracted a significant number of players, so P2E gaming still remains very much in its infancy. Nevertheless, newer games are emerging with significantly higher production values, which run on cheaper and faster blockchains such as Solana and Polygon. Perhaps the most successful and well-known game so far since *Cryptokitties* in 2017 is *Axie Infinity* (AI with the AXS token), a tournament game on Ethereum, in which people match off their NFT 'creatures' (or Axies) against others to win an in-game currency (known as 'Smooth Love Potion' or SLP) (Aguila et al., 2022; De Jesus et al., 2022). These Axies (the NFTs) have to be purchased and the cost has steadily risen since the game was launched in March of 2018.

[6] A drop is when the NFTs are released for purchase to buyers. There is often a specific advertised time at which this occurs. NFTS often sell out in minutes.

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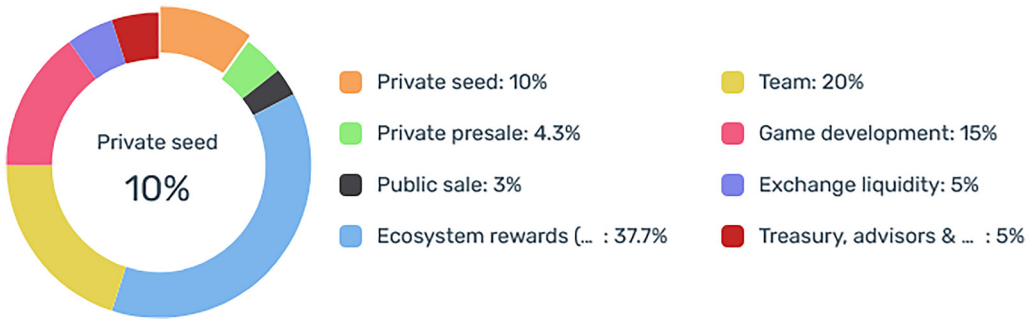


Fig. 2. Token allocation for Solchicks (*Source*: https://cryptorank.io/ico/solchicks)

AXS was one of the most successful crypto projects in 2021 and the price of the token skyrocketed, even during a mid-year 2021 crash, attracting thousands of new players. Players reported earning several hundreds of dollars per week and the project introduced a 'scholarship system' which allowed asset holders (Axie owners) to rent out their Axies to players elsewhere in the world to play on their behalf (in return for a cut of the earnings). This shared similarities with the model used by *Cryptokitties* which allowed players to rent out their NFTs to others. Axie Infinity's (AI) success was generally longer lived than *Cryptokitties* and the project achieved a multi-billion dollar market capitalization based on token value, but the project has lost a very large proportion of its players during 2021–22 (De Jesus et al., 2022). This is because of the over-supply of Axies, the cost of entry, diminishing returns and also the general loss of retail interest in the crypto-currency market due to the succession of market downturns in the same period.

UNDERSTANDING THE BENEFITS AND RISKS TO CONSUMERS

The P2E model has the potential to yield a number of benefits to both consumers as well as the industry. For consumers, the use of blockchain technology provides an opportunity for gamers to gain greater ownership over their digital assets (currency and NFTs); provides a potential source of revenue; will link more skillful play with valued game outcomes; and, boost the price of crypto-currencies associated with the games (both the in-game currencies as well as that of the Layer 1 on which the game is based). Revenue from the NFT sales can also be more easily directed back to artistic creators and avoid some of the issues of copyright violation and piracy observed before FTP games were introduced (Davidovici-Nora, 2013). From an industry perspective, P2E has the potential to increase the price of crypto-currencies and boost technological development; allow greater control over the game assets (the NFTs) through official and authorized trading platforms (i.e., to avoid the problems of early RMT on third party sites); and, build ecosystems which enable the best players to benefit from longer-term investments in the game. However, it is important to be mindful of the potential risks associated with P2E and the challenges that will need to be addressed. There are a number of these and so we have set these out in several sections.

Tokenomics and inflation

The most insidious and often hidden problem with many new crypto-currency projects (including many games) is that the in-game token which is earnt from playing may not retain its value. When projects are developed, a substantial proportion of the tokens are held by the project founders, the development team, and private owners (usually venture capitalists). This can often be 30–40% of all tokens. An example is Solchicks (Cryptorank, 2022), a high production-value game under development on Solana. As can be observed (refer to Fig. 2), only around 37% of the tokens are identified as being associated with use of the ecosystem (https://whitepaper.solchicks.io/). A significant proportion is allocated to the developers, advisors and the team, with around 14% given out in private or presale events. Such information is not usually easily available to the public and often requires experience in the crypto-markets to know where to look.

Some fortunate public investors can gain access to these tokens through initial decentralised exchange offerings (or IDOs) often via 'launch pads' (e.g., Seedify, Starlaunch, Pulsepad). To be eligible for these early offerings, people usually have to purchase and stake specific launch pad tokens. Often to get reasonable allocations to purchase (e.g., $200), investors might need to spend more than $UK25k worth of launchpad tokens to be part of higher launchpad 'tiers' (readers can find details of one of the most significant launchpads here https://medium.com/seedify/the-updated-tier-system-c9652ce5cf5b). All of these parties receive the tokens at IDO or pre-IDO prices which is usually many times lower than the price at which the token is released on the market. Thus, it is not uncommon for tokens purchased for a few cents (eg. $.05) at IDO to enter the market for over $1 and then, through market forces, increase to several dollars thereby yielding the early investors a 50–300X return on their investment.[7] In this way,

[7]Readers can identify many examples using Coinmarketcap.com in combination with cryptorank.io which lists the release or Initial Coin/Dex Offering price. Thetan Arena ($.08 to $20.40 or 255X); Mines of Dalarnia (0.075–4.35 or 58X) or Star Atlas ($.00138 to $0.25 or 181X).

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Fig. 3. Example of price action for an inflationary token (*Source*: Coinmarketcap.com): Between mid-Dec 2021 and mid-March 2022 the price fell from $10.6 to $0.78 (–93%) vs. Bitcoin which fell from $46.6 k to $39.3 k (–16%)

the venture capitalists are rewarded for their investment in the project by being able to sell their tokens at much higher prices. In many of these projects (and on Solana in particular) only a very small proportion of tokens are released into the market initially (e.g., 5–10%). The rest are often subject to a withholding period or 'cliff'. Once this passes, then tokens are unlocked for the early investors in a series of stages or 'tranches' as part of a vesting schedule. As a result, the supply of the tokens continuously rises over time, usually just after the main retail market has purchased the tokens and invested into the game. Retail investors are therefore left earning and holding a token which inevitably loses value as more and more of the supply is released (usually over about 2 years). As a result, the rewards from the game are continuously devalued and those who invested after the IDO may lose 90% of the value of any tokens purchased.

For example, Fig. 3 shows the price action for *Thetan Arena* which had only 27% of total supply in circulation even by March 2022 (https://doc.thetanarena.com/whitepaper). The IDO price for this token was $US.08 (https://cryptorank.io/ico/thetan-gem), but the Coinmarketcap plot for this project makes it difficult to see any price lower than around $1.40 (https://coinmarketcap.com/currencies/thetan-arena/). At peak, the price reached around $20 per token, but fell to $1 (a 95% loss of value in a period of less than 3 months). Some of this was, unquestionably, due to broader market conditions (the crypto downturn at the same time), but tokenomics is also likely to have played a role. Figure 4 shows how the release of tokens increased in the period associated with the price action and what any potential investors face in the future. Sites such as https://messari.io/ allow investors to examine the vesting schedule for project (i.e., how many tokens will be released over time or the likely inflation), but this information is not usually available for smaller gaming or very new projects and has to be observed from white papers or other sources.

As a result, inexperienced investors are unlikely to be aware of this type of problem which relates to another domain of knowledge; namely: the mathematics of investment and trading. In effect, to avoid experiencing financial harm, gamers would require knowledge of investment strategies and trading. Such advice is, however, rarely provided by social media sites (e.g., YouTube channels) that promote these tokens, often after the IDO has been completed.

Competition and unsustainable gaming models

Another difficulty with P2E is that game rewards can become very diluted. If games are potentially profitable, this encourages other competitors to enter the market. This means that it may become increasingly difficult for individual players to earn an income from the game. For example, in 'Axie Infinity' (AI), a significant portion of players' income is received through 'breeding' Axies and selling them on the AI marketplace (Aguila et al., 2022). Early investors attracted the greatest profit, with Axies being sold for an average of $200 in mid 2021 (De Jesus et al., 2022). However, as the value of NFTs is often relative to their scarcity, the growth in

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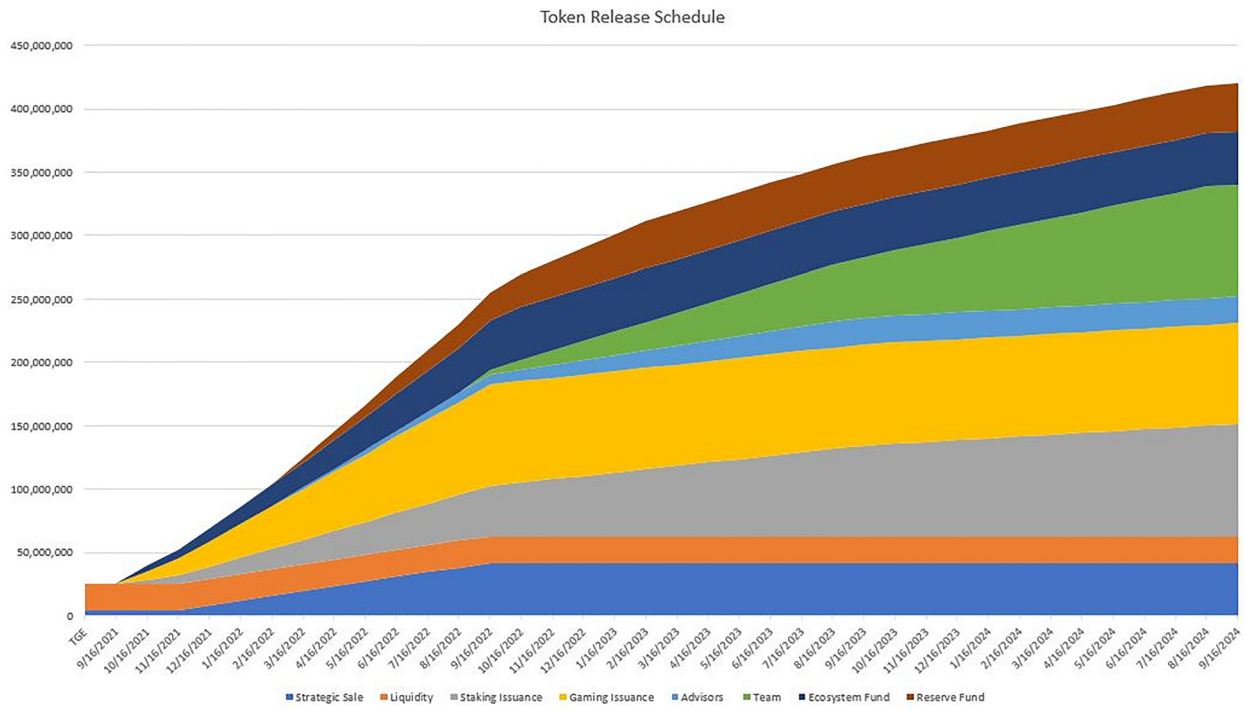


Fig. 4. Thetan Arena token vesting schedule: the square marks out the period September 2021 to March 2022. (https://doc.thetanarena.com/economy/theta-gem)

popularity of AI resulted increased 'breeding' and a surplus volume of Axies on the market; decreasing the price of this NFT to an average of $6 USD by mid 2022 (Dowling, 2022). A similar issue may arise if a very small group of players or a syndicate of players dominate the game by purchasing the best NFTs and sharing the game-play. A further complexity is likely to be the emergence of bots or computerized players that use methods to play the game continuously and in an optimized way that is beyond the scope of everyday players. All of these are potential issues that plagued *Cryptokitties,* and will need to be monitored as this form of technology develops (Jiang & Liu, 2021).

A parallel issue with AI is the games overall lack of long-term economic viability. Like the majority of P2E models, AI relies on players financial input/output to regulate the value of the in-game currency. In other words, the games economy is influenced by the number of players investing into AI, relative to the number of tokens being 'cashed out'. With the recent steady decline of new players, the game is in a current state of inflation, with SLP prices dropping from a high of $0.42 to $0.01 USD as of early 2022 (Aguila et al., 2022). The rate of inflation and individual returns may only continue to worsen as the platform struggles to maintain its current market share and has to compete with the introduction of newer P2E games and cryptocurrency platforms more broadly. This problem is further exacerbated by the fact that playing leads to the production of more and more in-game currency. In other words, players could become victims of their own success. In effect, the better people become in the game or the more upgraded and productive their NFTS, the more in-game currency they will earn. Without additional use cases or burning of this token, the price will gradually go down. Issues such as this affected games such as Axie Infinity, but also the game *Townstar*, a popular agricultural game in the *Gala Games* ecosystem. Thus, a fundamental challenge for these game ecosystems will be to find ways to encourage players to spend the in-game token. Upgrading and buying new game NFTs may only work for some time. Some ideas may include creating other collective content which is exclusively available for those who spend the currency, but which does continue to earning; access to new content; the ability to rework existing assets, or access other opportunities such as competitions or affiliative products and services.

Late-entry risks

A third and related challenge is the fact that those who enter later into the game may stand very little chance of earning a good return. For example later-comers may find that the best quality NFTs are too expensive to purchase and be up against players who have very developed NFTs and a much better position in the game (Jiang & Liu, 2021). Such players may also be faced with a depreciating currency and declining returns from any attempts to invest the currency into DEFI protocols operating in conjunction with the game (Annual Percentage Returns or APRs on yield farming is often very high initially, but drops as the size of the liquidity pool increases). A final problem is that the popularity of the game may be short-lived. With so many new games coming onto

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the market and the potential advantages to early adopters, the inflow of people may slow over time thereby leading to reduced demand for the in-game currency, as seen in *Axie Infinity* (Aguila et al., 2022; De Jesus et al., 2022) and *Cryptokitties* (Jiang & Liu, 2021). When combined with the off-loading of currency by earlier investors in the project and/or the game (who were able to benefit from the higher market price of the token), this means that late adopters may be faced with an economy with falling prices and reduced liquidity to dispose of their tokens. Jiang and Liu (2021) showed that these problems led to the rapid decline in the number of players of Cryptokitties, with the many thousands who had entered the game in December 2017 no longer playing only a few weeks later.

Exploitation

A further risk with these games is the potential for exploitation. If it is possible for early investors and owners of NFTs to lend out their assets to others, it is possible that people (and young people in particular) from developing nations may be most attracted to scholarship roles. It is known, for example, that some gaming guild projects target developing nations as the most likely source of potential participants (Francisco et al., 2022). For example, Axie Infinity (AI) has obtained a lot of interest in countries such as the Philippines because of its potential attractiveness as a source of income to lower income gamers. As with some other games that have previously allowed people to play for in-game assets and sell them on third party sites, concerns have been raised that P2E games could lead to exploitation of low paid workers who might be encouraged to engage in long periods of repetitive gaming ("grinding") for rewards which are shared with others. Similarities between this activity and the process of "gold farming" could potentially be drawn. "Gold farming" was the term used to describe gaming operations in countries such as China and various parts of South-East Asia in which people would work long hours in factory-like conditions to earn in-game currency or assets (Dibbell, 2015; Nakamura, 2009; Tai & Hu, 2018; Woodcock, 2018). An important current development in crypto-currency/ blockchain market has been the development of guilds which enable people to share and rent assets if they cannot afford the high entry cost required to purchase some NFTs, but this does raise the possibility that some of the concerns raised about "gold farming" could re-emerge in a new form or under a different name. Unverified reports on the Internet and social media include accounts of "scholars" having to send nude pictures of themselves before being signed or being asked to agree to highly unbalanced deals or "cuts" in revenue earned (Hackernoon.com).

Extrinsically motivated game-play and grinding

A potential psychological risk associated with highly monetized games is that the motivation for gaming may switch from intrinsic enjoyment or challenge, to a predominant focus on the monetary outcome of the activity (extrinsic motivation) (Mills & Allen, 2020; Peracchia, Presaghi, & Curcio, 2019). The effects of high extrinsic motivation within a video-gaming context are well documented, and associated with greater problem gaming (Mills, Milyavskaya, Heath, & Derevensky, 2018) poorer self-control and maladaptive gaming behaviors (Mills & Allen, 2020). Emerging research indicates these effects may be intensified within a P2E setting– whilst traditional online games were designed for enjoyment, the introduction of P2E has caused a shift in consumer interest (Aguila et al., 2022; De Jesus et al., 2022). As a result, players report a greater desire for financial incentives within monetised gaming, often at the expense of genuine enjoyment (De Jesus et al., 2022). An additional consequence of increased extrinsic motivation may be players engaging in 'grinding' behaviours, which involves the repetitive completion of menial gaming tasks to obtain additional merit points or in-game currency (Columb, Griffiths, & O'Gara, 2022; King, Delfabbro, & Griffiths, 2010). Grinding may therefore increase the frequency and duration of play and create greater risk of harm associated with excessive gaming. Further, within a monetised gaming context, grinding may encourage greater purchases of 'pay-to-skip' or other microtransactional content, allowing tedious game play to be avoided and desired content to be obtained quicker (Columb et al., 2022; Hamari et al., 2017). More broadly, the shift towards gaming as a monetary activity may not well received by many gamers who already regard features such as loot boxes as a short-cut to game progress and an anathema to what should essentially be a skill-based activity or one based on entertainment (Darakjian, 2015; Macey & Bujic, 2022; Tregel, Schwab, Nguyen, Müller, & Göbel, 2020).

Attractiveness to riskier players

As research into loot boxes, micro-transactions and cryptocurrency trading has shown, it is possible that these games may be attractive to people who already have an interest in higher risk gaming or speculation (Gibson et al., 2022). One hypothesis is that people who are already highly invested in gaming and who are willing to spend money on in-game assets will be more likely to view these new gaming models as attractive (Delfabbro, King, & Arthur, 2021; Delfabbro, King, Arthur, & Georgiou, 2021; Li et al., 2019). Although this might be beneficial to gaming if the adoption of blockchain validates the ownership or in-game assets and enables greater financial returns, it may also mean that those who are tempted to accelerate their game progression by purchasing loot-boxes might be more inclined to take similar 'financial short-cuts' in P2E gaming. In other words, such people may be more tempted to spend money (e.g., buy more NFTs on open markets) rather than earn these rewards through game-play. The other hypothesis is that P2E gaming may attract many people who are already engaged in more speculative trading in the crypto-currency market. Engagement in crypto-currency trading has an association with higher impulsivity and problem gambling, so that there is a greater likelihood of people with an existing

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propensity to take greater risks to be engaged in this form of gaming. Given that many new gaming projects are likely to have small market capitalizations (often under $50 m), the token prices are likely to be much more volatile and have the potential for greater downside movements if there are market corrections (although they can also increase dramatically in price for short periods during bull-markets) (https://www.coinbase.com/learn/crypto-basics/what-is-market-cap). Investment in what are often called low and micro-cap projects is generally considered the highest risk and most speculative form of crypto-currency investment and is often differentiated from longer-term investment in Bitcoin, Ethereum and the larger Layer 1 projects with market caps in the billions. A large market cap (over $10b) takes more sell pressure to drop or increase the price, whereas it is much easier for smaller projects (e.g., $50 m) to experience significant price moments because less money is required to shift the price. Most gaming projects (see https://coinmarketcap.com/view/gaming/) have market-caps under $1USb. Apart from Axie Infinity, there is no standalone game at the present time with a market capitalization above $US1b. Many are under $100 m and are considered small projects.

BUSINESS ETHICS AND CONSUMER PROTECTION

The analysis in this paper has implications for a number different areas and stakeholders. From a business perspective, there is a need to ensure that some duty-of-care is applied when implementing these games to avoid replication of the issues associated with "gold farming" and general labor exploitation. An ethical approach will be to maintain awareness of how the game is being utilized around the world; to have a clear statement of principles; some sort of process for registration for guilds using any scholarship or NFT rental program. There should be reporting mechanisms that enable the game operator to take action against individuals who may be engaging in unscrupulous practices (e.g., disallow rewards or the use of certain NFTs or addresses) based on confirmed misuse of the technology. In addition, some minimum rates of return could be set and potentially some reward structures based on the level of engagement, rather than just actual rewards (e.g., some NFTs) to give scholarship players opportunities to elevate their status in the game.

There is also the need for player/consumer protection, particularly in relation to education regarding the nature of the games: the potential risks of excessive gaming; the tokenomics and potentially inflationary nature of the reward tokens; the potential factors that may serve to reduce the benefits for new players over time; and potential strategies that might be used to mitigate risk. These may include not buying the gaming token too early, converting any early gains into USD stable-coin to hedge against future declines in value; having a time and monetary budget when playing; and, treating the game more as a play and earn exercise rather than as a source of income.

More broadly, there is a need to develop a code of practice or industry regulation to mitigate potential risks. These involve: greater transparency in the tokenomics and likely effect on the price of tokens over time; opportunities for late-comers to gain some benefit from the game (e.g., rewards based upon game-play that is not solely influenced by the possession of expensive NFTs); and, health and safety information about the potential risks of excessive gaming. An important element will be to make the activity enjoyable so that the monetary element of the game is not seen as the sole motivation for gaming. Genuine rewards should be obtainable by those who play skillfully and even a small random element in some reward structures (note: without the need to pay anything) could create greater equity for players with different levels of investment in the game. Game designers might also consider structural features such as burning tokens or setting maximum supply to reduce the inflationary nature of reward tokens.

CONCLUSION

In conclusion, it seems likely that the growth in P2E games will continue over the next 2–3 years such that this is likely to become a market with millions of consumers and potentially billions invested or staked in the games as well as the associated NFTs. Such games are also likely to overlap considerably with developments in the metaverse, which refers to the development of increasingly realistic and immersive virtual worlds. For these reasons, it is important for ongoing and timely academic research to monitor the uptake and effects of these games. Consumers are most likely to benefit from information, protections and regulation that is evidence-based and which involves a collaboration between developers, gaming platforms, and the consumer themselves. Future work could examine the prevalence of this activity and the extent to which its adoption is best predicted by existing gaming interests (i.e., does it attract conventional gamers?) or will it be a vehicle for widening the range of speculative activities currently undertaken in the crypto-currency market (i.e., will it introduce crypto-currency investors into gambling). There is also a need for further research into the ethics of the scholarship programs that is inclusive of the experiences of people in countries which are particularly involved in this activity.

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