

# FunFair – Valuation of a Blockchain Gambling Token

By Cypher Capital

## Abstract

This whitepaper examines the blockchain gambling startup FunFair, and explores potential values of its utility token, FUN. FunFair seems well placed to exploit low consumer trust in gambling operators, with market leading technology, appealing games, and a strong management team. Their “Fate Channels” technology allows for verifiable blockchain games to be executed quickly, and with comparable transaction costs to credit card transfers. Token value projections have assumed online casino market adoption rates of 10 to 20 % after four years. Strong sales and marketing execution, as well as brand development, will be critical to achieving these rates. A “burn” of 4B to 8B tokens in 2017 has been assumed, with 50% of total tokens entering circulation for transactions. Potential end year-four token values range from \$0.40 to \$1.15, representing ~ 17 to 51x multiples of price as of writing. Discounting these values by a required 40% annual rate of return gives present values of FUN tokens, if bought by investors today, ranging from ~ \$0.10 to \$0.30 – multiples of ~ 4.5 to 13x over today’s price. Clearly, a successful blockchain gambling company, using its own utility token in games, could generate an economy of considerable size.

## Introduction

In the world of cryptocurrency, the first question an analyst must ask is “why does this application need a blockchain?” With online gambling the answer is clear – trust. Consumer attitudes strongly reflect a lack of trust, which may be a key factor in limiting growth. The UK Gambling Commission’s 2016 survey<sup>1</sup> of 4,000 participants revealed that 48% had recently<sup>2</sup> gambled, but only 12.8% did so online (excluding National Lottery products). Only 34.3% agreed that gambling is “conducted fairly and can be trusted”, in a location where online gambling is legal and licensed. Clearly there is value to the consumer in a product they consider to be fairer and more trustworthy. The immutability and verifiability of blockchain transactions and smart contracts may offer just such an increase in trustworthiness.

H2 Gambling Capital estimates the 2017 worldwide online gambling market size to be \$49B, with betting (49%) and casino games (25%) the largest sectors.<sup>3</sup> This is expected to increase to \$68B in 2022, with an average compound annual growth rate (CAGR) of 6.8%. Market size in the gambling industry is defined as the gross winnings of game operators in that market. These estimates are illustrated in figure 1 below. By contrast, the total worldwide gambling market size in 2016 was

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<sup>1</sup> <http://www.gamblingcommission.gov.uk/PDF/survey-data/Gambling-participation-in-2016-behaviour-awareness-and-attitudes.pdf>

<sup>2</sup> In the past four weeks.

<sup>3</sup> <http://www.igamingbusiness.com/news/igaming-dashboard-october-2017>

estimated at \$450B<sup>4</sup>, ~ 10x the online market. Any blockchain gambling system that can expand into the offline market has a very large opportunity.

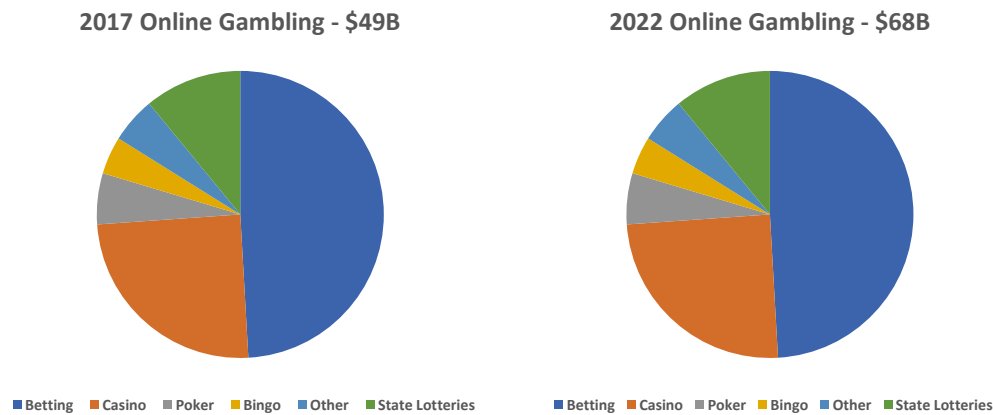


Fig. 1, Estimated worldwide online gambling market sizes. Source: H2 Gambling Capital.

Continuing with the theme of consumer appeal, for wide adoption a blockchain gambling system will need to offer comparable user experience and convenience to conventional online gambling games. This includes gameplay quality and speed, onboarding experience, and transaction costs and convenience. Additionally, the blockchain trust advantage will need to be maximised by clear and convincing communication of the immutability and verifiability of the system, reinforced by recognizable branding.

All relevant blockchain casino and poker gambling startups have based their technology upon Ethereum (ETH) smart contracts and monetary transfers. The implementations differ widely however, and their details are critical to product viability – verifiability and immutability rely on transaction and game validation being achieved on-chain, but transaction and smart contract operations incur significant monetary costs (Ethereum gas cost) and time delays, hence the critical need to efficiently complete these operations.

There are three relevant companies in the blockchain casino space; all are startups. Additionally, Virtue Poker is developing a system for poker.

- **FunFair** – currently offers prototype roulette, baccarat, and slot machine games. Their off-chain “showcase” section features several other game types. Wagers are conducted using their FUN utility token, which confers access and payment rights.
- **DAO Casino** – currently offers prototype blackjack and dice games. The internal token, BET, is used as a sub-currency within games for conducting wagers. BET acts purely as a utility token.

<sup>4</sup> <https://www.statista.com/statistics/253416/global-gambling-market-gross-win/>

- **Edgeless** – currently offers on-chain prototype blackjack game. Casino system that offers 0% house edge. As blackjack and video poker are games of skill and luck, they plan to profit from mistakes players make. EDG token is used as a sub-currency within games for conducting wagers. However, 40% of all Edgeless’ casino profits will be sent to the “Edgeless Lounge” prize pool. The lounge game is a special lottery game designed to favour the player. Each month EDG tokens can be used to play the lounge game and win a share of the prize pool. This lottery or sweepstake may be viewed by regulators as a dividend in disguise.

There are three essential problems to solve:

- Efficient generation and validation of random numbers (RNs).
- Efficient transfer of funds between participants.
- Validation that all participants in a game are using the same software.

Consider a game of roulette conducted between a player and a casino dealer. The player and dealer must transfer funds to the game, which are stored in an on-chain contract, and for each spin wagers are made, a random number is generated to decide the game outcome, and winnings are transferred from dealer to player or *vice versa*. If every spin requires on-chain generation or storage of the random number and funds transfer, then play will be slow and costs will rapidly mount. This process is illustrated in figure 2 below.

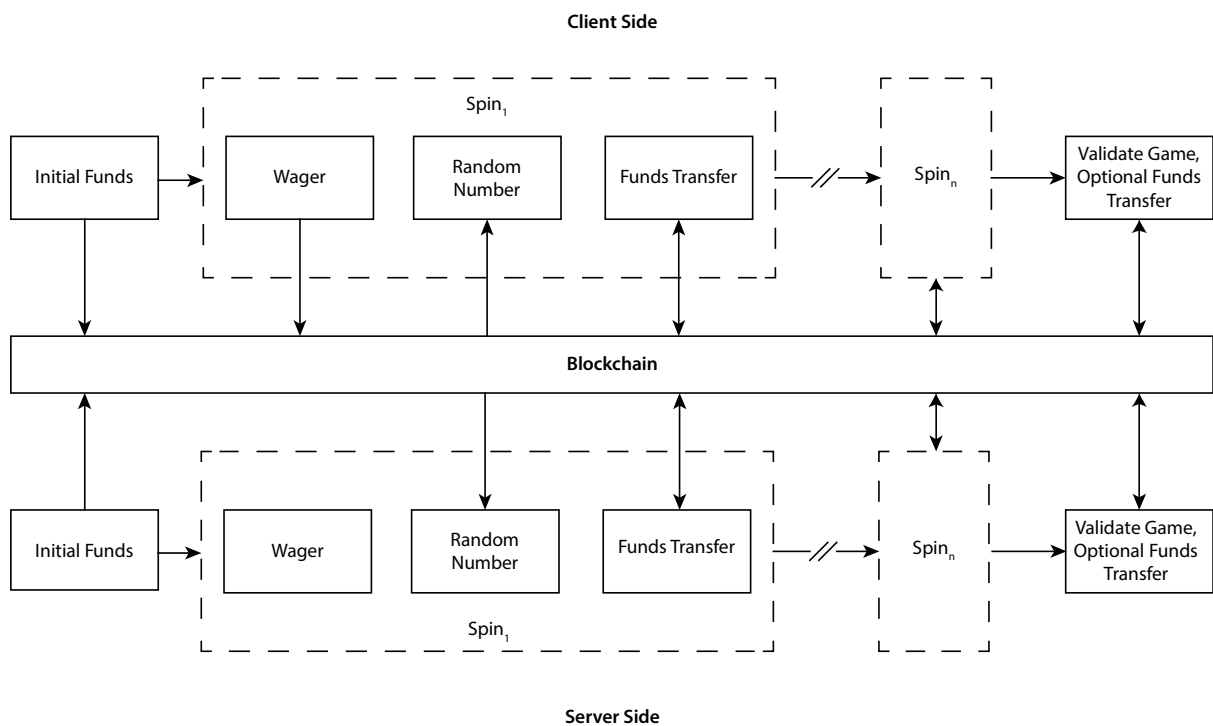


Fig. 2, Process flow for blockchain roulette game, with all interactions logged on-chain, and random numbers generated on-chain. Note the need for on-chain storage, RN generation, and funds transfer on every spin of the game. All interactions are cryptographically signed.

“State Channels” have been proposed as a solution to high transaction costs and long wait times. These are off-chain, secure channels between two or more parties (i.e. game participants) that allow communication of information (wagers, random numbers, outcomes), and storage and updating of a contract’s or variable’s state (game status). Games based on them have been implemented with various levels of success, with FunFair the most advanced to date. Transaction costs for commencing, playing, and settling a game are given below, and compared with Winsome’s on-chain blackjack game. See Appendix 1 for transaction details.

**FunFair** roulette costs:

- Commence game: 0.0044 ETH (\$1.47 at time of play).
- End game: 0.0036 ETH (\$1.21 at time of play).
- Comparable to credit card charges in traditional online gambling.

**DAO Casino** blackjack costs:

- Commence game: 0.0459 ETH (\$11.80 at time of play).
- End game: 0.0023 ETH (\$0.59 at time of play).

**Edgeless** on-chain blackjack costs:

- All operations including each wager: 0.0077 ETH (\$1.80 at time of play).

**Winsome** on-chain blackjack costs:

- Commence game: 0.0047 ETH (\$1.35 at time of play).
- Every game action: (“hit”) 0.0059 ETH (\$1.69 at time of play).
- End game: 0.0101 ETH (\$2.89 at time of play).

## FunFair - Technology

FunFair have taken an approach to state channels that minimises interactions with the Ethereum blockchain, but fulfils all the conditions for a verified game. Their technology, "Fate Channels", is based on generation of RNs from a single initial, blockchain stored seed, with validation of all RNs from that seed at the end of the game of many rounds of wagers. The random number generation process is illustrated in Figure 3 below.

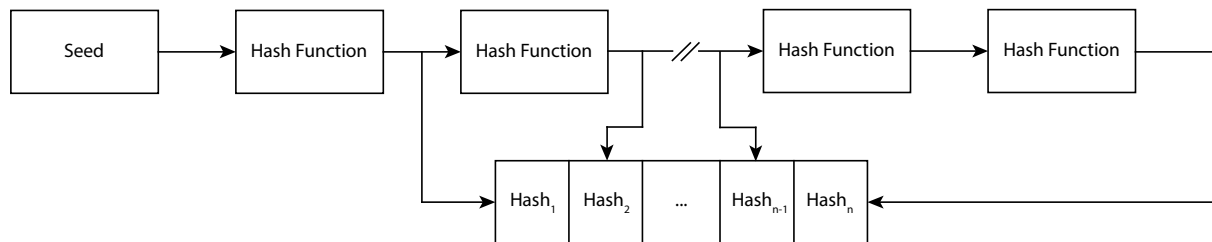


Fig. 3, Generation of hash chain for random number generation. Hash values are used as random numbers in the game. Server and client hash values are combined on both participants' game software for each game outcome. The initial seeds are encrypted and stored on the blockchain at game commencement. At game end, the initial seeds are revealed, the last used hash values are sent to the blockchain, and the hash chains are computed and verified by each party. All interactions are cryptographically signed.

For both client and server, a seed string (encrypted and stored on-chain at game commencement) is hashed by an irreversible, uniform output probability function similar to SHA-3 or SHA-256. Each hash value produced is fed into the hash function again, with hash values stored in an array, until a sufficient number for a game's random outcomes has been produced. This produces a chain of hash values that can be reproduced deterministically from the initial seed value but, due to the irreversible nature of the hash function, cannot be calculated in reverse. i.e.  $hash_2$  can be calculated from  $hash_1$ , but  $hash_1$  cannot be calculated from  $hash_2$ . When the hash values are used to generate random numbers starting from the last value and working backwards, other parties cannot calculate the next value, but after the game all hash values can be validated by calculating them from the then disclosed seed value.

To begin a game, the game contract, which consists of the game software, is retrieved from the Ethereum blockchain, the hash chain is computed, and the encrypted seed and initial funds are committed to the blockchain. The software is retrieved by both player and server, and the fate channel is generated from it. Wagers are sent to the Fate Channel, and both sides commit the last random number from their hash chain for the first game outcome. These two numbers are combined in the fate channel, and are sent to both sides, who repeat the operation locally. The outcomes are calculated on channel and by both participants, with agreement required to continue. The game state, including each side's funds status, is updated on the channel, and the process repeats until the game ends. As the operations take place off-chain, they are completed quickly, in line with traditional online casino games.

At the game end, the encrypted seeds are revealed, and the forward chains are calculated. Each random number and game outcome are verified, and if agreement is reached, the smart contract copies are hashed and validated on-chain. Funds are transferred and logged on-chain as well. This process allows for a verified game with only two blockchain interactions – game initialisation and funds commitment, and game validation and funds settlement. The Fate Channel process is illustrated in figure 4 below.

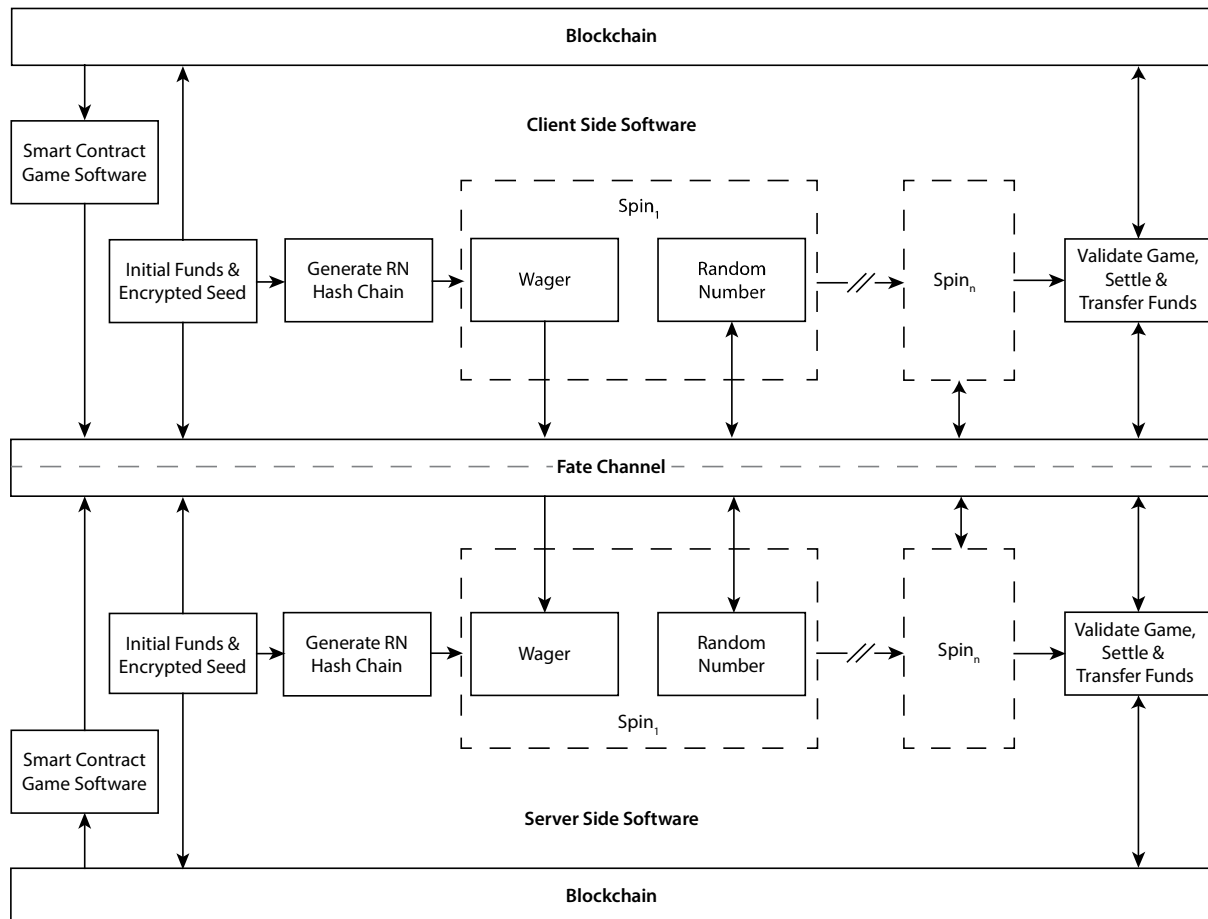


Fig. 4, Process flow for FunFair Fate Channel roulette game. At commencement, game software is retrieved from the Ethereum blockchain as a smart contract, the random number hash chain seeds are encrypted and stored on-chain, and funds are committed to the blockchain. All further game actions are conducted off-chain via the Fate Channel, until on-chain game validation and funds settlement at the end. As a state channel, the Fate Channel keeps track of the state of the game. Random numbers in the game are generated by combining server and client hashes. All interactions are cryptographically signed.

FunFair’s process fulfils the three criteria outlined earlier, and does so with relatively low Ethereum transactions costs, as illustrated by the costs of playing a game, which are comparable to credit card charges in traditional online gambling. The Ethereum transactions are examined in the Introduction section of this paper.

This technology may also be applicable to other types of online gambling, giving FunFair the potential to enter the betting, bingo, and poker markets. A further possibility is to enable peer-to-peer gambling,

where games are conducted between two or more participants, without involving a central server. This would further increase their ability to penetrate the market, by enabling more people to operate casino games.

There are technical challenges remaining for the Fate Channel technology though. There will always be pressure to reduce transaction costs and times, and competitors will look to exploit the open nature of Ethereum to reproduce technology. Games with cards that remain “face down” over two or more wagers pose a challenge, as the sharing of random numbers between participants makes it difficult to prevent a nefarious player from calculating the identity of those cards. Methods for countering Mental Poker cryptographic problems have been proposed as solutions for this challenge. Games with more than two players, especially with some players joining or leaving mid-game, may also pose technical challenges, and increase transaction costs. Most online casino games do not require this though. Finally, to make good on the promise of game validation, the implementation of a “Verify” or “Audit” button in games is desired.

## FunFair – Market Execution

FunFair's technical advantages and challenges were described in the previous section. The characteristics determining their ability to penetrate the market are examined here.

Foremost is their experienced management team. Co-founder Jez San has extensive experience in video game entrepreneurship and design, including founding Argonaut Games PLC and listing it on the LSE, eventually gaining an OBE for services to the industry. In online gambling, San founded the well-known poker software company PKR.com in 2006, leaving in 2009, well before its eventual demise in 2017. Other blockchain investments include cryptocurrency exchange Kraken, and Bitcoin payment provider BitPay.

The other founders, Jeremy Longley and Oliver Hopton, have considerable industry experience from their time at PKR.com, and COO David Greyling has six years of experience as an executive at \$2B revenue gambling firm William Hill. Additionally, FunFair is known to have extensive contacts with the traditional online gambling industry.

Their current games are well designed and visually appealing, performing quickly and with comparable transaction costs to credit card based online gambling. This sets their gaming experience apart from the often crude or simple games offered by other blockchain startups, and enables them to compete on both user experience, and enhanced trustworthiness, with traditional online gambling. Their strategy of offering gaming solutions to existing online operators, and receiving a cut of revenue, avoids head-on competition with many of the biggest names, while potentially maximising adoption, and hence the size of the FUN economy. Further, their planned peer-to-peer technology will expand the number of operators who can offer their products to consumers. Their technology might also be extended to betting and bingo, increasing their addressable market size. An announcement, this year, of a partnership with a prominent online gambling operator would go a long way to establishing their brand, and building confidence in their operation.

FunFair are moving quickly to establish a recognisable and appealing brand identity. Success at doing so is a key factor in market development. A strong brand will be necessary to communicate the increased trustworthiness of their games and technology. Their games' visually appealing and smooth user experience enhance that brand. A blockchain gambling firm with sufficiently strong brand, and technology, may even be able to provide software to the 9x larger off-line gambling market, thereby further expanding the FUN economy.

As of 31 August 2017, they were known to have raised \$32M<sup>5</sup>, giving them the necessary capital for the first round of expansion.

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<sup>5</sup> <https://funfair.io/funfair-company-update-31-august-2017/>



The greatest threats to their success are potential consumer indifference, and relatively low barriers to market entry. The former would seem less likely, given the low trust levels for traditional gambling revealed by surveys. However, brand development, and sales and marketing execution, will be critical. The latter is exacerbated by the open nature of Ethereum, and related blockchain, technology. The question must be asked: what's to stop another group replicating the key technology? First mover advantage is one factor, enhanced by keeping their software and smart contracts closed-source for now. Intellectual property protection such as patents are another method. If established online gambling operators continue to dominate the market, and use out-sourced blockchain games, then this may be a viable approach. Continual improvement of core technology to stay ahead of competition will likely be important. Additionally, well designed game software will allow superior user experience, even if competitors successfully copy the Fate Channel technology. Finally, a strong brand that is linked to trustworthiness may be the highest barrier to entry.

## FUN Token Valuation

One of the insights of the Ciaian *et al.* <sup>6</sup> 2016 paper on the economics of Bitcoin price formation was that currency value is in large part driven by market development. This view was further suggested for other cryptocurrencies and tokens in their subsequent publication.<sup>7</sup>

For utility tokens, the value of their market is determined by the monetary demand,  $M^D$ , for the economic utility they provide. The supply of tokens,  $M^S$ , is given by the product of the number of tokens in circulation,  $N_T$ , and their price,  $P_T$ . i.e.

$$M^D = M^S = P_T \cdot N_T$$

FunFair’s token, FUN, acts purely as a utility token, as it’s only intended use is within games for conducting wagers. In this manner it is analogous to a casino chip. This is illustrated in figure 5 below.

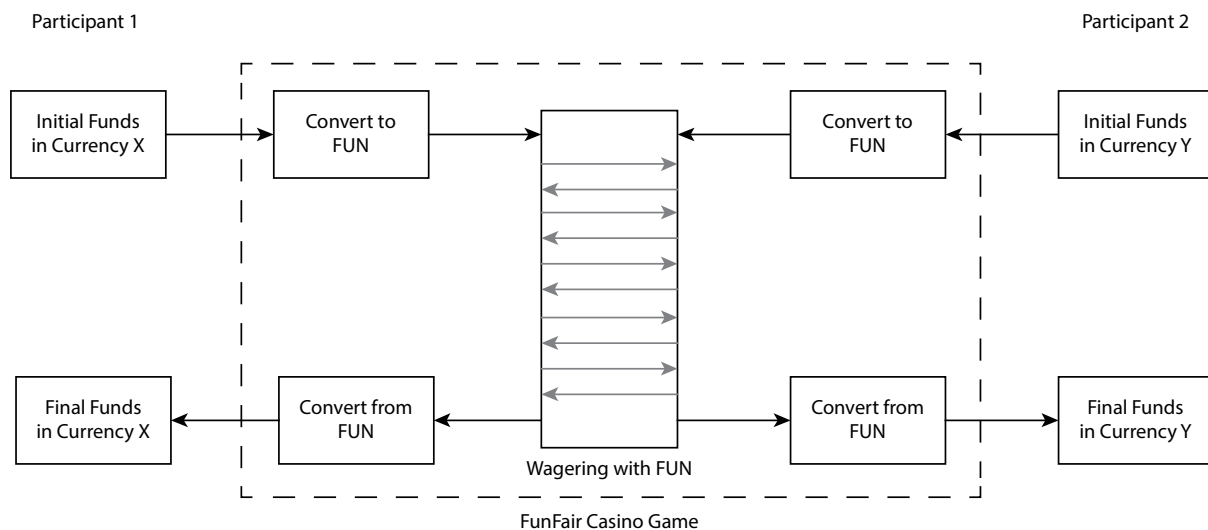


Fig. 5, Economic use of FUN token in FunFair casino games. At game commencement, funds are transferred into the game, where they are exchanged for FUN. All wagering takes place in FUN. At game end, funds are settled in FUN, which is then likely to be exchanged for the participants’ original currency. Typically, participant 1 is a player, and participant 2 in the “bank” or “house”. Note that FUN is only used in the internal wagering for the game. In this manner it is analogous to a casino chip.

In the FunFair games, economic value is added by playing the games and winning or losing money. The economic value added in a given period is the net money won. i.e. The amount that participants

<sup>6</sup> Pavel Ciaian, Miroslava Rajcaniova, *et al.* (2016) The economics of BitCoin price formation, *Applied Economics*, 48:19, 1799-1815, DOI: 10.1080/00036846.2015.1109038

<sup>7</sup> Pavel Ciaian, Miroslava Rajcaniova, *et al.* (2017) Virtual Relationships: Short- and Long-run Evidence from BitCoin and Altcoin Markets. *arXiv:1706.07216* [q-fin.EC]. <https://arxiv.org/abs/1706.07216>

spend, on net, on the games, which is equivalent to a casino's gross winnings. However, the demand for FUN per year is given by the amount of money exchanged for FUN to be wagered per year. Taking house risk advantage at ~ 2%, ~ 50x must be wagered per amount won. i.e. the annual transaction volume is ~ 100 x annual gross winnings (both client and server/casino must commit funds). As FUN is likely to be immediately sold again at game end, token velocity is expected to be high.

From the definition of monetary velocity, we define token velocity,  $V_T$ , as the number of times a token is used for transactions in a given period of time. This definition allows relation of token monetary demand to transaction volume,  $T$ , and velocity as follows.

$$M^D = \frac{T}{V_T}$$

Returning to the definition of token supply, we calculate token value as follows,

$$P_T = \frac{T}{N_T \cdot V_T}$$

As of writing, Network Value to (daily) Transactions Value (NTV) reported by *Coin Metrics*<sup>8</sup> ranges from ~ 2.8 to 460, implying annual velocities of 0.8 to 130 (NTV is the inverse of per day Velocity value). The 130 value is an outlier however, with 55 the next highest. Additionally, due to uncertainty as to whether multiple blockchain addresses involved in transactions may be controlled by the same entity ("churn"), these values may overestimate velocity.<sup>9</sup> Due to FUN's expected high velocity, 60/year was chosen for valuation purposes. *cf.* Ethereum's estimated velocity of 38.

With the valuation model in place, four more variables must be estimated: total addressable market (TAM), market share, number of tokens in circulation, and discount rate for risk compensation.

TAM can be estimated from leading data provider H2 Gambling Capital's online gambling market statistics, available from iGaming Business Limited's *iGaming Dashboard*<sup>10</sup>. Annual market segments sizes are summarised in table 1 below.

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<sup>8</sup> <https://coinmetrics.io/nvt/>

<sup>9</sup> Harry Kalodner, Steven Goldfeder, *et al.* (2017) BlockSci: Design and applications of a blockchain analysis platform. *arXiv:1709.02489v1* [cs.CR]. <https://arxiv.org/abs/1709.02489>

<sup>10</sup> <http://www.igamingbusiness.com/news/igaming-dashboard-october-2017>

	2016	2017	2018	2019	2020	2021	2022
<b>Betting</b>	22.16	24.09	26.02	27.36	29.41	31.09	32.84
<b>Casino</b>	11.16	12.16	13.16	13.87	14.81	15.56	16.32
<b>Poker</b>	2.71	2.82	2.92	2.93	2.99	2.99	2.98
<b>Bingo</b>	1.93	2.08	2.23	2.33	2.42	2.48	2.53
<b>Other</b>	2.40	2.53	2.65	2.70	2.74	2.73	2.72
<b>State Lotteries</b>	4.44	5.38	6.47	7.57	8.64	9.68	10.85
<b>Total</b>	44.81	49.07	53.44	56.77	61.01	64.53	68.25

Table 1, Worldwide online gambling market sizes (\$B).

As established earlier, FunFair are well placed and connected to penetrate the online casino market. Indeed, they may well establish a presence in other online markets, and their technology and brand may find a niche in the offline casino and gambling world. Accordingly, limiting their TAM to online casino games may be conservative, but it is the market they are best placed to succeed in, and the one they have focussed their information releases upon. Hence, valuation will be based on casino TAM.

Year-4 market adoption values of 10 to 20% have been considered, with an “s-shaped” logistic curve for estimating behaviour over time. Due to the FunFair’s technological readiness, market experience and connections, and capable team, year-1 adoption rates of > 1% are achievable. Adoption and market value (gross winnings) curves are displayed in figures 6 and 7 below.

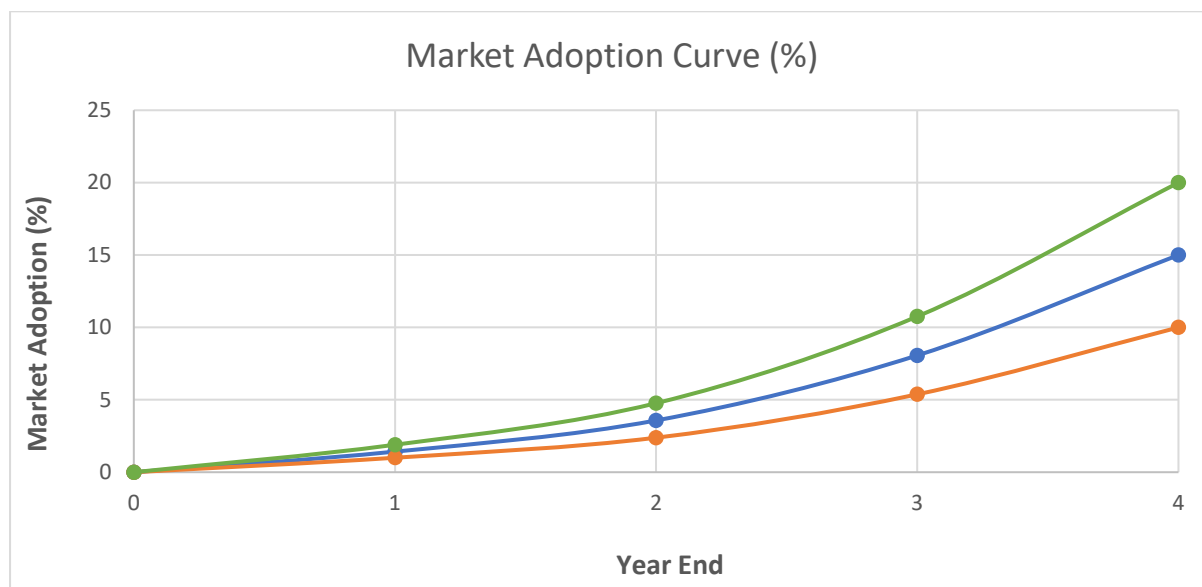


Figure 6, Market Adoption predicted from logistic curve with four years lag time and 10 to 20 % year-4 adoption. TAM limited to online casino games.

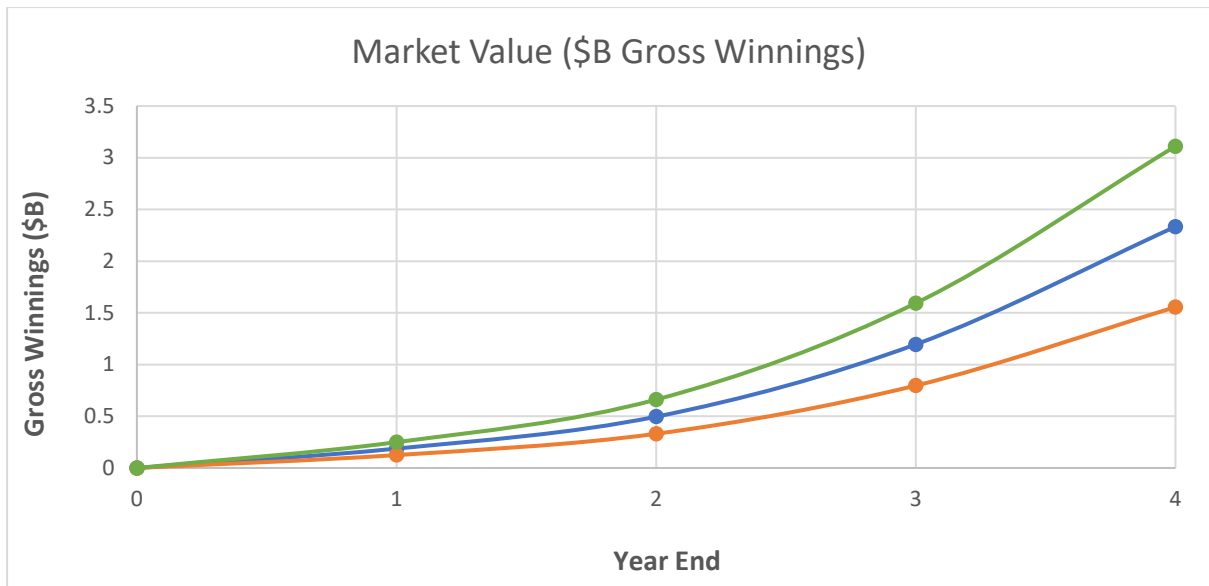


Figure 7, Market Growth predicted from logistic curve with four years lag time and 10, 15, or 20 % year-4 adoption. TAM limited to online casino games.

Currently there are 17.17B FUN tokens in existence, with 4B of those released to market.<sup>11</sup> It is likely that several billion more will be destroyed (“burned”) in 2017. Of the 13.17 retained by FunFair, a burn of 4B tokens would be realistic, with up to an additional 4B more burned. Of the remaining coins, some will be held, while others will be actively exchanged in the FUN economy. ARK Investment Management LLC and Coinbase estimated that only 46% of Coinbase customers used Bitcoin as a transactional medium.<sup>12</sup> Taking the hold to circulate ratio at 50% for both tokens so far released, and those retained by FunFair, gives ~ 6.5B to 4.5B tokens in circulation. *cf.* The 4B that would be circulating if FunFair did not release any more over the next 4 years, and those released tokens were used for transactions.

Having successfully completed an ICO that gained them \$32M (as at 31 August 2017)<sup>13</sup>, with beta products available, and a large expansion into the market planned to begin in early 2018, FunFair can be considered as a startup in its second or expansion stage. By the estimates of Scherlis & Sahlman<sup>14</sup>; Sahlman, Stevenson & Bhide<sup>15</sup>; and various commentators, a discount rate of 30 to 50% would be appropriate. This valuation has used 40%.

Combining these predictions of TAM and adoption rates, with estimates of wager to win ratio, token circulation velocity, and proportion of tokens circulating as a transactional medium, allows estimation of token value over the next four years. End year-4 values range from ~ \$0.40 to \$1.15, depending on

<sup>11</sup> <https://coinmarketcap.com/currencies/funfair/>

<sup>12</sup> <http://research.ark-invest.com/bitcoin-asset-class>

<sup>13</sup> <https://funfair.io/funfair-company-update-31-august-2017/>

<sup>14</sup> Sahlman, William A., Daniel R Scherlis. (2009) *A Method For Valuing High-Risk, Long-Term Investments: The "Venture Capital Method"*. Harvard Business School Background Note 288-006, July 1987. (Revised 2009.)

<sup>15</sup> William A. Sahlman, Amar Bhide, Howard Stevenson. (1998) *Financing Entrepreneurial Ventures*. Business Fundamentals, HBS Number: 9202. Harvard Business School.

market adoption and number of tokens burned. These values are multiples of ~ 17 to 51x the FUN price as of writing. Estimated future token values for 6B tokens burned are illustrated in figure 8 below.

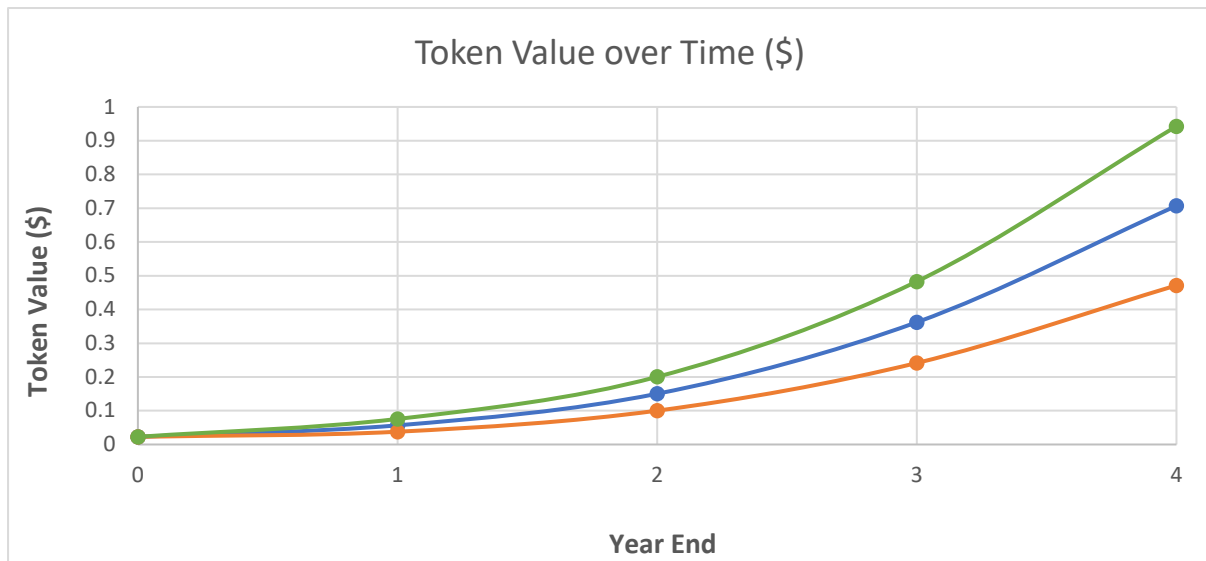


Figure 8, Estimated future FUN token values with 6B tokens burned, and year-4 market adoption rates of 10, 15, and 20 %.

These value estimates imply present values for the token, given a certain discount rate to compensate for risk and the time value to money. A 40% annual return was determined to be a reasonable expectation for FUN investors. The predicted present values of FUN tokens if bought by investors today range from ~ \$0.10 to \$0.30 – multiples of ~ 4.5 to 13x. Clearly, a successful blockchain gambling company, using its own utility token in games, could generate an economy of considerable size, given market adoption. FUN present values calculated from various scenarios for end year-4 are given in table 2 below.

Tokens Circulating (B)	Market Adoption Rate (%)		
	10	15	20
4.5	0.150	0.225	0.300
5.5	0.123	0.184	0.245
6.5	0.104	0.156	0.208

Table 2, Predicted FUN token Present Values (\$) for various scenarios of circulating token number and market adoption rate.

## Appendix 1: Ethereum Transactions

### FunFair roulette:

Commence game: 0.0044 ETH (\$1.47 at time of play).

<https://ropsten.etherscan.io/tx/0x62ea13955b9de9625d5be1994ec368f0cc752c29a4dc49dfda66c7b49150a628>

End game: 0.0036 ETH (\$1.21 at time of play).

<https://ropsten.etherscan.io/tx/0xd78518b88ccb784368149154d42923de7a34db89ec118bc2c9e9b758f8b9e843>

### DAO Casino blackjack costs:

Commence game: 0.0459 ETH (\$11.80 at time of play).

<https://ropsten.etherscan.io/tx/0x1e0285ed338834cad65f2369ff718a86d9fd311b1078892ba5f2d43fa15430db>

End game: 0.0023 ETH (\$0.59 at time of play).

<https://ropsten.etherscan.io/tx/0x175f2bdc9a0aaa5d99a90dc6db6181e3e91b0e97ab78ca66c73d0a6093054a27>

### Edgeless on-chain blackjack costs:

All operations including each wager: 0.0077 ETH (\$1.80 at time of play).

<https://ropsten.etherscan.io/tx/0x3800b69b9eec0acfd515c3b4b84a304542d0c498fbf5508310948ffa15bc0594>

### Winsome on-chain blackjack costs:

Commence game: 0.0047 ETH (\$1.35 at time of play).

<https://ropsten.etherscan.io/tx/0xdf69017fc9d4808ebdd14bb0b904a2780cbdac5469adfa35b6d87285965b573>

Every game action: ("hit") 0.0059 ETH (\$1.69 at time of play).

<https://ropsten.etherscan.io/tx/0x9246a620c87fc6ed461c4effec00ef0304f7ac4d47223709894ad1e204784e83>

End game: 0.0101 ETH (\$2.89 at time of play).

<https://ropsten.etherscan.io/tx/0x88259773c74372696916c8b9ada865a5fcf6bced46af84e2f172acc5bdf28cd>