



Andrade, M., & Newall, P. W. S. (2023). Cryptocurrencies as Gamblified Financial Assets and Cryptocasinos: Novel Risks for a Public Health Approach to Gambling. *Risks*, 11(3), [49].  
<https://doi.org/10.3390/risks11030049>

Publisher's PDF, also known as Version of record

License (if available):  
CC BY

Link to published version (if available):  
[10.3390/risks11030049](https://doi.org/10.3390/risks11030049)

[Link to publication record in Explore Bristol Research](#)  
PDF-document

This is the final published version of the article (version of record). It first appeared online via MDPI at <https://doi.org/10.3390/risks11030049> . Please refer to any applicable terms of use of the publisher.

## University of Bristol - Explore Bristol Research

### General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:  
<http://www.bristol.ac.uk/red/research-policy/pure/user-guides/ebr-terms/>

Review

# Cryptocurrencies as Gamblified Financial Assets and Cryptocasinos: Novel Risks for a Public Health Approach to Gambling

Maira Andrade <sup>1</sup> and Philip W. S. Newall <sup>2,\*</sup>

<sup>1</sup> School of Psychology, University of East London, London E16 2RD, UK

<sup>2</sup> School of Psychological Science, University of Bristol, Bristol BS8 1TU, UK

\* Correspondence: philip.newall@bristol.ac.uk

**Abstract:** Policymakers' attempts to prevent gambling-related harm are affected by the 'gamblification' of, for example, video games and investing. This review highlights related issues posed by cryptocurrencies, which are decentralised and volatile digital assets, and which underlie 'cryptocasinos'—a new generation of online gambling operators. Cryptocurrencies can be traded around the clock and provide the allure of big potential lottery-like wins. Frequent cryptocurrency traders often suffer from gambling-related harm, which suggests that many users are taking on substantial risks. Further, the lack of regulation around cryptocurrencies and social media echo chambers increases users' risk of being scammed. In comparison to the conventional regulated online gambling sector, cryptocasinos pose novel risks for existing online gamblers, and can also make online gambling accessible to the underage, the self-excluded, and those living in jurisdictions where online gambling is illegal. Researchers and policymakers should continue to monitor developments in this fast-moving space.

**Keywords:** gamblification; cryptocurrency; Bitcoin; investing; betting; Ethereum; trading

**Citation:** Andrade, Maira, and Philip W. S. Newall. 2023. Cryptocurrencies as Gamblified Financial Assets and Cryptocasinos: Novel Risks for a Public Health Approach to Gambling. *Risks* 11: 49. <https://doi.org/10.3390/risks11030049>

Academic Editor: Mogens Steffensen

Received: 3 November 2022

Revised: 12 January 2023

Accepted: 16 February 2023

Published: 22 February 2023



**Copyright:** © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

There is increasing awareness of the financial and health costs of gambling-related harm (DCMS 2020; Regan et al. 2022; Select Committee on the Social and Economic Impact of the Gambling Industry 2020; van Schalkwyk et al. 2019; Wardle et al. 2019; Muggleton et al. 2021). Harm appears elevated with online gambling, where an ever-increasing range of regulated gambling products are now available online, 24 h a day (Allami et al. 2021). This perhaps explains why calls to treat gambling as a public health issue are especially pronounced in the UK (Orford 2019; Cassidy 2020), which has the world's largest regulated online gambling market (Gambling Commission 2018). Two proposed harm reduction reforms are reductions on the maximum speed and bet size allowable on games such as online slots (Newall 2022). However, any efforts to reduce the harm from the regulated online gambling sector should be mindful of relevant technological developments elsewhere.

Recently, research has expanded the term "gamblification" beyond its initial description of how the gambling industry aimed to normalise gambling participation (McMullan and Miller 2008) to also include gambling-like mechanisms being applied to non-gambling contexts such as videogames (Macey and Hamari 2020). Given the novelty of the term, its conceptualisation is still up for much valid debate. For example, the gamblification of investment products has recently been defined as a more narrow concept where three key features should be present (Newall and Weiss-Cohen 2022): (1) the product uses design techniques first honed by the gambling industry; (2) investors who use it display similar behavioural patterns to disordered gamblers, such as chasing

losses (Gainsbury et al. 2014); and (3) that the investment is rarely profitable in the long-term. A broader definition of gamblification has also been proposed based on the analysis of its previous uses in the gambling literature (Macey and Hamari 2022). This broader definition includes two key features: (1) affective gamblification, which has been categorised as affective-emotive (i.e., products, services or individuals that are promoted through gambling activities); or affective-normalising (i.e., normalising gambling participation through, for example, sports and celebrity sponsorships); and (2) effective gamblification, which has two subtypes including effective-full fidelity (i.e., the full reproduction of gambling products are implemented in non-gambling contexts), and effective partial-fidelity (i.e., partial reproductions of gambling products are implemented in non-gambling contexts, meaning one key component of gambling is missing, such as the stake or the prize).

Cryptocurrencies are a novel technological development, and the volatility of cryptocurrency prices means that they raise similar issues around gamblification. While the gamblification of products and services is an emerging area that scholars should keep addressing from multiple perspectives (as highlighted by Macey and Hamari (2022)), since cryptocurrencies are largely sold as an investment product this review will primarily rely on the narrower definition of gamblified investment products proposed by Newall and Weiss-Cohen (2022). However, cryptocurrencies pose another unique risk with respect to gambling, in that an increasing number of sophisticated online “cryptocasinos” allow people to gamble online using cryptocurrency assets as their wagers (Brown VII 2022). These cryptocasinos can present many of the same risks as the regulated online gambling market, in that they can offer the same range of products including online slots and sports betting. Cryptocasinos can also present novel risks that may complicate matters for policymakers, given that they currently lie outside of the UK online regulated market, and gambling via cryptocurrencies can pose additional and poorly understood risks. This narrative review aims to examine the novel risks posed by cryptocurrencies as gamblified investment assets, and as a currency used in unregulated cryptocasinos. Additionally, it aims to provide an up-to-date assessment of potential implications for research and policy in this rapidly changing market. To our knowledge, this is the first paper to review how the gamblification of cryptocurrency investing and online cryptocasinos intersect, and their potential associations with gambling-related harm.

While the focus of this article is to provide the reader with a comprehensive review of gambling-related risks associated with cryptocurrency as an emerging technology, other risks to consumers, including fraud and market manipulation as well as the role of social media on such risks, are also reviewed so as to present a more complete picture of all intersecting factors. Currently, we believe a narrative review can provide an adequate overview of the literature, given the limited number of relevant studies available. Study selection criteria included all peer-reviewed studies related to cryptocurrency trading, cryptocasinos and gambling-related harm. As of January 2023, there have been eight peer-reviewed studies conducted on cryptocurrency trading and its associations to gambling and gambling-related harm (Delfabbro et al. 2021a; Johnson et al. 2023; Kim et al. 2020; Mills and Nower 2019; Oksanen et al. 2022a, 2022b; Philander 2023; Sonkurt and Altınöz 2021; Steinmetz 2023). Additionally, seven peer-reviewed studies have been published on cryptocasinos with a focus on safer gambling features, gambling behaviour and/or policy and regulation (Brown VII 2022; Andrade et al. 2022; Newall and Andrade 2022; Owens and Lavitch 2013), three of which focused on the less popular Dapps (Gainsbury and Blaszczynski 2017; Meng and Fu 2020; Scholten et al. 2020), blockchain casinos that have remained largely theoretical when compared to widely popular web-based cryptocasinos, such as ‘stake.com’.

## 2. The Gamblification of Investing

The trading of investments is not categorised as a type of gambling, and trading disorder is not a formal diagnosis (Grall-Bronnec et al. 2017). Nevertheless, excessive

traders often turn to disordered gambling treatment programs for support, and discussions around investments frequently occur on gambling peer support forums (Bradley and James 2021). According to Arthur et al. (2016), despite being different concepts, investing and gambling are substantially linked empirically. At the individual level, problematic speculation was found to be at the intersection of both activities, and to be strongly correlated to problematic gambling (Arthur et al. 2016). Speculative investments are high-risk and short-term (e.g., day-trading and penny stocks) and may also involve the use of certain speculative strategies such as leverage, shorting and derivatives (Oksanen et al. 2022a; Arthur et al. 2016). Two recent studies have found that investors with greater compulsive gambling symptoms were twice as likely to invest in derivatives and leveraged products than baseline investors (Cox et al. 2020) and that problem gambling was significantly associated with frequency of trading (Mosenhauer et al. 2021). Gambling and trading therefore intersect in several ways. Smartphone apps now make high-frequency trading as easy as playing on an online casino. Furthermore, high-frequency trading has been associated with disordered gambling (Grall-Bronnec et al. 2017; Shin et al. 2015; Cox et al. 2020), and is unlikely to result in profitable returns (Barber et al. 2014; Bondt and Thaler 1985). Disordered gamblers are also especially attracted to wagers with the allure of big lottery-like potential wins (Kyonka and Schutte 2018), and this is a tendency which can attract them to either high-risk stocks or to a class of investments known as ‘derivatives’.

### 3. Cryptocurrency Trading

Cryptocurrencies are digital assets that can be anonymously transferred without the need for financial intermediaries (i.e., banks) (Nakamoto 2008). These are therefore decentralised ‘peer-to-peer financial’ transactions. This decentralised and peer-to-peer system can work as all transactions are recorded, time-stamped and verified on what is known as a ‘Blockchain’: a digital recording which is held across many computers around the world (Fang et al. 2022). The first Blockchain token, Bitcoin, was introduced in 2009 with the ambitious goal of eliminating financial intermediaries, as a decentralised digital currency that could be transferred across the globe using cryptographic functions (Harwick 2014). This new concept has sparked great interest, and by February 2022 there were over ten thousand cryptocurrencies in circulation (Statista n.d.).

Cryptocurrencies are famous for their volatility (Yin et al. 2021), with the most recent marked drop for Bitcoin to the present time occurring between April and October 2022 when Bitcoin lost 57% of its value (CoinMarketCap n.d.a). Such falls are not unprecedented in the stock market, with the US stock market having comparable falls on three occasions across the 20th century (Mishkin and White 2002). However, the frequency with which these sizeable falls occur is higher with cryptocurrencies, as Bitcoin prices have dropped by more than 50% six times in the past thirteen years, and the rival cryptocurrency Ethereum has crashed by more than 50% five times since 2017 (DeMatteo 2022). Arguably, this greater volatility in cryptocurrencies than the conventional stock market arises because it is harder to agree on the underlying value of a cryptocurrency compared to a stock. Despite the many similarities between cryptocurrency trading and conventional investments, several studies have shown that the profile of cryptocurrency investors differ significantly from non-cryptocurrency investors. Cryptocurrency investors have been found to be predominantly male and significantly younger than non-cryptocurrency investors. Findings also showed that cryptocurrency investors had a higher percentage of university degrees and higher incomes when compared to conventional stock investors (Hasso et al. 2019; Zhao and Zhang 2021; Ante et al. 2022; Hackethal et al. 2022). Furthermore, a crucial difference has been argued to exist at the very concept of a cryptocurrency, its value (Delfabbro et al. 2021b). Stocks provide tangible cash flows to their owners, while the potential rewards from cryptocurrencies are less clear and are much debated (Shiller 2017b).

Although cryptocurrencies are in principle decentralised, a new ecosystem of financial intermediaries and trading exchanges has nevertheless arisen for cryptocurrencies. As cryptocurrencies are novel and unregulated, this has led to many hacking thefts, frauds, and scams, leading to losses for many cryptocurrency investors. Similar events do also occur with conventional financial intermediaries—for example with Barings bank closing in 1995 due to the actions of a rogue trader—but these events are arguably also more frequent with cryptocurrency markets (Dupuis and Gleason 2021; Gandal et al. 2018). A recent analysis revealed that between 2011 and 2021, hacking of cryptocurrency exchanges amounted to a total loss of over USD 7 billion (Charoenwong and Bernardi 2021). One of the largest of these happened recently, with the Binance platform losing over GBP 500 billion to a recent hack.

#### **4. Risks of Investing in Cryptocurrency**

##### *4.1. Market Manipulation*

There are a range of market manipulation schemes beyond hacks that can harm cryptocurrency investors. Market manipulation is not new, and it is deeply rooted in the history of conventional stock markets, with, for example, ‘boiler room schemes’ pressurising investors to buy specific unworthy stocks (Leinweber and Madhavan 2001). However, the extent to which market manipulation occurs is heightened due to anonymity and lack of regulatory protections with cryptocurrencies (FCA 2022).

Market manipulation schemes can have different goals and effects on the market. ‘Pump-and-dump’ price distortion schemes are possibly the most relevant to naive cryptocurrency investors (Eigelshoven et al. 2021). Pump-and-dumps involve artificially inflating the price of acquired assets so they can be sold at a much higher price than they were bought for (Kamps and Kleinberg 2018). In the cryptocurrency market the price inflation of coins (the pump phase) mainly occurs within online pump groups, with mass buying of coins coordinated by those who participate. These online groups can be found in several social media platforms (e.g., Twitter, Reddit and Telegram) (Mirtaheri et al. 2019). Once the previously agreed target price is reached, members of the groups sell their coins at a profit (the dump phase) (Eigelshoven et al. 2021). The coin’s price increases can be used to generate excitement amongst naive cryptocurrency investors and encourage them to buy the coin at the elevated price—purchases that will likely be bought from members of the pump group, who look to secretly sell their coin. While pump-and-dump schemes in conventional trading markets, such as penny stocks, can take several days or weeks to achieve their goals (Kamps and Kleinberg 2018), a study has found that cryptocurrency pump-and-dumps often take less than a day, with two events analysed in the study taking less than 10 min (Martineau 2018). Finally, a recent study examined the impact of Elon Musk’s cryptocurrency-related tweets on the pricing and trading volume of cryptocurrencies. Findings revealed that Musk’s tweets had significant effects on these markets, with increases in trading volume being observed in the minutes following the tweets and non-negative tweets resulting in abnormal positive returns. These results suggest that Musk’s tweets may have the potential to influence investor behaviour and are especially significant in the context of market manipulation as well as the role of social media, leadership, and influencers in the cryptocurrency trading market (Ante 2023).

##### *4.2. Behavioural Similarities between Cryptocurrency Traders and Gamblers*

In certain circles, the average cryptocurrency investor might be portrayed as a tech-savvy visionary, able to foresee the future of currency and financial organisation in what is currently being termed ‘web 3.0’. This view is enhanced by stories in the press of people who invested in Bitcoin by 2013 or earlier, and now have large portfolios based on relatively small initial investments. However, in some ways this is an unrepresentative portrayal, similar to how lotteries work to enhance the visibility of their few big winners. The average Bitcoin investor nowadays, who is unable to profit from these large early

gains, is more likely than a conventional investor to be actively trading in order to try and recover from previous losses (Kim et al. 2020).

To date, eight published studies have investigated the links between cryptocurrency trading and gambling-related harm (Johnson et al. 2023). Two studies compared cryptocurrency traders, conventional stock traders, and frequent gamblers (Mills and Nower 2019; Delfabbro et al. 2021a). Results showed that the frequency of cryptocurrency trading was positively correlated with higher frequency of gambling activities and high-risk stock trading (Mills and Nower 2019). Moreover, Problem Gambling Severity Index scores (PGSI-(Ferris and Wynne 2001)) positively predicted the number of cryptocurrency trades, the hours spent trading and the frequency with which cryptocurrencies' prices were checked (Delfabbro et al. 2021a). Studies that compared cryptocurrency investors, conventional stock traders and non-investors found that cryptocurrency traders reported higher rates of gambling, video gaming, and excessive alcohol use than non-investors and conventional investors (Oksanen et al. 2022a). Furthermore, Kim et al. (2020) found that Bitcoin investors had significantly higher problem gambling scores than conventional traders, and that the scores positively predicted Bitcoin investment. The study also found that Bitcoin investors exhibited behavioural characteristics similar to those of gamblers, particularly regarding their tendency to engage in frequent, short-term trading and to continue investing despite experiencing losses. 'Chasing losses' has been found to be a common feature of excessive stock trading and is also observed in pathological gambling (Dixon et al. 2018; Sadock and Sadock 2011). Novelty-seeking and low cooperativeness scores of Bitcoin investors were also found to be similar to those of gamblers (Janiri et al. 2007). These results suggest that Bitcoin investors have a higher propensity to engage in gambling-like behaviour, tend to trade excessively and exhibit personality and psychological traits similar to those of gamblers, such as being sensation-seeking and impulsive (Kim et al. 2020). One further study showed that many cryptocurrency users who also gamble show signs of overinvolvement (Steinmetz 2023). One study compared cryptocurrency investors who frequently checked cryptocurrency prices (at least once every hour) or traded daily with other cryptocurrency investors who stated they did not engage in these activities (Sonkurt and Altınöz 2021). Participants who tracked coin prices every hour or less, as well as those who reported trading daily, had significantly higher scores on the Pathological Trading Scale than the other groups. One longitudinal study found that changes in cryptocurrency trading predicted excessive gambling, which was also found to be more common amongst cryptocurrency traders (Oksanen et al. 2022b). The study also found that rates of excessive gambling were significantly higher for participants who traded cryptocurrencies and gambled offshore. Lastly, one study examined "meme" cryptocurrency trading only (Philander 2023); results showed that participants involved in meme cryptocurrency investments showed higher risks of gambling problems, higher levels overconfidence, and also perceived financial uncertainty as less risk than others. Overall, these studies highlight several behavioural similarities between frequent cryptocurrency trading and disordered gambling.

#### *4.3. Social Media and Herd Behaviour*

Cryptocurrencies are a product of technological advances, but their success can be, at least partially, attributed to internet culture. Dogecoin is an excellent example of how online culture can drive cryptocurrency prices via herd behaviour. Many cryptocurrencies are invented with a specific 'use case' in mind, such as greater anonymity or transaction speed. This is not the case with Dogecoin, which was created as a joke to poke fun at the intense internet culture around other cryptocurrencies. Dogecoin's main feature is its piggybacking on an existing internet meme around Shiba Inu dogs. Dogecoin was propelled to fame thanks to its loyal online community and Elon Musk's Tweets (Benaim 2018; Tandon et al. 2021). Initial increases in price for Dogecoin then created more interest, which led to more buyers, and therefore created a positive feedback loop of further price increases. In May 2021, at the peak of its Twitter popularity, Dogecoin's market cap

peaked at USD 85 billion. As of October 2022 the coin has lost over 85% of its value, with a market cap just above USD 11 billion (CoinMarketCap n.d.b). Dogecoin illustrates how the prices of cryptocurrencies are at least partly driven by investor sentiment.

Investor sentiment and herd behaviour are relevant to stock market investing too, where the coordinated actions of investors can drive self-fulfilling price changes (Shiller 2016). This was relevant in the dot com bubble, where the internet facilitated communication between investors, as well as providing new stocks to speculate on. This also happened more recently with the 'Gamestop' stock in 2020 (Umar et al. 2021). However, these dynamics can be again especially pronounced with cryptocurrencies (Kumar 2021).

Studies have found that herding behaviour is not only present in the cryptocurrency market, but it is also most pronounced during periods of uncertainty (Ballis and Verousis 2022). The role of social media in predicting cryptocurrency bubbles and prices has been widely researched, with Twitter being the platform investigated by most studies. Research findings suggest that social media sentiment not only plays a meaningful role in predicting cryptocurrency bubbles (Phillips and Gorse 2017) and prices, both negatively and positively (Chen et al. 2017; Serafini et al. 2020; Phillips and Gorse 2018; Hao et al. 2019), but also future profits (Garcia and Schweitzer 2015). One of the studies that investigated the predictive power of Twitter sentiment over cryptocurrency prices also found that between 1–14% of posts collected for analysis were from bot accounts (Kraaijeveld and De Smedt 2020).

Despite the previously discussed risks, many choose to start or to continue investing in cryptocurrencies. A recent literature review examined the factors that can influence cryptocurrency adoption (Alzahrani and Daim 2019). The review categorised these factors as: technical (i.e., factors related to blockchain technology and cryptocurrency characteristics, such as being a decentralised system, its anonymity, fast transfers and security); economic factors, which includes low transactions costs, the acceptance of the coin by businesses, and investment opportunity; social factors, (e.g., subjective norms and influencers); and individual factors such as technological curiosity, and privacy. Given the powerful influence of internet culture and community (i.e., social media) on the cryptocurrency market, as illustrated above, one may argue that the social element should be a particularly important factor to consider when examining individuals' decisions to invest in cryptocurrency. Shiller (2017a) has highlighted the importance of narrative economics for the understanding of economic fluctuations. Narrative economics has been conceptualised as popular narratives that share an element of epidemic-like contagion. These narratives can easily spread because they can elicit emotional reactions or appear to advance self-interest (Shiller 2017a). The narrative economics framework can provide one possible explanation for why people invest in cryptocurrency despite the risks. There is empirical support for social networks having a significant effect on conventional stock market participation (Hong et al. 2004; Brown et al. 2008; Kaustia and Knüpfer 2012), with one study also showing that market entry is not diminished by negative returns as these are not usually discussed amongst social groups (Kaustia and Knüpfer 2012). In addition to the evidence that social media and online forums can have a powerful influence on cryptocurrency prices (Phillips and Gorse 2017; Chen et al. 2017; Serafini et al. 2020; Phillips and Gorse 2018; Hao et al. 2019; Garcia and Schweitzer 2015; Kraaijeveld and De Smedt 2020), there is some evidence to support social factors (i.e., social groups online and offline) having a significant influence on individuals' decisions to invest in cryptocurrency. A 2021 survey conducted by the Financial Conduct Authority (FCA) found that friends, family and online forums such as Reddit, were the biggest sources of information for UK adults before they decided to purchase cryptocurrencies (FCA 2021).

Furthermore, a recent study proposed a new model that aimed to provide an explanation to a range of online-related phenomena observed in the cryptocurrency space (Pedersen 2022). Findings showed how the 'meme' phenomena, as seen in the case of Dogecoin (Benaïm 2018; Tandon et al. 2021), is one example of 'viral' narrative that can

have a powerful effect on the market. Additionally, the study highlights other internet-related factors that contribute to cryptocurrency becoming an attractive investment despite its risks, including online echo chambers (e.g., Reddit) where positive views of the market are amplified by confirmation bias and influencers' judgements become the 'expert' opinion (Pedersen 2022). Studies have also shown how influencers play an important role in the cryptocurrency market. For instance, a study found evidence of abnormal returns increasing following cryptocurrency-related content posted by YouTube influencers. The abnormal returns also increased prior to the event, potentially due to the influencers announcing their content in advance on other social media platforms or offering exclusive early access to premium subscribers (Lath 2022). Given the growing evidence in support of social networks', especially online communities', effects on cryptocurrency investing, it is important to consider how this effect may also be indirect. While many individuals may, for example, decide to purchase cryptocurrencies because of their potential for high returns, this belief might stem from online influence. Fear of missing out (FOMO) is another example of a motivation to invest (Delfabbro et al. 2021b) that could be a consequence of online narratives related to cryptocurrencies being highly profitable. Finally, online narratives related to high returns, including wide-spread success stories of early investors and millionaire influencers, exemplify one of the potential outcomes of gambification proposed by Macey and Hamari (2022), in which media is used to promote and profit from a glamorised "high-roller lifestyle".

## 5. Cryptocasinos

Cryptocurrencies were introduced as methods of payment in online casinos almost a decade ago (in 2013) when it was estimated that around one hundred operators started accepting Bitcoin for deposits (Owens and Lavitch 2013). According to a report released by the Asian Racing Federation Council on Anti-illegal Betting and Related Financial Crime (2021) (in November, 2020), there were 780 online casinos, sports books, bingos and poker rooms accepting five of the biggest cryptocurrencies in the world (as per market cap values-Bitcoin, Ethereum, Tether, XRP and Bitcoin Cash). Today, there are 946 of these websites accepting the same five cryptocurrencies in the same categories mentioned above (Casino City: Your Casino Directory n.d.); a 21% increase in 24 months. Moreover, It is estimated that between 2014 and 2017, crypto casinos accepted over 24 billion bets, totaling four billion USD or 3.2 billion GBP (Brown VII 2022). Today, cryptocurrency gambling has gone from a theoretical possibility (Gainsbury and Blaszczynski 2017; Scholten et al. 2020; Meng and Fu 2020) to a rapidly expanding market capable of offering consumers a wide range of sophisticated products that are easily comparable to conventional operators (Andrade et al. 2022). These cryptocasinos have also reached new levels of popularity and legitimacy, sponsoring some of the biggest sports teams in the world (Newall and Xiao 2021), as well as mainstream celebrities (Davies and Rosca 2022). Recently, this popularity growth has been a major topic of discussion within online streaming communities and the media. Twitch.tv, one of the biggest gaming platforms in the world where over 75% of users are between 16–34 years old (Twitch.tv n.d.), has just placed a ban on crypto gambling streams (Tundik 2022). Nevertheless, the platform allowed the live streaming of cryptocurrency gambling to millions of young viewers across the world for over 18 months, the consequences of which are not yet known.

Using cryptocurrencies to gamble online poses other unique and poorly understood potential risks. People are likely to gamble more when using intangible currency, which is one reason why casinos use chips instead of cash, and one contributing factor for why conventional online gambling can be so harmful (Siemens and Kopp 2011). This last risk is likely heightened with cryptocasinos, which uniquely involve gambling via a digital asset that is itself highly volatile. This means that individuals engaging in online crypto gambling are not only likely disinhibited by the intangible nature of cryptocurrency, but also of the value of the cryptocurrencies they are using to wager, due to their volatility.



This is an added risk beyond more conventional failures in age and identity verification, which the next section highlights amongst current popular cryptocasinos.

The various 'use cases' for cryptocurrencies have been said to revolutionise a number of online activities as part of 'web 3.0', for example the use of digital payments. One such attempted revolution was in the design of online casinos. The odds of winning on casino games such as roulette are set so that gamblers lose money over time, a concept called the 'house edge' (Newall et al. 2020). Two cryptocurrencies were launched to promote 'edgeless' cryptocasinos, where the odds of winning were fair (Newall and Andrade 2022). However, like some other cryptocurrency-based ventures, one of these cryptocasinos turned out to be a scam, which took millions of dollars from investors (Isaacs n.d.), while the other cryptocurrency appears dormant with very few active users (Newall and Andrade 2022). Given the complete overlap between cryptocurrency investing and cryptocasinos when it comes to cryptocurrencies that are created to be exclusively used to gamble, it can be argued that this specific intersection exemplifies what has been termed affective-emotive gamblification (Macey and Hamari 2022), in which gambling is used to promote a new product or service, in this case new crypto coins. This argument is further strengthened by the fact that one edgeless casino was never launched as it was a scam, and the other failed to succeed as a casino despite the relative initial success of the coin (Newall and Andrade 2022).

Given the failure of edgeless cryptocasinos to date, other cryptocasinos have largely mimicked the form and range of products offered by conventional online gambling operators. A recent study investigated the safer gambling and consumer protection practices of forty frequently visited online crypto operators, such as their enforcement of age verification and the availability of safer gambling tools and messages (Andrade et al. 2022). The findings showed substantial failings, especially when compared with previous analysis of similar criteria in conventional online operators from the UK and Ireland (Bonello and Griffiths 2017; Catania and Griffiths 2021; Cooney et al. 2021).

Results revealed a widespread lack of identity verification, both during registration and when requesting cryptocurrency deposit links, suggesting increased risks for young individuals and those who have self-excluded (Hayer et al. 2020), as both groups could easily access the websites anonymously. None of the operators required proof of address or identity before allowing registration, and two operators also allowed the registration of underaged users. Users were able to request to deposit cryptocurrency for wagering on 37 out of 40 operators (92.5%) without providing proof of identity or address. These sites were also broadly accessible. Twenty-two operators (55%) could be accessed directly from the UK, while the remaining 18 (45%) could be accessed from the UK by using a Virtual Private Network (VPN) service. This last point shows how cryptocasinos could also provide access for people living in jurisdictions where online gambling is illegal.

Further findings suggested that cryptocasinos could be considered riskier to gamble on than conventional online operators, even for people who can otherwise gamble online legally. Over 70% of the operators did not provide links to gambling or age filtering software in their pages, and 62.5% did not offer self-assessment tests (Andrade et al. 2022). Rates were also generally worse than those found by similar previous studies on UK and Irish conventional online gambling operators (Bonello and Griffiths 2017; Catania and Griffiths 2021; Cooney et al. 2021). For example, only 15% of crypto operators offered some type of limit setting tool (i.e., deposit, loss, wager, or session limits) compared to an average of 85% for conventional online operators, while 42.5% of cryptocasinos offered cooling-off periods and 60% offered voluntary self-exclusion compared to averages of 84.2% and 93.1% for conventional operators, respectively. A total of 37.5% of crypto operators offered no safer gambling tools to consumers while an average of only 5% of conventional operators offered no tools. Finally, the study also assessed customer service practices after operators were contacted about a user's sense of impaired control when gambling; 64.7% of the operators continued to send promotional material after contact, including some that had deleted or blocked the user's account due to the content of the

original message compared to rates of 27% and 14% in two of the previous studies of traditional operators (Bonello and Griffiths 2017; Catania and Griffiths 2021).

## 6. Conclusions

Technological change has led to a proliferation of gambling-like content into new walks of life, such as video games and investing (Macey and Hamari 2022) and investment products (Newall and Weiss-Cohen 2022), and these changes pose risks to public health approaches to reduce gambling-related harm (Orford 2019; Cassidy 2020). The present review has considered how the latest developments in cryptocurrencies contribute to this area of gamblification and attempts to reduce the burden of gambling-related harm. Findings show that based on previous conceptualizations of investment gamblification (Newall and Weiss-Cohen 2022), cryptocurrency trading can be considered a gamblified market in several aspects. Much like conventional high-frequency trading and online casinos, cryptocurrency exchange apps now facilitate high-frequency, 24-h trading opportunities. Moreover, research has shown that cryptocurrency investors display behavioural patterns that have been previously observed in gamblers, such as chasing losses and trading compulsively (Kim et al. 2020). Finally, while cryptocurrencies can be marketed as novel yet attractive products, their current elevated prices suggest little further profit potential for new investors. Additionally, a number of elevated risks similar to online gambling and the seedier side of conventional investments have been found, including market manipulation and scams (Leinweber and Madhavan 2001; FCA 2022; Eigelshoven et al. 2021; Kamps and Kleinberg 2018; Mirtaheeri et al. 2019; Martineau 2018) which can appear attractive via the distorted lens of social media (Benaim 2018; Tandon et al. 2021; Shiller 2016; Umar et al. 2021; Kumar 2021; Ballis and Verousis 2022; Phillips and Gorse 2017; Chen et al. 2017; Serafini et al. 2020; Phillips and Gorse 2018; Hao et al. 2019; Garcia and Schweitzer 2015). The lack of regulatory protections in cryptocurrencies adds further support to this narrative of increased risks for many users. Cryptocasinos are a final related development considered by this review. Findings have shown that despite being widely unregulated, these casinos are easily accessible (Andrade et al. 2022), while also being allowed to build an image of legitimacy through major sports advertisements and celebrity sponsorships (Newall and Xiao 2021; Davies and Rosca 2022). Additionally, substantial failings in consumer protection practices of online cryptocasino operators have been uncovered, which indicate an increased risk for underage and self-excluded individuals as well as those living in jurisdictions where online gambling is illegal, especially when the anonymity and volatility of cryptocurrencies are also considered (Andrade et al. 2022).

The current review offers an important contribution to the literature, providing a broad overview of cryptocurrencies and their potential risks. However, limitations can be identified and findings should be interpreted with caution. As previously mentioned, the current literature is limited, and more research is needed so as to inform future policy decisions. Furthermore, more research will allow for systematic reviews and meta-analyses to be conducted, making findings more robust. While all peer-reviewed studies conducted on the main topics (i.e., cryptocurrency trading, cryptocasinos and gambling-related harm) have been selected for review due to their small numbers, which significantly reduces selection bias, studies selected from the wider cryptocurrency literature related to market manipulation, online fraud, and social media, were not selected using specific inclusion or exclusion criteria. Since this is a fast-moving area of research we suggest that findings should in future be summarized using different methodologies (e.g., meta-analysis) as more evidence emerges.

Finally, given the exceptionally limited literature, non-fungible tokens (NFTs) were not covered in this review. NFTs are cryptographic digital assets (e.g., images, and songs) that rely on blockchain technology to secure their value, which is closely related to the price of Ethereum (Apostu et al. 2022; White et al. 2022). Despite both NFTs and cryptocurrencies being based on blockchain technology they are not the same, as NFTs

cannot be exchanged as currency (Dowling 2022). However, NFTs can overlap significantly with cryptocurrencies in the ways they are used. For example, recent research has explored the role of NFTs on 'Play to Earn' (PTE) online gaming (Delic and Delfabbro 2022; Aguila and Bartolata 2022), as well as their use for in-game collectables such as VGO skins (Gonserkewitz et al. 2022). Additionally, NFTs have also been compared to highly speculative markets, where investors expect to profit from 'hyped' digital assets valued substantially above their actual price (Ma and Wen 2022). A recent study also found that despite its potential for high returns, the NFT market is highly volatile (White et al. 2022). Therefore, as research develops, future reviews examining gambling-related products will likely include several areas such as investing and video-gaming, as they progressively intersect under the umbrella of emerging technologies and the gamblification of their applications.

The findings highlighted in this review have several implications for policy and regulation. Currently, both the Financial Conduct Authority and the Gambling Commission have highlighted the difficulties associated with regulating cryptocurrencies-based products (FCA 2022; Gambling Commission 2022). However, policymakers may also want to consider other approaches that could improve consumer protections. For example, social media and streaming websites have become a powerful advertising tool for both cryptocurrency investment and cryptocasinos (Ante 2023; Lath 2022). It can be argued that the recent ban on cryptocurrency gambling products by 'Twitch.tv' (Tundik 2022) is an example of self-regulation. However, it could be beneficial for policymakers to consider the risks highlighted in this review in order to make informed decisions on how to regulate cryptocurrency marketing strategies that could potentially lead to public harm. Moreover, both cryptocasinos, cryptocurrency exchanges and trading apps have been allowed to advertise in professional sports, which significantly increases their consumer reach. Preventing cryptocurrency trading apps and cryptocasinos from advertising in sports until potential risks are better understood could be a significant step in harm reduction (Andrade et al. 2022; Newall and Xiao 2021). This is especially significant in the context of the UK government's consideration of banning gambling advertisements in sports. Overlooking gambling-like markets, such as cryptocurrency exchanges and trading apps, could potentially cause the public to see these products as less risky than gambling (Newall and Xiao 2021). Furthermore, the current policy debate around the regulation of online gambling in the UK should consider the novel risks associated with the cryptocasino black market. Cryptocasinos could become a much greater challenge than conventional black markets, since freely available VPNs allow gamblers to circumvent geolocation blocks, and the intrinsic anonymity of cryptocurrencies can prevent operators from blocking bank or card payments from excluded and underage customers (Andrade et al. 2022). Lastly, given the complexity and scale of the issues surrounding cryptocurrencies, policymakers will likely have to consider several approaches to regulation, which may also include research-informed financial education aimed at helping consumers make informed decisions, as well as protecting them from widespread frauds commonly found in the cryptocurrency space (Fernandes et al. 2014).

This is a fast-moving area, and so any policy developments should also be supported by improvements to the underlying evidence base. Future studies should consider exploring behavioural data from cryptocasinos, as they may provide significant insights into gambling behaviour, including how it may differ from the behaviour of traditional online gamblers. Additionally, findings from a previous study showed that digital money may contribute to impaired control in gamblers (Hing et al. 2015); hence, gambling researchers may wish to investigate how gambling with digital fiat currency may differ from using cryptocurrencies. Lastly, given the significant overlap between cryptocurrency trading and cryptocurrency gambling, future studies should aim to examine behavioural similarities and decision-making strategies amongst those experiencing harm from cryptocurrency-based gambling and cryptocurrency-based trading.

**Author Contributions:** Conceptualization, M.A. and P.W.S.N.; writing—original draft preparation, M.A.; writing—review and editing, M.A. and P.W.S.N. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- (Aguila and Bartolata 2022) Aguila, Desireh Ann, and Joshua Miguel Bartolata. 2022. “AXEing the Axie Infinity (AI): The AI of Modern Gaming, Business Model Strategem, and Global Economy towards Cryptocurrency Era”. BSc dissertation, College of Liberal Arts and Sciences, Dasmariñas, Philippines, February. <https://doi.org/10.13140/RG.2.2.10609.56162>.
- (Allami et al. 2021) Allami, Youssef, David C. Hodgins, Matthew Young, Natacha Brunelle, Shawn Currie, Magali Dufour, Marie-Claire Flores-Pajot, and Louise Nadeau. 2021. A Meta-analysis of Problem Gambling Risk Factors in the General Adult Population. *Addiction* 116: 2968–77. <https://doi.org/10.1111/add.15449>.
- (Alzahrani and Daim 2019) Alzahrani, Saeed, and Tugrul U. Daim. 2019. Analysis of the Cryptocurrency Adoption Decision: Literature Review. Paper presented at the 2019 Portland International Conference on Management of Engineering and Technology (PICMET), Portland, OR, USA, August 25–29, pp. 1–11.
- (Andrade et al. 2022) Andrade, Maira, Steve Sharman, Leon Y. Xiao, and Philip Newall. 2022. Safer Gambling and Consumer Protection Failings amongst 40 Frequently Visited Cryptocurrency-Based Online Gambling Operators. *Psychology of Addictive Behaviors*. <https://doi.org/10.1037/adb0000885>.
- (Ante 2023) Ante, Lennart. 2023. How Elon Musk’s Twitter Activity Moves Cryptocurrency Markets. *Technological Forecasting and Social Change* 186: 122112. <https://doi.org/10.1016/j.techfore.2022.122112>.
- (Ante et al. 2022) Ante, Lennart, Ingo Fiedler, Marc von Meduna, and Fred Steinmetz. 2022. Individual Cryptocurrency Investors: Evidence From A Population Survey. *International Journal of Innovation and Technology Management* 19: 2250008. <https://doi.org/10.1142/S0219877022500080>.
- (Apostu et al. 2022) Apostu, Simona Andreea, Mirela Panait, László Vasa, Constanta Mihaescu, and Zbyslaw Dobrowolski. 2022. NFTs and Cryptocurrencies—The Metamorphosis of the Economy under the Sign of Blockchain: A Time Series Approach. *Mathematics* 10: 3218. <https://doi.org/10.3390/math10173218>.
- (Arthur et al. 2016) Arthur, Jennifer N., Robert J. Williams, and Paul H. Delfabbro. 2016. The Conceptual and Empirical Relationship between Gambling, Investing, and Speculation. *Journal of Behavioral Addictions* 5: 580–91. <https://doi.org/10.1556/2006.5.2016.084>.
- (Asian Racing Federation Council on Anti-illegal Betting and Related Financial Crime 2021) Asian Racing Federation Council on Anti-illegal Betting & Related Financial Crime. 2021. *A Report of Blockchain and Cryptocurrencies in Illegal Betting*. Hong Kong: Asian Racing Federation, pp. 482–92.
- (Ballis and Verousis 2022) Ballis, Antonis, and Thanos Verousis. 2022. Behavioural Finance and Cryptocurrencies. *Review of Behavioral Finance* 14: 545–62. <https://doi.org/10.1108/RBF-11-2021-0256>.
- (Barber et al. 2014) Barber, Brad M., Yi-Tsung Lee, Yu-Jane Liu, and Terrance Odean. 2014. Do Day Traders Rationally Learn about Their Ability? *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2535636>.
- (Benaim 2018) Benaim, Mickael. 2018. From Symbolic Values to Symbolic Innovation: Internet-Memes and Innovation. *Research Policy* 47: 901–10. <https://doi.org/10.1016/j.respol.2018.02.014>.
- (Bondt and Thaler 1985) Bondt, Werner F. M. De, and Richard Thaler. 1985. Does the Stock Market Overreact? *The Journal of Finance* 40: 793–805. <https://doi.org/10.2307/2327804>.
- (Bonello and Griffiths 2017) Bonello, Maris, and Mark D. Griffiths. 2017. Analyzing Consumer Protection for Gamblers Across Different Online Gambling Operators: A Descriptive Study. *Gaming Law Review and Economics* 21: 278–85. <https://doi.org/10.1089/gltre.2017.2134>.
- (Bradley and James 2021) Bradley, Alex, and Richard J. E. James. 2021. Defining the Key Issues Discussed by Problematic Gamblers on Web-Based Forums: A Data-Driven Approach. *International Gambling Studies* 21: 59–73. <https://doi.org/10.1080/14459795.2020.1801793>.
- (Brown et al. 2008) Brown, Jeffrey R., Zoran Ivković, Paul A. Smith, and Scott Weisbenner. 2008. Neighbors Matter: Causal Community Effects and Stock Market Participation. *The Journal of Finance* 63: 1509–31. <https://doi.org/10.1111/j.1540-6261.2008.01364.x>.
- (Brown VII 2022) Brown VII, Samuel Hoy. 2022. Gambling on the Blockchain: How the Unlawful Internet Gambling Enforcement Act Has Opened the Door for Offshore Crypto Casinos Notes. *Vanderbilt Journal of Entertainment and Technology Law* 3: 535–60.
- (Casino City: Your Casino Directory n.d.) Casino City: Your Casino Directory. n.d. Available online: <https://www.casinocity.com/> (accessed on 7 January 2023).
- (Cassidy 2020) Cassidy, Rebecca. 2020. *Vicious Games: Capitalism and Gambling*. London: Pluto Press.

- (Catania and Griffiths 2021) Catania, Maris, and Mark D. Griffiths. 2021. Analyzing Consumer Protection for Gamblers Across Different Online Gambling Operators: A Replication Study. *International Journal of Mental Health and Addiction* 1–16. <https://doi.org/10.1007/s11469-021-00695-9>.
- (Charoenwong and Bernardi 2021) Charoenwong, Ben, and Mario Bernardi. 2021. A Decade of Cryptocurrency ‘Hacks’: 2011–2021. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3944435>.
- (Chen et al. 2017) Chen, Yu-Chi, Jen-Chen Tsai, Yiing-Mei Liou, and Paul Chan. 2017. Effectiveness of Endurance Exercise Training in Patients with Coronary Artery Disease: A Meta-Analysis of Randomised Controlled Trials. *European Journal of Cardiovascular Nursing* 16: 397–408. <https://doi.org/10.1177/1474515116684407>.
- (CoinMarketCap. n.d.a) CoinMarketCap. n.d.a. Bitcoin Price Today, BTC to USD Live, Marketcap and Chart. Available online: <https://coinmarketcap.com/currencies/bitcoin/> (accessed on 1 January 2023).
- (CoinMarketCap. n.d.b) CoinMarketCap. n.d.b. Dogecoin Price Today, DOGE to USD Live, Marketcap and Chart. Available online: <https://coinmarketcap.com/currencies/dogecoin/> (accessed on 1 January 2023).
- (Cooney et al. 2021) Cooney, Caoimhe, David Columb, Joao Costa, Mark D. Griffiths, and Colin O’ Gara. 2021. An Analysis of Consumer Protection for Gamblers Across Different Online Gambling Operators in Ireland: A Descriptive Study. *International Journal of Mental Health and Addiction* 19: 19–31. <https://doi.org/10.1007/s11469-018-9968-7>.
- (Cox et al. 2020) Cox, Ruben, Atcha Kamolsareeratana, and Roy Kouwenberg. 2020. Compulsive Gambling in the Financial Markets: Evidence from Two Investor Surveys. *Journal of Banking & Finance* 111: 105709. <https://doi.org/10.1016/j.jbankfin.2019.105709>.
- (Davies and Rosca 2022) Davies, Rob, and Matei Rosca. 2022. How UK Gambling Safeguards Fail to Defend Online Punters. *The Observer*. October 1.
- (Delfabbro et al. 2021a) Delfabbro, Paul, Daniel King, Jennifer Williams, and Neophytos Georgiou. 2021a. Cryptocurrency Trading, Gambling and Problem Gambling. *Addictive Behaviors* 122: 107021. <https://doi.org/10.1016/j.addbeh.2021.107021>.
- (Delfabbro et al. 2021b) Delfabbro, Paul, Daniel L. King, and Jennifer Williams. 2021b. The Psychology of Cryptocurrency Trading: Risk and Protective Factors. *Journal of Behavioral Addictions* 10: 201–7. <https://doi.org/10.1556/2006.2021.00037>.
- (Delic and Delfabbro 2022) Delic, Amelia J., and Paul H. Delfabbro. 2022. Profiling the Potential Risks and Benefits of Emerging “Play to Earn” Games: A Qualitative Analysis of Players’ Experiences with Axie Infinity. *International Journal of Mental Health and Addiction* 1–14. <https://doi.org/10.1007/s11469-022-00894-y>.
- (DeMatteo 2022) DeMatteo, M. 2022. Ethereum Price History: 2015 to 2022. *Time*. January 21.
- (DCMS 2020) Department for Digital, Culture, Media & Sport (DCMS). *Government Response to the House of Lords Gambling Industry Committee Report: Social and Economic Impact of the Gambling Industry*. Available online: <https://www.gov.uk/government/publications/government-response-to-the-report-of-the-house-of-lords-select-committee-on-the-social-and-economic-impact-of-the-gambling-industry/government-response-to-the-house-of-lords-gambling-industry-committee-report-social-and-economic-impact-of-the-gambling-industry-html> (accessed on 1 January 2023)
- (Dixon et al. 2018) Dixon, Melanie Rose, Isabelle Giroux, Christian Jacques, and Philippe Grégoire. 2018. What Characterizes Excessive Online Stock Trading? A Qualitative Study. *Journal of Gambling Issues* 38: 8–26.
- (Dowling 2022) Dowling, Michael. 2022. Is Non-Fungible Token Pricing Driven by Cryptocurrencies? *Finance Research Letters* 44: 102097. <https://doi.org/10.1016/j.frl.2021.102097>.
- (Dupuis and Gleason 2021) Dupuis, Daniel, and Kimberly C. Gleason. 2021. Old Frauds with a New Sauce: Digital Coins and Behavioral Paradigms. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.3904002>.
- (Eigelshoven et al. 2021) Eigelshoven, Felix, André Ullrich, and Douglas Parry. 2021. Cryptocurrency Market Manipulation: A Systematic Literature Review. Paper presented at the ICIS 2021—International Conference on Information Systems, Austin, TX, USA, December 12–15.
- (Fang et al. 2022) Fang, Fan, Carmine Ventre, Michail Basios, Leslie Kanthan, David Martinez-Rego, Fan Wu, and Lingbo Li. 2022. Cryptocurrency Trading: A Comprehensive Survey. *Financial Innovation* 8: 13. <https://doi.org/10.1186/s40854-021-00321-6>.
- (FCA 2022) FCA—Financial Conduct Authority Cryptoassets. Available online: <https://www.fca.org.uk/consumers/cryptoassets> (accessed on 1 January 2023).
- (Fernandes et al. 2014) Fernandes, Daniel, John G. Lynch, and Richard G. Netemeyer. 2014. Financial Literacy, Financial Education, and Downstream Financial Behaviors. *Management Science* 60: 1861–83. <https://doi.org/10.1287/mnsc.2013.1849>.
- (Ferris and Wynne 2001) Ferris, Jacqueline, and Harold Wynne. 2001. *The Canadian Problem Gambling Index*. Ottawa: Canadian Centre on Substance Abuse.
- (FCA 2021) Financial Conduct Authority (FCA). 2021. Research Note: Cryptoasset Consumer Research. Available online: <https://www.fca.org.uk/publications/research/research-note-cryptoasset-consumer-research-2021> (accessed on 11 January 2023).
- (Gainsbury and Blaszczynski 2017) Gainsbury, Sally M., and Alex Blaszczynski. 2017. How Blockchain and Cryptocurrency Technology Could Revolutionize Online Gambling. *Gaming Law Review* 21: 482–92. <https://doi.org/10.1089/glr.2017.2174>.
- (Gainsbury et al. 2014) Gainsbury, Sally M., Niko Suhonen, and Jani Saastamoinen. 2014. Chasing Losses in Online Poker and Casino Games: Characteristics and Game Play of Internet Gamblers at Risk of Disordered Gambling. *Psychiatry Research* 217: 220–25. <https://doi.org/10.1016/j.psychres.2014.03.033>.
- (Gambling Commission 2018) Gambling Commission. 2018. Review of Online Gambling. Available online: <https://assets.ctfassets.net/j16ev64qyf6l/mJ7A1C5buMifnkm2vTdEy/8fd73cbfb38ba4dd09c7e8134ef92566/Online-review-March-2018.pdf> (accessed on 1 January 2023)

- (Gambling Commission 2022) Gambling Commission. Blockchain Technology and Crypto-Assets. Available online: <https://www.gamblingcommission.gov.uk/licensees-and-businesses/guide/page/blockchain-technology-and-crypto-assets> (accessed on 1 January 2023).
- (Gandal et al. 2018) Gandal, Neil, J. T. Hamrick, Tyler Moore, and Tali Oberman. 2018. Price Manipulation in the Bitcoin Ecosystem. *Journal of Monetary Economics* 95: 86–96. <https://doi.org/10.1016/j.jmoneco.2017.12.004>.
- (Garcia and Schweitzer 2015) Garcia, David, and Frank Schweitzer. 2015. Social Signals and Algorithmic Trading of Bitcoin. *Royal Society Open Science* 2: 150288. <https://doi.org/10.1098/rsos.150288>.
- (Gonserkewitz et al. 2022) Gonserkewitz, Phil, Erik Karger, and Marvin Jagals. 2022. Non-Fungible Tokens: Use Cases of NFTs and Future Research Agenda. *Risk Governance and Control: Financial Markets and Institutions* 12: 8–18. <https://doi.org/10.22495/rgcv12i3p1>.
- (Grall-Bronnec et al. 2017) Grall-Bronnec, Marie, Anne Sauvaget, Claude Boutin, Samuel Bulteau, Susana Jiménez-Murcia, Fernando Fernández-Aranda, Gaëlle Challet-Bouju, and Julie Caillon. 2017. Excessive Trading, a Gambling Disorder in Its Own Right? A Case Study on a French Disordered Gamblers Cohort. *Addictive Behaviors* 64: 340–48. <https://doi.org/10.1016/j.addbeh.2015.12.006>.
- (Hackethal et al. 2022) Hackethal, Andreas, Tobin Hanspal, Dominique M. Lammer, and Kevin Rink. 2022. The Characteristics and Portfolio Behavior of Bitcoin Investors: Evidence from Indirect Cryptocurrency Investments. *Review of Finance* 26: 855–98. <https://doi.org/10.1093/rof/rfab034>.
- (Hao et al. 2019) Hao, Van Minh, Nguyen Huynh Huy, Bo Dao, Thanh-Tan Mai, and Khuong Nguyen-An. 2019. Predicting Cryptocurrency Price Movements Based on Social Media. Paper presented at the Machine Learning and Applications, Nha Trang, Vietnam, November 26–28; Edited by Lam-Son Lê, Van Hoai Tran and Michael Toulouse. Nha Trang: IEEE. pp. 57–64.
- (Harwick 2014) Harwick, Cameron. 2014. Crypto-Currency and the Problem of Intermediation. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.2523771>.
- (Hasso et al. 2019) Hasso, Tim, Matthias Pelster, and Bastian Breitmayer. 2019. Who Trades Cryptocurrencies, How Do They Trade It, and How Do They Perform? Evidence from Brokerage Accounts. *Journal of Behavioral and Experimental Finance* 23: 64–74. <https://doi.org/10.1016/j.jbef.2019.04.009>.
- (Hayer et al. 2020) Hayer, Tobias, Tim Brosowski, and Gerhard Meyer. 2020. Multi-Venue Exclusion Program and Early Detection of Problem Gamblers: What Works and What Does Not? *International Gambling Studies* 20: 556–78. <https://doi.org/10.1080/14459795.2020.1766096>.
- (Hing et al. 2015) Hing, Nerilee, Lorraine Cherney, Sally M. Gainsbury, Dan I. Lubman, Robert T. Wood, and Alex Blaszczynski. 2015. Maintaining and Losing Control during Internet Gambling: A Qualitative Study of Gamblers' Experiences. *New Media & Society* 17: 1075–95. <https://doi.org/10.1177/1461444814521140>.
- (Hong et al. 2004) Hong, Harrison, Jeffrey D. Kubik, and Jeremy C. Stein. 2004. Social Interaction and Stock-Market Participation. *The Journal of Finance* 59: 137–63. <https://doi.org/10.1111/j.1540-6261.2004.00629.x>.
- (Isaacs n.d.) Isaacs, Shihaam. n.d. ZeroEdge.Bet EXPOSED: Caught in Huge ETH Scam! Available online: <https://gamblescope.com/news/casino-news/zeroedge.bet-exposed-caught-in-huge-eth-scam.html> (accessed on 1 January 2023).
- (Janiri et al. 2007) Janiri, L., G. Martinotti, T. Dario, F. Schifano, and P. Bria. 2007. The Gamblers' Temperament and Character Inventory (TCI) Personality Profile. *Substance Use & Misuse* 42: 975–84. <https://doi.org/10.1080/10826080701202445>.
- (Johnson et al. 2023) Johnson, Benjamin, Steven Co, Tianze Sun, Carmen C.W. Lim, Daniel Stjepanović, Janni Leung, John B. Saunders, and Gary C.K. Chan. 2023. Cryptocurrency Trading and Its Associations with Gambling and Mental Health: A Scoping Review. *Addictive Behaviors* 136: 107504. <https://doi.org/10.1016/j.addbeh.2022.107504>.
- (Kamps and Kleinberg 2018) Kamps, Josh, and Bennett Kleinberg. 2018. To the Moon: Defining and Detecting Cryptocurrency Pump-and-Dumps. *Crime Science* 7: 18. <https://doi.org/10.1186/s40163-018-0093-5>.
- (Kaustia and Knüpfer 2012) Kaustia, Markku, and Samuli Knüpfer. 2012. Peer Performance and Stock Market Entry. *Special Issue on Investor Sentiment* 104: 321–38. <https://doi.org/10.1016/j.jfineco.2011.01.010>.
- (Kim et al. 2020) Kim, Hee Jin, Ji Sun Hong, Hyun Chan Hwang, Sun Mi Kim, and Doug Hyun Han. 2020. Comparison of Psychological Status and Investment Style Between Bitcoin Investors and Share Investors. *Frontiers in Psychology* 11: 502295. <https://doi.org/10.3389/fpsyg.2020.502295>.
- (Kraaijeveld and De Smedt 2020) Kraaijeveld, Olivier, and Johannes De Smedt. 2020. The Predictive Power of Public Twitter Sentiment for Forecasting Cryptocurrency Prices. *Journal of International Financial Markets, Institutions and Money* 65: 101188. <https://doi.org/10.1016/j.intfin.2020.101188>.
- (Kumar 2021) Kumar, Ashish. 2021. Empirical Investigation of Herding in Cryptocurrency Market under Different Market Regimes. *Review of Behavioral Finance* 13: 297–308. <https://doi.org/10.1108/RBF-01-2020-0014>.
- (Kyonka and Schutte 2018) Kyonka, Elizabeth G. E., and Nicola S. Schutte. 2018. Probability Discounting and Gambling: A Meta-Analysis. *Addiction* 113: 2173–81. <https://doi.org/10.1111/add.14397>.
- (Lath 2022) Lath, Khushi. 2022. Impact of YouTubers on Cryptocurrency Returns. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4262460>.
- (Leinweber and Madhavan 2001) Leinweber, David J., and Ananth N. Madhavan. 2001. Three Hundred Years of Stock Market Manipulations. *The Journal of Investing* 10: 7–16. <https://doi.org/10.3905/joi.2001.319457>.
- (Ma and Wen 2022) Ma, Mengzhong, and Yonggang Wen. 2022. Herding in the Non-Fungible Token (NFT) Market. *SSRN Electronic Journal*. <http://dx.doi.org/10.2139/ssrn.4285007>

- (Macey and Hamari 2020) Macey, Joseph, and Juho Hamari. 2020. GamCog: A Measurement Instrument for Miscognitions Related to Gamblification, Gambling, and Video Gaming. *Psychology of Addictive Behaviors* 34: 242–56. <https://doi.org/10.1037/adb0000526>.
- (Macey and Hamari 2022) Macey, Joseph, and Juho Hamari. 2022. *Gamblification: A Definition*. New York: Sage Publications. <https://doi.org/10.1177/14614448221083903>.
- (Martineau 2018) Martineau, Paris. 2018. Inside the Group Chats Where People Pump and Dump Cryptocurrency. Available online: <https://theoutline.com/post/3074/inside-the-group-chats-where-people-pump-and-dump-cryptocurrency> (accessed on 1 January 2023)..
- (McMullan and Miller 2008) McMullan, John L., and Delthia Miller. 2008. All in! The Commercial Advertising of Offshore Gambling on Television. *Journal of Gambling Issues* 22: 230–51. <https://doi.org/10.4309/jgi.2008.22.6>.
- (Meng and Fu 2020) Meng, Jonathan, and Feng Fu. 2020. Understanding Gambling Behaviour and Risk Attitudes Using Cryptocurrency-Based Casino Blockchain Data. *Royal Society Open Science* 7: 201446. <https://doi.org/10.1098/rsos.201446>.
- (Mills and Nower 2019) Mills, Devin J., and Lia Nower. 2019. Preliminary Findings on Cryptocurrency Trading among Regular Gamblers: A New Risk for Problem Gambling? *Addictive Behaviors* 92: 136–40. <https://doi.org/10.1016/j.addbeh.2019.01.005>.
- (Mirtaheri et al. 2019) Mirtaheri, Mehmoosh, Sami Abu-El Haija, Fred Morstatter, Greg Ver Steeg, and Aram Galstyan. 2019. Identifying and Analyzing Cryptocurrency Manipulations in Social Media. *arXiv arXiv*: 190203110.
- (Mishkin and White 2002) Mishkin, Frederic, and Eugene White. 2002. *U.S. Stock Market Crashes and Their Aftermath: Implications for Monetary Policy*. Cambridge, MA: National Bureau of Economic Research, p. w8992.
- (Mosenhauer et al. 2021) Mosenhauer, Moritz, Philip W. S. Newall, and Lukasz Walasek. 2021. The Stock Market as a Casino: Associations between Stock Market Trading Frequency and Problem Gambling. *Journal of Behavioral Addictions* 10: 683–89. <https://doi.org/10.1556/2006.2021.00058>.
- (Muggleton et al. 2021) Muggleton, Naomi, Paula Parpart, Philip Newall, David Leake, John Gathergood, and Neil Stewart. 2021. The Association between Gambling and Financial, Social and Health Outcomes in Big Financial Data. *Nature Human Behaviour* 5: 319–26. <https://doi.org/10.1038/s41562-020-01045-w>.
- (Nakamoto 2008) Nakamoto, Satoshi. 2008. Bitcoin: A Peer-to-Peer Electronic Cash System. October 31. Available online: <https://bitcoin.org/bitcoin.pdf> (assessed on 1 January 2023)
- (Newall 2022) Newall, Philip W. S. 2022. Reduce the Speed and Ease of Online Gambling in Order to Prevent Harm. *Addiction* 118: 204–5. <https://doi.org/10.1111/add.16028>.
- (Newall and Andrade 2022) Newall, Philip W. S., and Maira Andrade. 2022. Commercial Provision of Zero House-Edge Gambling Products. *Gaming Law Review* 26: 463–65. <https://doi.org/10.1089/glr2.2022.0035>.
- (Newall and Weiss-Cohen 2022) Newall, Philip W. S., and Leonardo Weiss-Cohen. 2022. The Gamblification of Investing: How a New Generation of Investors Is Being Born to Lose. *International Journal of Environmental Research and Public Health* 19: 5391. <https://doi.org/10.3390/ijerph19095391>.
- (Newall and Xiao 2021) Newall, Philip W. S., and Leon Y. Xiao. 2021. Gambling Marketing Bans in Professional Sports Neglect the Risks Posed by Financial Trading Apps and Cryptocurrencies. *Gaming Law Review* 25: 376–78. <https://doi.org/10.1089/glr2.2021.0027>.
- (Newall et al. 2020) Newall, Philip W. S., Lukasz Walasek, Arman Hassanniakalager, Alex MT Russell, Elliot A Ludvig, and Matthew Browne. 2020. Statistical Risk Warnings in Gambling. *Behavioural Public Policy* 1–21. <https://doi.org/10.1017/bpp.2020.59>.
- (Oksanen et al. 2022a) Oksanen, Atte, Eerik Mantere, Ilkka Vuorinen, and Iina Savolainen. 2022a. Gambling and Online Trading: Emerging Risks of Real-Time Stock and Cryptocurrency Trading Platforms. *Public Health* 205: 72–78. <https://doi.org/10.1016/j.puhe.2022.01.027>.
- (Oksanen et al. 2022b) Oksanen, A., H. Hagfors, I. Vuorinen, and I. Savolainen. 2022b. Longitudinal Perspective on Cryptocurrency Trading and Increased Gambling Problems: A 3 Wave National Survey Study. *Public Health* 213: 85–90. <https://doi.org/10.1016/j.puhe.2022.10.002>.
- (Orford 2019) Orford, Jim. 2019. *The Gambling Establishment: Challenging the Power of the Modern Gambling Industry and Its Allies*. Abingdon: Routledge.
- (Owens and Lavitch 2013) Owens, Martin, and Action A. Lavitch. 2013. Adding up the Bits and Pieces: How Big an Effect Will Bitcoin and Crypto Currency Exert on Remote and Interactive Gambling? *Gaming Law Review and Economics* 17: 760–64. <https://doi.org/doi:10.1089/glr2.2013.17107>.
- (Pedersen 2022) Pedersen, Lasse Heje. 2022. Game on: Social Networks and Markets. *Journal of Financial Economics* 146: 1097–119. <https://doi.org/10.1016/j.jfineco.2022.05.002>.
- (Philander 2023) Philander, Kahlil S. 2023. Meme Asset Wagering: Perceptions of Risk, Overconfidence, and Gambling Problems. *Addictive Behaviors* 137: 107532. <https://doi.org/10.1016/j.addbeh.2022.107532>.
- (Phillips and Gorse 2017) Phillips, Ross C., and Denise Gorse. 2017. Predicting Cryptocurrency Price Bubbles Using Social Media Data and Epidemic Modelling. Paper presented at the 2017 IEEE Symposium Series on Computational Intelligence (SSCI), Honolulu, HI, USA, November 27–December 1; Honolulu: IEEE, pp. 1–7.
- (Phillips and Gorse 2018) Phillips, Ross C., and Denise Gorse. 2018. Mutual-Excitation of Cryptocurrency Market Returns and Social Media Topics. Paper presented at the 4th International Conference on Frontiers of Educational Technologies, Moscow, Russia, June 25–27, pp. 80–86.

- (Regan et al. 2022) Regan, Marguerite, Maria Smolar, Robyn Burton, Zoe Clarke, Casey Sharpe, Clive Henn, and John Marsden. 2022. Policies and Interventions to Reduce Harmful Gambling: An International Delphi Consensus and Implementation Rating Study. *The Lancet Public Health* 7: e705–17. [https://doi.org/10.1016/S2468-2667\(22\)00137-2](https://doi.org/10.1016/S2468-2667(22)00137-2).
- (Sadock and Sadock 2011) Sadock, B. J., and V. A. Sadock. 2011. *Kaplan and Sadock's Synopsis of Psychiatry*. Philadelphia: Lippincott Williams & Wilkins.
- (Scholten et al. 2020) Scholten, Oliver J., David Zendle, and James A. Walker. 2020. Inside the Decentralised Casino: A Longitudinal Study of Actual Cryptocurrency Gambling Transactions. Edited by He Debiao. *PLoS ONE* 15: e0240693. <https://doi.org/10.1371/journal.pone.0240693>.
- (Select Committee on the Social and Economic Impact of the Gambling Industry 2020) Select Committee on the Social and Economic Impact of the Gambling Industry. 2020. *Gambling Harm—Time for Action*. London: Authority of the House of Lords.
- (Serafini et al. 2020) Serafini, Giulia, Ping Yi, Qingquan Zhang, Marco Brambilla, Jiayue Wang, Yiwei Hu, and Beibei Li. 2020. Sentiment-Driven Price Prediction of the Bitcoin Based on Statistical and Deep Learning Approaches. Paper presented at the Plenary Poster Session-I-P8, Glasgow, UK, July 19–24. Edited by A. Roy. Glasgow: IEEE, pp. 80–86.
- (Shiller 2016) Shiller, Robert J. 2016. *Irrational Exuberance*, 3rd ed. Princeton: Princeton University Press.
- (Shiller 2017a) Shiller, Robert J. 2017a. Narrative Economics. *American Economic Review* 107: 967–1004. <https://doi.org/10.1257/aer.107.4.967>.
- (Shiller 2017b) Shiller, Robert J. 2017b. What Is Bitcoin Really Worth? Don't Even Ask. *The New York Times*. December 15.
- (Shin et al. 2015) Shin, Young-Chul, Sam-Wook Choi, Juwon Ha, Jung-Seok Choi, and Dai-Jin Kim. 2015. Gambling Disorder in Financial Markets: Clinical and Treatment-Related Features. *Journal of Behavioral Addictions* 4: 244–49. <https://doi.org/10.1556/2006.4.2015.032>.
- (Siemens and Kopp 2011) Siemens, Jennifer Christie, and Steven W. Kopp. 2011. The Influence of Online Gambling Environments on Self-Control. *Journal of Public Policy & Marketing* 30: 279–93. <https://doi.org/10.1509/jppm.30.2.279>.
- (Sonkurt and Altınöz 2021) Sonkurt, Harun Olcay, and Ali Ercan Altınöz. 2021. Cryptocurrency Investment: A Safe Venture or a New Type of Gambling? *Journal of Gambling Issues* 47. <https://doi.org/10.4309/jgi.2021.47.8>.
- (Statista n.d.) Statista. n.d. Number of Crypto Coins 2013–2022. Available online: <https://www.statista.com/statistics/863917/number-crypto-coins-tokens/> (accessed on 1 January 2023).
- (Steinmetz 2023) Steinmetz, Fred. 2023. The Interrelations of Cryptocurrency and Gambling: Results from a Representative Survey. *Computers in Human Behavior* 138: 107437. <https://doi.org/10.1016/j.chb.2022.107437>.
- (Tandon et al. 2021) Tandon, Chahat, Sanjana Revankar, Hemant Palivela, and Sidharth Singh Parihar. 2021. How Can We Predict the Impact of the Social Media Messages on the Value of Cryptocurrency? Insights from Big Data Analytics. *International Journal of Information Management Data Insights* 1: 100035. <https://doi.org/10.1016/j.ijime.2021.100035>.
- (Tundik 2022) Tundik, Zoltan. 2022. The Twitch Ban on Crypto Casinos Explained. *European Gaming Industry News*. October 25.
- (Twitch.tv n.d.) Twitch.tv. n.d. Twitch.Tv. Available online: <https://twitch.tv/audience/> (accessed on 1 January 2023)
- (Umar et al. 2021) Umar, Zaghum, Mariya Gubareva, Imran Yousaf, and Shoaib Ali. 2021. A Tale of Company Fundamentals vs Sentiment Driven Pricing: The Case of GameStop. *Journal of Behavioral and Experimental Finance* 30: 100501. <https://doi.org/10.1016/j.jbef.2021.100501>.
- (van Schalkwyk et al. 2019) van Schalkwyk, May C. I., Rebecca Cassidy, Martin McKee, and Mark Petticrew. 2019. Gambling Control: In Support of a Public Health Response to Gambling. *The Lancet* 393: 1680–81. [https://doi.org/10.1016/S0140-6736\(19\)30704-4](https://doi.org/10.1016/S0140-6736(19)30704-4).
- (Wardle et al. 2019) Wardle, Heather, Gerda Reith, Erika Langham, and Robert D Rogers. 2019. Gambling and Public Health: We Need Policy Action to Prevent Harm. *BMJ* 365: 11807. <https://doi.org/10.1136/bmj.11807>.
- (White et al. 2022) White, Joshua T., Sean Wilkoff, and Serhat Yildiz. 2022. The Role of the Media in Speculative Markets: Evidence from Non-Fungible Tokens (NFTs). *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.4074154>.
- (Yin et al. 2021) Yin, Libo, Jing Nie, and Liyan Han. 2021. Understanding Cryptocurrency Volatility: The Role of Oil Market Shocks. *International Review of Economics & Finance* 72: 233–53. <https://doi.org/10.1016/j.iref.2020.11.013>.
- (Zhao and Zhang 2021) Zhao, Haidong, and Lini Zhang. 2021. Financial Literacy or Investment Experience: Which Is More Influential in Cryptocurrency Investment? *International Journal of Bank Marketing* 39: 1208–26. <https://doi.org/10.1108/IJBM-11-2020-0552>.

**Disclaimer/Publisher's Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.