Dean&Francis
ISSN 2959-6157

The Volatility Characteristics, Yield Influencing Factors, and Strategies of the Cryptocurrency Market

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Abstract:
The cryptocurrency utilizes cryptographic principles and ensures transaction security and control unit creation. Due to the lack of guaranteed institutions to maintain price stability, cryptocurrencies are often regarded as investment products rather than means of payment. Its main research fields include its impact on the economy, trading strategies, volatility, and return rates. This article analyzes two typical cryptocurrencies, Bitcoin and Ethereum, from the perspectives of background and market risks, and explores investment strategies in different contexts. The research aims to examine the influence of momentum effect, disposal effect, and investors' market attention on strategies, and designs three investment strategies, namely the single momentum strategy, the single disposal strategy, and the combined strategy. The volatility was measured through the Generalized Autoregressive Conditional Heteroskedasticity (GARCH(1, 1)) model, and the asymmetry of return volatility was calculated using the rolling sample test method to verify the existence of the anti-leverage effect. That is, the impact of positive news on income fluctuations exceeds that of negative news, and the research results are consistent with those of previous studies. And optimize the user decision-making in the game-based cryptocurrency trading market, analyze the impact on the cryptocurrency market under the influence of different factors, such as block size, discount factor, and total number of users.

Keywords: Cryptocurrency BTC; ETH; Transaction risk; Trading strategy; Volatility; Yield rate.

1. Introduction

Digital currency has attracted the attention of most investors and society. Due to the current market demand, digital currency has become an indispensable part of today's financial market [1]. However, a se-

ISSN 2959-6157

ries of reasons, such as sharp price fluctuations, low transaction efficiency, and high energy consumption, make it difficult for cryptocurrencies to be applied in daily life and prevent them from performing the same functions as digital currencies [1]. Meanwhile, researchers have also proposed corresponding detection and prevention strategies for the security vulnerabilities and attack methods of centralized and decentralized exchanges [2].

In recent years, the main research directions of cryptocurrencies have included the risks of cryptocurrencies, trading strategies, and the relationship between volatility and yield. For instance, some scholars have analyzed the characteristics of volatility and investor behavior, explored the distribution features of returns and price prediction methods, to explain the rules of market operation [3]. Andrew Philip studied the yield formatting features and combined many of these attributes into a model to conditionally measure the diverse nature of cryptocurrencies. The research found the leverage effect and the distribution of student errors [4]. Shen Dehua made price predictions, explaining the connection between investors' attention and Bitcoin's returns, trading volume, and realized volatility. Shen used the number of tweets on Twitter to measure the attention of more informed investors [5] and proposed a three-factor pricing model. Through the study of over 1,700 cryptocurrencies, it was found that small cryptocurrencies tend to achieve higher returns. The Model proposed by Shen and Wang is far superior to the cryptocurrency model, Capital Asset Pricing Model (CAPM) [6]. Cryptocurrencies are no longer confined to the traditional category of digital currencies but are gradually integrating into various fields of society through low-cost transaction models.

This article sorts out the existing relevant trading strategies and conducts a research review on the impact of investors' attention on volatility and return rates. Furthermore, this article examines whether there are similar anomalies in the cryptocurrency market as those in the stock market, whether these phenomena can be used to guide investment and the performance of investment strategies, and, at the same time, enable readers to recognize the trading risks of cryptocurrencies and understand related trading strategies.

2. Two Typical Cryptocurrencies

2.1 Bitcoin

Bitcoin is a decentralized virtual cryptocurrency proposed by Satoshi Nakamoto in 2008 and began circulating in 2009. It is transmitted through a P2P network, without the need for a central bank or financial institution. All transactions are recorded using blockchain, which is open and transparent. As the most well-known and leading cryptocurrency by market capitalization, many people believe that Bitcoin is safer and more reliable. Its generation rate slows down to avoid inflation. Transactions and mining can be carried out on any networked computer. The production speed limit of Bitcoin is 25 per minute. The Bitcoin system consists of six layers: the storage layer, the data layer, the network layer, the consensus layer, the RPC layer, and the application layer.

The storage layer is mainly used to store log data and blockchain metadata during the operation of the Bitcoin system. The data layer is mainly used to process various types of data in Bitcoin transactions. The network layer is used to build the P2P network at the bottom layer of Bitcoin, supporting the dynamic joining and leaving of multiple nodes. The consensus layer mainly adopts the PoW (Proof of Work) consensus algorithm; The RPC layer implements RPC services and provides a JSON API for clients to access the underlying services of the blockchain. The application layer mainly carries various Bitcoin applications. The most crucial layer in the Bitcoin system is the Blockchain, which is the core technology of Bitcoin and functions as a decentralized public ledger, recording the history of all Bitcoin transactions. This ledger is maintained by all nodes in the network, making it difficult to tamper with and serving as the foundation for the security and transparency of the Bitcoin system.

2.2 Ethereum

Ethereum is a global open-source public blockchain platform that enables developers to build smart contracts and decentralized applications, and to execute peer-to-peer contracts using its cryptocurrency, Ether. Proposed by Vitalik Buterin from 2013 to 2014, Ethereum was designed as the next-generation cryptocurrency and decentralized application platform, following Bitcoin, and is known as the world's computer. As of February 2018, the market capitalization of Ether was second only to that of Bitcoin. Ethereum has performed outstandingly in application development due to the flexibility and high security of smart contracts and has not been subject to major attacks. The evolution of Ethereum consists of four stages: Frontier, Homestead, Metropolis, and Serenity.

The Ethereum architecture is divided into seven layers: the storage layer, the data layer, the network layer, the protocol layer, the consensus layer, the contract layer, and the application layer, from bottom to top. The data layer is mainly used to process various types of data in Ethereum transactions. The data layer is similar to that of Bitcoin and is based on P2P networks. The protocol layer is the protocol support provided by Ethereum for the mutual invocation among various modules of the system, mainly including HTTP, RPC protocol, LES, ETH protocol, Whisper protocol, etc. There are two consensus algorithms for the consensus layer in the Ethereum system: PoW (Proof of Work) and PoS(Proof of Stake). The contract layer is divided into two layers. The bottom layer is EVM (Ethereum Virtual Machine, that is, Ethereum virtual Machine), and the smart contracts on the upper layer run in EVM. The usage layer has various derivative applications, such as dApps (Decentralized applications, distributed applications) and Ethereum wallets, and it is currently the most active layer for developers.

The most important Layer in the Ethereum architecture is the smart contract layer. This layer enables Ethereum to execute smart contracts, making Ethereum not only a cryptocurrency platform but also a decentralized application (dApp) development platform. Smart contracts are automated protocols running on the Ethereum network. They define a set of rules and conditions, and the contracts are automatically executed when the trigger conditions are met.

3. Risks of Cryptocurrencies

As a decentralized existence, cryptocurrencies cannot be completely eradicated from the physical and real levels. They still have a wide range of supporters among individual and non-governmental organizations in China [7]. These risks mainly include security risks, legal risks, policy risks, and moral risks.

Firstly, regarding price fluctuations, the prices of cryptocurrencies fluctuate sharply and lack stability. They are very likely to remain stable or experience a sharp drop in a short period of time. This is all due to the relatively low liquidity of the market, the fact that speculative sentiment is easily influenced by the market, and investors lack traditional asset valuation anchors.

Secondly, there is the security risk. Cryptocurrencies offer terrorist groups a more convenient way to transfer assets, avoiding reliance on traditional currencies or financial channels. They can be used as digital payment methods to purchase goods and services [7]. Therefore, terrorists can quickly raise funds across borders at a lower cost. Indonesian financial intelligence agencies have pointed out that Barun Naim, who was attacked in Jakarta in 2016, used PayPal and Bitcoin to obtain financial assistance from the Middle East to support terrorist activities on Java Island [8].

Policy is also a risk. Because different countries have varying degrees and capabilities in control over their own financial systems, and their attitudes towards cryptocurrencies also differ, this leads to global disparities. Researchers such as Chen believe that the United States holds a positive attitude towards cryptocurrencies. On January 23, 2025, US President Trump signed an executive order titled "Strengthening America's Leadership in Digital Financial Technology" [9]. The first step is to clearly abandon the promotion plan for the central bank's digital currency. Secondly, it is necessary to establish a strategic reserve centered on cryptocurrencies such as Bitcoin. The final step is to end Operation Strangle 2.0 during the Biden administration and achieve the legal status of stablecoins [9].

The last one is moral hazard. The cryptocurrency industry often experiences the phenomenon of projects running away. Some projects use high returns as bait, such as a Ponzi scheme that siphoned away 300 million US dollars. In addition, if the market manipulator manipulates the price of low-liquidity tokens to exploit retail investors, it will drive up the selling price [10]. There are also false projects in the market. For instance, Art Chain and Space Chain are suspected of false promotion. The party issuing the currency may convey false information to investors and induce them to trade, which poses a very high risk to investors.

4. Trading Strategies

4.1 Investment Strategy for the Cryptocurrency Market

Liu Shuai's research focuses on the "momentum effect" and "disposal effect" in investor behavior and designs quantitative investment strategies based on this. The momentum effect refers to the fact that assets that performed well in the past may continue to perform well in the future, while the disposal effect describes the behavior of investors who tend to sell profitable assets prematurely and hold loss-making assets. Researchers believe that these psychological effects have a significant impact on the cryptocurrency market and thus choose regression analysis to verify their existence.

Study the variation of the rate of return with parameter K in strategies with the same investment amount. The research first confirmed through empirical analysis that the momentum effect and the disposal effect do exist in the crypto market. Subsequently, three strategies were designed, namely the single momentum strategy, the single disposal strategy, and the combined strategy. The combined strategy operates through the framework of the "G/r strategy" in the hope of making more effective use of market information. In the strategy design, by comparing the initial classification results, the "G Low, G medium,

ISSN 2959-6157

G high" categories are re-sorted and classified, and an in-depth study is conducted on how the rates of order placement and order intake affect the strategy's returns.

To ensure the effectiveness of the strategy, the researchers excluded factors that could affect the results. For instance, the parameters provided in Figure 1 met the limit of J≥K. The vertical axis of Figure 1 represents the rate of change, and the horizontal axis shows the range of change of parameter K. The three curves in the figure respectively represent the fluctuations and trend changes of the disposal strategy, r/G strategy, and G/r strategy. As can be seen from the figure, all three trends show that the rate of return decreases as the parameter K increases. The trend of a single disposal strategy is superior to that of the r/G strategy and the G/r strategy.

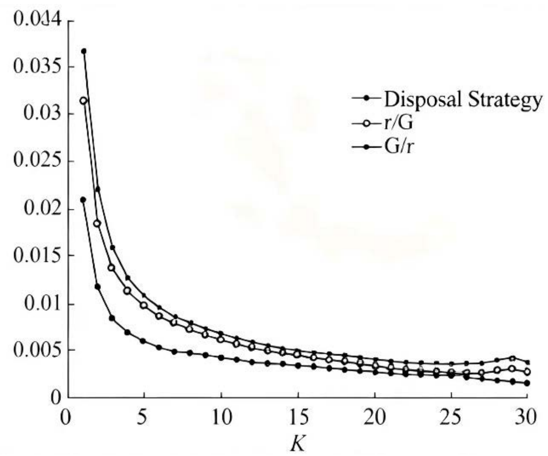


Fig. 1 The return rate of the strategy with equal investment amounts in the sample where the parameters conform to J≥K varies with K [11]

The information provided in Figure 2 is from the study of the rate of return on investment in strategies with equal investment quantities varying with parameter K. In Figure 2, the horizontal axis represents the range of variation of parameter K, and the vertical axis represents the range of variation of the rate of return. A more detailed explanation of this phenomenon is that during the comparison process, the trend is that the rate of return decreases as parameter K increases. The author found that when the holding period is the same, the G/r strategy and the r/G strategy perform better than the single momentum or disposal strategy. Especially in the samples screened by the t-test (5% confidence level), it indicates that the combined strategy outperforms other strategies after fully utilizing the information. Further analysis of Figures 1 and 2 also confirms the conclusion that the longer the holding period, the lower the return rate of a single strategy, while combining strategies can better utilize information.

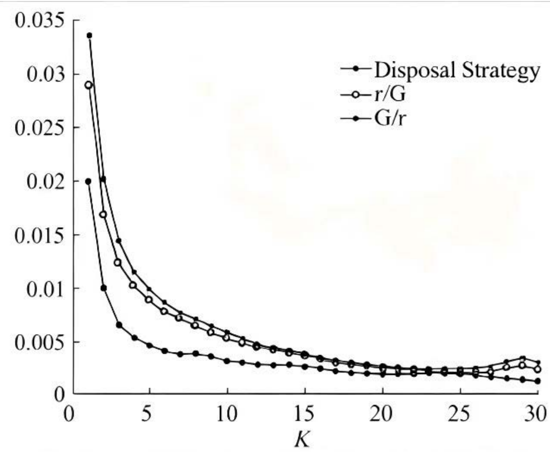


Fig. 2 The return rate of the strategy in the sample where the amount of invested currency is equal and the parameters conform to J≥K varies with K [11]

Finally, the study compared these four strategies with the equal-weight model and found that the strategy combining the momentum effect and the disposal effect was superior to the one that relied only on one type of investor behavior. The G/r strategy and the r/G strategy perform better in terms of return rate because they integrate information more effectively. However, the study did not cover margin and short selling, so these strategies may have deviations in practical application. Furthermore, the assumptions on which the theoretical model is based may not fully conform to market rules. Overall, the strategy that combines effects has demonstrated potential over traditional investment strategies.

4.2 User Decision-making in the Cryptocurrency Trading Market

Bi Hongliang focused on the decision-making process of users in the cryptocurrency trading market, with particular attention paid to the balance between privacy protection and transaction costs [12]. The key to the research lies in applying game theory and simulation techniques to analyze the different choice strategies of users when participating in the Zcash trading market and their impact on privacy and fees.

Under the premise of ensuring that transactions can be successfully packaged, how to minimize transaction fees and maximizing privacy are the main problems faced by Zcash users. As a cryptocurrency with privacy features, the literature first introduces Zcash and constructs a general trading market model, and then analyzes the decision-making behavior of users in different trading modes (such as unshielded trading and shielded trading).

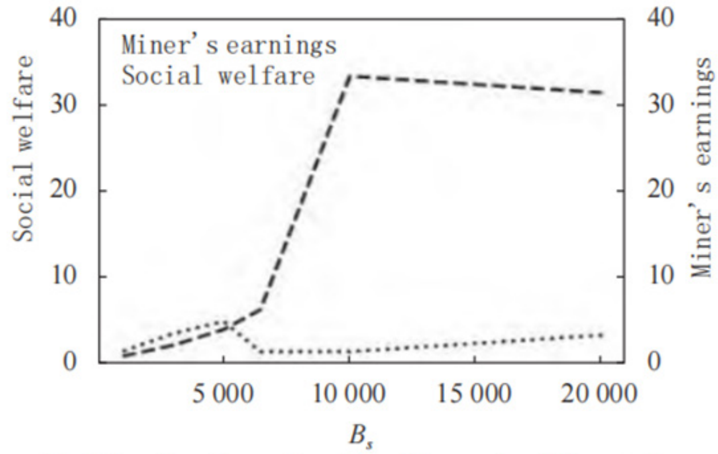
In the article, the author employs cooperative and non-cooperative game models from game theory to simulate the behaviors of users and miners. The author simulates the process of miners packaging transactions through the knapsack algorithm, obtaining a set of packaged transactions and a corresponding set of users in each round. Here, four algorithms are proposed, namely the sampling estimation algorithm of Shapley value (ApproShapley), the cost update rule, the trading market game (multiplicative weight algorithm update strategy), and the ε-greedy algorithm update strategy. In addition, the CoinJoin technology was introduced, and discussions were held on how to enhance privacy protection in transactions. They conducted a large number of simulation experiments to compare the selection tendencies of various transaction types under different user preferences and market conditions. Mainly through the simulation algorithm, two games in the entire trading system were simulated. Different update strategy algorithms were compared. The three types of trading markets, the traditional trading market and the unshielded trading market, were discussed, and users' preferences for different trading types were evaluated. For instance, in the anonymous set S, it is a coalition composed of all users i (ai = c) who participate in CoinJoin in the market. When users form an anonymous set, they jointly initiate transactions in an indistinguishable manner, and the focus of the discussion is the distribution of profits among users.

For the selection of the update strategy algorithm, a simulation program was run to simulate the Zcash trading market game involving several users and one miner. The update strategy algorithms in the trading market game were compared, and the user types were focused on to analyze their impact on user actions. It is concluded that for the user set Players with the same initial conditions, the update strategy of the ε-greedy algorithm converges faster. Under the condition that the total social welfare is similar, the packaging income of selfish miners under the update strategy of the multiplicative weight algorithm is slightly higher, with a smaller fluctuation range and higher stability. In the first 500 rounds, the multiplicative weight algorithm update strategy significantly brought higher social welfare to the trading market. However, after 500 rounds, the overall social welfare of the trading market under the two update strategies showed little difference. Through the analysis of the utility obtained by each user throughout the entire game process, this paper finds that the overall utility of users is higher under the update strategy of the multiplicative weight algorithm.

In the analysis of the three types of markets, given the time-driven characteristic of no-regret learning, the analysis of market games is also based on time. By observing the behaviors of different users, this paper finds that different users with the same value have similar behaviors in the selection of transaction types and transaction fees. Therefore, the classification is based on the D value of the users.

In addition, the article also takes into account the influence of various market parameters (such as block size, discount factor, etc.) on user behavior. As shown in Figures 3 and 4, the influence of different factors on the market is presented in detail. By constructing a general trading market model, which includes the description of the game between the two sides, sample analyses are conducted using different block sizes, discount factors, and total user numbers, and the algorithm of the trading market model is provided.

ISSN 2959-6157



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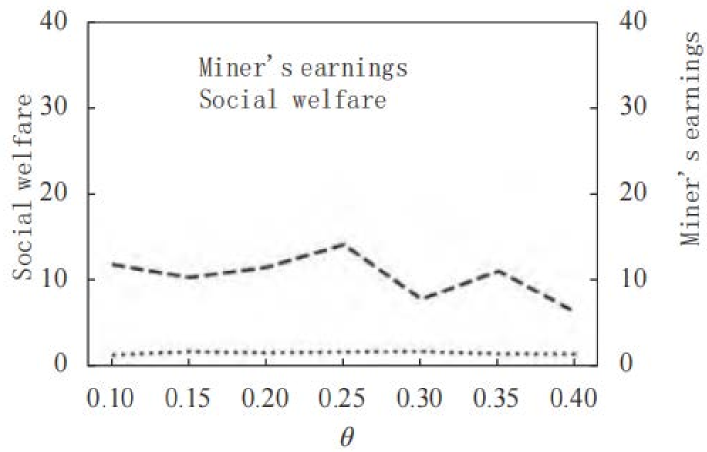

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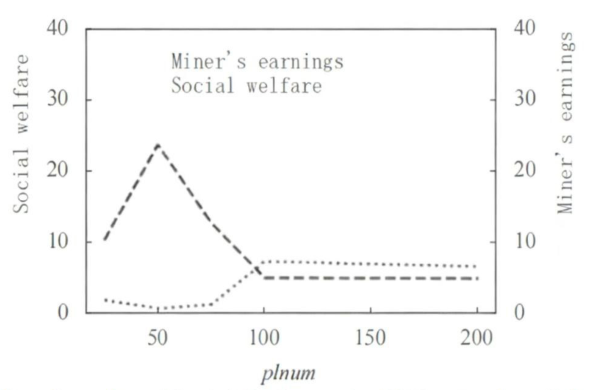

(c) Miner Rewards and Social Welfare under Different plnum Values

Fig. 3 Miner Revenue and Social Welfare under Different Parameters [12]

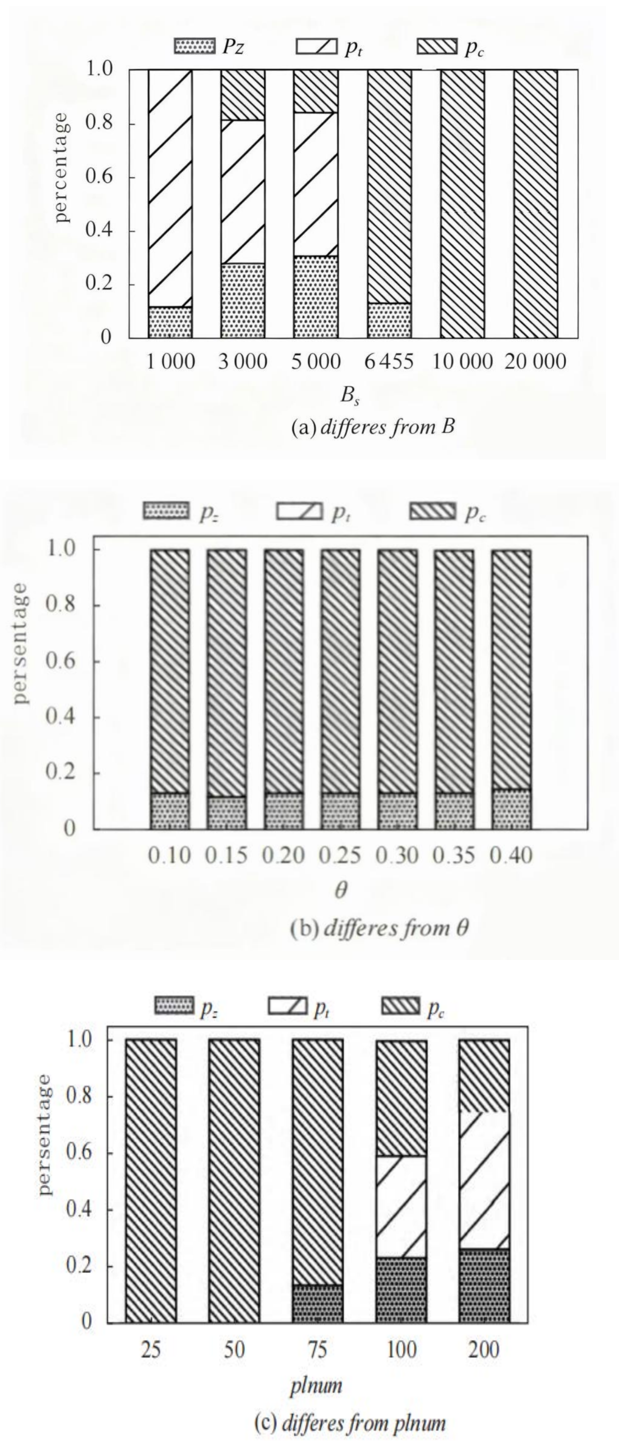

Fig. 4 Users' transaction preference tendencies under different parameters [12]

The strength of this research lies in its proposal of a novel and practically valuable market model, which can help understand the complex cryptocurrency trading market and user behavior. Meanwhile, the validity of the model was verified through simulation experiments. However, the drawback lies in that the simulation was not carried out in a real environment and mainly relied on assumptions and estimations, which may lead to limitations in the results. This research lays the foundation for subsequent studies on the cryptocurrency market and provides a powerful model to explore user decision-making behavior. In the future, this model can be extended to other privacy coins, such as Monero and Dash, further enriching the application of game theory in the field of cryptocurrencies.

ISSN 2959-6157

Meanwhile, the research also suggests that in the future, more complex factors in the actual market can be taken into account to enhance the applicability and accuracy of the model.

5. Conclusion

Cryptocurrencies have both advantages and limitations. Its main advantages include three aspects. First, it is decentralized, maintained by globally distributed nodes, not relying on centralized institutions, with anti-censorship capabilities, which can reduce cross-border transfer costs and shorten settlement times. Secondly, there is transparency and security. Transaction information is recorded in an unalterable and publicly queryable blockchain. The combination of cryptography and private key mechanisms can enhance asset security. The automated execution of smart contracts reduces human intervention. And the anti-inflation attribute, such as the limited issuance design of Bitcoin, is scarce and can hedge against the risk of fiat currency depreciation, while stablecoins like USDT and USDC help users maintain their purchasing power by pegging to the US dollar. The last point is that global payment cross-border transfers are not only efficient but also have no exchange rate restrictions, which is conducive to international investment and trade.

Its limitations are mainly reflected in the sharp price fluctuations, which are significantly influenced by speculative behavior, market manipulation, and policy changes. Insufficient scalability leads to a decline in transaction speed and high costs during network congestion, which limits daily payment applications. The environmental cost is high. For instance, the proof-of-work mechanism of Bitcoin consumes a large amount of energy and generates high carbon emissions. Security risks exist, including asset losses on trading platforms due to hacker attacks or vulnerabilities in smart contracts, as well as risks brought about by fraud.

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