YANYU CHEN, MIN TANG, RENQIANG XIE

Information Diffusion in Blockchain-Based Social Networks Using Evolutionary Game Theory

Blockchain-based social networks differ from traditional ones with respect to information diffusion. This study develops an evolutionary game model to investigate how blockchain features affect users' information diffusion behaviours, with the aim of boosting efficiency in social networks. The model provides a detailed analysis of the dynamic evolution of user behaviours across various scenarios. Using the Steemit platform as a case study and integrating theoretical and empirical analyses, the study validates the model's applicability and visually illustrates the characteristics of information diffusion through cloud maps. The findings reveal that a blockchain's core features, such as trust and incentive mechanisms, prompt users to adopt a more cautious approach when disseminating low-quality information—particularly distorted or malicious content—within social networks. These mechanisms ultimately contribute to an overall enhancement of content quality across social networks.

Keywords: *blockchain; social network; information diffusion; evolutionary game; Steemit*

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1. Introduction

Social networks serve as essential platforms in contemporary society. These networks not only enable the rapid dissemination and sharing of information but also play a role in strengthening human connections and mutual understanding. As of July 2024, the global Internet user base reached 5.45 billion, with 5.17 billion active users of social networks, representing an impressive 94.9% of the total user base (Statista Research Department 2024). This reveals the immense influence and popularity of social networks worldwide. Despite their rapid spread, traditional social networks face several critical challenges, including data privacy breaches, inadequate information authentication, and centralised platform control (Guidi 2020; Huang and Si 2024; Mlika, Karoui and Romdhane 2024), all of which negatively affect users' experiences and undermine their trust in these platforms. As a transformative tool that can address these issues, blockchain technology has revolutionised the operation of social networks through its unique attributes, including decentralisation, transparency, and immutability (Wilson et al. 2024; Yajam, Ebadi and Akhaee 2024). Blockchain-based social networks have several features related to information diffusion that are distinctive from their traditional counterparts. Moreover, certain inherent features (such as economic incentives and decentralised trust mechanisms) significantly increase users' participation enthusiasm and creativity concerning information diffusion, thereby fostering the dissemination of valuable information (Z. Karvalics and Nagy 2017).

Current research on information diffusion within blockchain-based social networks has a number of limitations, which are characterised in the following:

(1) <u>Inadequate theoretical frameworks.</u> Existing studies have been limited to traditional information diffusion models, such as the Susceptible-Infected-Recovered (SIR) model and modified versions thereof (Chen, Kong and Wang 2023; Ma et al. 2024; Pramanik 2023; Wanduku 2023). However, the applicability of these models in the unique environment of blockchain-based social networks—which are characterised by decentralisation and complex, dynamically-evolving user behaviours—has not been fully verified. This creates an urgent need to establish a theoretical framework that can account for dynamic changes, depict strategic interactions, and provide a deeper understanding of the information diffusion mechanisms in these contexts.

<u>(2) Disconnection between technical characteristics and information diffusion mechanisms.</u> While blockchain features profoundly influence information diffusion, existing studies have not been able to fully elucidate how specifically these features affect the information diffusion process. This gap in the literature warrants a thorough analysis of the relationship between technical characteristics and information diffusion mechanisms.

(3) <u>Insufficient empirical research and case studies.</u> Theoretical research requires empirical data to confirm the validity and practical relevance of models. However, the empirical research and case analyses conducted so far lack real-world data to substantiate theoretical models. Therefore, the applicability of research outcomes remains limited.

The present study uses evolutionary game theory to examine the effects of blockchain characteristics on information diffusion within social networks. As an analytical tool, evolutionary game theory offers a robust theoretical framework for examining the dynamic mechanisms, strategy selection processes, and long-term equilibrium states of information diffusion within blockchain-based social networks. This study comprehensively analyses how blockchain characteristics effectively curb the spread of distorted and malicious information, as well as the mechanisms underlying this inhibitory effect. The aim of the study is to enhance users' rationality and enthusiasm concerning information diffusion within blockchain-based social networks, which establishes its theoretical and practical significance.

Theoretical contributions: 1) This study deepens the understanding of blockchain-based social networks. By applying evolutionary game theory to analysing these networks, the study provides insights into the underlying mechanisms and patterns of information diffusion. In addition, it clarifies the influence of blockchain characteristics on the dynamics and patterns of information diffusion. 2) The study contributes to enriching the theoretical framework of information diffusion models. By incorporating blockchain characteristics and state transition probabilities, it develops a new information diffusion model and offers a fresh perspective and methodology for studying information diffusion. 3) The study expands the scope of application of evolutionary game theory to blockchain-based social networks, providing robust empirical evidence for its application and evolution across different fields.

Practical contributions: 1) This study offers insights for optimising the efficiency and effectiveness of information diffusion. Understanding the dynamics and patterns of information diffusion enables operators to effectively promote content, boost user engagement, and limit the spread of low-quality information. 2) The study addresses methods for enhancing network security and user trust by analysing the impact of these characteristics on information diffusion, thereby contributing to a healthier social network environment. 3) The study offers guidance for the innovation and growth of blockchain-based social networks. Through its in-depth analysis of the effects of blockchain characteristics on information diffusion, this study presents new social and business models that could drive further development of blockchain-based social networks. 4) The insights gained from analysing the impact of blockchain characteristics on information diffusion can inspire the application of blockchain technology to other domains.

2. Related research

2.1. Research on information dissemination in social networks

Broadly, a social network is a complex structure formed by individuals (whether people, organisations, or other entities) exhibiting friendships, family ties, work relationships, and shared interests or hobbies. In the digital age, social networks specifically refer to online platforms using Internet technology (such as Facebook, Weibo, WeChat, and LinkedIn) that enable users to create profiles, share content, engage with others (e.g., through liking, commenting, and sharing), and build social networks. Social networks facilitate communication and connection among people and serve as key channels for information dissemination, knowledge sharing, social mobilisation, and commercial marketing.

Information dissemination is defined as the process through which information is transmitted from a source to one or more recipients through various channels (Zhao et al. 2018). Information dissemination within social networks is a dynamic and complex process, as information can spread rapidly across various nodes (i.e., users) of the network (Krzanowski 2023; Razaque et al. 2022). The basic elements of information dissemination—communicator, content, medium, audience, and effect—were introduced by Harold (2013) and remain foundational in communication studies. Scholars have developed a range of models by using different approaches to analyse information dissemination in social networks; of these, infectious disease models are particularly notable. Due to the structural similarities between social networks and infectious-disease transmission patterns, researchers have adapted such models to assess the process of information dissemination; they have presented refined models, including the SEIR model (Xiao and Ruan 2007), the SIRS model for netizen emotion contagion (Zhao et al. 2018), the SCIR model for public opinion dissemination (Ding 2015), and improved SEIR models (Yang and Zhang 2018). In considering pairwise friendships and virtual community relationships, Shen et al. (2023) proposed an information dissemination model based on hypergraphs which aligns perfectly with the topology of online social networks. Wang et al. (2020) introduced concepts like the information exposure curve and individual influence in social networks, and they developed a model based on the memory effect in information sharing. Huang, Sun and Hu (2018) combined the infectious disease model with node attitudes to create a social network information dissemination model that factors in node attitudes. In short, information dissemination in social networks has been extensively studied, laying a solid foundation for the present study.

2.2. Research on information dissemination in blockchain-based social networks

Blockchain-based social networks represent a novel social network model that integrates blockchain technology and social networking. Several current social networking platforms—including Steemit, Minds, Akasha, and Peepeth—are based on blockchain technology. Steemit combines content creation with cryptocurrency rewards to motivate users to produce high-quality content. Minds emphasises privacy protection and users' control over their data; it not only provides cryptocurrency rewards for content creation but also supports the development of decentralised applications. Akasha, based on the Ethereum blockchain, enables social interaction through smart contracts and stores data in a distributed network, both of which contribute to enhanced security. Peepeth is similar to X (formerly Twitter): with information on the blockchain being tamper-proof, the authenticity and reliability of the content is guaranteed.

Through key elements like distributed storage, cryptography, consensus mechanisms, and smart contracts, blockchain technology provides social networks with robust mechanisms for trust, incentives, and the protection of information and user rights; these mechanisms address many of the challenges faced by traditional social networks. Along these lines, Li et al. (2024) proposed a blockchain-based plagiarism identification scheme for social network users, to safeguard the rights of original authors and to ensure users' accountability concerning plagiarism. Zhu, Hu and Lv (2021) developed various privacy protection schemes to address information leakage in social networks, which offered valuable insights into information security and social network safety. Zhou and Wang (2021) introduced a public opinion management system model for social networks based on blockchain concepts and technologies, thereby aiding in the management and mitigation of risks associated with online public opinion. Some scholars have also explored information dissemination within blockchain-based social networks. For example, Cui and Qiang (2021) proposed an information dissemination model for blockchain-based social networks that focused on factors such as user trust and economic incentives; their work highlighted how these elements influence information dissemination. In addition, Bin, Sun and Zhou (2019) developed a blockchain technology-based public opinion dissemination model for social networks, which could curb the spread of false online public opinions and foster a healthier online environment for public opinion dissemination—giving it practical significance.

2.3. Research on blockchain applications based on evolutionary game theory

Evolutionary game theory combines game-theoretic analysis with dynamic evolutionary processes. Unlike traditional game theory, it assumes bounded rationality (rather than full rationality), meaning that game players learn, experiment with errors, and imitate, thereby dynamically adjusting their strategies to maximise their interests (Yang and Ma 2020; Zhang et al. 2022). Scholars have applied evolutionary game theory to analyse issues in the blockchain environment. For example, Han et al. (2024) developed an evolutionary game model involving government departments, blockchain service providers, and third-party regulatory agencies to analyse the sharing of government data on blockchains; their study sought to improve governmental governance capabilities and public service levels through concrete and actionable recommendations for improving government data-sharing practices on blockchain. Wu and Liu (2024) established a tripartite evolutionary game model involving regulators, carriers, and shippers to explore the application of blockchain technology in the safety supervision of road transport for dangerous goods, analysing how different variables influence the strategic choices of the involved parties. Liu et al. (2024) developed a complex network evolutionary game model to analyse farmers' financing behaviours on the blockchain; their study worked to address information asymmetry between farmers and financial institutions, which results in financial institutions being reluctant to lend and which poses financing difficulties to and imposes high costs on farmers. They identified key factors influencing farmers' adoption of blockchain, and they contributed to enhancing incentive and financial-product innovation mechanisms, whereby they supported the broader adoption of blockchain technology. Li et al. (2023) used evolutionary game theory to create a model for data-sharing behaviour among scientific researchers on the blockchain. Finally, Xu, Zhang and Chen (2023) developed an evolutionary game model to study cooperation in green procurement between small and medium-sized suppliers and core manufacturing enterprises, with the aim of improving environmental management and social responsibility performance across the green supply chain. These studies clearly indicate extensive application of evolutionary game theory to investigations of blockchain technology-related issues.

In summary, scholars have extensively explored the use of evolutionary game theory in areas like information dissemination on social media and blockchain applications. However, as discussed above, some limitations in the current research remain to be addressed. This study addresses these gaps by analysing the characteristics of information dissemination in blockchain-based social media using evolutionary game theory and by providing empirical support for the findings.

3. Evolutionary game analysis of information dissemination among users in blockchain-based social networks

3.1. Analytical process of evolutionary game theory

Evolutionary game theory is a theoretical framework that examines how strategic interactions within a population evolve over time; it integrates concepts from game theory and dynamic systems theory (Kou et al. 2024; Zhang et al. 2022). Originating from biological evolution, this theory has been widely applied in the fields of economics and sociology to analyse the formation of social habits, norms, institutions, and systems, as well as their influencing factors. The basic analytical process of evolutionary game theory comprises three stages (Wang, Ma and Zhang 2024; Zhi et al. 2024):

Model Construction. In this initial stage, it is essential to clarify the participants in the game, their strategic choices, and the impact of these choices on their respective payoffs. Based on these parameters, a payoff matrix is constructed which reflects the payoffs received by each participant under various combinations of strategies. This matrix serves as the foundation for subsequent analyses.

Model Solution. This stage primarily involves constructing replicator dynamics equations that describe changes over time in the proportions of various strategies within the participant population. With these equations solved, equilibrium points of the game can be identified. The stability of these equilibrium points is then analysed using the Jacobian matrix, to determine evolutionarily stable strategies (ESS).

Result Visualisation. In this stage, the system's evolutionary process under various conditions is observed through simulation of parameter assignments and initial probability settings. This entails verifying the correctness of ESS—i.e., verifying whether the system evolves from various initial states to the expected stable strategies—and conducting a parameter sensitivity analysis to assess the effect of parameter changes on the system's evolutionary path. Finally, the results of the evolutionary game are visually presented through the plotting of curves of system states over time or through comparisons of evolutionary path diagrams under various parameters.

These three stages collectively form the core of evolutionary game theory simulation, thereby providing a robust tool for analysing the dynamic evolution of game systems.

3.2. Game behaviour in information dissemination within blockchain-based social networks

Users' information dissemination behaviour in blockchain-based social networks is notably more cautious, due to the combined influence of incentive, trust, and community-governance mechanisms.

First, users who post authentic, credible, and valuable information receive rewards based on the information quality, and users who reshare high-quality information may also earn rewards. Conversely, a user who shares distorted or inappropriate information may face penalties. This incentive mechanism encourages users of blockchain-based social networks to carefully weigh the pros and cons before disseminating information, leading them to approach the information they encounter with greater caution (Li, Xie and Xu 2022; Tang et al. 2023).

Second, the trust mechanism inherent in blockchain-based social networks plays a significant role. Each user action is recorded on a distributed ledger with a timestamp, which makes the shared information resistant to tampering or deletion. This aspect enhances information credibility and transparency: because they know that their actions will be recorded and verified by the entire network, users exercise caution when disseminating information. Moreover, users are aware that posting false information or engaging in malicious dissemination can severely damage their reputation within the network (Guidi, Michienzi and Ricci 2020; Wang et al. 2024).

Lastly, community governance mechanisms in blockchain-based social networks significantly influence users' information dissemination behaviours. Such mechanisms typically include voting, consensus, and arbitration structures. These encourage users to consider the impact of their actions on the network when disseminating information; the awareness that their actions will be evaluated by the entire community prompts users to be more cautious in their information dissemination behaviours, to avoid potential controversies or disputes (Chen 2023; Hu, He and Feng 2022; Hu and Qi 2023).

In short, the collaborative interplay of incentives, trust mechanisms, and community governance in blockchain-based social networks creates a secure, trustworthy, and stable social network environment. These factors collectively influence users' information dissemination behaviour, which is more cautious and exhibits game-theoretic psychological characteristics throughout the information dissemination process.

3.3. Model construction

3.3.1. Construction of payment matrix

In line with the above discussion, this study considers the following parameter assumptions in developing the evolutionary game model:

(1) Two members of the social network, A and B, receive the same information.

(2) Users A and B have two choices: forward the information, or not. Let $x \subseteq [0,1]$ and $y \subseteq [0,1]$ denote the probabilities of A and B forwarding the information, respectively. Accordingly, 1-x and 1-y denote the probabilities of A and B not forwarding the information, respectively.

(3) Users A and B receive a basic benefit *I* for forwarding the information, along with a basic risk *R*.

(4) If both A and B forward the information simultaneously, the propagation effect is amplified, resulting in an additional benefit *ΔI* and an additional risk *ΔR* for both.

		Node user B	
		forward y	not forward 1-y
Node user A	forward x	(I+ΔI-R-ΔR,I+ΔI-R-ΔR)	(I-R,0)
	not forward 1-x	(0,I-R)	(0,0)

Table 1. Payment matrix for information propagation in social networks (Sources: created by author)

3.3.2. Local stability analysis

From Table 1, we can deduce the following equations.

Member A's expected benefit when choosing to forward information is:

$$U_{11} = y(\mathrm{I} + \Delta I - \mathrm{R} - \Delta R) + (1-y)(I-R) = y(\Delta I - \Delta R) + (I-R)$$

Member A's expected benefit when choosing not to forward information is:

$$U_{12} = 0$$

Therefore, the average benefit of member A's mixed strategy is:

$$\overline{U_1} = xU_{11} + (1-x)U_{12} = x(y(\Delta I - \Delta R) + (I-R))$$

The replicator dynamics equation for member A choosing to forward information is:

$$F(X) = \frac{dx}{dt} = x(U_{11} - \overline{U_1}) = x(1-x)(y(\Delta I - \Delta R) + (I - R))$$

Similarly, the replicator dynamics equation for member B choosing to forward information is:

$$F(Y) = \frac{dy}{dt} = y(U_{21} - \overline{U_2}) = y(1-y)(x(\Delta I - \Delta R) + (I - R))$$

Setting =0 and =0, we obtain five local equilibrium points of the evolutionary game system: $E_1(0,0)$, $E_2(0,1)$, $E_3(1,0)$, $E_4(1,1)$, and $E_5(\frac{R-I}{\Delta I-\Delta R}, \frac{R-I}{\Delta I-\Delta R})$. The Jacobian matrix J of the dynamic evolution system for information dissemination in blockchain-based social networks can be obtained by calculating the partial derivatives of the replication dynamics equations of members A and B:

$$\begin{bmatrix} (1-2x)(y(\Delta I - \Delta R) + (I - R)) & x(1-x)(\Delta I - \Delta R) \\ y(1-y)(\Delta I - \Delta R) & (1-2y)(x(\Delta I - \Delta R) + (I - R)) \end{bmatrix}$$

When a certain equilibrium point satisfies the conditions of the determinant of the Jacobian matrix $det\ J>0$ and the trace of the Jacobian matrix $tr(J)<0$, we can determine whether that local equilibrium point is in a locally asymptotically stable state. If it is a stable state, then the equilibrium point is considered to represent the system's evolutionary stable strategy. Table 2 presents the results of the local stability analysis of the system.

Equilibrium Points	Determinant of J	Trace of J (notation)
$E_1(0,0)$	$(I-R)^2$	$2(I-R)$
$E_2(0,1)$	$-((\Delta I - \Delta R) + (I - R))\ (I - R)$	$(\Delta I - \Delta R)$
$E_3(1,0)$	$-((\Delta I - \Delta R) + (I - R))\ (I - R)$	$(\Delta I - \Delta R)$
$E_4(1,1)$	$((\Delta I - \Delta R) + (I - R))^2$	$-2((\Delta I - \Delta R) + (I - R))$
$E_5(\frac{R-I}{\Delta I-\Delta R}, \frac{R-I}{\Delta I-\Delta R})$	$-2(R-I)(1-\frac{R-I}{\Delta I - \Delta R})$	0

Table 2. Local stability analysis of information forwarding by users in blockchain-based social networks (Sources: created by author)

As Table 2 indicates, three situations can be identified:

(1) When $I\text{-}R<0$ — that is, $I<R$, $det\ J>0$, and $tr(J)<0$ at point $E_1(0,0)$ — the point can be considered an equilibrium point. In this scenario, both A and B choose not to forward information, which causes the users' information forwarding behaviours

in the social network to gradually evolve towards point (0,0), ultimately converging at equilibrium point E_1.

(2) When $(\Delta I - \Delta R)+(I - R)>0$, and $tr(J)<0$ at point $E_4(1,1)$, the point can be considered an equilibrium point. Here, both A and B choose to forward information, which causes users' information forwarding behaviours in the social network to gradually evolve towards point (1,1), eventually converging at equilibrium point E_4.

(3) $E_2(0,1)$, $E_3(1,0)$, and $E_5(\frac{R-I}{\Delta I-\Delta R}, \frac{R-I}{\Delta I-\Delta R})$ are identified as nonequilibrium points. These points evolve towards either (0,0) or (1,1), ultimately converging at equilibrium points *E1* or E_4.

3.3.3. Parameter simulation

Four sets of parameter values (presented in Table 3) are selected for analysis, and the evolution process of users' forwarding behaviours in blockchain-based social networks is simulated using MATLAB software. The simulation results are presented in Figure 1.

Group	I	R	ΔI	ΔR
Case 1	0.5	2	0.5	2
Case 2	0.5	1	0.5	1
Case 3	1	0.5	1	0.5
Case 4	2	0.5	2	0.5

Table 3. Simulation parameter values for the evolution of users' forwarding behaviours (Sources: created by author)

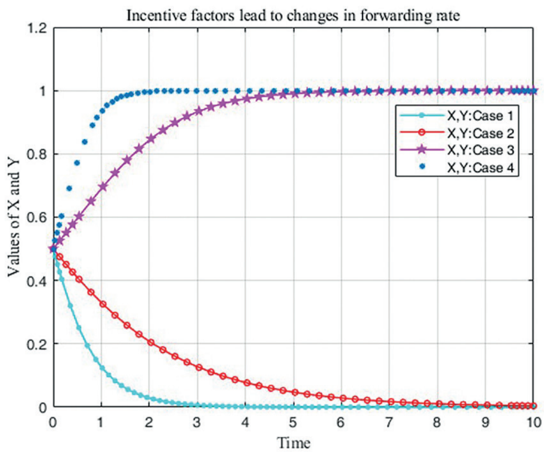

Figure 1. Evolution results of users' information dissemination behaviours in blockchain-based social networks (Sources: created by author)

In Cases 1 and 2, where $I<R$ and $\Delta I<\Delta R$, the evolution converges towards (0,0), as shown in Figure 1. Due to the larger difference between the values of I and R and between ΔI and ΔR, the convergence curve in Case 1 is steeper than that in Case 2, implying faster convergence.

In Cases 3 and 4, where $I>R$ and $\Delta I>\Delta R$, the evolution converges towards (1,1); due to differences in the specific values of I and R as well as in ΔI and ΔR, Case 4 converges more rapidly.

The results presented in Figure 1 both are consistent with the conclusions in Section 3.3.2 and align with real-world situations.

3.4. Empirical study

3.4.1. Theoretical analysis

This study uses the Steemit platform to examine the impact of blockchain incentive mechanisms on information dissemination by social network users. Steemit is a well-known blockchain technology-based network (Steemit 2016) where the creation and dissemination of information are stored immutably on the public blockchain Steem (Guo and Hu 2020). As mentioned above, Steemit encourages the production and dissemination of high-quality information through an incentive mechanism that includes the following key aspects (Kim and Chung 2018):

(1) Publishing high-quality content: Users earn more Steem token rewards when they create content of high quality that garners more likes.

(2) Disseminating high-quality content: Users who support high-quality content early through liking, commenting, or sharing receive more Steem token rewards.

(3) Holding Steem power: Similar to equity dividends, users can use “upvotes” and “downvotes” to determine the earnings of each piece of content.

These incentives drive users to choose high-quality resources when publishing and sharing information in order to maximise their token rewards. Additionally, each user has a reputation score that can only be increased through posting, commenting, and liking; if a user supports or shares content that is later found to be malicious or of low quality, not only the publisher but also the users who forward and like it face reductions in both their tokens and their reputation points. Therefore, users in the Steemit network are more cautious about publishing content, and they avoid casually forwarding unverified or malicious information (Fang and Wang 2022; Zhao and Zhou 2022).

The above analysis indicates that in the Steemit social network, the risks associated with forwarding unverified or malicious information outweigh the potential benefits. For group forwarding, the additional benefits from the expanded dissemination effect are significantly lower than the additional risks. Figure 2 illustrates the overall trend of information forwarding in the Steemit social network.

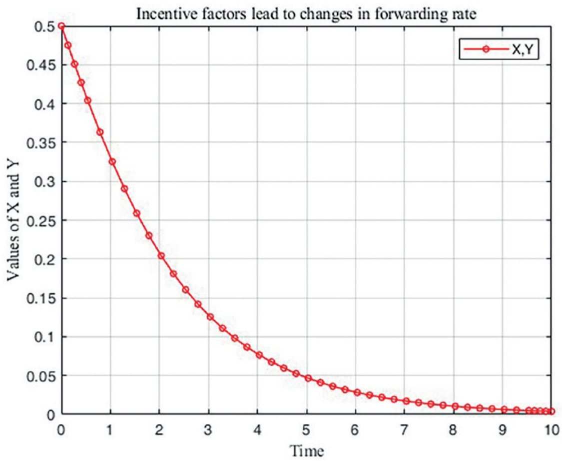

Figure 2. Trend of information forwarding in the Steemit social network (Sources: created by author)

3.4.2. Data validation

From October 11, 2024, to October 13, 2024, we collected article data from the Steemit platform using keywords such as ‘artificial intelligence (AI)’, ‘5G’, and ‘cloud computing’ to further verify the characteristics of information dissemination within the Steemit social network. The analysis focuses on the fields of publishers and responders. After data cleaning, 8,557 records remain. We utilise Gephi software to generate an information dissemination cloud map of the Steemit platform, with platform users as nodes and commenting relationships as edges (Kandonga, Ding and Yuan 2022; Zhao et al. 2018), as depicted in Figure 3.

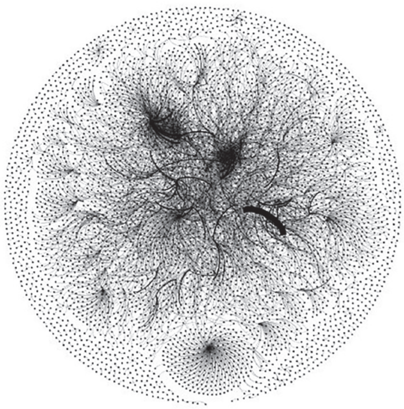

Figure 3. Information dissemination cloud map of the blockchain community (Sources: created by author)

In Figure 3, the dots indicate user nodes, and the lines between nodes indicate interactions among users, with the thickness of a line signifying the frequency of interactions. The figure shows that despite numerous nodes in the blockchain community, core users account for only a small fraction: overall, the distribution of nodes is relatively scattered, with limited closeness in user interactions and a relatively low volume of comments. This suggests that users in the blockchain community are more rational and exercise caution in sharing “uncertain” information. Such behaviour helps reduce the circulation of false or spam information and ensures wide visibility of high-quality content on the platform.

4. Conclusions and implications

4.1. Conclusions

This paper explores the influence of blockchain characteristics on information dissemination within social networks through the lens of evolutionary game theory, and it analyses the underlying mechanisms in suppressing misinformation and harmful content. Theoretically, this study advances the understanding of blockchain-based social networks, enriches the theoretical framework of information dissemination models, and broadens the application of evolutionary game theory. Practically, the research findings can help optimise information dissemination efficiency, improve network security and user trust, and offer valuable guidance for innovation and growth in blockchain-based social networks. In addition, this study provides insights into the application of blockchain technology in fields such as copyright protection, finance, and supply chain management.

Through its theoretical analysis and empirical testing, this study draws three conclusions from the proposed evolutionary game model.

(1) Greater Caution and Information Credibility in Blockchain-based Online Communities

In social networks leveraging blockchain technology, users’ information dissemination behaviours are shaped by a combination of personal interests, social needs, and economic incentives. This convergence makes users more cautious when disseminating information, particularly in relation to its content value and to the authenticity and reliability of its source, as spreading false information could harm both their reputation and their economic interests. This dynamic fosters the sharing of accurate and credible information within social networks, which in turn establishes a foundation for a healthier and more orderly online environment.

(2) Improved Content Quality and Suppression of False Information

A blockchain’s immutability and transparency ensure high-quality content in social networks. In blockchain-based communities like Steemit, high-quality content is more likely to receive recognition and economic rewards due to its value, which encourages users to be creative and willing with regard to producing quality content. At the same time, blockchain's inherent characteristics naturally suppress false information: since false content hardly gains community trust and support, its spread within such networks is hindered. This mechanism not only depollutes the online environment but also increases users' trust and satisfaction with the social network.

(3) Simplified and Direct Social Network Structure

Empirical analysis of the Steemit platform reveals that the blockchain's trust and incentive mechanisms facilitate simpler and more direct interactions among users. This shift streamlines the complex hierarchies and intermediary layers that are typical to traditional social networks, leading to more efficient and rapid information flow. As users become more discerning and selective, the overall volume of information may decrease but the quality and value of shared content continue to increase. This optimised network structure not only enhances the efficiency of information dissemination but also reduces management costs, which in turn provides robust support for the sustainable development of social network platforms.

4.2. Implications for management

Based on the research conclusions, four management implications are proposed.

(1) Continuously Explore and Optimise Innovative Incentive Mechanisms

Social network platforms should persistently explore and innovate around incentive mechanisms for blockchain technology, to better stimulate users' creativity and motivation for dissemination. Incentivising users based on multidimensional factors—such as user behaviour data, content quality assessments, and social influence—is crucial to ensuring fairness and effectiveness. Additionally, integrating more economic elements and business models (such as advertising revenue sharing and paid reading) can diversify users' revenue streams and incentive methods.

(2) Strengthen User Education and Guidance

To improve users' ability to understand blockchain technology and to assess information authenticity, platforms should boost education and guidance efforts. This can be accomplished through lectures, training sessions, online courses, and other educational initiatives. These efforts should focus on the fundamental principles, application scenarios, and potential risks of blockchain technology, as well as on strategies for evaluating information authenticity. Establishing a user-reporting and -feedback system can encourage active reporting of false information and misconduct, further cultivating a healthier online environment.

(3) Continuously Optimise and Upgrade the Social Network Structure

Social network platforms should leverage the blockchain's advantages to refine network structures and thereby increase the efficiency and quality of information dissemination. Introducing advanced technologies such as machine learning and natural language processing can enable precise analysis and prediction of user behaviour, as well as intelligent classification and filtering of content. Moreover, exploring blockchain-based data-sharing and collaboration mechanisms can support seamless information exchange and resource sharing across different platforms.

(4) Balance Community Autonomy and Supervision

Platforms should promote user involvement in community governance and rulemaking, to achieve autonomy and self-regulation; nevertheless, maintaining regulatory oversight and intervention is necessary to ensure compliance and standardisation within the community. A balance can be achieved through smart contracts and automated monitoring systems which enable real-time oversight and early warnings of community activities as well as timely interventions for violations. This integrated approach can not only maintain community order and stability but also enhance user engagement and creativity.

5. Limitations and future research directions

5.1. Research limitations

This study examines user behaviour and information dissemination mechanisms in blockchain-based social networks under the reasonable assumption that users are aware of the risks and benefits; however, the study has its limitations. First, in the operation of blockchain platforms, multiple factors may interfere with certain mechanisms (Li and Palanisamy 2019). This study neither considers these factors nor comprehensively explores how the diversity, complexity, and dynamics of various mechanism designs affect user behaviour and information-dissemination efficiency. For instance, different configurations of incentives (such as reward structures, distribution methods, and penalties) can lead to significant differences in user behaviours. Second, the empirical analysis is restricted to a single platform (Steemit) with a limited dataset, which may impact the generalisability and reliability of the findings. Differences in user demographics, platform features, and operational strategies across platforms could affect user behaviour and dissemination patterns.

5.2. Future research directions

To address the aforemented limitations, future research should more comprehensively analyse how blockchain characteristics influence user behaviour, with a particular emphasis on the effects of complex and dynamic incentive mechanisms on user actions and dissemination efficiency. Expanding the empirical scope to include more blockchain-based social platforms, as well as gathering richer data, will enhance the comprehensiveness and robustness of the findings. Additionally, examining platform-specific variations will shed light on how different platform features influence user behaviours and information dissemination mechanisms; this can offer valuable insights for the optimised design and sustainable development of blockchain-based social networks.

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