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Blockchain-based Distributed Financial Trust Evaluation System and Operation Mechanism

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Abstract: The functioning of the present-day financial system relies on the movement of funds and information. DeFi (Decentralized Finance), utilising blockchain technology, possesses the capability to establish autonomous and trustworthy smart contracts that do not require the involvement of intermediaries for escrow and auditing purposes. This results in the creation of a financial system that is characterised by its openness and transparency, devoid of any form of identity-based discrimination, and accessible to all individuals. The utilisation of a private blockchain system facilitates enhanced efficiency, while concurrently ensuring the attainment of privacy and security objectives. Moreover, such a system aligns more closely with prevailing regulatory standards. The Coalition Chain has the characteristic of a scale-free network, with its nodes following a power law distribution. This work aims to investigate credit governance from the standpoint of group behaviour and provide optimisation solutions accordingly.

Keywords: DeFi; Blockchain; Distributed Finance System; Credit Governance.

1. Introduction

The ongoing convergence of contemporary information technology with the financial sector is generating novel iterations of technology-driven financial services, sometimes referred to as ITF in. For instance, the application of financial technology (FinTech) involves the utilisation of machine learning and artificial intelligence to analyse vast amounts of data, enabling the assessment of creditworthiness among various users. Consequently, diverse financial services are introduced. Additionally, DeFi (Decentralized Finance) has emerged on a global scale, leveraging the anonymity or semi-anonymity provided by blockchain technology. This has resulted in the creation of numerous decentralised financial derivatives and associated services.

This work presents a novel approach to analysing evolutionary economics by including the Epidemic Model. Specifically, we apply this model to examine the credit performance of DeFi financial inclusion, focusing on group behaviour. The present study formulates a differential dynamics equation to discern between traditional finance and decentralised finance scenarios. Additionally, it categorises the social network population into three distinct groups: individuals who have already generated credit, those who have experienced credit loss, and those who possess borrowing demand but have not yet borrowed. This categorisation allows for an analysis of the evolving patterns of group credit within private and alliance chains, taking into account the influence of heterogeneous populations.

2. Literature Review

2.1. DeFi and Inclusive Finance

DeFi (Decentralized Finance) refers to a distributed and decentralised financial framework that operates on a blockchain infrastructure. The implementation of blockchain technology in this financial form has successfully achieved disintermediation, resulting in a significant reduction in transaction costs associated with intermediary linkages.

The robust advancement of inclusive finance is an indispensable necessity for China to construct a comprehensive and affluent society. In theory, decentralised finance (DeFi) is a highly promising approach to achieving financial inclusion. DeFi has the ability to create a financial system that operates through the automated execution of smart contracts without third-party oversight or auditing. The system is characterised by its inherent openness and transparency, the absence of any form of identity discrimination and the fact that any individual can participate.

Nevertheless, the existing DeFi (Decentralized Finance) ecosystem lacks the attributes of being universally accessible and inclusive. The term "universal" pertains to widespread adoption, as exemplified by MakerDAO, the leading DeFi project on the Ethereum network, often referred to as the central bank of Ether. However, it is noteworthy that even MakerDAO, with its significant success, has a user base of only over 6,000 individuals. Consequently, DeFi remains a niche domain primarily appealing to technology enthusiasts and venture capitalists. Conversely, the term "beneficial" denotes accessibility, allowing any individual to participate in the financial system without facing discrimination based on their identity. However, the current state of DeFi is characterised by substantial barriers to entry, including high thresholds, costs, and risks. Blockchain libertarians prioritise DeFi (Decentralized Finance) as a financial ecosystem that operates without the need for permission. They argue that developers, nodes responsible for bookkeeping, and users should all be able to participate without requiring authorisation. Their objective is to establish an ecosystem that is entirely open, transparent, and adaptable. Furthermore, they contend that regulation and DeFi can be treated as distinct entities, suggesting that discussions on regulation should not encompass DeFi. The finance industry is subject to extensive regulations, with the global financial system implementing measures such as Know Your Customer (KYC) protocols and regulations pertaining to anti-money laundering, anti-terrorist financing, and anti-tax evasion. Additionally, the industry requires various permits, licences, and certifications, making it challenging to establish a fully integrated financial model.

When considering the future trajectory of DeFi, it is crucial that all assets are pass-through, property rights are created, and that traditional high-barrier financial authorisers are replaced by no-barrier, open and transparent codes and smart contracts, and a fully open financial system is created on a global scale. Nevertheless, achieving complete decentralisation and disintermediation in the realm of DeFi (Decentralized Finance) is not entirely viable. Instead, what appears to be more attainable is the establishment of a weakly centralised open financial system. It is anticipated that DeFi built on private and alliance chains will experience significant development. This is due to the inherent advantages of private and alliance chain technologies over public chains in the practical implementation phase. These advantages include the ability to offer tailored deployment solutions through Blockchain as a Service (BaaS), as well as the capacity to connect nodes with authorised access under adaptable permission control mechanisms. In relation to this matter, The Economist magazine and Vitalik Buterin, the esteemed founder of Ether, are highly relevant. According to The Economist, digital currencies are regarded as mere manifestations of a larger phenomenon, wherein the underlying trust mechanism is considered the fundamental innovation. Consequently, it is argued that an unrestricted reliance on individual volition alone is insufficient, and digital currencies cannot entirely supplant the regulatory oversight provided by central banks. Vitalik Buterin, the prominent figure behind Ethereum, shares the perspective that the implementation of blockchain technology does not necessarily adhere to a purely decentralised model. He argues that various types of blockchain systems will cater to diverse circumstances and demands.

2.2. Credit Characteristics of DeFi

DeFi stands for Decentralised Finance, a peer-to-peer digital system that operates on the principles of blockchain technology to facilitate decentralised transactions. In a transaction, it is not necessary for the involved parties to possess prior knowledge of each other's credit status, nor is it required to seek validation from a trusted intermediate organisation. Instead, the establishment of confidence within the market is solely reliant on the principles of machine trust. Without a doubt, the issue of ensuring trustworthiness among parties involved in transactions remains a significant challenge inside the DeFi system or the blockchain-based digital realm. Within the context of a blockchain system, the process of de-crediting is achieved only through cryptographic algorithmic operations. However, it is important to note that the de-crediting environment present within the blockchain system cannot be readily extended outside the confines of the blockchain itself. In order to address the issue of credit trading in real-world contexts, it remains necessary to incorporate trusted intermediaries within society, notwithstanding the departure from the natural landscape of Token trade. In instances such as illicit darknet transactions, it is common practise to establish a third-party escrow account (referred to as Escrow Account) to boost credit and guarantee the completion of the actual transaction consideration.

Nevertheless, it is indeed accurate to state that a significant portion of decentralised finance (DeFi) products lack on-chain identity. This is primarily due to the prevalent utilisation of cryptographic techniques, including zero-knowledge proofs, combinatorial signatures, and homomorphic encryption, for the purposes of encryption and authentication within the DeFi ecosystem. While these cryptographic methods effectively safeguard the privacy of users' transactions, they simultaneously hinder the feasibility of conducting credit assessments solely based on individual entities. The integration of on-chain and off-chain situations is essential for the advancement of financial inclusion through DeFi. Consequently, conducting an analysis of credit governance from the standpoint of group behaviour is a viable approach. This study presents the EpidemicModel as a tool for analysing the credit governance issue in DeFi, with the aim of improving financial inclusion scenarios through an examination of group behaviour.

3. Research Process

3.1. Group Credit Modelling for DeFi Inclusion

The spread of information and the activity of groups in social networks typically exhibit a diffuse nature. The viral infection model is extensively employed in the domains of network information dissemination and group behaviour research as a fundamental mathematical framework for investigating the velocity, extent, trajectory, and dynamics of viral infections.

The viral infection model comprises a system of differential kinetic equations that typically categorises individuals into three groups: the susceptible class (S), the infectious class (I), and the recovered class (R). The choice of model for studying outbreaks and transmission processes depends on the subject of study and the stage of development. Three commonly used models are the SI model, the SIR model, and the SIRS model. The SI model focuses solely on susceptible (S) and infected (I) individuals, examining the outbreak and transmission process. The SIR model expands upon the SI model by including a recovered (R) category, accounting for individuals who have moved out of the infected state. Finally, the SIRS model incorporates the recurring process of individuals transitioning from the recovered state (R) back to the susceptible state (S), in addition to the components of the SIR model. This study utilises the SIR model as a theoretical framework, differentiates between conventional finance and decentralised finance scenarios, and categorises the credit groups within the social network into three distinct groups: 1) individuals who have already established credit and are considered trustworthy (T); 2) individuals who have already generated credit but have defaulted on their obligations (O); and 3) individuals who are in need of credit but have not yet established a credit history (N).

In the realm of traditional finance, the composition of the credit providers' group, denoted as T, and the credit recipients' group, denoted as O, is subject to modification when the inclusion of the group N, which possesses a desire for credit but has not yet generated credit, occurs. The availability of credit for an individual with a good credit history (N^T) or a person with a poor credit history (N^O) inside a certain group (N) will be positively influenced by the number of individuals with good credit (T) and the number of individuals with poor credit (O) in that group. Conversely, the availability of credit will be negatively influenced by the default rate that occurs after credit has been extended. The trustworthiness and default risks inherent in traditional banking are likely to permeate the landscape of decentralised finance, resulting in comparable patterns of behaviour between the two. Based on this, the model can be designed as follows:

$$\begin{cases} \dfrac{dm_l^T}{dt} = \lambda_l^T N^T m_l^T - \sigma_l^T m_l^T \\ \dfrac{dm_h}{dt} = (\lambda_h^T N_l^T N_h^O + \lambda_h^O N_l^O N_h^T) m_h - \sigma_h m_h \\ \dfrac{dm_l^O}{dt} = \lambda_l^O N^O m_l^O - \sigma_l^O m_l^O \end{cases} \tag{1}$$

The aggregate count of individuals in groups T and 0, who have produced credit, is standardised to a value of 1. This implies that the parameters indicate proportions or percentages. Let m represent the quantity of individuals inside the credit producers group, l symbolise traditional credit, h represent DeFi credit, λ denote credit success (specifically, credit availability), and σ signify default.

In this context, m_l^T represents the count of individuals who hold traditional credit and are considered trustworthy. λ_l^T represents the rate of successful participation in traditional credit among these trustworthy individuals, while σ_l^T represents the rate of default on traditional credit among them.

Similarly, m_h^T represents the count of individuals who act as creditors in the decentralised finance (DeFi) space and are considered trustworthy. λ_h^T represents the rate of successful participation in DeFi credit among these trustworthy individuals, while σ_l^T represents the rate of default on DeFi credit among them.

The variable m_l^O represents the count of defaulters who have traditional creditors. λ_l^O represents the rate of successful participation in traditional credit among the defaulters. Lastly, σ_l^O represents the rate of default on traditional credit among the defaulters.

The variable m_h^O represents the count of DeFi creditors within the group of defaulters. Meanwhile, λ_h^O signifies the rate of successful participation in DeFi credit among the defaulters. Lastly, σ_l^O denotes the rate of default on DeFi credit among the defaulters.

The variable N^T represents the count of individuals who are sought after as credit keepers but have not yet generated credit. Similarly, the variable N^O represents the count of individuals who are sought after as defaulters but have not yet generated credit. N_l^T represents the count of credit keepers among the sought-after but uncredited individuals who will engage in traditional credit. N_h^T represents the count of credit keepers among the sought-after but uncredited individuals who will engage in DeFi credit. N_l^O represents the count of defaulters among the sought-after but uncredited individuals who will engage in traditional credit. Finally, N_h^O denotes the count of individuals who are sought after but not creditworthy, and will participate in DeFi credit or traditional credit.

When examining traditional and decentralised finance exclusively, it can be posited that the behavioural characteristics of these two financial models are conceptually equivalent during the early phase. And it exists:

$$\begin{cases} m_l^T + m_h^T + N^T = 1 \\ m_l^O + m_h^O + N^O = 1 \\ N^T = N_l^T + N_h^T \\ N^O = N_l^O + N_h^O \end{cases} \tag{2}$$

Research has demonstrated that the propagation of credit inside social networks exhibits characteristics akin to those of an infectious "virus". Equations (1) and (2) provide a system of nonlinear multivariate differential equations that pose challenges in terms of their solvability. Given the premise that the behavioural attributes of a particular group within the social network remain consistent throughout both traditional banking and decentralised finance, the model is rendered more straightforward by the application of symmetry, namely the notion that:

$$\begin{cases} \lambda_l^T + \lambda_l^o = \lambda_l \\ \lambda_h^T + \lambda_h^o = \lambda_h \\ \sigma_l^T + \sigma_l^o = \sigma_l \\ N_l = N_l^T + N_l^O \\ N_h = N_h^T + N_h^O \\ N = N^T + N^O \\ m_l^T = m_l^o = m_l \\ m_h^T = m_h^o = m_h \end{cases} \tag{3}$$

Substituting equation (3) into equation (1) yields:

$$\begin{cases} \dfrac{dm_l}{dt} = \lambda_l N m_l - \sigma_l m_l \\ \dfrac{dm_h}{dt} = 2\lambda_h N_l N_h m_h - \sigma_h m_h \\ N = N_l + N_h \\ m_l + m_h + N = 1 \end{cases} \tag{4}$$

Given that the participation process of individuals who are in demand but lack credit finally follows a diffusion scenario, it is beneficial to make the assumption that a certain proportion, denoted as θ (where $0 < \theta < 1$), avail themselves of decentralised finance (DeFi) credit. This proportion θ is referred to as the intrusion proportion. Consequently, the following relationship holds:

$$\begin{cases} N_h = \theta N \\ N_l = (1-\theta) N \end{cases} \tag{5}$$

3.2. Private Chain-based Group Credit Governance Analysis

3.2.1. Private Blockchain and Random Network

A private blockchain, also known as a private distributed ledger, utilises blockchain technology for bookkeeping purposes. It operates with multiple nodes, similar to the general structure of a blockchain, and exhibits the characteristic of openness commonly associated with blockchain systems. However, it also imposes limitations on write and read permissions, thereby ensuring a heightened level of privacy and security. Private blockchain networks often eliminate the consensus mechanism of "mining" due to their restricted accessibility, resulting in a significant enhancement in execution efficiency. Due to their ability to expedite transactions, reduce expenses, enhance privacy, and ensure data integrity, numerous prominent financial institutions have a proclivity towards using private chains. Simultaneously, numerous nations express concerns regarding the "anonymisation" of public blockchain networks. Instead, they embrace a financial regulatory approach that emphasises reliable and secure interactions facilitated by trusted identities. It is evident that the structure of private blockchains, coupled with licencing mechanisms, aligns more closely with these requirements. The Hyperledger project exemplifies the implementation of private blockchain technology, which has garnered significant attention and advancement in various domains, including supply chain management.

A Random Network refers to a network configuration characterised by a connectivity distribution that adheres to a Poisson distribution. Additionally, the nodes within this network exhibit a roughly equal number of connections. The random network exhibits three fundamental characteristics: a Poisson degree distribution, a short average distance, and a small clustering coefficient. The licenced blockchain architecture demonstrates several key features. Firstly, participating nodes undergo authentication through licencing. This ensures that only authorised nodes are permitted to join the network. Secondly, the bookkeeping environment within the architecture is deemed credible, instilling trust in the system. Additionally, the connections between nodes exhibit a symmetric probability distribution. Furthermore, the probability distribution of the degree distribution of the network at each interval is equiprobable. In other words, the likelihood of a node having a certain degree is equal across the network, aligning with the characteristics of a stochastic network.

3.2.2. Group Credit Governance for Random Network

In a Random Network, the network node degree k ~ (k), so the first two equations of equation (4) are changed to:

$$\begin{cases} \dfrac{dm_l}{dt} = \lambda_l \langle k \rangle N m_l - \sigma_l m_l = 0 \\ \dfrac{dm_h}{dt} = 2\lambda_h \langle k \rangle N_l N_h m_h - \sigma_h m_h = 0 \end{cases} \tag{6}$$

Substituting Eq. (5) into Eq. (6), it is easy to obtain the critical values of creditworthiness of the trustworthy group and the untrustworthy group in DeFi:

$$\lambda_h^c = \frac{\sigma_h \lambda_l^2}{2\theta(1-\theta)\sigma_l^2 \langle k \rangle} \tag{7}$$

The relationship between the critical value λ_h^c of the creditworthiness of the two populations in a private chain random network can be observed from equation (7). It is evident that λ_h^c is directly proportional to λ_l^2 and inversely proportional to θ^2. Given the significant creditworthiness (λ_l^2) observed among the homogenous population, it becomes necessary for the private chain to undergo licence authentication in order to gain access. Additionally, considering the tiny intrusion ratio (θ), the occurrence of defaults on a wide scale is highly improbable.

To facilitate a more comprehensive examination of the impact of variables such as the proportion of the trustworthy group and the proportion of the defaulter group on λ_h^c in the context of Decentralised Finance (DeFi), we conducted a simulated analysis using the parameters outlined in Table 1.

Table 1. Simulation parameter values

Name of parameter	DeFi credit population share	DeFi credit default rate	Traditional channel credit success rate (availability)	Traditional Channel Credit loan default rate	Number of network nodes
parameter sign	θ	σ_h	λ_l	σ_l	<K>
Parameter Median	2.50%	5%	20%	1%	5
Parameter range	[0,0.05]	[0,0.1]	[0,0.4]	[0,0.02]	2-9
Observations: 1. The credit default rate in the decentralised finance (DeFi) sector is estimated by considering the credit default rate in the peer-to-peer (P2P) lending sector. 2. The approximate success rate (accessibility) of loan through traditional channels is derived from the data collected during one million visits to small and medium-sized enterprises by the Guangdong Provincial Banking and Insurance Commision in 2022. 3. According to the statistical data from the Guangdong branch of the People's Bank of China in 2022, the credit default rate in the traditional channel can be estimated by the non-performing loan rate.					

The outcomes of the simulation study are depicted in Table 1 (refer to Appendix 1 for the underlying code of the simulation). Based on the findings presented in Table 1, it is evident that there exists a notable relationship between the percentage of DeFi credit population within the range of [0,0.05] and the critical value of λ_h^c, as influenced by the parameter σ_h Specifically, as σ_h is incremented from 0 to 0.1, there is a corresponding increase in λ_h^c from 0 to 0.5. Furthermore, this increase exhibits a steep slope, indicating a strong and significant impact. Conversely, the impact of σ_l on λ_h^c is quite insignificant, and the correlation between the two variables has a less pronounced slope.

This finding can be corroborated in the context of supply chain financing scenarios. Blockchain technology in the domain of supply chain finance guarantees the veracity, precision, and transparency of data. Through a shared ledger, multiple participating entities are able to coexist in an environment of collaborative supervision. Furthermore, the verification of transaction behaviours among these entities effectively prevents the possibility of private collusion. This ensures that supply chain finance successfully facilitates trade financing, capital flows, and risk mitigation throughout the entire end-to-end supply and distribution chain.

3.3. Analysis of Group Credit Governance based on Coalition Chains

3.3.1. Coalition Chains and Scale-Free Networks

A consortium blockchain is a type of blockchain where the consensus mechanism is collectively decided and managed by a specific set of pre-selected internal nodes. Other nodes can only access and not participate in the consensus. A consortium chain often consists of nodes that are associated with physical institutions, which are arranged to align with these nodes. The process of joining or leaving the network is strictly regulated and requires authorisation. These physical institutions constitute a collective of shared interests, and data within the chain is exclusively accessed, modified, and transported. Coalition chains present a hybrid solution that strikes a balance between the unrestricted transparency of public chains and the significant centralisation observed in private chains. A federation chain restricts access to its features exclusively to its members, making it well-suited for a collaborative federation comprising numerous organisations. Common examples of coalition chains consist of R3CEV, also known as the R3 Blockchain Consortium, among other similar entities.

The coalition chain exhibits the characteristic of a Scale-free Network, as determined by analysis using graph theory and network theory. The coalition chain can be characterised as an intricate network that exhibits several traits such as self-organisation, self-similarity, attractor dynamics, small-world phenomenon, and scale-free behaviour. The degree distribution of the network conforms to the characteristics of a power law distribution, which is a typical attribute of scale-free networks. throughout the coalition chain, the central node that is predetermined is referred to as the Hub in the scale-free network. Other nodes are only able to decide whether to access and engage in transactions based on the established regulations. Consequently, the distribution of connection statuses throughout the coalition chain exhibits a significant degree of unevenness. The concept of scale-free networks is to quantify the non-uniform distributions observed in complex networks, which have various properties such as fault-tolerance, robustness, and vulnerability.

3.3.2. Group Credit Governance in Scale-Free Networks

Replace equations 1 and 2 of Eq. (4) with the coupled form of the scale-free network:

$$\begin{cases} \dfrac{dm_{lk}}{dt} = \lambda_l k N \Phi - \sigma_l m_{lk} = 0 \\ \dfrac{dm_{hk}}{dt} = 2\lambda_h k N_l N_h \Psi - \sigma_h m_{hk} = 0 \end{cases} \tag{8}$$

where:

$$\begin{cases} \Phi = \sum_{k'} P(k'|k)\, m_{lk'} \\ \Psi = \sum_{k'} P(k'|k)\, m_{hk'} \end{cases} \tag{9}$$

Substituting the last two equations of equation (4) and equation (5) into equation (7)

gives:

$$a(1-m_{hk})^2 = m_{hk} \tag{10}$$

where:

$$a = \frac{A\Psi k}{(\lambda_l k\Phi + \sigma_l)^2}, \text{ and } A = \frac{2\lambda_h \theta(1-\theta)\theta_l^2}{\sigma_h} \tag{11}$$

We consider the case where the intrusion ratio θ is small, at which point a Taylor expansion of Eq. (10) and taking a second-order perturbation can be obtained:

$$m_{hk} = \frac{A\Psi k}{(\lambda_l k\Phi + \sigma_l)^2} \tag{12}$$

Substituting Eq. (12) into Eq. (9) yields the self-consistent equation:

$$\begin{cases} \Phi = \sum_k P(k|k') \dfrac{\lambda_l k \Phi}{\lambda_l k\Phi + \sigma_l} \\ \Psi = \sum_k P(k|k') \dfrac{A\Psi k}{(\lambda_l k\Phi + \sigma_l)^2} \end{cases} \tag{13}$$

where:

$$P(k|k') = \frac{kP(k)}{\langle k \rangle}, \text{ and } P(k) \sim k^{-\gamma}$$

Equation (13) is the main result of the symmetric model. In the coalition chain, the maximum degree of the network distribution nodes is sufficiently large, and if γ is taken appropriately, it is easy to find the critical value as follows:

$$\begin{cases} \lambda_l^c \sim \dfrac{\langle k \rangle}{\langle k^2 \rangle} \sigma_l \\ \lambda_h^c \sim \dfrac{\langle k \rangle}{\langle k^2 \rangle} \times \dfrac{\sigma_h}{2\theta(1-\theta)} \end{cases} \tag{14}$$

According to equation (14), it is evident that in the case of scale-free networks, both λ_l^c and λ_h^c converge towards zero. Nevertheless, the value of λ_h^c might still be significantly high even in cases when the intrusion ratio θ is relatively low. The economic implication of a small intrusion ratio θ for different credit types is a reduced likelihood of large-scale defaults. Conversely, if a significant number of different credit types intrude into the structure of a scale-free network, it can potentially result in widespread assimilation of alien elements. This assimilation can lead to changes in the trustworthiness of individuals, both increasing and decreasing trustworthiness. Consequently, the group credit performance of the scale-free network may exhibit multivariate characteristics.

The aforementioned assertion finds partial validation in the developmental trajectory of the R3 Alliance blockchain, which was instigated by R3CEV.The primary objective of the R3 Blockchain Alliance is to simplify the intricate financial operations by establishing a network consisting of contracts. This network aims to ensure the reliability and uniformity of credit transaction verification by utilising Distributed Ledger Technology (DLT). However, the implementation of this process encounters various challenges due to the existence of diverse credit systems. Nevertheless, the project encounters various challenges and uncertainties throughout its course, primarily stemming from the diverse credit types of the participating institutions. This variability in credit performance leads to a series of complications, including the initiation phase, the withdrawal of certain institutions, and conflicts during operation.

3.4. Policy Recommendations

Decentralised finance (DeFi) is characterised by a distributed ledger system that is both open and transparent. It operates without the need for involvement from third-party institutions for verification purposes. Furthermore, it is accessible to all individuals without the requirement of licencing. With low barriers to entry, wide coverage and low costs, DeFi is a viable option for promoting financial inclusion. Naturally, the efficacy and potential risks of the aforementioned subject have yet to be substantiated through practical examination. Additionally, the credit performance of users within the collective necessitates ongoing observation and accumulation.

At now, a deficiency persists in the regulatory oversight of Decentralised Finance (DeFi), with the regulatory framework remaining underdeveloped. It is recommended that there be a degree of differentiation in the particular regulatory measures.

(1) DeFi, which operates on private chains, exhibits licencing characteristics and has not yet established a novel financial model. Moreover, the likelihood of widespread defaults occuring in this model is comparatively lower than that of the traditional financial framework. Therefore, it is advisable to incorporate DeFi into the existing financial regulatory framework. This entails subjecting it to market entry requirements and business regulations that adhere to

consistent rules and risk control measures. Such measures are essential to uphold fair competition and prevent regulatory arbitrage.

(2) DeFi based on the alliance chain has the business characteristics of being led by authoritative organisations and followed by participating organisations, the group credit performance may be complex and variable, and the risk volatility brought about by the herd effect and market resonance is difficult to avoid, and will possibly affect financial stability. Consequently, the stability of the financial system may be impacted. Hence, it is imperative to adhere to the principle of "technology neutrality" in the context of supervision, ensuring that monitoring aligns with the inherent characteristics of financial activities. Additionally, it is crucial to promptly conduct a thorough analysis, known as "penetrating characterisation," as part of the supervisory process.

4. Conclusion

In theory, decentralised finance (DeFi) holds promise as an optimal means to attain financial inclusivity. In fact DeFi is still a niche game for tech geeks and venture capital circles, with high thresholds, high costs and high risks.

With the integration of "zero knowledge proof" verification in DeFi, the absence of identity on the blockchain within most DeFi products poses challenges in conducting credit analysis on individual entities. However, for DeFi to effectively promote financial inclusion, it is imperative to combine on-chain and off-chain scenarios. Consequently, it becomes viable to examine credit governance through the lens of collective behaviour.

This research presents a novel approach to analysing evolutionary economics and applies the Epidemic Model to examine the credit performance of DeFi inclusive financing, focusing on group behaviour. This study formulates a differential dynamics equation to differentiate between traditional finance and decentralised finance scenarios. It further categorises individuals within social networks into three groups: credit generators, credit losers, and individuals with borrowing demand but no borrowing history. The aim is to analyse the dynamics of group credit in private and alliance blockchain networks, taking into account the influence of heterogeneous groups.

The use of a private blockchain not only enhances operational efficiency, but also addresses concerns regarding privacy and security, aligning with regulatory standards. The features of the nodes in a private chain exhibit similarities to those of a random network. By considering the degree of the nodes in the random network, this study deduces the group credit performance of the private chain. The findings suggest that within the context of private chain technology, the incidence of intrusion among social network participants is minimal, the likelihood of widespread default is low, and the credit system demonstrates stability.

Simultaneously, this study examines the collective credit performance of the federated chain by integrating the network coupling structure. The findings suggest that the credit performance of a group may exhibit multivariate characteristics in a scale-free network. If various forms of credits are introduced on a wide scale, it could potentially result in significant heterogeneous assimilation.

In light of the varying characteriszations of credit performance in private chains and alliance chains, it is recommended to implement distinct regulatory measures. Specifically, the DeFi activities within private chains should be integrated into the current financial regulatory framework, while the regulation of DeFi activities within alliance chains should be promptly and qualitatively implemented, taking into account technological neutrality.

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