Inherent Defects in Smart Contract Dispute Resolution: Legal Challenges and Solutions

Qingfeng Li[1],Jialu Qi[2]
[1]Law school of Hangzhou Dianzi Unversity, LQF@hdu.edu.cn
[2]Law school of Hangzhou Dianzi Unversity, 232340004@hdu.edu.cn

Abstract: With the continuous development of smart contracts, new types of disputes involving smart contract transactions are increasing day by day, giving rise to smart contract dispute resolution mechanism. The mechanism is embedded in smart contracts as a new type of dispute resolution in the form of code and can respond promptly when disputes arise. In the course of practice, although the smart contract dispute resolution mechanism has demonstrated its efficiency beyond the traditional dispute resolution mechanism, it has also gradually revealed its potential risk points. Based on the analysis of the current legal framework, it can be seen that the inherent defects of the smart contract dispute resolution mechanism are centerd on the three dimensions of misconduct of the adjudicating bo dy, lack of procedural justice, and disconnection of effectiveness. Therefore, it is necessary to propose solutions to the inherent defects, by improving the access threshold of the adjudicating body, setting up uniform and clear adjudication norms and evidence review procedures, perfecting the adjudication validity determination and multi-dimensional relief measures and other optimization paths, to further give full play to the advantages of the high efficiency and security of the smart contract, in order to look forward to realizing the symbiosis of value between the technological trust and the judicial credibility.

Keywords: Smart Contract, Dispute Resolution, Decentralized justice

Introduction

Since the concept of Bitcoin was first proposed in 2008, blockchain technology has opened the door to a new world for mankind, and its application in the legal field has also covered multiple areas such as judicial depositions, enforcement, and the right to personal information in the past decade. Back in 2019, General Secretary Xi Jinping stressed the need to strengthen blockchain standardization research and enhance international discourse and rule-making power during the 18th collective study of the

Political Bureau of the Central Committee.[1] From the technical level, blockchain is advancing from Blockchain 1.0 (digital currency), Blockchain 2.0 (distributed application, the smart contract, and virtual machine) to Blockchain 3.0 (cross-chain interaction, multi-chain fusion, and value internet). From the legal level, the Supreme People's Court has continuously issued relevant judicial interpretations on the application of blockchain in the judicial field during the two years of 2021 and 2022, which will help blockchain technology to be rapidly integrated into all aspects of judicial adjudication, and lay down a judicial guarantee for China's digital transformation.[2] As a representative work of blockchain technology, smart contract provides a relatively safe transaction environment and high execution efficiency for on-chain transactions due to its technical characteristics that distinguish it from traditional transaction methods. Relying on blockchain and Ethereum technology, it is endowed with the characteristics of "decentralization" and "anonymity". However, the development of technology cannot absolutely avoid disputes, and will even generate on-chain disputes that are different from traditional disputes.[3]

In order to solve the new type of on-chain disputes, the smart contract dispute resolution mechanism has gradually emerged in history and has rapidly become one of the important means of "ruling the chain with the chain". This mechanism is different from the traditional dispute resolution mechanism, but it directly uses the technology platform and code embedding to input the corresponding procedures into the smart contract, suspend the execution of the smart contract and intervene in the dispute resolution after the dispute arises, and the measures related to the different types of smart contract dispute resolution mechanism intervening in the dispute resolution are also presenting the phenomenon of differentiation. The dispute resolution mechanism adopted by smart contracts mainly resolves disputes directly on the chain, but due to the special characteristics of blockchain, Ethereum and other technologies, the dispute resolution mechanism of smart contracts is endowed with a process different from the traditional dispute resolution mechanism. However, the seemingly efficient and flexible smart contract dispute resolution mechanism is still a product of the foreign rule of law framework. In the transplantation application of smart contract dispute resolution mechanism under the technology without borders, it can be found that there are still inherent deficiencies and defects under the framework of the rule of law in China, such as the fairness of the group decision-making on the chain, the legal effect of the chain judgment, and the lack of review procedures and so on, which are still unable to be effectively solved. Therefore, it is necessary to analyze the inherent defects of the smart contract dispute resolution mechanism under the existing legal framework of our country from the current situation of the smart contract dispute resolution mechanism and improve the smart contract dispute

---

[1] See Zhiming Zheng and Wangjie Qiu, '我国区块链发展趋势与思考 [Development Trend and Thinking of China's Blockchain]' (2020) 1 *Bulletin of National Natural Science Foundation of China* 5.

[2] See Wenting You, '民法典对智能合约的法律规制 [The Legal Regulation of Smart Contracts by Chinese Civil Code]' (2023) 12 *Theory Monthly* 125.

[3] See Jinfan Yang, '基于区块链的纠纷解决机制研究 [Research on the Blockchain-based Dispute Resolution Mechanism]' (2021) 4 *Journal of Shaanxi Normal University(Philosophy and Social Sciences Edition)* 163.

resolution mechanism with a localized vision, to substantially solve the problems of smart contract dispute resolution.

1. Status of application of smart contract dispute resolution mechanisms

In today's digital wave, smart contracts are used in many fields such as supply chain management, real estate transactions, financial services, etc., relying on their own characteristics, while China's judicial field relies on blockchain to create a smart judicial collaboration system. As of February 2024, data from the Dune Analytics analysis platform shows that the number of smart contracts on the Ethereum chain has exceeded 50 million, and the value of virtual currencies held by smart contracts with different applications has exceeded $300 billion.[4] As a carrier of the technical practice of "code is law"[5], smart contracts not only provide an enforcement paradigm that reconstructs traditional contractual relationships, but also have a profound impact on the rules of group autonomy driven by technology.[6]

1.1 The creation of smart contract dispute resolution mechanisms

Smart contracts based on blockchain technology were introduced in 2015 with the help of Ether, and have been widely used in many areas of social practice due to their decentralization, non-tampering, automatic execution, and other features that can reduce transaction costs and improve transaction efficiency. The 2018 China Blockchain Industry White Paper published by the Ministry of Industry and Information Technology (MIIT) states that a smart contract is an event-driven, stateful, multi-recognized procedure that runs on top of a blockchain and is capable of automatically processing assets according to preset conditions. Plus, the biggest advantage of smart contracts is the use of procedural algorithms to enforce contract terms instead of humans.[7] In order to be able to better apply smart contracts and achieve the effect of avoiding disputes, scholars in the field of law have begun to carry out in-depth research on smart contracts, but most of the literature only stays on the contractual attributes of smart contracts and does not peek into the fact that the smart contract as a technology in itself still has the possibility of generating risks. Even though the automatic execution of smart contract transactions can reduce some of the disputes from the source, it will not eliminate the disputes because of the

---

[4] See Xiangfu Zhao and Long He, '以太坊智能合约安全漏洞检测 [Ethernet Smart Contract Security Vulnerability Detection]' (2024) 8 *IEEE Spectrum* 57.

[5] A foundational concept articulated by Lawrence Lessig in his seminal work Code and Other Laws of Cyberspace, positing that the software architecture of the Internet—its code—constitutes a regulatory mechanism comparable to legal norms. Within this framework, those who design and control code exercise a form of regulatory authority, raising critical questions regarding its normative legitimacy and democratic accountability. In recent developments, this concept has evolved with the rise of smart contracts, which embed legal agreements directly into executable code. This technological shift significantly reconfigures the relationship between law and code by enabling the automatic enforcement of rights and obligations without the need for traditional legal institutions.

[6] See Ye Wu, '元宇宙：法律图谱与规范逻辑 [Metacosmos: Legal Mapping and Normative Logic]' (2023) *China Renmin University Press* 70.

[7] Ministry of Industry and Information Technology Information Center (中华人民共和国工业和信息化部信息中心), *White Paper on China's Blockchain Industry* (2018) (《2018 年中国区块链产业白皮书》) 99.

automatic execution.[8] Quite the contrary, unique new types of disputes are spawned in the operation of smart contracts. The anonymity of smart contracts leads to the difficulty of identifying the capacity of civil subjects, the automatic enforceability leads to the limitation of the free will of the parties, and the decentralization excludes traditional dispute resolution mechanisms, among other risks.

The fundamental reason why smart contract disputes are "new" is that the risks arising from smart contracts due to their technological characteristics cannot be applied to dispute resolution mechanisms under the traditional rule of law framework. Under the current framework of the rule of law, the "life journey" of a traditional contract generally needs to go through the process of contract formation, entry into force, performance and so on. The conclusion and execution of a contract, as a civil legal act of the parties, is usually made in the form of an expression of intent, and the contract is concluded through an offer or a promise. After the contract is formed and comes into effect, the parties abide by the relevant legal principles and perform their obligations in accordance with each other, thus fulfilling the purpose of the contract. From the Civil Code of the People's Republic of China contract and relevant judicial interpretations, it is not difficult to see that traditional contract disputes involve the meaning of the expression is not true, the performance does not comply with the agreement and so on many levels; in the practice of the level of the contract disputes are endless, the areas involved are also very extensive. However, in the implementation of smart contracts, there are still risks that cannot be solved by the existing rule of law theories and norms. During the operation of the smart contract, the parties as the chain user will be in an anonymous state, in the smart contract data transmission link, through the asymmetric key technology for the subject of communication and exchange. This operation can effectively alleviate the problem of data security and privacy protection, but at the same time, it will also cause practical difficulties in identifying the real subject. In addition, the smart contract is still essentially a computer programme written in code, and the meaning is presented through the form of code, while constituting an unchangeable smart contract. In the case of automatic enforcement, although it can to a certain extent avoid the traditional contract performance does not meet the agreement and other disputes, in fact, the automatic enforcement will limit the change of the parties' meaning, resulting in the traditional dispute resolution mechanism of the cost of relief. Not only that, smart contract transactions may cause disputes due to code errors, code loopholes, hacker attacks, prediction machine errors, and changes in policies and regulations.

In summary, in the process of technological development, there does not exist an flawless technology. The birth of emerging technologies is highly likely to give rise to frontier legal issues. The governance of science and technology still needs to follow the ever-extending regulatory logic. By embedding smart contract dispute resolution

---

[8] See Wulf Kaal, 'Evolution of Law: Dynamic Regulation in a New Institutional Economics Framework' (2024) 1 *in Festschrift In Honor Of Christian Kirchner* 2-3.

mechanisms, the operation of the smart contracts becomes more secure, thereby providing enhanced protection for the rights and interests of on-chain users.

1.2 Application of smart contract dispute resolution mechanisms

The decentralized and pseudonymous nature of smart contracts persist as permanent attributes of the technology.[9] Under the existing rule of law framework, in order to truly overcome the potential risk points of the automatic execution process of smart contracts, it is necessary to governance mechanisms must be embedded within blockchain's architectural infrastructure. Specifically, a dispute management module can be preset in the contract code, so that when the system detects a dispute arising from a transaction, it will automatically activate the execution pause mechanism and initiating an on-chain coordination process simultaneously. This dynamic adjustment mechanism allows for adaptive correction of the smart contract execution path through the negotiation results verified by multiple parties while maintaining the decentralized nature of the blockchain. The idea was initially conceived by Vitalik Buterin, the founder of Ethereum, in the aftermath of "The DAO" in 2016, and focused on the creation of a Decentralized Court, or "Distributed Court".[10] Subsequently, a series of European and American technology companies began to implement the idea on the public chain, and successively released more than a dozen dispute resolution solutions that were also based on blockchain technology but in different forms, which in turn evolved into three different types of smart contract dispute resolution mechanisms, namely the crowd-sourcing model, the arbitration model, and the court model. The crowd sourcing model represented by Kleros, Aragon Court, and Jur (Open Layer) is essentially a conversion of the dispute resolution method in which a third-party authority intervenes into a method in which a non-special smart contract user adopts a specific way of dispute adjudication.[11] The arbitration mode adds an arbitration clause when the user signs a smart contract, with details of when and how to apply arbitration for disputes are terms negotiated ex ante by contracting parties, Confideal and Codelegit are the representative institutional models under this mode. In October 2019, Hangzhou Internet Court applied blockchain smart contract technology to the judicial field for the first time, and for automated dispute resolution across contract lifecycle phases.[12] This smart contract judicial application is deployed on top of the alliance chain, and is mainly applied to the whole process of contract signing, performance, and dispute resolution, to achieve the purpose of improving the rate of contract fulfillment and boosting the efficiency of smart contract execution, as well as resolving a small number of possible breaches of contract with high efficiency, speed, and low cost. With the in-depth application of smart contracts in the judicial field, the Supreme People's Court issued the Opinions

---

[9] See Wulf A. Kaal and Craig Calcaterra, 'Crypto Transaction Dispute Resolution' (2018) Spring *The Business Lawyer* 54-58.

[10] See Jinfan Yang, '基于区块链的纠纷解决机制研究 [Research on the Blockchain-based Dispute Resolution Mechanism]' (2021) 4 *Journal of Shaanxi Normal University(Philosophy and Social Sciences Edition)* 166.

[11] See Xuhui Fang, 'ODR——多元化解决电子商务版权纠纷新机制 [ODR——A New Mechanism to Solve E-commerce Copyright Disputes in Multiple Ways]' (2017) 4 *Legal Forum* 157.

[12] Cyberspace Administration of China, 'The First Blockchain Smart Contract Judicial Application Launched: New Technology Builds a "Smart Line of Defense" for Online Integrity' (Cyberspace Administration of China, 29 December 2019) https://www.cac.gov.cn/2019-12/31/c_1579328270387357.htm accessed 19 March 2025.

of the Supreme People's Court on Strengthening the Judicial Application of Blockchain, aiming to deepen the construction of the national smart courts and guide the direction of typical scenarios of blockchain application in the judicial field.[13]

Smart contract disputes are exhibit distinctive attributes compared to conventional contractual conflicts, and the smart contract dispute resolution mechanism is also special compared to the traditional dispute resolution mechanism, i.e., resolving disputes arising from smart contracts on top of blockchain technology. Firstly, the smart contract dispute resolution mechanism is algorithmically integrated into smart contract architectures, which can be suspended through technical means to reduce the loss in time; secondly, the final solution reached through the smart contract dispute resolution mechanism can still be executed by the smart contract, to achieve the purpose of the smart contract. From the above special features, it can be seen that the smart contract dispute resolution mechanism has, to a certain extent, put forward a remedy for the potential risks that may be brought about by the anonymity and automatic execution of smart contracts. At the same time, the smart contract dispute resolution mechanism relying on the blockchain can be resolve disputes at transaction-layer speed to disputes, the current different modes of the smart contract dispute resolution mechanism can be a total of different types of smart contract dispute resolution mechanism for users to choose according to their situation, the cost and complexity of the process. In addition, the smart contract dispute resolution mechanism avoids the problems of reduced speed and automation of transaction execution caused by traditional litigation, game-theoretic incentive models and cryptographic algorithms to construct a decentralized dispute justice platform, and records the execution of the smart contract and the dispute resolution process on the blockchain to ensure the authenticity of the data on the blockchain.[14]

In general, both domestic and international practice environments, as well as the dual academic fields of technology and jurisprudence, have actively responded to and practiced the efficient development and safe application of smart contract technology. The smart contract dispute resolution mechanism has emerged in the wave of the times and is developing rapidly, providing better rights and interests protection solutions for smart contract users and even blockchain users.

---

[13] See Fuhui Sun, '<最高人民法院关于加强区块链司法应用的意见>理解与适用 [Understanding and Applications of "Opinions of the Supreme People's Court on Strengthening Blockchain Application in the Judicial Field"]' (2022) 4 *China Journal of Applied Jurisprudence* 31-34.

[14] Yann Aouidef, Federico Ast and Bruno Deffains, 'Decentralized Justice: A Comparative Analysis of Blockchain Online Dispute Resolution Projects' (2021) March *Frontiers in Blockchain* 2.

2. Inherent defects in smart contract dispute resolution mechanisms

The application of smart contract dispute resolution mechanism in practice has gradually formed an algorithmic justice ecosystems – decentralized governance frameworks. The smart contract dispute resolution mechanism based on blockchain and code can, to a certain extent, reduce the ambiguity and uncertainty in the interpretation of the relevant rules compared to the traditional dispute resolution mechanism.[15] However, the reality is that, as Ethan Katsh, the father of online dispute resolution, observed, the speed with which technology generates disputes exceeds its ability to resolve them.[16] Although the smart contract dispute resolution mechanism has shown better performance than the traditional dispute resolution mechanism in dealing with smart contract disputes, it is still impossible to ignore the inherent defects that may exist in itself.

2.1 Vacuum exists in access and performance of smart contract dispute adjudicators

2.1.1 Unrestricted adjudicator qualification thresholds

In the Rule of Law Social Governance Doctrine in China, dispute resolution often takes the introduction of a third party or a third-party authority, supplemented by a neutral third party to achieve fairness and justice through the corresponding procedures. To solve the problems it may involve, the smart contract did not introduce the leading party of dispute resolution, only based on the blockchain technology so that the cryptographically enforced peer-to-peer adjudication protocols. Smart contracts are algorithmically enforced agreements devoid of legal subjectivity.[17] Compared to traditional contracts, smart contracts transmute relational trust into cryptographic verification and obligations relationships, laws and regulations under the representation of meaning, thus allowing trusted transactions and operations to be carried out without the backing of trust. In short, the trust between people in traditional contracts is transformed into technological trust under the technical means of "decentralized justice", showing a technological fiduciary displacemen.

Because of the characteristics of smart contracts techno-centric design of blockchain-native mechanisms, most of the dispute resolution methods under the smart contract dispute resolution mechanism are only based on some specific conditions as the standard for the entry threshold of the adjudicator, rather than a substantive examination of the corresponding qualifications, which almost belongs to the state of zero threshold compared with the traditional dispute resolution

---

[15] See Aifei Chen, '区块链共谋的反垄断监管 [Antitrust Supervision of Blockchain Collusion]'(2022) 4 *Modern Law Science* 152-153.

[16] Yann Aouidef, Federico Ast and Bruno Deffains, 'Decentralized Justice: A Comparative Analysis of Blockchain Online Dispute Resolution Projects' (2021) March *Frontiers in Blockchain* 2.

[17] Andreas M Antonopoulos and Gavin Wood, 精通以太坊：开发智能合约和去中心化应用 (喻勇, 杨镇, 阿剑, 任露露 and Elisa Jiang trs, 机械工业出版社 2019) 134.

mechanism.[18] For example, in the role of juror in Kleros for handling disputes, users only need to pledge PNK tokens to become juror candidates, and the probability of eventually being able to become a juror in smart contract dispute handling is directly proportional to the number of tokens being pledged.[19] In the practice of Aragon Court, Jur, Juris, and other platforms, it can be seen that the resolution of smart contract disputes is similar to Kleros, which adopts the token method to select the adjudicator candidate. On the contrary, the traditional dispute resolution mechanism, whether it is arbitration or litigation is bound to intervene in the authoritative personnel with legal qualifications as a public third party, to the existing laws and regulations as the benchmark, in the evidence of both parties to make a just, fair and legal decision. Therefore, the smart contract dispute resolution mechanism only based on the number of tokens to determine the qualification of the adjudicator to intervene in the dispute is not in line with the entry threshold of legal dispute resolution.

2.1.2 Lack of norms for the performance of adjudicators in smart contract disputes

In addition to the problem of the low entry threshold of adjudicators in the smart contract dispute resolution mechanism, there is no unified and clear guidance for adjudication in the process of dispute resolution, i.e., adjudicators exercise unrestrained discretionary authority and are not bound by authoritative norms. In the practice of smart contract dispute resolution mechanism, the adjudicator is not bound by any legal norms, but by the "Schelling point" incentive mechanism in the game theory, the adjudicator is expected to make the so-called "fair and just" majority decision in order to get more tokens by the stake-weighted voting incentivized by cryptoeconomic rewards.[20] The majority decision is expected to be "fair and just" in order to get more tokens. Based on Thomas Schelling's game theory, in the absence of communication or trust, "Schelling Points" can reflect the behaviour that each person expects the other to do. In short, in smart contracts with anonymity and decentralization features, adjudicators cannot communicate and there is no basis for trust, and groups are more likely to make profit-maximizing conformity over substantive justice, thus forming decentralized justice on blockchain technology. For example, the dispute resolution mechanism in Kleros adopts a game-theoretic incentive mechanism, which believes that it is necessary to ensure the honesty of adjudicators through an incentive mechanism, so as to achieve fairness and justice in dispute resolution.[21]

However, decentralized justice that relies on game-theoretic incentives fail to satisfy core juridical principles at the legal level. Adjudicators are incentivized to vote in favour of the side they believe the majority of adjudicators will support, which is a

---

[18] See Jiaqi Huang, '智能合约众包争议解决机制的探究：基本特征、现实困境与完善路径 [Exploring the Smart Contract Crowdsourcing Dispute Resolution Mechanism:Fundamental Characteristics,Realistic Dilemmas and Improvement Paths]' (2024) 4 *Commercial Arbitration & Mediation* 62.

[19] Clément Lesaege, Federico Ast and William George, *Kleros Short Paper v1.0.7* (September 2019) https://kleros.io/whitepaper.pdf

[20] Thomas C Schelling, *The Strategy of Conflict*, trans Zhao Hua (Huaxia Publishing House 2011) 57.

[21] See Aifei Chen, '区块链智能合约纠纷解决的可能性边界 [The Possibilities for Blockchain Smart Contract Dispute Resolution]' (2024) 5 *Journal of Comparative Law* 199.

consensus-driven decisions lack normative safeguards. From a legal point of view, a fair and just adjudication should satisfy both substantive and procedural justice, including independent and neutral adjudicators, lawful and fair procedures, correct application of the law, and safeguards and remedies for the rights of the parties. The smart contract dispute resolution mechanism relies only on the adjudicator's own judgement and is cryptoeconomic expediency, which obviously deviates from the application of law in the true sense.[22] As Habermas' idea of procedural justice advocates, fair and just adjudication is the cornerstone of the rule of the law society, and procedural justice is needed to guarantee substantive justice, and the combination of legal professionalism and social consensus to achieve "visible justice".[23] The efficiency-fairness tradeoff is indisputable, but it is undeniable that values such as fairness and just procedures in traditional dispute resolution mechanisms and even in traditional legal frameworks are of broader legal significance. [24]Obviously, the lack of corresponding norms for smart contract dispute adjudicators will inevitably affect the fairness and justice of dispute resolution.

2.2 Disclosure of evidence and review mechanisms for smart contract disputes are too simple

2.2.1 Evidence disclosure mechanism for smart contract disputes needs urgent clarification

The principle of "whoever asserts, whoever produces evidence" is one of the important principles of the discovery mechanism, and the law grants the parties the right to make their own assertions, while at the same time giving them the duty to do so.[25] The self-executing nature of smart contracts and the immutability of the code make them naturally have the attribute of "self-authenticating evidential status", thus easily triggering the misunderstanding that "the disclosure of evidence has already been completed by the technology". In addition, the smart contract dispute resolution mechanism compared with the traditional dispute resolution mechanism, there is a more special way of generating and fixing evidence. This includes generation-type evidence and transformation-type evidence. Generation-type evidence refers to the transaction information generated on the chain and fixed along with the execution process of the smart contract; transformation-type evidence refers to the form of evidence generated in the physical world relying on blockchain technology and transformed into data on the chain, which is mostly the evidence submitted by the parties to the dispute. On the one hand, an oversimplified evidence disclosure mechanism may lead to passive reliance on the technology black box by adjudicators, which may lead to ignoring challenges to some evidence and incorrectly determining the facts of the case. On the other hand, the principle of technological neutrality does not mean that technology can replace the legal process, over-reliance on technical

---

[22] Yann Aouidef, Federico Ast and Bruno Deffains, 'Decentralized Justice: A Comparative Analysis of Blockchain Online Dispute Resolution Projects' (2021) March *Frontiers in Blockchain* 6.

[23] See Xiaojun Gong, '哈贝马斯程序正义思想及其现代意蕴 [Habermas' Thought on Procedural Justice and Its Modern Implications]' (2012) 11 *People's Tribune* 144.

[24] See Aifei Chen, '区块链智能合约纠纷解决的可能性边界 [The Possibilities for Blockchain Smart Contract Dispute Resolution]' (2024) 5 *Journal of Comparative Law* 201.

[25] *Zhonghua Renmin Gongheguo Minshi Susong Fa* [Civil Procedure Law of the People's Republic of China] (adopted 1991, amended 2021), art 67.

means such as hash value comparison, thus neglecting the substantive judgement of the evidence. At the same time, the evidence disclosure mechanism in the smart contract dispute resolution mechanism neither permits parties to provide further clarification on doubtful evidence nor allows them to submit supplementary evidence.

Users and adjudicators of smart contracts are distributed around the world, with multidisciplinary participant backgrounds, and legal cultures and specific legal norms are not shared and quickly understood, as they are distinctly political in nature.[26] The smart contract dispute resolution mechanism lacks clear and specific standards for the submission of evidence, and the evidence submitted by the parties to the platform before the commencement of the adjudication and the evidence fixed in the operation of the smart contract will become the entire basis for the adjudication. Currently, the lack of uniform evidence standards in the smart contract dispute resolution mechanism not only fails to guarantee the completeness of evidence submission, but also easily leads to the deviation of the adjudication results, thus forming 'islands' of evidence disclosure under different modes.

2.2.2 The excessive high threshold of the evidence review mechanism in smart contract disputes

The blockchain evidence involved in smart contract disputes is different from that in traditional disputes, and the impose heightened evidentiary scrutiny. Under China's existing legal framework, what can't be avoided no matter what kind of evidence is the examination of its authenticity, legality, and relevance. The first case of national blockchain deposit in Hangzhou Internet Court was decided, which for the first time confirmed the legal effect of electronic data deposited using blockchain technology and clarified the method of reviewing and judging blockchain electronic deposits. Therefore, the blockchain evidence determination method, not only requires authenticity, legality, and relevance determination, but also requires to evidence of solid evidence, the way of evidence is in line with the relevant provisions of the electronic data and the evidence of the size of the proof of power determination.[27] For example, the qualification review of the evidence deposit platform, the credibility review of the technical means of evidence collection, and the review of the integrity of evidence preservation.

The blockchain evidence involved in smart contract disputes is different from that in traditional disputes, and the review of blockchain evidence is more difficult.[28] Since the evidence in smart contract disputes is essentially composed of code, there will likely be difficulties in reviewing and identifying the evidence. In practice, both the authoritative third party in the traditional dispute resolution mechanism and the adjudicator in the smart contract dispute resolution mechanism often do not receive professional training in the field of computers, and thus lack the professional ability to

---

[26] Yannick Gabuthy, 'Blockchain-Based Dispute Resolution: Insights and Challenges' (2023) *Games* 14(5) 75, 5.

[27] Hangzhou Huatai Yimei Cultural Media Co Ltd v Shenzhen Daotong Technology Development Co Ltd (杭州华泰一媒文化传媒有限公司诉深圳市道同科技发展有限公司) (Hangzhou Internet Court, [2018] Zhe 0192 Minchu No 81), 6.

[28] Larry D Wall, '"Smart Contracts" in a Complex World' (Federal Reserve Bank of Atlanta, July 2016) https://www.atlantafed.org/cenfis/publications/notesfromthevault/1607.aspx

review the code. Code, as a form of linguistic expression, converts meanings into a way that technology allows to be executed, but for the parties and adjudicators, it is tantamount to increasing the epistemic barriers to evidentiary review smart contracts and the disputes that arise from them. If the adjudicator is unable to read the relevant evidence, it means that it is difficult for him or her to ascertain the facts of the case. Therefore, how to review the evidence in the form of code or the contract itself has become the most critical dispute resolution difficulty.[29] Under such circumstances, if the dispute resolution mechanism for smart contracts fails to provide a uniform and clear mechanism for disclosing and reviewing evidence, it will not be conducive to the making of fair and just decisions.

2.3 Legal effect and remedies for smart contract dispute decisions still unclear

2.3.1 Uncertainty about the legal effect of smart contract dispute awards

In traditional dispute resolution mechanisms, both arbitration and litigation require the generation of legally binding instruments such as awards and judgements that comply with legal norms and can only come into effect after the rules for entry into force stipulated in the law have been met. At the same time, the effective award has legal coercive force, and can provide the parties to force the other party to fulfill their obligations and other guarantees. Generally speaking, the entry into force of the award, judgement needs to meet the content of the legal, legal form, and legal procedures at the same time. Legal content means that the content of the decision, judgement must be ruled in accordance with the law, in accordance with the law and take into account the rationale; legal form means that the seal of the institution must be stamped, and the content of the instrument is complete, including the elements required by law; legal procedure means that in accordance with the provisions of the law and to meet the rules of the entry into force of the service. The majority decision under the game-theoretic incentive mechanism has neither a uniform and clear basis for decision-making, nor does it adequately examine the evidence to determine the facts of the case, and it does not substantively safeguard the parties' right to debate and participate in the procedure.[30]

In addition, awards made under the smart contract dispute resolution mechanism rely on blockchain technology to make awards automatically enforceable. However, in essence, awards that have coercive and safeguard measures should be legal and effective, and the automatic enforcement of awards under the smart contract dispute resolution mechanism after a majority decision by the adjudicator clearly lacks a review of the legitimacy of the award. The automatic enforcement of smart contracts implies that the parties have substitutes traditional legal trust with cryptographic certainty, which to a certain extent eliminates the right to dispose of the contract in certain circumstances, including the process of contract enforcement and the enforcement of the award. As a matter of fact, technical trust is not sufficient to

---

[29] See Aifei Chen, '区块链智能合约纠纷解决的可能性边界 [The Possibilities for Blockchain Smart Contract Dispute Resolution]' (2024) 5 *Journal of Comparative Law* 201.

[30] See Aifei Chen, '区块链智能合约纠纷解决的可能性边界 [The Possibilities for Blockchain Smart Contract Dispute Resolution]' (2024) 5 *Journal of Comparative Law* 199.

completely exclude the possibility of judicial intervention, and complete technical trust does not fully protect the legitimate rights and interests of the parties. Undoubtedly, the improvement of efficiency is one of the major advantages of smart contracts, but if it is sacrificed by compromising fundamental legal safeguards and restricting the parties' dispositive rights, it is still highly questionable and controversial whether smart contracts can fulfill the legal expectations expected by society.

2.3.2 Lack of remedies after smart contract dispute adjudication

In the traditional dispute resolution mechanism, the rules for the entry into force of different types of judgments, i.e., the parties appealing against the judgement and requesting a second trial, are clearly stipulated, thus fully guaranteeing the parties' right to procedural remedies. Post-judgement remedies can play a positive role in correcting erroneous decisions, upholding procedural justice, safeguarding the parties' right to participate, balancing differences in litigation capacity, and promoting the uniform application of the law, among other aspects. The smart contract dispute resolution mechanism does not provide for post-decision remedial measures, and its decisions are automatically enforced. In this case, it is very easy to lead to the party's right to participate in the process can not be guaranteed, the wrong decision can not be corrected promptly and the party suffering irreparable losses. In essence, the lack of post-adjudication remedies in the smart contract dispute resolution mechanism clearly violates the original intention of the smart contract dispute resolution mechanism embedded in the smart contract.

Although some smart contract dispute resolution mechanisms provide for an appeal mode, the high cost of appeal and the solidified adjudication model prevent the appeal mode from realizing its true role. Specifically, if a party is dissatisfied with the decision, he or she can file an appeal, and the cost of the appeal is mainly used to increase the number of adjudicators or to pay for the cost of adjudication again. For example, Kleros provides that if a party is dissatisfied with a juror's decision, he or she may appeal, with twice as many jurors as in the first instance, and with a corresponding increase in fees,[31] while JuryOnline provides that users may arbitrate once for free, with a corresponding fee for a second appeal. In the case of incremental fees, the parties may give up pursuing the protection of their rights based on cost and transaction efficiency, which leads to the automatic enforcement of erroneous judgments. The adjudication model of the smart contract dispute resolution mechanism, in a nutshell, is group decision-making[32]. Group decisions made under a model without a uniform and clear basis for adjudication and with simplified procedures for reviewing disclosure of evidence not only fail to guarantee the effectiveness of adjudication, but also increase the barriers to taking remedial

---

[31] Clément Lesaege, Federico Ast and William George, *Kleros Short Paper v1.0.7* (September 2019) https://kleros.io/whitepaper.pdf

[32] 'Group Decision-Making', also known as collective decision-making, refers to the process in which multiple participants collaboratively engage in decision analysis and formulation to leverage collective wisdom. In the context of dispute resolution through smart contracts, it refers to a decision-making process where the majority consensus of decentralized mechanisms, such as blockchain-based voting and random jury systems, determines the resolution outcome.

measures, making it more difficult and costly for users to defend their rights. Even if the appeal model increases the number of adjudicators, it will not be able to obtain a fair decision in a substantive sense. Due to the shortcomings of the smart contract dispute resolution mechanism, the remedial measures taken are still “treating the symptoms but not the root cause”.

To sum up, the smart contract dispute resolution mechanism seems to be efficient and safe, but it actually hides inherent defects. Firstly, there is a lack of effective constraints on the access and performance of adjudicators; blockchain technology relies on DAO governance or algorithmic arbitration, and adjudicators have neither legal qualifications nor uniform adjudication norms. Second, although relying on blockchain to ensure data authenticity, the evidence disclosure and review mechanism lacks procedural safeguards and ignores the substantive review of evidence relevance and legality. Finally, the effectiveness of the ruling and the relief system is not connected with the legal framework, and the result of the ruling has not been included in the judicial confirmation procedure, so the wrong ruling faces the double dilemma of “technological irreversibility” and “no judicial relief”. While actively using technology for digital governance, there is still a need to pay attention to the blind spots in governance under the heavy use of technology.

3. The optimisation path of smart contract dispute resolution mechanisms

While the decentralization feature of smart contracts relying on blockchain technology is reshaping the transaction paradigm, the endogenous defects of its dispute resolution mechanism are facing a deep conflict between ‘technological rationality’ and ‘juridical values’. The current smart contract dispute resolution mechanism, whether crowdsourcing model or arbitration model, relies excessively on code logic to maintain automatic enforcement and decentralized justice, resulting in an imbalance of power and responsibility of the adjudicator, formal review of evidence, and structural lack of remedial channels, which continue to erode the legitimacy of the system. These deficiencies not only expose the obstacles to the adaptation of the existing technological architecture to legal principles, but also highlight the deep-seated contradiction of the disordered synergy of the on-chain and off-chain governance systems. Therefore, it is necessary to propose solutions to the inherent defects in a targeted manner, and at the same time, further bring into play the advantages of efficient and secure smart contracts in anticipation of realizing the value symbiosis of technological trust and judicial credibility.

3.1 Building a full-cycle regulatory system for access and performance of adjudicators

While striking a balance between efficiency and fairness and justice, attempts have been made to establish an access and evaluation system for adjudicators. The

zero-threshold access of adjudicators in the smart contract dispute resolution mechanism, even though it is compatible with the technical concept from the purpose of pursuing high efficiency and safety, is essentially a disregard of the traditional legal principles. Compared to the traditional dispute resolution mechanism, the adjudicator in the smart contract dispute resolution mechanism is not restricted by strict professional knowledge, but professional knowledge is still a necessary element for procedural justice.[33] Firstly, based on not reducing the efficiency of smart contracts themselves, attempts are made to classify smart contract disputes according to the different points of dispute or the complexity of the case. By way of case diversion, the reality of no or low entry threshold for adjudicators is further weakened. In addition, a professional knowledge test is set up for users to become referee candidates, and referee candidates are classified according to their professional level. Candidates with higher levels of expertise will be matched with more complex cases, and vice versa for simpler cases, thus improving the accuracy and efficiency of adjudicator dispute resolution to a certain extent. Secondly, to ensure the openness and authenticity of the process of 'recruitment and selection' of adjudicators, and to ensure the effective operation of game theory and incentive mechanism, the transparent implementation of the procedure will undoubtedly provide further positive feedback for the fairness and impartiality of dispute resolution. Finally, the adjudicator should also establish a post-decision evaluation mechanism, which can contain objective factors such as the speed of dispute handling, the number of disputes handled, and subjective factors such as the evaluation of the parties to the disputes, and further to the adjudicator's professional competence and other comprehensive interpretation, so that the adjudicator can deal with the disputes in the process of continuous acceptance of supervision and evaluation.

While focusing on the adjudicator itself, the smart contract dispute resolution mechanism still needs to formulate unified and clear adjudication norms to ensure the normality and consistency of dispute resolution. Essentially, the lack of adjudication norms in smart contract dispute resolution results from a structural mismatch between the decentralized technology architecture and the traditional legal value system. Existing adjudication activities rely on highly fragmented platform autonomy rules, which lack substantive absorption of traditional legal principles (e.g., procedural due process, principle of proportionality) and fail to form a technically enforceable uniform standard. This double disconnect leads to the dilemma that similar disputes may face "different judgments for similar cases", which seriously undermines the predictability and authority of the adjudication results. In addition, the dispute resolution of smart contracts usually relies on the incentive mechanism of game theory to motivate the adjudicators to make a more consistent majority judgement, so as to prevent the value of "interest-only theory" from disrupting the normal process of dispute handling. However, the majority decision under the incentive mechanism does not necessarily mean a fair and just judgement, so it is extremely important to

---

[33] James Metzger, 'Decentralized Justice in the Era of Blockchain' (2018) *International Journal of Online Dispute Resolution* 79.

formulate a general consensus judgement specification for the accuracy of the judgement result. The adjudication norms of smart contract disputes should contain principle provisions and specific adjudication norms, the principle provisions pay more attention to the adjudicator's fairness, impartiality, independent voting and other behavioral constraints, and the specific adjudication norms are more inclined to theoretically apply the existing legal norms in order to improve the accuracy of the dispute resolution. Based on the entry threshold of adjudicators and the establishment of adjudication norms, it tries to carry out full-cycle constraints and supervision on adjudicators, so as to further rectify the subject misconduct in the process of intelligent dispute resolution.

3.2 Establishment of a tiered process for disclosure and review of evidence in disputes

In the process of dispute resolution, the smart contract dispute resolution mechanism lacks specific rules and procedures for evidence disclosure and review, and fails to safeguard the legal rights of the disputants to cross-examine and submit additional evidence. Smart contract disputes involve both generative and transformative evidence, and the current dispute evidence disclosure and review process needs to break through the limitations of ‘chain data worship’ and adopt layered governance from a legal perspective to further reconstruct procedural justice. Through the construction of layered dispute evidence disclosure and review standards, the smart contract dispute resolution mechanism can further obtain higher quality evidence, which plays a more important role in the restoration and determination of the facts of the case. The core of hierarchical review lies in the dynamic balance between differentiated verification standards and the right to cross-examine, i.e., different types of evidence are given differentiated standards of evidence disclosure and review. For example, generative evidence (such as transaction hash, and timestamp) is categorized into the automated review layer, relying on the inerrancy of blockchain technology to achieve efficient formal verification; while transformative evidence (evidence submitted by the parties) is incorporated into the substantive review layer, with the help of a credible execution environment to achieve cross-validation under privacy protection, and the adjudicator will make a value judgement of the relevance and legitimacy of the evidence based on specific adjudication specifications. At the same time, in order to protect the disputing parties' right to cross-examine, the optimized path of transforming code logic into visual evidence chains can be adopted so that the disputing parties can view and cross-examine the evidence promptly. At the technical level, this layered architecture can rely on blockchain technology to guarantee the efficiency advantage of evidence review; at the legal level, the composite rule of technical rigidity and legal flexibility fills the fault of the application of the traditional procedural rights in the smart contract, and ultimately realizes the evidence review from the “data truth” to the “factual credibility”. Ultimately, it realizes the paradigm upgrading of evidence review from “data truthfulness” to “factual credibility”.

With regard to the dilemma of evidence review in smart contract disputes, consideration can also be given to the use of technical means to further fix the evidence, so as to determine the legitimacy and authenticity of the source and collection of evidence. Some foreign scholars have pointed out that the contractual content related to the transaction, the applicable substantive law and procedural law, and the dispute resolution norms adopted after the dispute arises can be set as the parameters in the smart contract, and embedded into the code of the smart contract through the form of code.[34] If a smart contract dispute arises under such circumstances, the corresponding transaction parameters can be used directly as evidence to prove the main facts, which ensures the legality and authenticity of the evidence and further enhances the efficiency of dispute resolution. Based on the domestic blockchain distribution and public regulation level, domestic scholars believe that the technical means can allow domestic regulators to further determine the state of a particular smart contract market, which has a significant effect on reducing the cost of regulation and enforcement, and enhancing the strength of regulation.[35] The mechanism of evidence disclosure and review in smart contract disputes is governed by the combination of technology and law, which is essentially to rebuild 'visible justice' in the code order, not only to safeguard the autonomy value of decentralized justice of smart contracts relying on blockchain technology, but also to realize the re-balance between technical rationality and legal rationality through the institutional embedding.

3.3 Improvement of mechanisms for the convergence of the effectiveness of awards and multidimensional remedies

Although awards under the smart contract dispute resolution mechanism can be automatically enforced by relying on smart contracts, they are not subject to the same legal validity as awards and judgments under the traditional dispute resolution mechanism. To put it simply, whether the judgement made by the smart contract dispute resolution mechanism has legal effect is still a blank state. In the case of technical trust can not completely exclude judicial intervention, how to connect the smart contract dispute resolution mechanism and the traditional dispute resolution mechanism has become a top priority. There is a structural conflict between the decentralized justice of smart contracts and the centralized authority structure of China's current legal system. The confirmation of the legal effect of the smart contract dispute resolution mechanism is by no means a simple rule repair for the existing legal framework, but has become a pilot test for the transformation of legal paradigm in the digital era. The core lies in the reconstruction of the relationship between law and technology, and the law needs to shift from an 'external regulator' to an 'endogenous architect', and deeply participate in the design of technology through the codification of rules. In addition, technology needs to be transformed from a 'disruptive force' to a 'rule of law-enhancing tool', with legal values embedded in the code layer. For the smart contract dispute resolution mechanism, we can refer to the

---

[34] Darcy W.E. Allen, Aaron M. Lane & Marta Poblet, 'The Governance of Blockchain Dispute Resolution' (Fall 2019) *Harvard Negotiation Law Review* 88-89.

[35] See Aifei Chen, '区块链智能合约纠纷解决的可能性边界 [The Possibilities for Blockchain Smart Contract Dispute Resolution]' (2024) 5 *Journal of Comparative Law* 204.

online dispute resolution mechanism, through the legitimacy review of the content and procedure of the ruling to confirm the legal effect of the ruling. Only by realizing the two-way transformation of technology and law can the system of on-chain adjudication and off-chain validity be truly closed, so that decentralized governance and legal order can move from antagonism to symbiosis.

Whether and how further remedies can be applied to the awards under group decision-making in the smart contract dispute resolution mechanism remains the ultimate safeguard of the parties' rights. First, in the appeal mode of the smart contract dispute resolution mechanism, the relevant costs should be reduced to alleviate the economic pressure of the parties, so that a smaller economic cost can be exchanged for the possibility of a correct ruling. At the same time, different dispute resolution methods can be introduced in the appeal mode, to a certain extent, weakening the impact of the existing deficiencies in the smart contract dispute resolution mechanism on the accuracy of the decision. Secondly, some scholars hold the view that "blockchain technology may lead to a society in which traditional laws are replaced by autonomous rules", and with the introduction of blockchain technology and corresponding smart contracts, more and more people are calling for the abandonment of the traditional legal contractual framework and its replacement by autonomous rules on the blockchain.[36] In essence, however, a majority decision made by an adjudicator who is a layperson, even with the help of his or her own understanding and relevant adjudicative norms, does not necessarily imply that the decision is legal and sensible. In the current process of legal development, only the current framework of the rule of law can provide predictable results for the parties, and only the current effective legal norms can provide convincing results for the parties. With technology still a black box, it is undeniable that centralized justice remains the last line of defence in maintaining social justice.

4. Conclusion

As an interdisciplinary product combining two fields, technology and law, smart contract dispute resolution mechanisms face the challenges of innovation and integration. A smart contract is a digitally defined commitment that can be executed automatically and with minimal human intervention.[37] The functional realization of smart contracts is made possible by the birth of blockchain technology, and the combination of the two is regarded in the computer field as a landmark upgrade in the blockchain world.[38] As the application of blockchain technology and smart contract

---

[36] Primavera De Filippi and Samer Hassan, '从"代码即法律"到"法律即代码"——以区块链作为一种互联网监管技术为切入点 [From "Code is law" to "Law is code" : Taking Blockchain as an Internet Regulatory Technology as the Entry Point]', trans Lei Zhao and Jianfeng Cao, (2018) 5 *Science Technology and Law Chinese-English Version* 14.

[37] See Xiaoxu Ma, Maoling Luo, Fan Yang, Jinbao Wang, Min Xiao and Fei Tang, '基于零知识证明的跨链隐私智能合约 [Cross-chain Privacy Smart Contract Based on Zero-knowledge Proof]' (2024) 2 *Communications Technology* 166.

[38] See Tianyuan Hu, Zecheng Li, Bixin Li and Qihao Bao, '智能合约的合约安全和隐私安全研究综述

technology continues to penetrate into the judicial field, scholars in China have focused their research on the specific application of smart contracts in the dimension of "derivation theory", with a view to maximizing the use of the advantages of smart contracts in China's legal environment.[39] Summarizing the current research results, the overall research seldom involves the 'ontological' dimension of the original transaction on the smart contract chain and the supporting dispute resolution mechanism. In fact, smart contract as a code as the form of expression of the technology carrier, is still part of the product of human intelligence, and can not do to avoid disputes, smart contract dispute resolution mechanism was born due to the needs of smart contract users.

Based on the analysis of the current legal framework, it can be seen that the inherent defects of the smart contract dispute resolution mechanism are concentrated in the three dimensions of the adjudicator's misconduct, the lack of procedural justice and the disconnection of the effectiveness of the articulation. The low entry threshold of adjudicators and the lack of uniform and clear norms in adjudication, whether the majority decision under the game theory incentive mechanism has legitimacy and fairness still cannot be guaranteed; the lack of dispute evidence disclosure and review mechanism, ignoring the importance of evidence for the determination of the facts of the case, and depriving the parties of the right to confrontation; the validity of the decision can not be recognized by the current law, and the obstruction of further remedial paths, which make the smart contract dispute resolution mechanism unable to play its expected function. All of these have prevented the smart contract dispute resolution mechanism from fulfilling its expected functions. With regard to the inherent defects of the mechanism, we propose an optimization path based on the existing legal framework. To build a full-cycle regulatory system for access and performance of adjudicators to improve the quality of adjudicators and enhance the accuracy and legitimacy of adjudication. At the same time, a hierarchical procedure for disclosing and reviewing evidence in disputes has been set up to clarify the importance of evidence in fact-finding and to safeguard the parties' right to cross-examine. In addition, it has perfected the mechanism of convergence and multi-dimensional relief for the effectiveness of decisions, providing the last line of judicial defence for the protection of rights.

The development of technology is just like a wave surging forward, smart contracts as one of the key technologies of technology-enabled justice, not only need to use its advantages to help the construction of justice, but also need to use legal means to solve its potential risks, and ultimately achieve the optimization of the dispute resolution mechanism of smart contracts and China's judicial construction of the synergistic innovation.

[Contractual Security and Privacy Security of Smart Contract:A System Mapping Study]' (2021) 12 *Chinese Journal of Computers* 2486.

[39] See Aifei Chen, '区块链智能合约纠纷解决的可能性边界 [The Possibilities for Blockchain Smart Contract Dispute Resolution]' (2024) 5 *Journal of Comparative Law* 196.

References

Aouidef, Y., Ast, F., & Deffains, B. (2021). Decentralized justice: A comparative analysis of blockchain online dispute resolution projects. *Frontiers in Blockchain*, March, 1–9.

Antonopoulos, A. M., & Wood, G. (2019). *Mastering Ethereum: Building smart contracts and DApps* (Y. Yu, Z. Yang, J. A. Jian, L. Ren, & E. Jiang, Trans.). Mechanical Industry Press.

Chen, A. (2024). 区块链智能合约纠纷解决的可能性边界 [The possibilities for blockchain smart contract dispute resolution]. *Journal of Comparative Law*, 5, 196–208.

Chen, A. (2022). 区块链共谋的反垄断监管 [Antitrust supervision of blockchain collusion]. *Modern Law Science*, 4, 145–157.

Cyberspace Administration of China. (2019, December 29). The first blockchain smart contract judicial application launched: New technology builds a "smart l ine of defense" for online integrity. https://www.cac.gov.cn/2019-12/31/c_1579328270387357.htm

De Filippi, P., & Hassan, S. (2018). 从"代码即法律"到"法律即代码"——以区块链作为一种互联网监管技术为切入点 [From "Code is law" to "Law is code"]. *Science Technology and Law Chinese-English Version*, 5, 7–18.

Fang, X. (2017). ODR——多元化解决电子商务版权纠纷新机制 [ODR: A new mechanism to solve e-commerce copyright disputes]. *Legal Forum*, 4, 155–160.

Gabuthy Y. (2023). Blockchain-Based Dispute Resolution: Insights and Challenges. *Games 14(5) 75*, 1–9.

Gong, X. (2012). 哈贝马斯程序正义思想及其现代意蕴 [Habermas' thought on procedural justice and its modern implications]. *People's Tribune*, 11, 144–145.

Huang J., (2024). 智能合约众包争议解决机制的探究：基本特征、现实困境与完善路径 [Exploring the Smart Contract Crowdsourcing Dispute Resolution Mechanism:Fundamental Characteristics,Realistic Dilemmas and Improvement Paths]. *Commercial Arbitration & Mediation*, 4, 50–71.

Hu, T., Li, Z., Li, B., & Bao, Q. (2021). 智能合约的合约安全和隐私安全研究综述 [A study on smart contract security and privacy security]. *Chinese Journal of Computers*, 12, 2485–2514.

Kaal, W., & Calcaterra, C. (2018). Crypto transaction dispute resolution. *The Business Lawyer*, Spring, 1–59.

Kaal W. (2024). Evolution of Law: Dynamic Regulation in a New Institutional Economics Framework, *in Festschrift In Honor Of Christian Kirchner*, 1, 1-18.

Lesaege, C., Ast, F., & George, W. (2019). Kleros short paper v1.0.7. https://kleros.io/whitepaper.pdf

Ma, X., Luo, M., Yang, F., Wang, J., Xiao, M., & Tang, F. (2024). 基于零知识证明的跨链隐私智能合约 [Cross-chain privacy smart contract based on zero-knowledge proof]. *Communications Technology*, 2, 166–172.

Metzger, J. (2018). Decentralized justice in the era of blockchain. *International Journal of Online Dispute Resolution*, 69–81.
Ministry of Industry and Information Technology Information Center. (2018). White paper on China's blockchain industry (《2018 年中国区块链产业白皮书》). China Information Industry Press.
Sun, F. (2022). 《最高人民法院关于加强区块链司法应用的意见》理解与适用 [Understanding and applications of "Opinions of the Supreme People's Court on Strengthening Blockchain Application in the Judicial Field"]. China Journal of Applied Jurisprudence, 4, 31–42.
Schelling, T. C. (2011). *The strategy of conflict* (Z. Hua, Trans.). Huaxia Publishing House.
Wall, L. D. (2016, July). "Smart contracts" in a complex world. Federal Reserve Bank of Atlanta. https://www.atlantafed.org/cenfis/publications/notesfromthevault/1607.aspx
Wu, Y. (2023). 元宇宙：法律图谱与规范逻辑 *[Metacosmos: Legal mapping and normative logic]*. China Renmin University Press.
Yang, J. (2021). 基于区块链的纠纷解决机制研究 [Research on the blockchain-based dispute resolution mechanism]. *Journal of Shaanxi Normal University (Philosophy and Social Sciences Edition)*, 4, 163–176.
You, W. (2023). 民法典对智能合约的法律规制 [The legal regulation of smart contracts by Chinese Civil Code]. *Theory Monthly*, 12, 125–134.
Zhao, X., & He, L. (2024). 以太坊智能合约安全漏洞检测 [Ethernet smart contract security vulnerability detection]. *IEEE Spectrum*, 8, 56–58.
Zheng, Z., & Qiu, W. (2020). 我国区块链发展趋势与思考 [Development trend and thinking of China's blockchain]. *Bulletin of National Natural Science Foundation of China*, 1, 2–6.