Legal Effect of Smart Contracts Based on Blockchain

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Abstract. Smart contracts are increasingly used in financial innovation area. In view of smart contracts' legal effects, a study is implemented in this paper. First, Smart contracts appear as a set of computer codes, and carry the mutual consensus of the transaction parties and under the principle of freedom of contract form. Thus, smart contracts can be understood as a type of contractual written form in the high-tech context. Then the agreement automatic enforcement was made by the five-element structure, and the traditional situation of enforcement uncertainty was avoided. The results show that it is necessary to examine whether the meaning of the machine matches the meaning of the party, and whether the machine meaning is in conformity with the legal provisions. Finally, the conclusion was drawn that the legal effect of smart contract can be clarified in response to the booming financial technology.

Keywords: Smart contracts · Legal effect · Automatic enforcement

Driven by big data, cloud computing, artificial intelligence, blockchain and mobile internet, the Fintech industry has become a high-level development form of modern finance with national strategic significance. The financial industry enabled by science and technology is rapidly becoming a new engine of innovative economic development. In 2016 and 2018, the official White Paper "China Blockchain Technology and Application Development" issued by the Ministry of Industry and Information Technology of China, emphasized that smart contracts are one of the six core technologies of the blockchain and an important cornerstone of future digital civilization. Smart contracts have received extensive attention from the financial practice community. More and more companies and investment focus on the field of smart contracts. Smart contracts are different from traditional contracts, and their widespread use in the field of practice faces questions about whether they have legal effect and what kind of legal effect. If the legal validity of smart contracts is not studied in a timely and in-depth manner, it will not only place the current smart contracts application in the risk of legal uncertainty, but also delay and reduce the development of Fintech and international competitiveness.

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1 The Essence of Expression Will in Smart Contracts

Blockchain-based smart contracts can form trust among strangers. At present, they have been widely used in finance and other fields. In sharp contrast to the booming smart contract practice, the "legal effect of smart contract" and "what kind of legal effect" are rarely studied. To answer these questions, first of all, it is necessary to analyze what is the essence behind the smart contract: is it simply computer codes, machine meaning, or is it carrying the meaning of human being? If it is a machine expression of human meaning, can it be the consensus of both parties to the transaction? Analyzing the legal relationship behind the smart contract and the formation process of the smart contract is undoubtedly the key of the problem solving.

1.1 Legal Relationship Behind Smart Contracts

Blockchain-based smart contracts are a high-tech form of innovative transactions that bring together the participation of multiple parties. From the perspective of the core subjects, smart contract transactions include blockchain platform providers, transaction parties, smart contract producers, and transaction validator [1].

- **Blockchain platform provider.** Blockchain platform providers provide users with a complete set of blockchain systems to ensure that the platform has features such as decentralization, openness, autonomy, immutability, and traceability. The platform has the function of sending and storing data, verifying transactions, and running programs intelligently. Blockchain platform establishes a mechanism of providing trust among strangers. Technically, the blockchain platform consists of a data layer, a network layer, a consensus layer, an incentive layer, and a smart contract layer [2]. The legal relationship between the blockchain platform provider and the smart contract trader is the relation of platform services supplying and accepting. The platform provider should technically guarantee the stability, security, and continuity of the features mentioned above.
- **Parties of the transactions.** Both parties of the transaction are users of the blockchain platform, and use the trust and intelligent mechanism created by the blockchain technology to carry out various transactions. There is a contractual relationship between the two parties. They agree on the subject matter, price, mode, performance method, time limit, etc. The two parties enjoy rights and perform obligations in accordance with the agreement.
- **Smart contract makers.** A smart contract maker is a very special type of subjects in smart contract transactions. They do not exist in traditional contract transactions. Such subjects accept the commission of the transaction party to provide technical language interpretation services that help to convert the commercial contracts expressed by the two parties in natural language into Smart contracts edited in computer language. Smart contract producers compile codes because transacting parties believe their technical skills,

so they have the obligation to correctly understand the contractual meaning of the transacting parties, accurately translate it into computer codes, and ensure that the codes can be executed correctly.

– **Transaction validator.** Effective nodes in the blockchain network play the role of smart contract transaction verifiers. They compete for bookkeeping rights, receive remuneration, witness transactions, build blocks, and record them in the blockchain in accordance with the unified rules of the entire network. For smart contract transactions, the owner of an effective node provides transaction witness, verification, and bookkeeping services for a fee. Its core obligation is to correctly witness the transaction and ensure that the verified transaction is authentic and legal.

The various parties involved in blockchain smart contracts are in a legal relationship network. Smart contracts are agreements in which transaction parties arrange transaction content, their respective rights and obligations, and are written in machine language; smart contracts can only be executed in a reliable and automatic fulfillment function offered by the blockchain platform provider; blockchain as a peer-to-peer network community, witnessing and recording transactions are inseparable from the participation of node users. The smart contract itself and the blockchain environment in which it resides bring together multiple parties' rights and interests. Although the appearance of the smart contract is computer codes, it is actually a reflection of the expression will of the transaction parties; the normal execution of the smart contract must also get the clear cooperation of other parties.

1.2 The Formation of Smart Contracts

Transactions through smart contracts can be roughly divided into two types: one is that the two parties negotiate first, enter into a traditional contract, and then form a smart contract; the other is that one party to the transaction drafts the transaction terms and translates them into computer codes deployed on the blockchain and the counterparty "Click" to enter into the smart contract.

In the first type, the two parties to the transaction agree on the transaction itself, form a traditional written or oral contract, and agree to use the blockchain-based smart contract for transactions. At this time, the transaction party needs to download the blockchain application to become a node in the blockchain network. The client of a full node usually includes functions such as account creation, wallet management, mining management, data management, and deployment of smart contracts. The verbal or written contract (usually an electronic contract) which is already formed by the two parties of the transaction is written in natural language and cannot be identified and run even if it is uploaded to the blockchain as an electronic record. To make a smart contract, you need to convert the contract terms into computer codes and upload it to the blockchain [3]. Therefore, it is necessary to convert the formed natural language into computer codes. The transaction party entrusts the smart contract producer to use a computer language such as Solidity to edit the smart contract, edits the metadata through an editor, and finally publishes it to the blockchain platform [4].

Every node scattered the smart contract on the blockchain [5]. Smart contract will be executed in the operating environment provided by the blockchain platform (such as the "Ethernet virtual machine"). Once specific conditions are met, they are automatically executed. Smart contracts and automatic execution are witnessed on the entire network. The rights and obligations deployed in the smart contract are realized.

One party to the transaction drafts the contract terms and translates them into computer codes, which reflects the transaction intentions of the drafter. What needs to be discussed here is whether the later party agrees on the rights and obligations arrangements in the smart contract, and whether the parties to the transaction have reached an agreement on the content of the smart contract. The legal requirement for consensus protects the contractual freedom of the parties. Each party should have the opportunity to understand and understand the terms of the draft contract and have the right to choose whether to agree. The law should make it not easy but also not difficult for the parties to form consensus [6]. 112 (a) of the United States Uniform Computer Information Transaction Act stipulates that "click" usually has the legal effect of "consent", and "click" is regarded by all rational persons as consent, just as the meaning of consent is expressed orally [7]. In addition, the US "Electronic Signatures in Global and National Act" also recognized the legal effect of electronic signatures. Article 48 of "E-Commerce Law of the People's Republic of China" stipulates that: "E-commerce parties' use of automatic information systems to enter into or perform contracts has legal effect on the parties using the system." Article 49 states: "Commodities issued by e-commerce operators or if the service information meets the conditions of the offer, the user selects the product or service and submits the order successfully, and the contract is established. If the parties agree otherwise, the agreement will be adopted." It can be seen that China and the United States hold that reading the contract terms offered unilaterally and clicking by the counterparty are usually regarded as accepting the terms of the contract and reaching agreement.

Regardless of whether the two parties of the transaction first form an agreement and then convert it into a smart contract, or unilaterally provide smart contract and the counterparty "click" to enter, smart contracts are not just cold computer code as shown on the surface, and expression of will and consensus behind them.

2 The Legal Effect of Smart Contract Codes

Since the smart contract can present the wills and consensus of both parties in the transaction, it can enter the field of contract law and become a legal contract or part of the legal contract. However, traditional contract forms are written or spoken, and do not include computer code forms which have very different appearances. Then whether the code appearance of a smart contract meets the legally required contract form and whether it has formal validity are the next questions we should answer immediately.

The parties agreed that writing on paper was a traditional written form recognized by most national contract laws. Are smart contracts essentially consistent with traditional written forms? Can it be recognized by contract law? The nature of smart contracts as modern digital high-tech products is loaded with information about transactions. Reviewing and exploring the inherent logic of the history of human information recording and transmission can help us answer the question.

2.1 The Nature of the Information Carrier in Traditional Written Form

Information is a reflection of the state and change of the subjective and objective world, and its expression forms vary with the progress of science and technology. In the ancient times, the rope was used for recording. The information of an event was recorded by a rope, but the content of expression was very limited and there were difficulties in transmission. Since human beings invented language, language has become an information carrier and an expression tool for expressing the subjective and objective world. Human natural language includes both oral and written forms. The oral form is based on phonemes and is fleeting without the recording of modern technology. Written records can be preserved and as proofs. Bamboo slips, silk crickets, and paper are such written forms with human constant exploration efforts for a long time. Paper has outstanding performance in terms of easy transmission, low cost, and popularity. As a historical selection, paper has become the main carrier of human languages. The information corresponding to human languages has also been recorded on paper in large quantities.

How to spread the text written on paper, and how to transmit the wills of trade parties when they do not meet each other? "Pigeon Mail" and "Messenger" are familiar methods to transmit information. In paper era, the only way to transfer text information is relying on the change of physical space of paper space. Although paper has a significant advantage in recording language information, it is difficult to transmit quickly, and the bread, deep and frequent commercial transactions need new ways to carry information.

2.2 Wired Transmission

How to increase the speed of information transfer between the parties who do not meet each other has become the direction for the further development of commercial transactions. Can information be expressed only in natural language? Can natural language transmission be transmitted only through paper writing? There are more than 6000 natural languages in the world expressing ideas and conveying information in different social groups. Observing from another perspective, we will find that natural language is actually a set of codes about subjective and objective world information, and the information encoding methods of different

social groups are different. Since human natural language is just a way of encoding information, is there any other way of expressing information besides natural language? Inspired by the American doctor Jackson's discovery: "No matter how long the wire is, current can flow through quickly", Morse matched human language with electrical symbols (spark and spark length). When transmitting information, first step is to translate natural language into Electric symbols, the electric symbols are quickly transmitted to the destination with current, and then the electric symbols are translated into natural language, so that the information transfers much faster than in Paper Era.

While exploring the rapid transmission of text messages, people are constantly thinking about how to transmit sound over long distances. From the perspective of contract form, voice is oral. Transmission of sound over long distances allows people to make oral contracts over long distances. Although they are all converted into electrical symbols, the basic theory of conversion is different. The telegram converts text symbols into electrical symbols, while the telephone converts sound into electrical symbols. Specifically, it converts sound vibrations into electronic vibrations. Electronic vibration is reduced to sound. The long-distance transmission of human language in written and verbal through "wired" technology has greatly improved the efficiency of communication between the two parties of the transaction.

2.3 Wireless Transmission

Both the telegraph and the telephone were transmitted by wired at the early stage, relying on the laying of wired cables. Telegraphs or telephones cannot complete long distance transmissions without lines. The science and technology community began to think about how to get rid of the shackles of "wired" and to search for larger, faster, and more accurate information transmission. "Wireless" technology has entered the stage of history. Communication scientists use the characteristics of electromagnetic wave signals that can be transmitted in free space to convert text, sound, and images into electrical signals, which are then transmitted by a transmitter, transmitted in a transmission medium, and converted to text, sound or image by the receiver. The era of wireless transmission of information breaks through the constraints of wired connection, and further expands the number of transaction subjects represented by long-distance communication on the basis of wired transmission.

2.4 Digital Signal

Since the invention of computers by John von Neumann in 1946, people have begun to think about how information can be used and transmitted on computers due to their unparalleled superiority in computing, analysis, storage, and anti-interference. The computer uses binary. In order for the computer to identify, analyze, and process the information used in commercial transactions, the

electrical symbols must be digitized. Then the logic of the generation and transmission of the information including the will representation has changed substantially: the text, sound, and image are converted into electrical signals, the aforementioned analog signals should be converted into digital forms of "0" and "1", and then the digital signals are modulated and transmitted. After receiving the digital signals, the receiver processes the reverse step to convert digital signals to text, sound, and images. With the advent of the digital age of the computer, electronic data, data messages, and electronic contracts have emerged as the means of communication between the parties. These methods can be almost synchronously transmitted remotely, which greatly improves the efficiency of negotiations.

2.5 Computer Codes Expressing Wills

Digital technology processes natural language into binary numbers, and traditional written contracts are converted into electronic contracts that can be transmitted by computers. However, digitization is much more than that. Numbers can not only be stored and transmitted, but can also be calculated under the premise of conforming to the rules of computer operation. The computing structure of "If ... then ..." can match the contract logic of "What kind of behavior should the parties do when some specific conditions are met?" The smart contract has discovered the mystery and pushed the electronic contract to be executable. If the electronic form expands the space for the parties to express and exchange wills, then smart contracts can automatically execute the terms of the transaction while converting the parties' intentions into digital codes. The "stationary" contract, which could only be contained on paper or electronic media, as the specific basis for the contractor to perform the contract, took a historic step and became an "active" contract.

From the perspective of information theory, computer codes are just like the "knots", languages, telegrams, telephones, data messages, etc. that appear in the long river of history, carrying the party's wills, and they have the logic basis of expression wills. The use of code calculations to execute transaction arrangements is also in line with the wills of the parties of the transaction (see Table. 1).

Human language, electronic symbols, and computer codes have enriched information sources about subjective and objective world. As long as the information sources is correct, the forms carrying information mentioned above is reliable, accurate, and reliable. Commercial contracts embody the parties' intentions, and the expressions of wills recorded on paper are mandatory acts that are bound by law. Since electronic symbols and computer numbers can also accurately express the wills of the parties, it is logical that electronic and digital forms can become legally recognized forms and have legal effect. Article 10 of Contract Law stipulates: "Forms of Contract: Writing Requirement A contract may be made in a writing, in an oral conversation, as well as in any other form." The basic type of form is intended to show the limits of freedom of contract [8]. Article 11 gives the definition of Writing: "A writing means a memorandum of

Table 1. History of information recording and transmission.

Information	Non-verbal era	Language era					
		Pre-paper period	Traditional writing	Electronic form			
				Wired transmission	Wireless transmission	Digital transmission	Digital transmission and calculation
Content	Things, viewpoints, ideas, etc. in the subjective and objective world						
Information expression	Behaviors, things, such as knotting notes	Languages	Languages	Electricity symbol	Electromagnetic wave	Digital (Electronic contract)	Digital code (smart contract)
Information record carrier	Other things	Bamboo slips, silk urns, walls	Paper	Cables, etc.	Radio waves, etc	Computer network	Computer, network, distributed ledger
Information dissemination	Physical transfer of things	Physical transfer of bamboo slips and silkworms	Physical transfer of paper	Language electric symbol	Languages Electricity symbol	Language electric symbol digital	Language electric symbol digital Code operation

contract, letter or electronic message (including telegram, telex, facsimile, electronic data exchange and electronic mail), etc. which is capable of expressing its contents in a tangible form." UCC 2-201 of the Uniform Commercial Code stipulates that "(1) except as otherwise provided in this section, a contract for the sale of goods for the price of $500 or more is not enforceable by way of action or defense unless there is some writing..." UCC expanded the written form as 1–201 states: "'writing' includes printing, typewriting, or any other intentional reduction to tangible form." US courts consider that tangible forms include electronic contracts because electronic contracts can be stored on a computer's hard drive and can be printed [9]. The electronics and data have been recognized by Chinese and American law.

A smart contract is computer code based on electronic data. Its direct expression is not electronic human natural language, but it records and conveys the meaning of the parties and can fulfill and realize the wills of the transaction parties. From the "principle of contract form freedom", the contract codes carry the parties' wills and can be "tangibly expressed", so smart contracts can become a contract form for parties to choose and computer codes can be considered as a kind of writing. The opinion of the US Commodity Futures Trading Commission is the proof of this logical reasoning, and they believe: "Existing law and regulation apply equally regardless what form a contract takes. Contracts or constituent parts of contracts that are written in code are subject to otherwise applicable law and regulation" [10].

3 The Legal Effect of Smart Contract Automatic Performance

Both Chinese law and American law have adopted expanded interpretation to recognize electronic contracts, which is actually giving legal effect to contract forms in a static state. The electronic contract only records the contents of the contract in the form of electronic and digital. In addition to the electronic form, the smart contract is more important in that it can automatically execute the terms of the contract. Traditional contract performance relies on both parties to "do it for themselves" or "commit other people to do it", and there must be "do" or "do not" by the transaction party. Once the smart contract is set up, no active or passive cooperation of the parties is required. As long as certain conditions are met, the smart contract performs automatically. Then whether the automatic performance without parties' behavior has legal effect should be carefully examined.

3.1 Structure of Smart Contracts

According to system theory, structure is the internal basis of function, and function is the external manifestation of elemental structure; certain structures always show certain functions, and certain functions are always generated by specific structures [11]. So how can smart contracts be fulfilled automatically?

It is bound to be inseparable from its special structure. The computer industry pays more attention to the smart contract structure. Experts generally think that smart contracts should generally have 5 basic elements: electronic contracts, blockchains, protocols, causality, and procedural steps [12]. The five-element structure of a smart contract facilitates its automatic performance. An electronic contract is an expression of the intention of the parties to the transaction. It is expressed in electronic data and can be stored in a computer and transmitted through the network. Electronic contracts are legal forms recognized by Chinese law and US law. This is just the electronicization of traditional written contracts. It is only the premise that smart contract performance has the most basic legal effect.

For smart contracts to achieve intelligence, they must be built in an environment where strangers can trust each other. The advent of the blockchain has broken through the problem of "zero information" but "trust" between strangers. Until the invention of blockchain, smart contracts can become a reality from a dream. Blockchain distributed storage, strangers witnessing transactions, and special consensus mechanisms enable smart contracts to facilitate strangers to establish trust relationships and enter trading contract relationships without the need for traditional third-party mechanisms.

The electronic contract written in natural language presents the wills of the parties, the parties can recognize, but the computer is not able to recognize, understand and process, because it just stores and transmits the electronic contract as a bunch of data. Therefore, for electronic contracts to be recognized and run by computers, human natural language needs to be translated into computer languages that computers can recognize. In the blockchain environment, Turing Complete programming language has completed this historical mission, and the protocols written by the programming language have completed the conversion from "human meaning" to "machine meaning".

Different from "cause leads effect", "cause leads no effect", "no cause but effect", and even completely random action modes in human world, computer behavior logic is more rigorous and strict. The logic structure of computer is "If ... then ..." the next behavioral requires a "trigger factor", and the computer can make the triggered behavior happen when the triggering factor is met. Computer protocols follow strict rule of causality and can form clear "cause must lead effect" behavior expectations. It is based on this point that the behavior path of computer operation can form symmetrical information between the parties and further increase the trust of transactions between strangers.

Computers operate on the logic of causal relation. It requires that the natural language contracts should be converted into causal relation, and then combed into a step-by-step process relationship. There are clear procedures and steps, one by one, and the goals of the protocol will be achieved step by step according to the sequence of events.

3.2 Institutional Significance of Smart Contracts Automatic Performance

Smart contracts have fundamentally changed the way contracts are performed. For thousands of years, the performance of a contract requires the parties to perform a specific action. Taking the most common commercial sales contract as an example, the seller needs to deliver the goods, the buyer needs to pay for the goods, and the performance of the contract requires the parties' positive/negative behavior. However, when facing the future that has not yet occurred and experienced, the information on whether the parties have performed the contract is distributed asymmetrically among the parties to the contract. After the contract is signed, because the specific behavior is future and uncertain, the parties' concerns can never be eliminated: the seller is worried that the buyer will not pay after delivery; the buyer is worried that the seller is not delivering or the quality of the goods is less than expected. In the performance of real-world contracts, the buyer and the seller fail to perform or perform the contract in accordance with various appearances, and the conflicts between the parties have never ceased. In the face of transaction disputes, how to settle disputes, civil and commercial law has developed a set of rules to deal with it after a long period of exploring: "the defense of Consecutive Performance", "the defense of Simultaneous Performance" and "the defense of Right to Suspend Performance". If the contract is not performed or not performed as agreed, the contract law has designed the liability for breach of contract. For disputes arising from the contract which is not performed or performed as agreed, the dispute settlement system arranges negotiation, mediation, litigation, and arbitration. Except for negotiation, which involves negotiation between the parties to solve the problem, the other methods need to pass through a third party, such as a mediation committee, court, arbitration commission, and relevant government departments. The third party also develops a set of substantive and procedural rules to solve contract disputes.

Smart contracts arrange specific performance actions into computer programs in advance. When specific "if" conditions are met, the computer automatically performs the specific actions of the parties to the transaction. In the context of asset digitization and the Internet of Things, transaction behavior will inevitably be performed as promised, which will change the asymmetric information between parties about whether the traditional contract is performed or not. The parties of the smart contract will form the expectations and confidence that the contract will perform. Smart contracts have the potential to create trust and facilitate transactions as promised, even without intermediaries. Once the contract can be performed accurately and realistically, the space of institutional arrangements such as contract non-performance and partial performance will be greatly reduced, and the cost of maintaining and operating these systems will also be reduced accordingly. Observing from the perspective of contract performance, transactions using smart contracts are improving in the direction of facilitating parties to enter transactions and reducing the cost of legal systems for contract performance.

3.3 Standards for Legal Effect of Smart Contracts Automatic Performance

Article 60 of Contract Law of the People's Republic of China stipulates: "Full Performance"; Performance in Good Faith The parties shall fully perform their respective obligations in accordance with the contract. The parties shall abide by the principle of good faith, and perform obligations such as notification, assistance, and confidentiality, etc. in light of the nature and purpose of the contract and in accordance with the relevant usage. In ordinary contract cases, it is not necessary to answer the question of whether the performance of the contract has legal effect. This is because the contract is legally valid after the parties with the capacity for civil conduct have expressed their unanimous agreement, meet the legal requirements, and obtain a positive evaluation of the law. A contract that is established and effective shall be performed in a comprehensive, complete, and honest manner, and the parties' performance in accordance with the contract is naturally legal and effective. It is worth noting that traditional contract performance is performed "by the parties" or other agents, and traditional contract law and judicial practice focus on whether the performance is in accordance with the provisions of a valid contract, and do not care about the law of contract performance The issue of validity is that the performance of "acting by yourself" in accordance with a legal and valid contract naturally has legal effect. However, the emergence of smart contracts has brought about different ways of contract performance, showing a parallel picture of "human performance" and "machine performance". Correspondingly, a question arises: is "computer performance" the method of legal effect?

From the structure of the smart contract, it can be seen that the electronic contract represented by electronic data written in natural language is the true meaning of the parties, and the computer actually runs the computer protocols (electronic protocols) written with the electronic contract as the script. The computer does the operation of computer protocols have the legal effect of performing the contract by parties? This may not be an easy question to answer. First of all, what is the standard of legal effect of contract performance? The legal effective contract is transferred to the computer to perform according to the rules of the computer, which involves the legal evaluation of the way the computer performs.

The basis for the legal effect of the "act for yourself" performance is that the contract itself is legally valid. Naturally performing acts such as "delivering the goods" and "paying the price" itself conform to the expression of intention of the parties to the effective contract and legal requirements. There is a change from the "electronic contract" to the "computer protocol". During the change, whether there is inconsistence between the "computer protocol" and the "electronic contract" should be decided. If there are inconsistencies, the legal effectiveness of smart contract performance may be questioned.

The meaning of natural human language does not match the meaning of machine word by word. First, electronic contracts are written by human natural language as electronic data storage and transmission, following the rules

of natural language. Computer protocols follow the rules of the computer, and there is a big difference between the two. Human language is dominated by the human brain and inseparable from thinking, and the relationship between language symbols and things is arbitrary, so human natural language is very complicated. It is difficult for current science and technology to fully simulate the language function of the human brain, and it is not yet possible to achieve a complete translation between human language and computer language. Therefore, there are cases where the meaning of the machine does not match the meaning of natural human language. Second, the electronic contract is reached, drafted and signed by the parties through consensus. Computer protocols need to be written by professionals proficient in computer programming languages. In the context that machine language is not mastered by the vast majority of people, it is rare that both parties of the transaction are proficient in computer languages and can draft agreements. Computer agreements are often entrusted to smart contract producers to write. Different drafters of computer protocols and electronic contracts have different understandings of contract contents and legal points, which results the inconsistency of meaning conversion.

The meaning of the machine is inconsistent with legal requirements. The application of smart contracts in the financial field involves financial institutions, financial consumers, technology companies, and blockchain platform entities. The protection of financial security and financial consumers has always been an important legislative goal of multinational financial laws. Financial risks (including technical risks) control, financial consumer privacy, and protection of information rights are the focus of U.S. and Chinese laws. Computer protocols focus on the logical self-conformity of the computer world, lack of concern about technological risks, financial system risks, violation of consumer rights, and other violation of mandatory legal provisions. For example, in The DAO (Distributed Autonomous Organization Event) in 2016, participants holding DAO tokens jointly voted on the invested project. This project is legal under the premise of complying with relevant laws, but has been hacked because of its smart contract. The attack was "hard-forked" on the Ethereum platform, which meant that from the time the data was recovered to the forked transactions (both hacking and legitimate transactions), the legal effect of its performance was denied.

There is still room for judging the legal effect of smart contracts performance. The core that needs to pay attention to is whether the meaning written by the parties in the electronic contract are consistent with the meaning of the computer protocol written in machine language. When there are inconsistencies, are there rules for conflict resolution? Determine the effectiveness of smart contract performance according to the rules of dispute resolution. In addition, it is necessary to determine whether the computer protocol violates or has the possibility of violating the mandatory provisions of the law, and to determine the legal effect of performance according to whether the computer protocols are legal.

4 Legislative and Judicial Practice in U.S

The history of financial law in the United States is a history of continuously facing financial innovation and coping with financial risks. Under the fintech wave, how to stand at the forefront of the times, and how to allow technological innovation to further promote the in-depth development of the United States' finance and economy, have become an important issue pondered by the states and the United States. California, Vermont, Nevada, Delaware, and other states are actively developing blockchain technology legislation practices. 3 Arizona, Tennessee, and Wyoming are at the forefront of smart contract legislation. The state laws of the three states all involve smart contracts. Because of the different legislative contexts, the understanding and regulations of smart contracts have similarities as well as differences.

4.1 Legislative Practice in the United States

The United States is good at using legal activities to support and promote innovation. Many states have passed legislation to actively respond to innovative technologies such as blockchain and smart contracts. On March 29, 2017, Arizona commented on the revised regulations, Article 44-7061 stipulates signature and records protected by blockchain technology, smart contracts, and ownership of information; effective March 22, 2018 Note 47-10-201 of the Tennessee Code of Regulations provides for "distributed ledger technology"; the Wyoming Law Note, which came into effect on July 1, 2019, provides for "perfection of digital asset security interests". The three US legislative pioneers placed the provisions of smart contracts in different contexts (see Table 2). They both have the same legislative understanding and different emphasis.

Arizona is the earliest state to actively embrace smart contracts among the 50 states in the United States. It is after the advent of the blockchain environment that smart contracts have truly achieved their ideal vision, and before 2017 the blockchain was already at the technology Frontier positions, so the state's legislation is directly concerned with blockchain and smart contracts.

Tennessee passed an act the following year to recognize smart contracts, but the legislation adopted the term "distributed ledger technology" instead of blockchain. Legislators believe that the essence of blockchain is distributed ledger technology, and the latter is a superordinate concept of the former. In response to the open extension of technology, legal stability and forward-looking requirements, legislators adopted the more scientific concept "distributed ledger technology". The state further clarified the legal effect of executing transaction contracts through smart contracts. Tenn. Code Ann. §47-10-202 states that: "Smart contracts may exist in commerce. No contract relating to a transaction shall be denied legal effect, validity, or enforceability solely because that contract is executed through a smart contract." Arizona Annotated Revised Statutes § 44-7061: "C. Smart contracts may exist in commerce. A contract relating to a transaction may not be denied legal effect, validity or enforceability solely because that contract contains a smart contract term." The provisions of the two states

Table 2. Statutes about Smart Contract in Arizona, Tennessee and Wyoming.

State	Arizona	Tennessee	Wyoming
Code	44-7061	44-10-201; 44-10-202	34-29-103
Effective Dates	3/29/2017	3/22/2018	7/1/2019
Content	C. Smart contracts may exist in commerce. A contract relating to a transaction may not be denied legal effect, validity or enforceability solely because that contract contains a smart contract term 2. "Smart contract" means an event-driven program, with state, that runs on a distributed, decentralized, shared and replicated ledger and that can take custody over and instruct transfer of assets on that ledger	47-10-201: (2) "Smart contract" means an event-driven computer program, that executes on an electronic, distributed, decentralized, shared, and replicated ledger that is used to automate transactions, including, but not limited to, transactions that: (A) Take custody over and instruct transfer of assets on that ledger; (B) Create and distribute electronic assets; (C) Synchronize information; or (D) Manage identity and user access to software applications 44-10-202: (c) Smart contracts may exist in commerce. No contract relating to a transaction shall be denied legal effect, validity, or enforceability solely because that contract is executed through a smart contract	(B) A smart contract created by a secured party which has the exclusive legal authority to conduct a transaction relating to a digital asset. As used in this subparagraph, "smart contract" means an automated transaction, as defined in W.S. 40-21-102(a)(ii), or any substantially similar analogue, which is comprised of code, script or programming language that executes the terms of an agreement, and which may include taking custody of and transferring an asset, or issuing executable instructions for these actions, based on the occurrence or nonoccurrence of specified conditions

appear to be the same. However, in reality, there are substantial differences. On the basis of recognizing the effectiveness of smart contracts, Tennessean State legislation further recognizes the effectiveness of executing contracts through smart contracts.

Wyoming act regulates smart contracts in the "digital assets" section. Wyo. Statues believe that: "smart contract" means an automated transaction, which is comprised of code, script or programming language that executes the terms of an agreement. The state law also provides technical means such as private keys and multi-signature, but it is estimated that the purpose of applying technology is to trade, and the essence of the behavior is still digital asset trading, so it shows the legislative layout of smart contracts stipulated in Articles 34-29-103 in the "Performance of Digital Asset Rights" section. The state statute's understanding of smart contracts has actually gone a step further. Arizona and Tennessee consider smart contracts to be a program. Wyoming law considers smart contracts to be "negotiated in code, script, or programming language to execute an agreement". It is, affirming that computer languages such as the codes of a smart contract can be an expression of intention and form of consultation.

In spite of the above differences, the legislation of the three states also has the same understanding: First, there exist traditional transaction contracts and

smart contracts. The former are contracts of electronic records and transactions, and they are in the electronic form written with human natural language, which is the legal form protected by law. Arizona and Tennessee consider the latter to be an event-driven process, and Wyoming considers smart contracts to compromise with code, script, or programming language to execute an agreement. Second, the signature in the blockchain and distributed ledger is an electronic signature, and the traditional transaction contract is an electronic record, which has legal effect. Third, smart contracts run on distributed, decentralized, shared, and replicable ledgers. Fourth, smart contracts can be used for automated transactions, including custody or transfer of digital assets. Fifth, smart contracts have legal effects. Wyoming and Tennessee recognize that the execution of transaction contracts through smart contracts is effective, that is to say they recognize the legal effect of smart contracts automatically performance. At the same time, it can be seen from the language used in the statute that there are also other negative factors to legal effect.

4.2 Judicial Practices of U.S. on Smart Contracts

On June 14, 2018, the Southern District Court of Florida in the United States ruled the first case involving smart contract, Rensel v. Centra Tech. Inc [13]. On the one hand, the case reflects that the U.S. courts have to face the new issue of smart contracts and consider them in judicial decisions; on the other hand, it can help us to see the judicial attitudes of the U.S. courts towards smart contracts. First, the court recognizes both sales agreements and smart contracts. The sales agreement is an electronic contract about Centra Tech.'S token CTR sales (referred to as the "sales agreement"). As the defendant did not have sufficient evidence to prove the plaintiff Rensel accepted the sales agreement, the defendant's claim that the parties signed the sales agreement was not recognized by the court. Smart contracts can automatically perform exchange transactions between CTR and other tokens, such as Ethereum and Bitcoin. The plaintiff conducts token transactions through smart contracts. Second, the sales agreement is inconsistent with the content of the smart contract. Entering a smart contract does not mean that the parties agree to the sales agreement. If the seller wants to claim that the buyer who is bound by the smart contract is also bound by the sales agreement, the seller bears the burden of proof. If the seller cannot prove it, two parties are only bound by the smart contract, and the content represented by the smart contract is recognized by the court, that is, the smart contract is no longer just a bunch of codes. Third, the court recognized the practical effects of automatic execution of smart contracts and transaction performance. The plaintiff used smart contracts to exchange 16.1 Ether for CTR and Bitcoin. The automatic transaction and transaction consequences were accepted by the court. The court held that the two parties have no objection to the transaction itself, but there was a dispute over the standard and amount of damages. Fourth, the defendant's obligation to compensate is not the defendant's use of smart contract as a contract method, but the defendant's public issuance of tokens CTR

which were not registered with the securities registration department, violated the Securities Law.

5 Enlightenment from U.S. Legislation and Judicial Practice of Smart Contracts

5.1 Promoting Fintech by Legal Innovation

Finance is the core of a country's economy, and economic competition largely depends on financial competition. "A history of financial development is a history of scientific and technological progress. The financial industry and financial supervision have always followed the pace of scientific and technological innovation [14]." Although technology changes with each passing day and its changes are far greater than the corresponding legal changes [15], financial laws set boundaries and rules of conduct for fintech and the fate of emerging technologies will be directly determined. If FinTech with development prospects is denied by law, it may cause a country to miss a good opportunity to gain a competitive advantage in international financial competition. The history of the development of US financial law shows us its open and positive attitude to respond to high-tech. When mobile internet technology emerged in the United States and was widely used in the payment field, the effectiveness of mobile payment was solved in the subsequent Electronic Fund Transfer Act; when credit accounts such as credit cards were used for mobile payments, Regulation Z regulated the related cost and expense disclosure and dispute settlement procedures; electronic transactions such as mobile payments involve identification; the Fair and Accurate Credit Transaction Act solves the problem of identity theft in electronic transactions. Technology is neutral, and US law is good at playing its positive role and retaining its aggressiveness to improve technology innovation. Chinese law can learn experiences from the openness of American law in responding to science and technology. The legal system can be divided into legislative, judicial, and regulatory divisions, each with its own weight, promoting joint innovation and coordinating governance. The legislation recognizes the legal status of smart contracts and the legal effect of performing contracts, establishes a legal attitude that recognizes innovation and technology; the judiciary flexibly responds to various problems that arise in the practice of smart contracts; and the regulation departments focus on the prevention of risks in smart contracts.

It is worth mentioning that Arizona and Tennessee's legislation on smart contracts is worth learning. The states recognize the smart contract from the negative perspective: "No contract relating to a transaction shall be denied legal effect, validity, or enforceability solely because that contract is executed through a smart contract." Legislative techniques that affirm the legal validity of smart contracts from the opposite side can have two functions: one is that the adoption of smart contracts does not invalidate the transaction agreement; the other is that smart contracts themselves can not directly lead to the validity of transaction agreements, and they should also be examined under the legal framework of contract law.

5.2 Freedom of Contract Performance, and Recognition of Automatic Performance of Smart Contracts

Arizona, Tennessee, and Wyoming consider smart contracts as computer programs whose core functions include escrow and transfer of funds. All three states' legislation respects the principle of freedom of contract performance. China's legislation on the method of contract performance is in Article 12 of the Contract Law, which states: "The contents of a contract shall be agreed upon by the parties, and shall generally contain the following clauses: ... (6) Time limit, place and method of performance." It is also recognized that the contract performance mode reflects the parties' autonomy. Therefore, that the parties agreed to perform by smart contracts complies with the principle of contract freedom as well as the legal provisions.

While recognize the way smart contracts are performed, we should also be aware of the special nature of editing computer language. In legal system arrangements, the following two points must be noted: First, the fact parties using the smart contract formally indicates that the transaction parties choose the automatic execution. Once the smart contract is performed, one party proposes that it is not his/her genuine intent to transaction through smart contract. Under such a circumstance, the court should review, and may support the claim when the burden of proof is completed. Second, the application of smart contracts in the blockchain network environment violates the compulsory provisions of law, administrative regulations, and the results of the legal review about the performance by smart contract may be invalid.

5.3 Freedom of Contract Form, Leaving Space for Computer Codes

Although several states of the United States have reached a consensus on the issue of "smart contract as a form of contract performance", they have not answered from the front about whether "smart contracts are contracts" or "computer code is a form of contract". Arizona statutes state "contract contains smart contract terms". From a semantic perspective, this state recognizes that smart contract can be part of a contract. Since the smart contract is part of the contract content, to some extent the smart contract carries the wills of the transaction parties. Although Rensel v. Centra Tech. had a sales agreement and a smart contract, the plaintiff Rensel only traded with the defendant through the smart contract. The actual effect of the two transactions was recognized by the court. This shows that smart contracts can be obtained as an agreement between the parties.

With the widespread application of blockchain and smart contracts, the gradual popularization of computer programming languages, and the increasing degree of understanding and use of computer language, China responds more actively to blockchain and smart contracts. We have to face the tension between computer language and natural language. To resolve the conflict between the two, the following factors need to be considered: First, who drafts the smart contract? Does the counterparty understand the true meaning expressed by the

smart contract computer code? Second, whether a party with an advantage of using computer language has abused its advantage to place the counterparty in an unfair position.

5.4 Hybrid Agreement

A hybrid agreement, involving electronic contracts and smart contracts, often occurs in real-world transactions. How should the relationship between the two be handled? The judicial practice in the United States has dealt with some conflicts between the two, and we can learn from them, but at the same time, when the legal system lays out rules for smart contract disputes in advance, it is necessary to clarify the relationship between the two and resolve conflicts in advance. From the real and possible situations that have appeared in the real world, they can be roughly divided into two categories: one is the coexistence of electronic contracts and smart contracts; the other is that the parties to the transaction only enter the electronic contracts or smart contracts.

As for the first type of situation, it can be divided into two cases where they are the same and they are not the same. If the two are consistent, the parties' intentions reflected in the smart contract can be confirmed in the electronic contract, and the electronic contract has been completely coded. If the two are inconsistent, it is necessary to carefully identify which of the following is inconsistent: First, the electronic contract has provisions, but the smart contract has no arrangements. This situation is equivalent to the smart contract only coding part of the content in the electronic contract, and the content in the electronic contract that is not automatically performed by the smart contract will continue to be performed according to the traditional performance method. Second, there are arrangements in smart contracts, but there is no agreement in electronic contracts, that is, the content of computer code programming in smart contracts is beyond the scope of electronic contracts. From the point of view of the transaction parties entering the smart contract, they have agreed to the content and method of automatic performance, and the performance of smart contract has legal effect. If the parties make claims that automatic performance was not genuine intentions, they shall take the burden of proof. Third, there are arrangements for electronic contracts and smart contracts, which conflict with each other. In response to such a situation, the core needs to determine which is the mutual assent reached by the parties. The judicial review should comprehensively consider the following factors: the process of electronic contract negotiation; the order in which electronic contracts and smart contracts are determined and made; the process of electronic contract negotiation; whether the smart contract producer has a computer language advantage and has abused that advantage; whether there was a test of smart contract completed by both parties; whether the transaction parties accept the result of the automatic execution of the smart contract.

The second type is that the transaction parties only enters into an electronic contract or a smart contract. If the two parties only have electronic contracts, this is actually a traditional electronic contract transaction, and the judicial

rules are clear. If the two parties did not sign the electronic contract and only entered the smart contract, that is the case of Rensel, this situation is essentially the same as the content of the smart contract coded beyond the scope of the electronic contract. The party denied the result undertake the burden of proof (see Table 3).

Table 3. Relationship between electronic contracts and smart contracts.

Coexist	Only one form
The two are consistent: The expression of meaning embodied in smart contracts can be confirmed by electronic contracts	With electronic contract and no smart contract: Perform the contract as agreed in the electronic contract
The two are inconsistent: 1. There are regulations in electronic contracts, and there are no arrangements for smart contracts. Contents not fulfilled in smart contracts are performed in accordance with electronic contracts 2. Smart contracts have arrangements, and electronic contracts have no provisions. The execution of a smart contract has legal effect, unless there is evidence that the content and execution method of the smart contract do not meet the true intention of the transaction party 3. Conflicts between electronic contracts and smart contracts. The core needs to determine who belongs to the party's true meaning	With smart contracts, no electronic contracts: Perform according to smart contract, if the parties put forward the opposite claim, they must bear the burden of proof and proof

6 Conclusion

China's legislation has not changed for smart contracts. Although the judicial practice community has already engaged in smart contract disputes, the focus of the case disputes does not involve the smart contract itself, but other civil rights, such as Beijing Xinfubao Technology Co., Ltd. v. Qizhong Mu, Alibaba v. Shanghai Blockchain Net Technology Co. Both of these technology companies have adopted smart contracts, but disputes entering the judicial process are reputation rights and trademark rights. In China, smart contracts are increasingly used in practical scenarios especially in the financial field, and the possibility of judicial practice facing legal issues of smart contracts has become higher and higher. Chinese law has a legal basis for embracing smart contracts, and US state law has recognized the legal effect of smart contracts in legal form. The positive response of U.S. law to the form of smart contracts and contract performance methods has enlightened us to proactively lay out legal resources in the legislative and judicial fields to promote the safe and healthy development of high-tech technology in many fields such as finance.

References

1. Zetzsche, D., Buckley, R., Arner, D.: The distributed liability of distributed ledgers: legal risks of blockchain. Univ. Illinois Law Rev. **2**(5), 1361–1406 (2018)
2. China Blockchain Technology and Application Development White Paper (2016)
3. De Sevres, N.K., Chilton, B., Cohen, B.: The Blockchain Revolution, Smart Contracts and Financial Transactions. 21 Cyberspace Law, 3 (2016)
4. Alharby, M., Aad, V.M.: Blockchain based smart contracts: a systematic mapping study. In: 3rd International Conference on Artificial Intelligence and Soft Computing 2017, vol. 08, pp. 125–140. AIRCC Publishing Corporation (2017). https://doi.org/10.5121/csit.2017.71011
5. Baker, E.D.: Trustless Property Systems and Anarchy: How Trustless Transfer Technology Will Shape the Future of the Property Exchange, 45 Sw. L. Rev. 351, 360–361 (2015)
6. Kunz, C.L., Chomsky, C.L.: Contracts: A Contemporary Approach. West Academic Publishing, St. Paul (2010)
7. Mann, R.J.: Electronic Commerce. Wolters Kluwer, Alphen aan den Rijn (2011)
8. Zhu, G.: Written form and establishment of contract. Chin. J. Law **41**(5), 61–78 (2019)
9. Bazak Intern. Corp. v. Tarrant Apparel Group, 378 F. Supp. 2d 377, S.D.N.Y. (2005)
10. LNCS. https://www.cftc.gov/sites/default/files/2018-11/LabCFTC_PrimerSmartContracts112718.pdf
11. Bertalanffy, L.V.: General System Theory: Foundations, Development, Applications. G. Braziller, New York (1987)
12. Möhring, M., Keller, B., Schmidt, R., Rippin, A.L., Schulz, J., Brückner, K.: Empirical insights in the current development of smart contracts. In: Twenty-Second Pacific Asia Conference on Information Systems 2018, Japan, p. 125 (2018). https://aisel.aisnet.org/pacis2018/146
13. Rensel, J.Z.T., et al., Plaintiffs v. Centra Tech, Inc., et al., Defendants: United States District Court, S.D. Florida. CASE NO. 17–24500-CIV-KING/SIMONTON
14. Zhou, Z.F., Li, J.W.: The transformation of the paradigm of financial supervision in the background of fintech. Chin. J. Law **40**(5), 3–19 (2018)
15. Taylor, K.C.: Fintech Law: A Guide to Technology Law in the Financial Services Industry. Bloomberg BNA, Arlington (2014)