On the Legal Protection for Blockchain Digital Assets under the Chinese Civil Code

Xiao Si[1]

[ABSTRACT] Along with the development and application of blockchain technology, blockchain digital assets represented by crypto currencies and digital collectibles have emerged on an as-needed basis. Despite such a bright development prospect, there has been neither clear stipulation about these assets' property attributes in legislation nor consensus on their attribute determination in China, making the legal uncertainty the biggest obstacle to the development and innovation of the blockchain digital asset market. There are fundamental differences between blockchain digital assets and traditional network virtual properties, such as game props. Blockchain digital assets have many new characteristics endowed by blockchain system so that they meet the requirements of certainty and controllability of objects of real rights (right in rem), which qualifies them to be included in the protection scope of real rights. Therefore, China should, based on Article 127 of its Civil Code, adopt the principle of differentiation in its future legislation for the protection of network virtual property: to apply the provisions of real rights to the network virtual property, such as blockchain digital assets that meet the characteristics of real rights, or to grant protection to the network virtual property with weak control in the form of contractual claims or new proprietary rights and interests. Thus, China can establish a blockchain digital asset market and resolve a series of subsequent questions related to bankruptcy, inheritance, divorce, etc.

Keywords: blockchain digital assets; network virtual property; intangible property; right in rem; incorporeal things

I. Introduction: Uncertain property attribute as the biggest obstacle to the development of the blockchain digital asset market

Since the emergence of bitcoin in 2009, the blockchain technology behind it has been

[1] About the author: Xiao (Jason) SI, Ph.D. in law, is Vice President of Tencent and Dean of Tencent Research Institute. He is also President of Shenzhen Copyright Association, Council Member of China Law Society, Executive Director of Copyright Society of China and Deputy Director of China Industrial Internet Development Alliance. He also serves as postgraduate supervisor of Peking University Law School since 2017. Contact of the author: jasonsi@tencent.com

continuously pursued by all circles across the globe. It has been regarded as the fifth disruptive computing paradigm and a new basic technology after mainframe computers, the PC, the Internet, and mobile Internet/social networks, as well as a new base for establishing economic and social systems.[2] In the field of digital assets, blockchain is a distributed ledger technology (DLT) that is permanent, non-tamperable, verifiable, trustless and programmable, which provides new paradigms for the creation, issuance, custody, trading, use, etc. of digital assets. As a new type of assets, crypto currency, crypto collectibles and other forms of blockchain digital assets have emerged on an as-needed basis to meet tech development demands. They have also been vigorously created in the development trend of asset digitization and data assetization driven by blockchain; these blockchain digital assets show a strong market vitality and a broad market prospect.

At present, there are more than 5,000 types of crypto currencies in the world. Its total market value was as high as 566 billion US dollars in 2017, but fell to 237 billion US dollars in 2019.[3] Among CryptoKitties, a representative product of crypto collectibles, 1.5 million players have spent 40 million US dollars in their play of the game.[4] In addition, the non-fungible token (NFT) is currently being rapidly developed because of the promotion of the ERC-271 standard made by the blockchain platform Ethereum.[5] As a result, more and more applications of crypto collectibles based on the NFT standard have emerged one after another.[6] It is expected that their value may reach tens of billions of US dollars in the next few years.[7]

Blockchain digital assets have advantages such as transparency, credibility,[8] encryption security, programmability,[9] the short period and low cost of transactions, simplification of right

---

[2] Melanie Swan, "Blockchain: Blueprint for a New Economy", *O'Reilly Media*, 2015, p.vii.

[3] Statista "Market Capitalization of Cryptocurrencies from 2013 to 2019", https://www.statista.com/statistics/730876/cryptocurrency-maket-value/ (last visited April 20, 2020).

[4] Rakesh Sharma, "Cryptokitties Are Still a Thing. Here's Why", https://www.investopedia.com/news/cryptokitties-are-still-thing-heres-why/ (last visited April 20, 2020).

[5] As the non-fungible token (NFT) standard used on Ethereum, a blockchain platform, ERC-721 provides basic functions for the tracking and transfer of NFT. *See* EIP 721: ERC-721 Non-Fungible Token Standard, https://eips.ethereum.org/EIPS/eip-721 (last visited April 20, 2020).

[6] Nick Tomaino, "Digital Collectibles: A New Category of Tokens Emerging", https://thecontrol.co/digital-collectibles-a-new-category-of-tokens-emerging-fb991c1dff6a (last visited April 20, 2020).

[7] Lucian, "The Blockchain Revolution in Collectibles: Digital Collectibles to Be Worth $10s of Billions of Dollars in the Coming Years", https://medium.com/@a.bogdanov001/the-blockchain-revolution-in-collectibles-digital-collectibles-to-be-worth-10s-of-billions-of-e8584c00e040 (last visited April 20, 2020).

[8] Both the source of the on-chain assets and the history of all transactions are recorded in a shared digital ledger, ensuring that assets and transactions are transparent, credible, and unaltered. In addition, a deployment of auditable smart contracts can provide relatively high transparency for the assets as well as the behavior and guarantee thereof.

[9] Blockchain architecture can be used to support the writing of different functions, such as the conditions for asset transfer and the behavior related to assets, into digital assets in the form of codes, and to realize an automation of distributing dividends from bonds and stocks as well as corporate decision-making notifications. Smart contract technology can be used to not only program complex behaviors into assets, but also to enable these behaviors to be automatically executed, thereby bringing about a high degree of automation to digital assets. To

management, permission of fractional ownership,[10] and convenience for community building.[11] Therefore, blockchain digital assets have not only been regarded as an important foundation for the development of digital economy in the future, but they also have been expected to bring about changes in asset form, financial system, business model, etc. However, there is a great uncertainty of blockchain digital assets in terms of legal status under China's current legal system. In short, users utilize blockchain to support their transactions involving digital assets, which often have economic value. Users can control their digital assets through private keys, but it is still unclear to what extent these assets constitute property in the legal sense. Such uncertainty can be understood from two perspectives: the legislative and judicial practice.

1.1 The legislative and academic status quo for blockchain digital assets in China

The first point of uncertainty regarding the property status of blockchain digital assets involves the lack of clear stipulation in legislation. In the process of formulating the "General Provisions of Civil Law" (i.e., the part "General Provisions" of China's "Civil Code"), there have been several revisions of the stipulations concerning network virtual property, and what was adopted in the end was only a provision in principle (Article 127): "Where there are provisions on network virtual property in any other law, such special provisions shall apply." This article shows that network virtual property can be the object of proprietary rights under the civil right system, but it fails to clarify what kind of proprietary right object it is. Therefore, although this article retains a space for the legal protection of network virtual property, the holders find it difficult to fully and stably protect their legal rights and interests of blockchain digital assets before the law on the protection of network virtual property as it is currently formulated. Furthermore, the blockchain digital asset market will hesitate to proceed for the lack of legal certainty and predictability. Although the Chinese authorities formulated financial policy documents such as "Notice on Preventing Risks of Bitcoins" and "Announcement on Preventing Financing Risks of Token Issuance", they hold that bitcoin and Ethereum are "specific virtual commodity" or "virtual currency" from the perspective of financial supervision. Thus, it is also difficult to clarify the property attribute of blockchain digital assets according to these documents.

In fact, the focus of previous discussions on digital assets before the emergence of blockchain

---

that end, new applications will be permitted to be developed for complex products and unprecedented application scenarios.

[10] Most crypto tokens can be subdivided to 18 decimal points, which means that tokenization can be used to make it easier for some changes in ownership of asset to be realized.

[11] For example, a start-up can build a community for its products or services by issuing tokens, which is somewhat similar to the early ICO projects. Thus, it can have more numerous investors with more diversity and participation compared to the traditional financial instruments.

technology has been the traditional network virtual property, such as game props, virtual items, accounts, domain names, e-mail addresses, electronic credits, and electronic coupons. These so-called virtual properties cannot be actually controlled but can be copied wantonly due to their general lack of scarcity and uniqueness. Thus, it would be strange to claim ownership of them. In academic circles, the theories about the legal attributes of the traditional network virtual property such as game props are mainly related to real rights or quasi-real rights, creditor's rights, intellectual property rights and other new types of proprietary rights.[12] However, there are insurmountable difficulties to define such virtual properties as real rights or quasi-real rights because under the traditional Internet architecture, such virtual properties are not allowed to be traded, or users often rely on the trusted third-party organizations during transactions. Users also highly rely on the technical support and guarantee of the network service providers when exercising their proprietary rights to and interests in such virtual properties because neither party has absolute control of such properties. Thus, the users have just a nominal owning and control of such property.

As early as 2003, the author of this paper proposed an idea that the traditional network virtual properties such as game props belong to the certificates of creditor's rights and for rights claiming.[13] Therefore, the general theory regards such virtual properties as legal civil rights and interests so that they can be protected by the legal systems under tort law, contract law, etc. to balance the interests between users and network service providers. The same conclusion can also be made according to Article 127 of China's "Civil Code". However, blockchain digital assets have many new characteristics that are different from the traditional network virtual properties such as game props. This means that it is arguable and inappropriate to mechanically apply the existing theories about the traditional network virtual properties to blockchain digital assets. In short, the emergence of blockchain digital assets calls for a reconsideration of the existing theories about proprietary rights.

1.2 The judicial practice concerning blockchain digital assets in China

The second point of uncertainty regarding the property status of blockchain digital assets involves a diversified determination of the legal attributes of blockchain digital assets in judicial practice. In recent years, the world has witnessed an increase of civil and criminal

---

[12] *See* Yang Lixin (杨立新), Lun Wangluo Xuni Caichan de Wuquan Shuxing Jiqi Jiben Guize (论网络虚拟财产的物权属性及其基本规则) [*On the Property Right Attribute of Network Virtual Property and its Basic Rules*], 6 Guojia Jianchaguan Xueyuan Xuebao (国家检察官学院学报) [JOURNAL of the NATIONAL PROCURATORS COLLEGE] 6, 6-7 (2004).

[13] Si Xiao's (司晓) Xuni Caichan de Xingzhi Jiqi Minfa Baohu (虚拟财产的性质及其民法保护) [THE NATURE OF VIRTUAL PROPERTY AND ITS PROTECTION IN CIVIL LAW], s*ee* the official website of Tengxun Yanjiuyuan (腾讯研究院) Tencent Research Institute (hereinafter "[Tencent Research Institute"), https://www.tisi.org/2329 (last visited May 10, 2020).

disputes involving digital assets such as bitcoin, but there have also been significant disagreements about how to provide legal protection for such new types of digital assets, and whether that protection should be provided. According to the *Zhonglun Report on the Legal Practice in Blockchain (Version 2.0)*, among the existing 507 judgment documents, 441 documents do not clearly state whether virtual currencies and related rights and interests are protected by law, only 66 documents take positions on the topic, including 17 in clear favor of legal protection for such currencies and related rights and interests, and 49 against legal protection. Moreover, those contracts involving crypto virtual currencies are often declared invalid and shall not be protected by law.[14] In addition to the difference in whether to provide legal protection or not, there are serious disagreements on the legal attribute of crypto virtual currencies in judicial adjudication. There have been diversified civil and criminal judgments on crypto virtual currencies, which can be divided into nine categories: (a) specific virtual commodities; (b) specific virtual commodities – illegal things; (c) specific virtual commodities – non-homogeneous goods; (d) property, things, commodities and proprietary interest in the general legal sense; (e) virtual property; (f) uncirculated currency; (g) virtual currency; (h) others' property and things; and (i) computer information system data.[15] Therefore, the lack of clear legal provisions on the protection of blockchain digital assets has led to different determinations on its legal attribute in judicial practice, and it is not conducive to the development and innovation of the blockchain digital asset market in China.

The failure of current legislation and judicial practices to provide definite and predictable legal protection for blockchain digital assets has become the biggest obstacle to the development and innovation of the blockchain digital asset market in China. This has been in sharp contrast with China's emphasis on the application of blockchain in digital asset transactions.[16] In this context, it is of great theoretical and practical significance to clarify the proprietary attributes of blockchain digital assets because a clarification of their legal status will not only strengthen the confidence in market, as well as certainty and predictability in law, but also be of great

---

[14] For example, the People's Court of Kaifu District, Changsha City, held in the case of Zhongya Zhineng Shuzi Keji (Shen Chou) Youxian Gongsi Su Changsha Shengda Shiye Youxian Gongsi (中亚智能数字科技（深圳）有限公司诉长沙盛大实业有限公司) [Zhongya Intelligent Digital Technology (Shenzhen) Co., Ltd. *v*. Changsha Shengda Industrial Co., Ltd.] concerning contract validity confirmation where the contract agreed upon by the parties on bitcoin exchange and consequences are invalid because the said contents violate China's monetary policy, namely, the mandatory provisions of the law. *See* the (2017) *Xiang* 0105 *Min Chu* 6277 *Hao* Civil Judgment rendered by the People's Court of Kaifu District, Changsha City.

[15] Zhonglun Law Firm's ZHONGLUN REPORT ON THE LEGAL PRACTICE IN BLOCKCHAIN (VERSION 2.0), http://www.zhonglun.com/uploadfile/c/中伦区块链法律实务报告 2.0 版.pdf (last visited April 20, 2020).

[16] On October 24, 2019, General Secretary Xi Jinping emphasized at the 18th group study session of the Political Bureau of the Central Committee of the Communist Party of China that the application of blockchain technology has been extended to many fields, including digital asset transactions, and that China should accelerate the development and innovation in blockchain technology and industry, and the session actively promoted a development integrating blockchain with the economy and society.

significance for the long-term development of the technology community, legal community, digital asset transaction market and the global financial service market. Furthermore, the legal attributes of blockchain digital assets are related to the transactions themselves and will exert huge influence on many legal relationships such as divorce, infringement, bankruptcy, inheritance, trusts and theft crime. In summary, the solution to the legal attributes of blockchain digital assets, a fundamental question in China, can help not only establish a new market, but also smoothly resolve a series of questions related to blockchain digital assets.

Based on the above considerations, this paper intends to provide a useful reference for the legal protection of blockchain digital assets in China by an in-depth understanding of blockchain technology and various forms of digital assets and an analysis of the proprietary attributes of blockchain digital assets. It should be noted that this paper does not discuss the topics such as financial supervision and monetary policy related to blockchain digital assets even though they have been hot topics in terms of blockchain supervision in China and the world.

II. The definition of blockchain digital assets

2.1 Definition and characteristics of blockchain digital assets

Blockchain digital assets are newly emerged intangible assets with their issuance, registration, storage, holding, transfer or transaction involving blockchain technology. As mentioned earlier, blockchain digital assets originated from the bitcoin system developed by Satoshi Nakamoto in 2008. Since then, many other systems and applications have emerged, and most of them involved a form of asset transactions. Being stored in a specific system in a digitized form, these assets are a digital representation of value or rights more often than not and are identified in the industry as crypto assets, crypto tokens, etc.[17] After considering the diversity of blockchain systems, their applications and the digital assets of such systems, it is safe to say that although there is not a precise definition of blockchain digital assets at present, the digital assets with blockchain systems as the basis for their existence have certain common forms and characteristics, and it is these new and unique characteristics that distinguish them from the traditional network virtual assets and physical assets. Generally speaking, blockchain digital assets have the following five common characteristics: (1) intangibility; (2) encryption attributes; (3) use of distributed ledgers; (4) decentralization; and (5) a consensus mechanism.

[17] Along with its combination with blockchain technology, the meaning of the term token has undergone many changes. In the early days of network development, it was generally used to refer to the code for login verification. With the development of blockchain applications such as bitcoin and ethereum, its meaning began to cover the concept of crypto currency and to be translated into “token (money)”. After the translation of “token” appears, its connotation is expanded and can be defined as a “certificate for negotiable encrypted digital rights and interests”. This paper uses the two translations of “token money” and “token” interchangeably with the concept of blockchain digital assets in a broad sense.

(1) Intangibility: Blockchain digital assets exist in a specific blockchain system. They are purely "virtual" assets because they are intangible and cannot be physically possessed.

(2) Encryption attributes: The generation, storage and transaction of blockchain digital assets rely on encryption technology to a huge extent. Existing blockchain digital assets are mainly composed of a public key and a private key. Although the public key is open to the public, the private key is a lengthy string generated by a random algorithm with characteristics such as unpredictability, nonappearance and randomness. When a digital asset transaction occurs, the private key can generate a public key, and the latter cannot be backtracked to the former, resulting in the security of the transaction and the privacy of the private key being guaranteed to a certain extent.

(3) Use of distributed ledgers: The transactions of blockchain digital assets are recorded by a distributed ledger, which ensures the features of the transactions such as transparency and non-tamperability. A typical distributed ledger uses blockchain technology, but other models and forms exist. However, a distributed ledger differs from a traditional ledger in that its distribution is on all nodes on the blockchain network, and the distributed ledger is independently saved and updated by every participant in the network in real time. It can be said that there are two core problems which need to be resolved for the safe and reliable transactions of digital assets: the first is to track which account is the owner of a specific asset at a specific time, and the second is to register the ownership changes for the specific asset. The two problems cannot be completed without distributed ledger technology.

(4) Decentralization: Blockchain digital assets ideally have the feature of decentralization. This means that blockchain technology can be used to directly support the transactions involving digital assets between users without financial intermediaries. Such a high degree of autonomy reduces the costs and improves the efficiency in transactions.

(5) A consensus mechanism: The rules governing transactions are established by the participants on informal consensus rather than by contracts or other legally binding methods. As the underlying technology of blockchain, the consensus mechanism may be used with different methods, such as proof of work and proof of stake.[18] When conducting information transmission and value transfer, the consensus mechanism can resolve and ensure the consistency and correctness of every transaction on all accounting nodes. The consensus mechanism is automatically executed, and it is only the transactions made according to the consensus mechanism and entered into the distributed ledger that will be accepted as valid by the participants.

[18] Jean Bacon et al., *Blockchain Demystified: A Technical and Legal Introduction to Distributed and Centralized Ledgers*, 25 RICHMOND JOURNAL of LAW & TECHNOLOGY 1, 4-16 (2018).

The consensus mechanism may also be used to decide which version of the distributed ledger is final.

2.2 The classification of blockchain digital assets

In general, blockchain digital assets[19] that meet these five characteristics can be divided into two categories: primary digital assets and digital assets that represent the traditional assets outside the system.

(1) Primary digital assets: Primary digital assets reference the primary assets on the chain, which exist entirely on blockchain, and have no "corresponding thing" (usually called assets or rights) outside the chain. The typical representatives of such assets are crypto currencies such as bitcoin. They also include digital collectibles or virtual items based on the applications of blockchain such as CryptoKitties. The former is a fungible token and similar to a fiat currency because every token is homogeneous, interchangeable and divisible; the latter is a NFT and similar to a physical form of collectibles because every such token is unique, non-interchangeable and indivisible. Primary digital assets, or pure digital assets, are pure computer code. They cannot be used as "agents" for various assets in the real world, and there is no central bank or physical assets behind them as support.

(2) Digital assets that represent the traditional assets outside the system: These assets are the digital representation of various physical or non-physical assets that exist in reality, and that are a representative form of circulation on the chain. Blockchain technology is an important tool to realize the digitization of assets or tokenization of assets by transforming the off-chain assets such as tangible commodities, real estate, company shares, money, debts, contract rights into a digital form, or transferring some already digitized rights and interests to the blockchain system. Thus, it can not only reduce transaction costs and resource consumption, but also make resource circulation more convenient.

The Token and Trustworthy Technology Service Providers Act of Liechtenstein that came into force in January 2020 also divides digital tokens into the two categories from the perspective of value sources: the token with an endorsement of real value can be regarded as a "container"

[19] In general, there are two classifications of blockchain digital assets outside China. The first includes payment/transaction token, asset/security token and utility token; and the second includes crypto currency, platform coin and token. In the second category, platform coin such as Ethereum, NEO and Ravencoin, a digital asset with general purpose, which is designed to facilitate different forms of point-to-point activities, such as decentralized software or applications (DApps), smart contracts and digital collectibles (such as CryptoKitties). Token (money) is a digital asset created on the basis of platform coins for specific purposes or application development, such as the aforementioned utility tokens and security tokens. The utility token has certain consumption functions on platforms or in services; the security token represents the relatively traditional asset interests such as stocks, debts and immovable property in order to add some additional interests accompanied by some features of digital asset market, such as higher liquidity, higher efficiency in cross-border transfer, higher cost-saving in the transfer of partial ownership, a higher transparency in dividend distribution and a higher speed in liquidation.

representing a certain right, whereas crypto currencies such as bitcoin or crypto assets are tokens for "empty containers".[20] However, the foresaid second type of digital assets or the tokens used as "containers" after the digitization of assets brings about new complexity to law, making it is very necessary to clarify the relationship between on-chain assets and off-chain assets. That prompts the question, what influence will be exerted by the on-chain transfer of such crypto assets on the ownership of the off-chain assets in the real world? Additionally, does such transfer mean a transfer of the off-chain assets? In essence, this transfer involves a question of whether such crypto assets can be identified as property certificates (title certificates) such as the immovables registrations, warehouse receipts, bills of lading, bonds, stocks and coupons. This paper only discusses the proprietary attributes of the primary assets on the chain (that is, the tokens as "empty containers").

III. Analysis of the property attributes of blockchain digital assets

As far as the primary digital assets on blockchain are concerned, this paper argues that they should be regarded as property in the legal sense and can be legally "owned" by people. Furthermore, if there is a breakthrough in the existing idea that "a thing must have a physical body" under China's current legal system, blockchain digital assets can be the objects of real rights so that the person who obtains such digital assets can enjoy their ownership, or they can enjoy the rights to possess, utilize, profit from and dispose of the assets. These points that advocate for the concept of legality and ownership are discussed further in the following section.

3.1 Demonstration that blockchain digital assets conform to the characteristics of real right

A real right is a *right in rem*, and it reflects a relationship of the right holder's control and dominance of a specific object. The core characteristic of a real right is its dominance and in rem nature with a thing as its object. Under Chinese law, there is no direct definition of a thing, but it is explained that the objects of a real right include the movables and immovables, and the rights are clearly stipulated by law in an enumerated way. Generally speaking, a thing, as an object of a real right, should have at least the legal characteristics such as specificity, controllability, availability and ethics. It is clear that blockchain digital assets meet the ethical requirement. Thus, the key for determining whether they are the objects of real rights under China's civil law is whether they are specific and controllable, as well as the understanding and interpretation of incorporeal things.

(1) Blockchain digital assets are specific, determinable, durable and stable objects that

[20] Teck Ming's KEY VIEWS ON 172 PAGES LIECHTENSTEIN BLOCKCHAIN ACT: TOKEN AND TRUSTWORTHY TECHNOLOGY SERVICE PROVIDERS ACT (TVTG), https://www.oulu.fi/blogs/node/192427 (last visited May 10, 2020).

meet the specific requirements of a real right object. In civil law, a thing must be independent and specific, must be distinguished from other things in real form, and must have certain durability and stability. Blockchain digital assets meet these requirements. In general, a blockchain digital asset is expressed by a pair of data parameters: a public key and a private key. As part of the public parameter, the public key is known to the world or all participants under the system, and contains information such as ownership, value and transaction history about the asset. As part of the private parameter, the private key is controlled by the holder, and is permitted to confirm the transformation and transaction of the crypto asset in a manner with digital signature and encrypted security. The transfer of digital assets must rely on the encryption and decryption of both of them, and the transaction cannot be completed by the public key or the private key alone. Therefore, according to the regulations under the relevant blockchain system, it is sufficient to determine a crypto asset through its public parameter, and it can be identified by everyone who has access to the system. This means that every crypto asset is specific. In particular, every NFT crypto asset is unique and cannot be copied.

In terms of durability and stability**,** the relatively perpetual existence of crypto assets is like other traditional financial assets. It means that they will always exist before they are revoked, exchanged, repaid or exercised. The stability of blockchain digital assets mainly involves two questions. First, although it needs some time to reach a consensus on the status of the ledger and the validity and order of transactions according to consensus mechanism, some believe that there is a risk that the earliest six blocks in the bitcoin system might be modified because temporary consensus may be changed. Although in this scenario the earlier ledger records were also unstable in theory, there will be an increasingly small possibility of it being changed over time. Second, although the change in the consensus mechanism might have been proposed, it has not been universally accepted by all participants, leading to a fork in the system. It means that the participants in different groups may follow different rules; in other words, they will recognize different transactions and maintain different ledgers. In essence, such practices will divide a blockchain system into two systems, each with its own crypto currency and separate ledger. The author believes that blockchain digital assets can still be regarded as property because there is no absolute certainty and stability, and they have sufficient perpetuity and stability even if the aforementioned questions are not resolved. Thus，for a commercial crypto asset system with a large number of participants, certain transaction history and stable rules, it has sufficient stability. To a lesser extent, even if when it comes to the traditional assets, they are still at risk of being reduced, rotten, lost or destroyed.

(2) Blockchain digital assets have a characteristic of controllability. The object in the civil

law must be controlled by people.[21] In general, the controllability here emphasizes the state or relationship between the civil subject and the objects. For example, a person can achieve the purpose of his right only according to his own intention,[22] a subject can act on the object on his own,[23] or he can unilaterally realize his own intention on an object without the cooperation of others' intentions.[24] If the civil subject's control of corporeal things is mainly represented by his control based on physical attributes, then the controllability of blockchain digital assets as intangible objects is represented by the control power generated from and based on technical attribute. In other words, although blockchain digital assets cannot be physically and realistically possessed, the holder of the private key can exercise an exclusive control of the specific digital asset by the private key, and such control is not influenced by the will of others.

First, the private key is crucial for the holder to exert control of blockchain digital assets. As previously mentioned, blockchain digital asset is often composed of a public key and a private key. The public key contains the encoded information of the relevant asset and is the open part of the key. The private key is a random parameter on every blockchain, and it is held by the user in private and not open to the public. The two together is a typical use of asymmetric algorithm encryption. The encryption confirmation process meets the requirements of control and exclusivity, and only the holder of the private key is permitted to trade in the crypto asset (e.g., transaction) in order to exclusively control the asset. It can be seen from the perspective of the dynamic transaction process that it is ensured that the transferred digital asset can only be unlocked by the assignee with his private key after it is encrypted by the assignor with the assignee's public key. The assignor uses his own private key for a digital signature, whereas the assignee uses the transferor's public key to authenticate the signature identity and confirm that the transaction source is correct. Therefore, a person who has a private key in the blockchain system owns a digital asset saved at the private key address. Thus, he can exclusively control the circulation of the asset according to his own will without any claim on anyone.

Second, this control is absolute and can exclude others from using the asset. Widely accepted theory said, "The right to dominance is a right by which the right holder can unilaterally exercise

---

[21] *See* Ran Hao (冉昊), Duiwuquan Yuduirenquan de Qufen Jiqi Shizhi (对物权与对人权的区分及其实质) [*The Difference between and Essence of Jus in Rem and Jus in Personam*], 3 Faxue Yanjiu (法学研究) [CHINSES JOURNAL of LAW (hereinafter "J. L. CHINA")] 99, 104 (2005).

[22] Sun Xianzhong (孙宪忠), Zhongguo Wuquanfa Zonglun (中国物权法总论) [*General Principles on Chinese Property Law*] 24 (2003).

[23] Li Xihe (李锡鹤), Dui Zhaiquan Bukeqinxing He Zhaiquan Wuquanhua de Sikao (对债权不可侵性和债权物权化的思考) [*On Non-Infringement and Propertization of Creditor's Rights as well as the Difference between Real Right and Creditor's Rights*] , 3 Huadong Zhengfa Xueyuan Xuebao (华东政法学院学报) [JOURNAL OF EAST CHINA UNIVERSITY OF POLITICAL SCIENCE AND LAW] 25, 26-28 (2003).

[24] Lin Xuxia (林旭霞), Xuni Caichanquan Xingzhi Lun [*On the Nature of Virtual Property Rights*] (虚拟财产权性质论), 1 Zhongguo Faxue (中国法学) [CHINA LEGAL SCIENCE (hereinafter "L. S. CHINA")] 88, 96 (2009).

his own right to an object without the cooperation of others."[25] In the past, the transactions of network virtual property such as game props often depended on network service providers who have strong control of such transactions because the users do not have absolute rights to the virtual assets, but rather creditors' rights to the network service providers. The virtual property is the certificate for users to claim rights against the network service providers. In the context of blockchain, the decentralization of blockchain means that the transaction of blockchain digital assets is completely determined by the private key holder, thereby ensuring that the private key holder has an absolute and unique control of his crypto assets. Furthermore, as mentioned earlier, the cryptographic authentication process used in blockchain architecture only allows a private key holder to trade his asset, and no person other than the holder, including the developers of the system, can take any action against his asset, thus guaranteeing the absolute (i.e., *contra omnes gentes*) control of the private key holder over the relevant asset. In summary, a blockchain digital asset can be exclusively controlled by a holder without a need to request the assistance from others, and the requirements of constituting a real right such as controllability and in rem nature have thus been met.

(3) Blockchain digital assets are available. Although the academic circles have not yet reached a consensus on the connotation of proprietary rights, it is generally recognized that property must have value, and an object in civil law must be possible to satisfy certain material or spiritual interests of its subject. There are many understandings of the term "value". It is generally believed that value is an objective existence and can be measured by the labor input contained in commodity production, whereas some views hold that value equals scarcity. In different scenarios, value can be embodied in different meanings such as a price in economy and a meaning or importance to people. According to Professor Wu Handong, an IP expert, "A right with personal interest of a subject as targeted matter should be regarded as a personal right. However, it cannot be asserted that proprietary right must be the right with economic interests as its contents."[26] The value is self-evident for digital assets endorsed by the assets of and rights to the immovables, physical goods, fiat currency, company's shares, creditor's rights, securities, etc.

As for an on-chain primary asset that does not represent any off-chain value, its value is endowed by a blockchain system and also depends on the social contract binding the participants, but its value will also fluctuate with the changes of economic and political environment. First, the scarcity of crypto assets is guaranteed by blockchain technology so that the holding and

[25] Jin Keke (金可可), Lun Zhipeiquan: Yi Deguo Minfaxue Wei Beijing (论支配权——以德国民法学为背景) [*On the Right to Dominance: with German Civil Law as the Background*] , 2 L. S. CHINA 68, 76 (2006).

[26] Wu Handong (吴汉东), Lun Caichanquan Tixi: Jianlun Minfadian Zhong de "Caichanquan Zongze " (论财产权体系——兼论民法典中的"财产权总则") [*On the System of Proprietary Rights and the General Principles of Proprietary Rights in China's Civil Code*], 2 L. S. CHINA 73, 73-74 (2005).

transaction of digital assets will not be meaningless just because such information can be infinitely copied. Bitcoin was once called “digital gold”. Specifically, its scarcity can be ensured by setting an upper limit of issuance and for the fact that it is difficult to mine.[27]

One can examine the online game virtual item market as an example as well. Blockchain technology can create virtual items with scarcity that are not controlled by anyone compared to the scarcity created by the traditional game developers based on their intentions and commitments; and virtual items have proprietary attribute because only a limited supply can create a great demand for these virtual items.[28] In addition, the digital assets on blockchain also have other meanings besides economic value, including the value for collection or the blockchain games, such as CryptoKitties and Decentraland, in which the unique digital collectibles and digital works of art in the game can be bought, collected and traded by and between users. Blockchain technology can ensure that such digital collectibles cannot be reproduced, and their scarcity is thus realized to satisfy people’s desires and fundamental needs to own rare things. NFTs can be used to represent any digital collectibles, and their scarcity and uniqueness make digital collectibles closer to the traditional physical collection activities such as traditional philately. Users can use crypto wallets in their smartphones to store and trade their NFT assets. For example, Gifto Wallet and Gifto Chain enables users to create and trade various virtual gifts, and supports such transactions to be paid by multiple crypto currencies and to operate on different platforms; this truly connects content creators and their fans with each other and each benefits from such connections.[29] At present, with the support of blockchain technology, especially the Ethereum blockchain ERC721 standard, digital collectibles are becoming blockchain applications with the brightest prospect after crypto currencies. In the future, online games, IP and original digital art and their combination will inject huge development vitality into the blockchain-based digital collection market.

In addition, the value based on a consensus mechanism cannot be denied because blockchain digital assets are saved in a specific system and their value will be lost after they are removed from the system. The traditional real rights law does not deny the existence of the value of a particular thing because it does not possess universality. For example, the law still recognizes the

---

[27] First, 21 million is the upper limit for bitcoin issuance. Second, there is a gradual increase of difficulty in bitcoin mining, and the output of bitcoin is reduced by half every four years. As of October 2019, 18 million bitcoins have appeared, leaving only 3 million bitcoins to be mined, showing an obvious scarcity.

[28] Mike Brusov, “Digital Assets Beyond Bitcoin: Three Blockchain Opportunities in Tech”, https://www.forbes.com/sites/forbestechcouncil/2019/08/07/digital-assets-beyond-bitcoin-three-blockchain-opportunities-in-tech/#654ff45b74b9 (last visited May 19, 2020).

[29] Gifto Official, “Gifto 3.0-Truly Universal Gifting”, https://medium.com/@gifto/gifto-3-0-truly-universal-gifting-21cd89e25798#:~:text=The%20Gifto%20Wallet%20allows%20users,through%20Gifto%20wallet%20apps%2Fbots (last visited June 3, 2020).

significance of a relative's relic, a small commodity with commemorative meaning even if it is just a photo or an old thing. Since the object with a value to a particular subject can be recognized as property, the value formed on the basis of a consensus mechanism should also be recognized and respected. Currently, there are more than 32 mainstream blockchain consensus algorithms. After an exploration period, the main research direction in the next stage will be the standardization of consensus algorithms, and a universal consensus algorithm may also be an agreed upon blockchain. Therefore, it is not appropriate to deny the value of blockchain digital assets just because of the differences in consensus mechanisms at this stage.

In summary, this paper argues that blockchain digital assets meet the characteristics of the objects of real rights. As a new type of intangible property, it has the features of real rights such as controllability and in rem nature. Additionally, the key for whether it can be included in the scope of the objects of real rights is the understanding and interpretation of such objects, which will be discussed below.

3.2 An analysis of the obstacles to include blockchain digital assets in the protection scope of real rights

Before the relatively new type of intangible property of blockchain digital assets is included in the scope of a real right, two obstacles must be resolved: whether the objects of real rights include incorporeal things, and how to remove the obstacles caused by the information attributes of blockchain digital assets.

3.2.1 Obstacles caused by the statutory types of real rights

Blockchain digital assets are intangible and purely virtual property with certain objects that can be controlled and used. This viewpoint conflicts with not only the idea from the traditional science of civil law that "a thing must have a physical body", but also the concept of incorporeal things within traditional civil law. This conflict creates obstacles to interpreting blockchain digital assets as the objects of real right protection.

First, blockchain digital assets are not corporeal things because they cannot be physically and realistically possessed. Article 115 of China's Civil Code states, "Things include the immovables and the movables. Where laws stipulate that rights are taken as objects of real rights, the provisions of such laws shall prevail." In general, the immovables and the movables mentioned in the article refer to corporeal things. Human's control of things has been improved with continuous developments in science and technology. Natural forces, such as the energy related to light, heat and electricity, have been accepted as "things" in civil law, and can be governed by the relevant

rules of the movables though they have no corporeal characteristics.[30]

Second, there are certain difficulties in classifying blockchain digital assets as "incorporeal things". In China's current real rights law system, the so-called "incorporeal things" generally refer to rights only, and need to be clearly provided by law. Therefore, because the concept that a thing must have a physical body and "incorporeal thing" only refers to rights, an exceptional method can be adopted for the objects that exist outside particular rights and have economic value: to interpret them as the exceptions of corporeal things or as other protected rights and interests in juxtaposition with the objects of real rights.

At present, the on-chain primary assets do not reference any rights that exist outside the chain, and they cannot be easily regarded as "incorporeal things" according to the traditional theory. However, with the development of immaterial wealth (property) in the digital age,[31] many scholars have begun to question and rethink the concept that "a thing must have a physical body", and they are seeking a possible method for protection. For example, some scholars hold that a unified concept should be established to include all proprietary rights and to form a new proprietary right system.[32] China has just adopted such a method in its Civil Code. Some scholars argue that real rights law is governed by proprietary relationship, and should include and reflect the property with monetary value formation in modern society by extending the denotation of incorporeal things according to their scientific principle.[33] At least, the above controversies show that there is still much room for discussing the concept and scope of things.

The author believes that the concept of intangible or incorporeal things should not be regarded as static, but rather as having enough flexibility to be adapted to the continuous development of a sociotechnical system. Since China's real rights law can accept the objects with incorporeal characteristics, such as electrical and heat energy, as "things" in the civil law and grant protection to them as the movables, there is now reason to include blockchain digital assets with real value in the scope of real rights protection. In the current digital and intelligent world, abstract and intangible property is emerging quickly.[34] Although the main part of intangible proprietary

---

30 LIU JIAAN (刘家安), Wuquanfa Lun (物权法论) [ON THE REAL RIGHT LAW] 12 (2015).

31 *See* Gao Zhiming (高志明), Feiwuzhi Caichan Xiangguan Falu Gainian de Yuyong Fenxi (非物质财产相关法律概念的语用分析) [*A Pragmatic Analysis of the Related Legal Concepts of Immaterial Property Laws*] , 3 DA LIAN LI GONG DA XUE XUE BAO（SHE HUI KE XUE BAN）(大连理工大学学报（社会科学版）) [JOURNAL OF DALIAN UNIVERSITY OF TECHNOLOGY (SOCIAL SCIENCE)] 87, 88-90 (2017).

32 Yang Lixin (杨立新), Zhonghua Renmin Gongheguo Minfa Zongze Yaoyi Yu Anli Jiedu (中华人民共和国民法总则要义与案例解读) [*The Key Points and Cases for Understanding the General Principles of Civil Law of the People's Republic of China*] 89 (2017).

33 Meng Qinguo (孟勤国), Wu de Dingyi Yu Wuquanbian (物的定义与《物权编》) [*The Definition of Thing and the Real Right Part in the Forthcoming China's Civil Code*] , 3 Faxue Pinglun (法学评论) [*LAW REVIEW*] 6, 6-7 (2019).

34 Wu Handong (吴汉东), Wuxing Caichanquan de Ruogan Lilun Wenti (无形财产权的若干理论问题) [*Some Theoretical Issues on Intangible Proprietary Rights*], 4 J. L. CHINA 79, 79-81 (1997).

rights is intellectual property,[35] intangible property like blockchain digital assets cannot be regarded as new intangible property under an intellectual property system. If the law were confined by the traditional view that a real right (ownership) could only be applied to tangible property, it would be impossible to provide adequate legal protection for blockchain digital assets, and it would not be conducive to the innovation and development of market for them. Furthermore, the expansion of a real right theory from tangible property to intangible property is an inevitable requirement for digital development.

Under the current development trend of the digital economy, blockchain digital assets undoubtedly represent the future. Thus, it requires appropriate development in the types of real right objects, an expansion of the concept of incorporeal things, or a recognition of digital assets as the "third kind of thing" other than corporeal or incorporeal things, with statutory rights as the core. If so, blockchain digital assets can be protected by law as the objects of real rights so that the real right system can advance with the times. Hence it is not only necessary for reality, but also a forward-looking move and legal innovation for the future. The author believes that blockchain digital assets should be protected by a real rights law because they are different from the traditional network virtual property in their possession of many new characteristics that align well with the real right theory. Therefore, such protection in China will not only have the least impact on the current property right system, but also provide complete legal protection for blockchain digital assets.

3.2.2 Obstacles caused by the information attributes of blockchain digital assets

In the legal sense, another obstacle regarding classification of blockchain digital assets as property is that it is difficult to regard purely digital information (i.e., data) itself as property even though the carrier of information may be recognized as property. Due to its lack of exclusivity, information can be copied easily, and it is impossible to differentiate its original and copy whereas both of them have the same commercial value. Once it is disseminated, information can be used by different people at the same time. Unlike property, information cannot be transferred but only transmitted. After the dissemination, both parties have the same information. These characteristics make it difficult to exert actual control over the information or decide who is the real owner of the information.[36] Therefore, some scholars hold that the data has no specificity and independence and cannot be covered by intangibles, included in the objects representing civil rights, or regarded

[35] Wu Handong (吴汉东), Wuxing Caichanquan Jiben Wenti Yanjiu (无形财产权基本问题研究) [*ON THE BASIC QUESTIONS OF INTANGIBLE PROPRIETARY RIGHTS*], 48 (2013).

[36] The information constituting a creative expression can be the object of intellectual property right, but it is substantially different from ownership.

as independent property.[37] However, virtual property, as electronic data, has the characteristics of circulation and sharing in nature, whereas copy, deletion, uploading and sending are its inherent functions, which are in direct conflict with the requirement of an object's certainty.[38]

As far as this issue is concerned, although blockchain crypto assets are represented by public and private data, it should not be deemed that crypto assets are composed of these data. On the contrary, the data should be regarded as the record of the assets and the key for the transaction of the assets. Therefore, the commercial value of crypto assets does not lie in the recorded data themselves, but in the possibility that the person in possession of the data can start, confirm and validate the transaction according to the rules of the system. In other words, what is important is not the information displayed by the data themselves but rather the ability the data brings to its owner. For example, the private key of the bitcoin system is a 256-bit randomly generated number, and such data has no value. The key is the mathematical relationship between the data and the corresponding bitcoin public address, which allows the transactions from this address to be signed with encryption and confirmed. Therefore, crypto assets are different from the intellectual property rights, which are also information. Crypto assets do not transmit, express or convey anything. They are just a token used in the system. Of course, an NFT asset, as a digital collectible, may involve both intellectual property rights and the ownership of NFT asset holder, and there is no conflict between them.

Furthermore, many questions faced by claiming ownership of information will not arise in the case of crypto assets. Although data related to crypto assets can be copied, the transaction ledger and consensus mechanism can prevent double spending by private key holders and ensure that the assets will not be controlled by multiple people at the same time. Even if the private key is shared with others through an off-chain transfer contract, another person will only have a temporary control. Once the assets are transferred on the chain, an exclusive control is achieved. Therefore, it can be said that crypto assets, as a collection of public data, private keys and system rules, conform to the characteristics of real right objects, and the nature of their information does not prevent them from constituting property in the sense of ownership.

Based on these arguments, it can be proposed that blockchain digital assets align well with real right theory, qualifying the assets to be accepted by a real right system as the objects of real rights. Legal holders can claim ownership of them, and they can enjoy the rights to possess, utilize,

---

[37] Mei Xiaying (梅夏英), Shuju de Falu Shuxing Jiqi Minfa Dingwei (数据的法律属性及其民法定位) [*The Legal Properties of Data and the Position of Data in Civil Law*], 9 Zhongguo Shehui Kexue (中国社会科学) [SOCIAL SCIENCE IN CHINA (hereinafter "S. S. CHINA")] 167, 170 (2016).

[38] Mei Xiaying (梅夏英), Xuni Caichan de Fanchou Jieding He Minfa Baohu Moshi (虚拟财产的范畴界定和民法保护模式) [*The Category Definition and Civil Law Protection Mode of Virtual Property*], 5 Huadong Zhengfa Daxue Xuebao (华东政法大学学报) [ECUPL JOURNAL] 42, 47-49 (2017).

profit from and dispose of them. However, it cannot be ignored that China is a country with a strict statutory real right system under which no clear legal provision has been made for blockchain digital assets. Therefore, they can be interpreted as a new type of intangible property in the current law and included in the protection scope of network virtual property provided for in Article 127 of China's Civil Code.

IV. Suggestions for the legal protection of blockchain digital assets under China's civil law systems

4.1 The relationship between blockchain digital assets and Article 127 of China's Civil Code

After years of academic discussions and industrial disputes, China addresses both the development trends of the digital age and the needs of property rights in its Civil Code. Before that, a principle provision was stipulated in Article 127 of China's General Provisions of the Civil Law that said: "Where any laws provide for the protection of data and network virtual property, such laws shall apply." The position of this article showed that the law has clearly defined network virtual property and data as the objects of civil rights and interests, though it did not clearly define them as the objects of rights, including real rights and other property rights. Moreover, the Civil Code has established a broad proprietary right system covering real rights, creditor's rights, intellectual property rights, and new intangible property such as data and network virtual property. In this context, the proprietary attributes of network virtual property and data have attracted the attention of academia and industry. In the *Opinions of the CPC Central Committee and the State Council on Improving the Systems and Mechanisms for Market-based Allocation of Factors of Production* released in April 2020, data are listed in parallel with the traditional production factors such as land, labor, capital and technology in addition to a clarification of the importance of data as a new type of production factor and a proposal to "improve the nature of property rights according to the nature of data".[39]

An exploration of its legislative process shows that the "General Principles of Civil Law (Draft)" considered in June 2016 actually provided separate provisions for network virtual property and data. Article 102 stipulated that "things" include immovables and movables, and that where laws stipulate that specific rights or network virtual property are taken as objects of the real rights, the provisions of such laws shall prevail. Article 108 listed "data information" as the objects of intellectual property rights. It can be said that the earliest legislative idea was to protect

[39] Cao Jianfeng's (曹建峰), Shuju Shangsheng Wei Shengchan Yaosu Diwei ，Gu Wai Sh Ju Zhengce Qushi Daigei Women Naxie Qishi ?(数据上升为生产要素地位，国外数据政策趋势带给我们哪些启示?) [WHAT CAN CHINA LEARN FROM OTHER COUNTRIES IN DATA POLICY TREND WHEN DATA ARISES AS A PRODUCTION FACTOR?], see the official website of Tencent Research Institute, https://tisi.org/14384 (last visited May 21, 2020).

network virtual property and data respectively as the objects of real rights and intellectual property rights. However, due to the huge controversies over these two articles at that time, the legislators later made some compromises in the form of the principle provisions of Article 127 of the General Principles of Civil Law. Nonetheless, some scholars argue that the textual evolution of the articles (draft) of the General Principles of Civil Law and the logical reasoning show that network virtual property is an object of real rights and a new type of thing (i.e., virtual thing) over which an ownership can be established.[40]

The author believes that the relationship between blockchain digital assets and Article 127 of the Civil Code can be understood at two levels. The first is the relationship between blockchain digital assets and data. In a broad sense, data[41] can cover intellectual property objects, network virtual property, etc. There are two meanings in this regard due to the characteristics and complexity of data. On the one hand, there may be multiple legal interests over data, which can include intellectual property rights on the data (including copyright, patent right and business secret), personal rights and interests (including personal information protection), contractual rights and proprietary rights in competition law.[42] On the other hand, it is difficult to establish a new absolute right like a real right outside the existing legal systems such as intellectual property rights.[43] Although it was previously mentioned that blockchain digital assets are essentially electronic data, a blockchain system helps them overcome the insurmountable obstacles to be the objects of ownership. In this sense, blockchain digital assets exceed the scope of data ownership in the general sense and should be given special treatment. The second is the relationship between blockchain digital assets and network virtual property. As a large category, network virtual property has many types such as accounts and virtual items, including blockchain digital assets. It is just a relationship between the general and the special. Different types of network virtual property have very different characteristics, which influence the form of the legal protection for them. This means that it is impossible to formulate uniform legal protection rules for network

---

[40] Yang Lixin (杨立新), Minfa Zongze Guiding Wangluo Xuni Caichan de Hanyi Ji Zhongyao Jiazhi (民法总则规定网络虚拟财产的含义及重要价值) [*Network Virtual Property under the General Rules of China's Civil Code: Definition and Implications*], 3 Dongfang Faxue (东方法学) [ORIENTAL LAW] 66, 66-67 (2017).

[41] Academia has reached no consensus on the difference between data and information, but use them without differentiation, which can be seen in the legislation such as the General Data Protection Regulation (GDPR). For the purpose of this paper, a unit of data is a binary code represented by 0 and 1, that is, a digital data, including structured data in the form of expression (stored in the database and used to logically express a realized data in a two-dimensional table structure) and unstructured data (such as text, documents, pictures, audios, videos and various reports).

[42] Cao Jianfeng (曹建峰), Minfa Zongze Shuju Baohu Lujing :Gaikuo Shi Baohu Ji Yu Zhishi Chanquan Xietiao (民法总则数据保护路径:概括式保护及与知识产权协调) [*Data Protection Approach in General Principles of China's Civil Law: Generalized Protection and Coordination with Intellectual Property*], 1 Dashuju (大数据) [Big Data Research] 92, 92-93 (2017).

[43] *See* Si Xiao （司晓）, Shuju Yaosu Shichang Huhuan Shuju Zhili Xin Guize (数据要素市场呼唤数据治理新规则) [*Data Element Market Calls for New Rules of Data Governance*], 3 Tushu Yu Qingbao (图书与情报) [LIBRARY AND INFORMATION] 7, 7-8 (2020).

virtual property, but it is necessary to make different rules for network virtual property according to their different types and characteristics.

In fact, to construct a theory on intangible property has great theoretical and practical significance in the current age with comprehensive digital development in economy and society. As a large category, intangible property is not a unified civil right, but may refer to different proprietary rights. For example, intangible property in the sense of intellectual achievements falls within the category of intellectual property rights, blockchain digital assets are more likely to fall within the category of real rights, and contractual claims and new types of property rights and interests may be beyond data and other network virtual property. This means that intangible property can be classified into the scope covered by real rights and intellectual property according to its nature and characteristics, and other intangible property that cannot be classified into the traditional proprietary rights can be protected by contractual claims and new proprietary rights. In contrast to other theories of treating all network virtual property as a new type of proprietary right (right and interest) without differentiation, the author proposes the intangible property theory with a consideration of the different characteristics of intellectual achievements, data and different network virtual properties. The theory has both an arrangement of appropriate property right protection mode based on such considerations, and a strict logical self-consistency. Therefore, the theory can also adapt well to the complicated and complex reality.

4.2 The choice for future legislation and judicature in China

Based on the aforesaid intangible property theory, the author believes that China should adopt a method of classified protection according to the characteristics and degree of controllability of different types of network virtual property when formulating the protection provisions for network virtual property in accordance with Article 127 of the Civil Code in the future. The author has a primary idea in this regard: there should be an application or referential application of the rules of real rights law in the protection of the network virtual property such as blockchain digital assets that meets the characteristics of real right; the protection granted to other network virtual property with relatively weak controllability should be based on their specific mechanisms, models and characteristics and in the form of contractual claims, new types of property rights, etc.

Under this legislative model, the first thing for a judicial organ handling a specific network virtual property is to determine whether it meets the requirements of real rights objects such as specificity, controllability and rem in nature. If the answer is yes, a court should protect such network virtual property as a real right; if the answer is no, it should protect it in other forms according to the specific situation. Based on the demonstration in this paper and by tokenization, blockchain can be used to create digital assets with unique characteristics, which could enable

people to make digital assets unique, unchangeable, unforgeable, non-copyable and absolutely transferable. These unique characteristics are sufficient to qualify the digital assets as the objects of real rights. Therefore, the primary blockchain digital assets on the chain meet the characteristics of real rights. Before the legislation clearly grants a protection of real rights to them, judicial organs may try to include them in the protection scope of real rights law without violating the basic spirit of the law by an expansive interpretation of the law, or at least grant them maximum protection according to Article 127 of the Civil Code.

4.3 Rules for the protection of blockchain digital assets as real rights

4.3.1 Owner of ownership and transfer rules.

Generally, an owner is defined as a person who legally possesses a tangible property (e.g., a book). When it comes to owners of blockchain digital assets, a person who knows and holds the private key of a crypto asset in a legal manner should generally be regarded as the owner of the asset. Of course, such determination also depends on the specific situation and the rules of the relevant system. For example, where a private key is held by a representative of another person (such as an employer or client), or by a custodian or intermediary, the ownership will be determined according to the rules on agency or trust. A crypto asset may have more than one key. If so, the ownership will be jointly owned or shared by multiple holders. If a hacker obtains a private key by illegal methods such as network attack or intrusion, he is naturally not a legal owner of the key, and the owner has the right to recover the asset when the hacker disposes of the asset. However, the bona fide acquisition rule for governing real rights may also be applicable to blockchain digital assets. The initial creation or acquisition of crypto assets relies on the rules of the system. For example, bitcoin is created as a reward in the mining process used to construct and confirm the ledger, and participants can achieve an initial acquisition of ownership of bitcoin by mining. In addition, it may be difficult to identify the true owner of a particular asset in a blockchain system that adopts anonymous transactions because all transactions are made and transmitted to an anonymous address identifier. However, this does not mean that the asset does not have an owner.

The transfer of blockchain digital assets usually takes place on the chain. When conducting a transaction, the assignor usually modifies the public parameter or generates a new parameter of his asset to create a record of the transfer (including the assignee’s information). Then, the assignor uses the private key to sign the transfer record digitally to complete the confirmation. After that, the asset is linked to the assignee’s private key and is under the assignee’s exclusive control. The ownership transfer is completed when the assignor completes the confirmation of the transaction and broadcasts it to the blockchain, namely when the transaction is accepted by the consensus

mechanism and recorded on the blockchain ledger. This means that the transfer of blockchain digital asset ownership is more similar to the registration of immovable property than it is to the delivery of movable property because the assignor usually generates a new or modified public parameter and private key for the crypto asset in the case of digital asset transfer. Although the data representing the “old” crypto asset still exists in the blockchain network, it has no value or function because the asset is deemed as having been spent or canceled under the consensus mechanism. The “new” crypto asset is represented by the new data and controlled by the new key. Obviously, this is essentially the same as the new registration made by a centralized immovable property registration agency for the transfer of immovable property and confirmation of the new ownership thereof.

Once the transaction is recorded on the blockchain ledger, any attempt by the assignor to retransfer the asset will not be accepted by the consensus mechanism, thereby avoiding the occurrence of double transactions. In addition, the phenomenon of selling one thing to two persons in reality may also befall blockchain digital assets. For example, there is a risk that the assignor may transfer the asset twice before the transaction is recorded on the blockchain ledger. If the second transfer is listed in the blockchain ledger before the first one, the assignee’s crypto asset in the first transaction will not be considered as a valid transfer, and thus it will be worthless in practice. In another example, an assignor could sign off-chain transfer contracts with two persons at the same time, but the second assignee completes the transfer before the first assignee. In these cases, because the time node of ownership transfer is determined by the record on the chain, the second assignee obtains ownership, and the assignee constitutes a breach of contract against the first assignee.

In addition, transfer may also be conducted off the chain. For example, the two parties signed a contract to transfer a crypto asset but fail to complete the on-chain transfer process. Although some Chinese Courts have made judgments that such contracts are invalid, this paper suggests that there is no justification for refusing to recognize and fulfill such contracts. However, an off-chain transfer will also result in practical difficulties: because the assignor still holds the key, he may bypass the off-chain contract and transfer the crypto asset again, leading to a repetitive transaction. These issues can be properly resolved within the existing legal framework of contract law. Of course, it also requires a legal recognition of blockchain-based signatures (the person conducting the transaction), time stamps (the time of transaction occurrence), confirmation (the person confirming the transaction) and “documents” (transaction or contract-related data).

4.3.2 Contents of blockchain digital assets as ownership rights

Generally speaking, under China’s civil law systems, the obligee of the ownership of a

blockchain digital asset as a real right enjoys the rights to possess, utilize, profit from and dispose of the asset. It is also possible to protect blockchain digital assets with reference to the regulations of the movables like intangibles such as electrical and light energy. This means that security rights such as mortgages, pledges, and liens can be established over blockchain digital assets. Traditionally, an establishment of a pledge or lien on movable property requires a transfer of physical possession of a thing, but blockchain digital assets cannot be physically possessed like tangible things. Does this mean that it is impossible to establish a pledge or lien on blockchain digital assets? The author tends to believe that the answer is yes. For example, restrictions may be imposed on the exercise of the asset through smart contracts, thereby generating certain automatically executed behaviors to meet the requirements of the security interest.

As far as crypto currencies are concerned, if their statuses as currency are recognized by legislation in the future, they will be protected as homogeneous goods. It implies that possession means ownership: there will be only an application of the principle of returning equal value in the case of return, it cannot be used as the object of a pledge, and no person can object to an enforcement of property.[44] Until then, however, crypto assets are still heterogeneous goods, and the rules for the protection of real rights should be applicable to blockchain digital assets.

V. Prospects for the application of blockchain digital assets

Blockchain technology provides new opportunities for the development of digital assets and transactions, which can more easily change an array of tangible and intangible assets into various types of “tokens” that can be widely traded and circulated as well as stored in a new (usually decentralized) way. This will open up new areas for the capital market as well as the broader market and economy. It can be said that the development in the past ten years or more has proved that blockchain technology is the best solution to digital asset transactions and applicable to any form of asset transactions. In addition to very broad prospects for the application of blockchain digital assets, there may be unprecedented new applications in the future. The recognition and protection in law will further stimulate the innovation and development of the blockchain digital asset market. The following are five exciting application scenarios for the future development of the digital economy.

(1) Asset digitization: Asset digitization or asset tokenization is a process of transforming traditional assets by “tokenization”, which brings new advantages to the registration, storage and transaction of traditional assets. Under blockchain framework, all assets can be changed into smart properties. That is, every asset can be written into blockchain and represented by a unique

[44] *See* Yang Yanchao (杨延超), Lun Shuzi Huobi de Falu Shuxing (论数字货币的法律属性) [*On the Legal Attributes of Crypto Currency*], 1 S. S. CHINA 85, 100-101 (2020).

identifier so that the asset can be tracked, controlled and traded, which means that all tangible and intangible assets can be registered and circulated on blockchain. This is a great vision of blockchain in the asset trading market, and an entirely new asset trading model is expected to be established. This development trend is called “tokenization”. The first wave under such a trend is the tokenization of financial assets because these markets have been digitized with the involvement of asset transfers and ledgers, making them naturally suitable for blockchain. The traditional liquidity financial markets related to stocks, creditor’s rights and derivatives are excellent applications of tokenization. As far as the initial offering of blockchain companies is concerned, STOs will be a phenomenal presence in the short and medium term. Tokenization can also be used to strengthen the liquidity of financial assets with poor liquidity such as private equity, venture capital and the immovables, and to grant liquidity to unlisted financial instruments such as an employee’s shares in private companies. The immovables are also expected to be moved on the chain so that people can register, transfer and trade them directly on blockchain. For example, the Red Swan, a US commercial immovable property trading company, and Polymath, a blockchain platform, have cooperated and tokenized immovable property with a value of 2.2 billion US dollar; this has created an immovable property transaction business based on blockchain, which not only provides investors with high liquidity, but also allows people who cannot afford to invest in the entire immovable property to invest in a part of it. A similar practice of tokenizing immovable property continues to emerge in 2020.[45] Of course, although it is a promising development of asset digitization in the future, there should be changes and preparation at an institutional level for the development to be realized.

(2) Property rights to data: In China, “data” was stipulated as production material for the first time in 2019, and its important status as a new production factor was further clarified in 2020. Under this background, there will be an increasingly strong demand for data ownership and transaction rules for the development of the digital economy. The government and all sectors of society are also calling for the establishment of a data property right system. For example, the European Union (EU) has proposed establishing data producer’s rights. This proposal outlines the rights that an owner or a long-term user of an equipment (such as the tenant) has based on his operations such as collection, analysis and processing, including the right to use and permit others to use the data as well as the right to prevent others from using or obtaining the data without authorization. The EU also clarifies that the right is a nature of ownership rather than a nature of

[45] Samuel Haig, “Red Swan and Polymath Tokenize $2.2 Billion of High End Real Estate”, https://cointelegraph.com/news/red-swan-and-polymath-tokenize-22-billion-of-high-end-real-estate (last visited May 18, 2020).

intellectual property.[46] Traditionally, however, to claim ownership of data information has to face many practical difficulties because of information's features such as non-exclusivity, dissemination, and possibility to be unlimitedly copied, which makes data claiming and data ownership determination pointless. However, blockchain technology can provide technical conditions for the construction of data property rights because blockchain can ensure that every digital object is unique and impossible to be copied and has a clear owner and a bounded account of the owner. Therefore, blockchain is expected to support the data transaction market to cover the right confirmation as well as the sharing, licensing and transaction of data.

(3) Digital Collectibles: There is a huge market of virtual items in online games. In 2018, global players spent 138 billion US dollar on games.[47] However, these items were not owned by game players in reality but stored in the servers of game service providers. In addition, all game players also face a risk that the virtual items may be lost, damaged, stolen or traded on the black market, resulting in a loss of hundreds of millions US dollars every year. Blockchain can provide a safe and reliable new way for storing, controlling, using and even trading in-game items, which will greatly increase their functional, economic and social values.

For example, game developers can, by using blockchain technology, create rare virtual items and ensure their scarcity because only limited supply can create great demand for these virtual items. Blockchain technology can also be used to safely and permanently store these virtual items, and to further support or prevent their transactions. In other words, blockchain technology can enable these virtual items to become real digital assets with property attributes. Tokenized digital collectibles are also worth consideration. For example, users can buy, collect and trade unique digital collectibles and digital artworks in blockchain games such as CryptoKitties and Decentraland. Such NFTs can represent any digital collectibles, and the scarcity and uniqueness features of the NFTs make digital collectibles closer to the traditional physical collection activities. Users can store and trade their NFT assets through a crypto wallet in their smartphones. As mentioned earlier, Gifto intends to create a common infrastructure for creating and trading virtual gifts, which is a typical representative application in this regard. In the future, there will be a combination of online games, IP and original digital art, and such combinations will inject huge development vitality into the blockchain-based digital collectibles market to meet people's

---

[46] Cao Jianfeng and Zhu Linhua (曹建峰，祝林华), Ouzhou Shuju Chanquan Chutan (欧洲数据产权初探) [*Preliminary Study on European Data Property Rights*] , 7 Xinxi Anquan Yu Tongxin Baomi (信息安全与通信保密) [INFORMATION SECURITY AND COMMUNICATIONS PRIVACY] 31, 33 (2018).

[47] Tom Wijman, "Mobile Revenues Account for More Than 50% of the Global Games Market as It Reaches $137.9 Billion in 2018", https://newzoo.com/insights/articles/global-games-market-reaches-137-9-billion-in-2018-mobile-games-take-half/ (last visited May 20, 2020).

fundamental desires and needs to own scarce things. In addition, "digital twins" targeted for luxury goods and other objects can also be created for new markets and usage methods.

(4) Digital commodities transactions: Users can buy digital commodities such as e-books, digital music and software in the digital world, but cannot have ownership of those commodities as in the real world because they are not tangible like paper books, CDs and DVD. Therefore, a model of intellectual property license is often adopted in the sale of digital commodities. However, the issue of digital resale has continuously prompted discussion among academic circles and judicial practices, specifically regarding the application of the intellectual property exhaustion principle in a network environment. To this end, blockchain technology can be used to support the resolution to the ownership remolding of digital commodities and to the transfer difficulties caused by information replication, thereby realizing the real transfer of digital commodities.

(5) Identity as an asset: Blockchain technology can be used to provide a feasible solution for personal digital identity management. On the one hand, users can have a better control of their personal information sharing scenarios, including who should be informed of private keys. On the other hand, it may even be possible to create new business models. For example, users may be permitted to monetize (e.g., rent or sell) their personal data.

In addition, tokenization can be used to measure, evaluate and trade things such as environmental impacts and other economic "negative externalities" that cannot be traditionally traded. These externalities (e.g., carbon credits) are considered to have important economic and social characteristics. It will be practical to use blockchain technology to tokenize such non-financial assets.

VI. Conclusions

In the ten-plus years of its development, blockchain technology has led to an increasingly booming digital asset market. Many countries have regarded blockchain and distributed ledger technology as breakthrough technologies in next few decades, and raised blockchain to be their national strategies one after another[48] to vigorously promote their development and application so that they may become the global blockchain innovation centers. In this context, although the market scale of digital assets based on blockchain is still very small due to the constraints of the imperfect systems and other factors, blockchain digital assets and smart contracts represent the future of economics and the legal field. There will be more scenarios for their application in the future, and more possibilities will be created by integrating blockchain into technologies such as artificial intelligence, the Internet of things (IoT) and virtual reality (VR). Before that, an

[48] *See* Tang Daosheng, Xu Siyan, Meng Yan and Cao Jianfeng (汤道生，徐思彦，孟岩，曹建峰), Chanye Qukuailian (产业区块链) [INDUSTRIAL BLOCKCHAIN] 240 (2020).

appropriate systematic and legal framework should be established for the development of blockchain digital assets and smart contracts. This framework should include, but is not limited to: the legal status of blockchain digital assets and smart contracts; whether a “token” as the carrier of off-chain rights is a legal and effective registration, certificates of rights (real rights certificates), or financial instrument; the legal recognition of signatures, time stamps, confirmations and acceptance of “documents” on the basis of blockchain; legal remedies for the undertaking of responsibility for and jurisdiction over digital asset transactions and smart contracts; the legal status and undertaking of responsibility related to a distributed autonomous organization (DAO). Only in this way can China ensure a sustainable innovation in blockchain digital assets and smart contracts, thereby taking the lead in the future digital economic development of the world.

For the purpose of this paper, crypto assets such as crypto currencies and digital collectibles have been identified as not having any off-systematic value or rights in the real world. As pure virtual assets, whether they can be regarded as legal property, especially being treated as a real right, depends on their characteristics, the rules of the system on which they exist and their related purposes (e.g., inheritance and divorce property division). In theory, as a new type of intangible assets, blockchain digital assets are obviously different from the traditional network virtual property such as game props; holders can exercise exclusive dominance and control over their blockchain digital assets based on private keys, which is most consistent with real right theory. Thus, it is enough for them to constitute the objects of real rights and to be accepted by the real rights law system. However, there are certain difficulties in incorporating them into the object scope of the China’s real rights law because it is a country with adherence to the principle of statutory real rights. In future legislation, China should adopt the principle of differentiation to include network virtual property such as blockchain digital assets that conform to the characteristics of real rights in the protection scope of its real rights law; in this way they will provide protection for other network virtual property with relatively weak controllability and dominance in the forms of contractual claims and new-type property rights and interests.

Of course, the reason for the development and growth of the decentralized blockchain digital assets is that the trust mechanism and code rules supported by blockchain technology play an institutional role to some extent to support safe and reliable point-to-point transactions. This means that blockchain can be used to support cross-platform and even de-platform business activities in the future, so that intangible assets such as goodwill, accounts and virtual items truly belong to the parties rather than being controlled or restricted by the platforms at present. However, it is impossible and unrealistic in the foreseeable future that the codes and technical rules would completely replace the law according to the ideas advocated by technology

enthusiasts.[49] That is the reason for the laws and institutions to be adaptable to the development trend of digital assets and smart contracts. In essence, people's behavior and activities around blockchain digital assets need to be co-adjusted by moral, legal, market, technical and other forces. After all, historical experience has shown that disruptive technology and law can always achieve each other's goals in the end, and it is believed that blockchain digital assets can also promote a legal innovation and reform in their development.

[49] *See* Si Xiao's (司晓), Jingji Zengzhang de Xinren Jichu（经济增长的信任基础）[TRUST FOUNDATION FOR ECONOMIC GROWTH], *See* the Wechat Official Account "Tencent Research Institute" , https://mp.weixin.qq.com/s/6eodjPivQN7FI8HZMNXSAg (last visited May 5, 2020).