IMPLEMENTATION OF SMART CONTRACTS SECURED BY DIGITAL RUBLE INTO THE RUSSIAN ECONOMY

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Abstract: *Over the past decade, the Russian Federation has made significant progress in the integration of digital technologies into its economy. These include the Quick Payment System (QPS), which facilitates the transfer of funds between commercial banks without the imposition of commission, and the establishment and maintenance of digital services such as "Government Services," which enables citizens to access government services and discharge government duties and fines remotely via a mobile application or online portal. However, the global landscape is constantly evolving, and these high-tech services are no longer considered innovative. One of the most contemporary technologies that all major global economies are striving to integrate into their financial systems is smart contracts. Russia is also planning to introduce smart contracts, and for this purpose, it is creating accompanying tools such as the "digital ruble," which will ensure the correct operation of this technology. This article aims to elucidate the principles of smart contracts in the Russian Federation, identify the advantages they offer over traditional contracts, examine the modalities of payment in this type of transaction, assess their impact on the Russian economy, and explore the prospects for their implementation and development in the context of current Russian realities.*

Keywords: *smart contract, digital ruble, blockchain, digital financial assets*
JEL: *O14, G28*

1. Introduction

It was observed by web users and programmers involved in researching and developing digital financial assets (DFAs) that a problem, termed "double spending", might restrict future growth in the field of DFA trading. The core issue pertains to users of the trading platform engaging in the expenditure of the same digital assets multiple times without encountering any restrictions.

To solve this problem, a person or group of people (still no confirmed information) named Satoshi Nakamoto published a project document in 2008 called "Bitcoin: A Digital Peer-to-Peer Cash System." This 8-page document contained an innovative idea: the introduction of blockchain technology to eliminate the problem of duplication of digital financial assets and to maintain confidence that no one could defraud users.

In the contemporary context, the blockchain is defined as a comprehensive and permanent record of transactions conducted by a decentralised community of users. This transaction register is updated in real time and accepted as fact by users, with copies of its database stored on each user's computer. This characteristic is pivotal in ensuring the seamless and transparent

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operation of the blockchain system, without the occurrence of "double spending" issues. In the event of such an occurrence, it would result in immediate conflict in the transaction history of each participant.

In order to comprehend the principles of blockchain, it is necessary to consider the operation of this registry, commencing from the lowest level. The lowest link in this case is defined as any transaction that occurs on the blockchain. Each transaction is considered complete and validated when it is grouped with several others and recorded in a special structure called a block (a special structure for recording a group of transactions in the blockchain system). The assembled blocks are then combined to create a blockchain.

The number of transactions in each block is limited and always equal, and each new block added to the chain contains information about the previous block. This is done so that the chain is continuous, and the transaction information contained in a block cannot be changed.

Each new block performs validation of the transactions whose information it contains and additional validation of transactions in all previous blocks in the chain. It is virtually impossible to change the information in a block that is in the chain, because then the information in all previous blocks would have to be edited, which would be noticed by other users.

As long as the transaction is not included in the block, the system considers that the number of digital financial assets on the digital wallet addresses of the buyer and seller remains unchanged. Therefore, it is technically possible for several different transactions to be executed to sell the same DFAs from one digital wallet to different buyers. Despite this, as soon as one of these transactions is included in the block, the system will ignore the other transactions with the same DFAs. In other words, the inclusion of a transaction in the block is a confirmation of its authenticity, regardless of the presence of other earlier or later transactions with the same digital financial assets.

Based on this, we can observe that blockchain has the following properties:

1) Decentralization;

2) Reliability;

3) Continuity;

4) Transparency;

5) Irreversibility.

However, even though blockchain was designed to provide a decentralized infrastructure for transactions, it can be made centralized. This possibility exists due to various blockchain algorithms such as Proof of Work, Proof of Importance, and Proof of Stake.

“Proof of Work” is the most commonly and long-used algorithm. In this algorithm, the user needs to prove that they have done the work. Whoever is the first to do the work is the first to choose a transaction status and receives a mining reward. This reward consists of all transaction fees for mining the block.

“Proof of Stake” is the simplest algorithm for confirming or rejecting transactions. In simple terms, whoever controls more money in the blockchain has more value. This algorithm is the most criticized because it turns the blockchain into a centralized distribution registry where power is distributed among a narrow circle of the wealthiest users, contradicting its creator's idea of a decentralized system.

The "Proof of Importance" algorithm is one of the least used mechanisms at the moment. It is used by users with the highest significance to confirm or reject transactions. In this algorithm, "importance" refers to the trust users have in the miners that form the blocks.

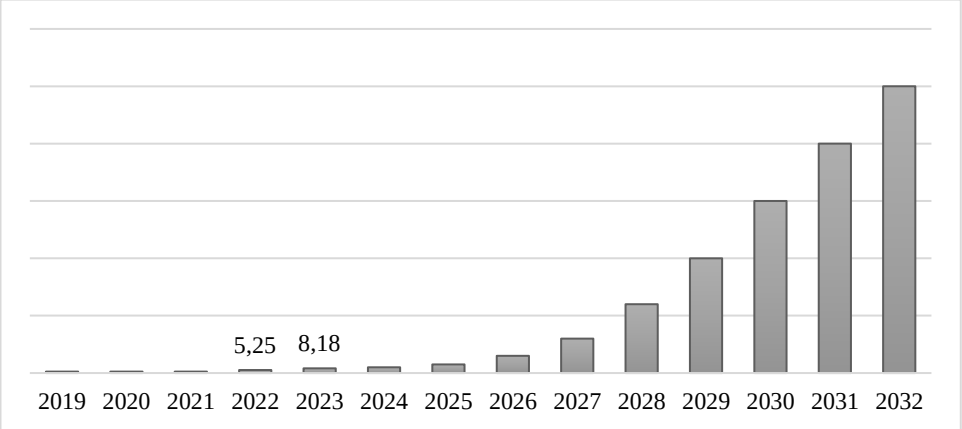
The importance factor of each user is based on the value it represents in the system. It decides which users have the right to engage in block mining, how often they can do it, and what their reward will be.

The peculiarity of this algorithm is that absolutely any user can get the right to engage in mining, regardless of how many DFAs are in their digital wallet. In this regard, this algorithm can be easily cheated by creating fake user accounts that will vote for the necessary miner. Some blockchain systems use this algorithm, but we believe it is unstable and needs improvements to make it less vulnerable to such fraud.

2. Data and Results

Today, the demand for blockchain is steadily increasing. Thus, according to Figure 1, we can see that the demand for blockchain technology is growing rapidly in North America. While today the market size of blockchain technology is approximately 10 billion USD, by 2032, the market size will increase tenfold to tens of billions of USD. In our view, one of the main reasons why the demand for blockchain is so high today, and will continue to grow in the future, is the possibility of realizing an instrument such as a "smart contract" in it.

Figure 1. Blockchain technology market size in North America, 2019-2032 (USD billion)



Source: www.fortunebusinessinsights.com

To date, there is no clearly defined definition for the concept of a 'smart contract' in Russian legislation. Of course, we can refer to the definition of an ordinary contract contained in paragraph 1 of Article 420 of the Civil Code of the Russian Federation, which states that "a contract is an agreement of two or more persons to establish, change or terminate civil rights and obligations." However, this definition is too general.

In the publications of the Russian scientific community, when defining the concept of smart contract, some researchers refer to A.I. Savelyev, who understands a smart contract as "a contract existing in the form of software code implemented on the blockchain platform, which

ensures the autonomy and self-execution of the terms of such a contract upon the occurrence of predetermined circumstances"[3].

Another part of the scientific community is more inclined to the definition that a smart contract is a special "digital algorithm describing a set of conditions, the fulfilment of which entails some events in the real world or digital systems."

In addition to the above definitions, there is also the definition by Nick Szabo, the person who developed the idea of a smart contract. He defines a smart contract as a computer protocol that fulfils the conditions of a contract.

Based on our understanding of the essence of the "smart contract," we have formulated a definition that we will rely on in our research: a smart contract is an electronic contract written using program code and existing in the form of a computer protocol that independently oversees the fulfilment of the terms of the contract.

The smart contract originated in 1994 when cryptographer and lawyer Nick Szabo first used the term. A smart contract is the result of the joint work of lawyers and programmers, where the former provide the terms of the contract, and the latter write the corresponding program code using ternary conditional operations.

However, unlike many other programs, a smart contract works with real assets. When a pre-programmed condition is triggered, the smart contract fulfils the corresponding contractual condition. It is important to note that Szabo's original theories on how these contracts could and should work remained unrealized in the 90s because there was no digital financial system that could support such complex programmed transactions. Only in 2008, with the advent of cryptocurrency and blockchain technology, was it possible to put the idea of smart contracts into practice. Many companies have actively taken up Szabo's idea, the most famous of which are Ethereum and Bitcoin. Today, smart contracts are used extensively in cryptocurrency exchange trading and in NFT (non-fungible token) trading.

Given the capacity of smart contracts to facilitate the exchange of a wide range of assets, it is reasonable to hypothesise that they will, in the near future, supersede some traditional written and electronic contracts with which we are familiar.

To understand how useful and effective a smart contract is, it is necessary to compare it with a conventional contract (see Table 1).

Table 1. Smart contract and traditional contract: main differences

Comparison criterion	Traditional contract	Smart contract
Control over fulfilment of transaction conditions	Rests with the parties to the contract/intermediaries	Independently monitors the fulfilment of conditions
Execution of funds transfer	Manually/ with the help of intermediaries	Automatically without intermediaries
Size of commission	Commercial banks charge large commissions for transferring large amounts of money	Minimal
Double interpretation	Present due to contradiction of state laws	None
Possibility of illegal enrichment	Yes	Minimised

[3] *Savelyev A.I. Contract Law 2.0: 'smart' contracts as the beginning of the end of classical contract law [Text] / A.I.Savelyev // Vestnik Civil Law - 2016 - No3 - P. 32 - 60.*

Possibility of changing the terms and conditions of the agreement	Yes	None

Source: compiled by the author

Let us list the advantages of a smart contract over a traditional contract:

1) No Intermediary Required: Smart contracts monitor the performance of the transaction by all parties to the contract without needing an intermediary. In a conventional contract, either a rightful intermediary or the contracting firm oversees the implementation of the terms. In the case of a smart contract, the software code oversees the execution of the terms of the transaction, saving time typically spent on compliance checks by the client firm or the authorized intermediary.

2) Efficiency of Fund Transfer: When parties enter into a conventional contract and fulfil the terms, funds are transferred either by the contracting firm to the executing firm's account or through a bank letter of credit. In the first case, the bank charges a fee, and the executing firm waits from hours to days for funds. In the second case, a tripartite agreement involves additional time and fees. Smart contracts streamline fund transfers, executing them within minutes and independently verifying the fulfilment of terms through uploaded documents.

In the first case, there is a commercial transfer of funds, for which the bank charges a fee. The executing firm then must wait from a few hours to a few days for the funds to reach its account.

In the second case, a tripartite agreement is concluded between the client firm, the executing firm and the commercial bank. Once the tripartite agreement is concluded, a special account is created at the intermediary bank, into which the client firm deposits the funds. Then, the executing firm provides the bank with documents confirming that it has fulfilled all the conditions of the agreement and only then is authorised to withdraw the money from the bank account.

In both cases, the parties to the transaction need to spend a lot of time to verify the fulfilment of the conditions and to make the payment, in addition, the client company has to pay the bank commission. A smart contract makes it much easier to supervise the transfer of funds because the funds are transferred within minutes, and to confirm that the terms of the transaction have been fulfilled, all necessary documents need to be uploaded and attached to the smart contract, which will verify them independently.

As mentioned above, when transferring funds for a transaction or opening a bank letter of credit, the commercial bank charges the ordering firm a commission of either a fixed amount or a percentage of the transaction. A smart contract secured by a digital ruble will require a much lower fee than a commercial bank. The reason for this is that the aim of a commercial bank is to make a profit, while the conclusion of smart contracts with payment in digital rubles will be made on the platform of the Bank of Russia, which is a non-profit organisation and does not pursue the goal of enrichment.

3) Unambiguous Interpretation: Smart contracts, being software code, follow a strict algorithm, eliminating the potential for double interpretation. In traditional contracts, terms can be contested after signing, leading to legal disputes. The straightforward nature of smart contract code ensures clarity and reduces the need for costly legal battles over interpretations.

The point is that when writing code, programmers follow a simple algorithm “If..., else...”. This algorithm allows you to provide for all possible conditions that are necessary to draw up a contract, making it so that any scenario has a predetermined outcome. In this case, if one of the

parties disagrees with the outcome of the smart contract transaction and decides to go to court to challenge the decision of the software code, the parties to the contract will not have to spend a huge amount of money and time on legal fees due to the unambiguous interpretation of the terms in the smart contract.

4) Transparency and Security: Smart contracts operate on blockchain technology, where unique blocks cannot be overwritten. This allows easy online access to transaction information and minimizes the risk of illegal enrichment by any party involved in the smart contract.

5) Flexibility: While traditional contracts are flexible and can be amended at any time, smart contracts lack this flexibility. However, if a smart contract's terms are not fulfilled, a new contract can be drawn up. Although this is not as flexible as a traditional contract, it still allows for modifications.

Having compared a smart contract with a traditional contract, we conclude that smart contracts are superior to traditional contracts in many aspects and represent the digitalization of both legal and economic spheres. As one of the leading powers actively introducing digital technologies into the economy, Russia stands to benefit significantly from creating a new payment infrastructure and the mass introduction of smart contracts, facilitated by the establishment of a digital ruble.

3. Discussion

3.1. Digital ruble

Starting in December 2021, Russia has been actively developing a "digital ruble." This innovation is being developed by the Central Bank of the Russian Federation in cooperation with commercial banks. As of today, the list of banks participating in the pilot for digital ruble transactions includes large banks such as ALFA-BANK JSC, VTB Bank (PJSC), Ingosstrakh Bank JSC, Sovcombank PJSC, Promsvyazbank PJSC, and others. Additionally, banks such as PJSC Sberbank of Russia, JSC Rosselkhozbank, JSC Russian Standard Bank, and other Russian banks plan to join the project.

According to the Central Bank of the Russian Federation, the digital ruble is the "third form of the ruble." Currently, there are only two forms of the ruble in mass use in Russia: cash (banknotes and coins) and non-cash (money in bank accounts). The digital ruble aims to introduce a new, third form of the ruble. Any individual or legal entity will be able to open only one digital wallet on the platform of the Central Bank, which will not be tied to any specific commercial bank. However, access will be provided through the commercial bank's application. This means that the commercial bank will act as an intermediary between the user and the Bank of Russia's platform, where their digital rubles will be stored.

Table 2 shows that the digital ruble shares similarities with both cash and non-cash money. However, in terms of the 'Form' parameter, the digital ruble has a clear distinction: it is a digital code recorded in the digital ruble system and operates on its platform, while also possessing the same security features inherent in its cash form. Despite the similarities and differences in the forms of Russia's national currency, digital rubles will be equivalent to cash and non-cash for users, i.e., one digital ruble equals one non-cash ruble, and one non-cash ruble equals one cash ruble, and vice versa.

Table 2. Comparison of the digital ruble with other forms of national currency

Parameter	Cash rubles	Non-cash rubles	Digital rubles
Form	Watermarked paper	Digital record in commercial bank database	Digital code secured by the CBR
Issuer	CBR	Commercial bank	CBR
Personalisation	Bearer	Personalised	Bearer Personalised
Means of payment	Offline	Online	Offline/online
Means of saving	Without interest accrual	Possible interest accrual	Without interest accrual
Possibility of crediting	Present	Present	None
Possibility of cashback	Present	Present	None

Source: compiled by the author on the basis on Ordynskaya M.E., Silina T.A., Tkharkakhova I.G. Digital ruble as a new form of money. Innovative economy: prospects of development and improvement 4(62),2022 – URL: https://cyberleninka.ru/article/n/tsifrovoy-rubl-kak-novaya-forma-deneg-1/viewer.

When discussing the management of funds stored in a digital wallet on the platform of the Central Bank of Russia, attention should be paid to the following operations:

1) Deposit and Withdrawal of Money: There are two options for replenishing the digital account: cash and non-cash. If you have non-cash funds in your bank account, you can simply top up your digital account without incurring bank charges. But if you have cash rubles, you must first deposit them into a commercial bank account and then transfer the non-cash funds to your digital account. When withdrawing funds, you will need to perform these operations in reverse order. Most of these actions can be completed through the commercial bank's application or website.

2) Transfer of Funds: To transfer digital rubles from one wallet to another, you will need to access your commercial bank's application, select the recipient by phone number, enter the amount, and confirm the transfer. Importantly, transferring digital rubles between ordinary citizens will incur no commission, while business transactions will involve minimal fees. Furthermore, the Bank of Russia states: “The digital ruble is being created to serve as another means for payments and transfers, which will not depend on the restrictions of banks in terms of commissions and limits.” This suggests that the limits for transferring digital rubles will be lower than those imposed by commercial banks for non-cash rubles.

3) Payment for Purchases: Many people think that digital rubles will only be used for online purchases or the acquisition of digital assets, but this is not the case. In fact, digital rubles can be used to pay for any goods because the digital ruble is not a separate currency linked to the ruble rate; it is simply the third form of the ruble, alongside cash and non-cash. To pay for a purchase, it will be enough to scan a QR code, select the digital ruble as the payment option, and confirm the transaction. Additionally, there are plans to introduce payment with digital rubles via NFC technology (near-field communication), allowing devices in proximity that support this technology to exchange data, including non-cash funds.

3.2. Prospects for the introduction of smart contracts secured by the digital ruble in the Russian economy

When discussing the prospects for the development and application of the digital ruble, it is important to mention that, in addition to being a means of payment, it is currently the only financial asset capable of securing transactions that will be made under smart contracts in Russia.

One of the main problems that smart contracts can address is facilitating the development of small businesses, specifically by providing protection for purchase/sale transactions of movable property between legal entities. The national project "Small and Medium-sized Entrepreneurship and Support for Individual Entrepreneurial Initiative" is being actively promoted in Russia. This project aims to support businesses at all stages of their development, with a primary focus on small businesses. However, it does not adequately address the primary concern of small businesses: the security of transactions. Often, to secure their transactions, small firms resort to financial instruments such as bank letters of credit, which require a portion of the company's revenue to cover bank charges.

To understand how much money small businesses spend on securing transactions, we studied which major banks offer letters of credit for legal entities in the sale and purchase of movable property in Russian rubles (see Table 3).

Table 3. Russia's largest banks by asset volume as of December 2023 and their ability to provide letters of credit for movable property

Bank	Total value of assets as of December 2023 in thousands of rubles	Possibility to provide legal entities with letters of credit for movable property for settlements in Russian rubles
1. Sberbank	50 695 718 774	Yes
2. VTB Bank	26 188 218 945	Yes
3. Gazprombank	15 296 029 418	Yes
4. Alfa-Bank	8 411 400 483	None
5. Moscow Credit Bank	4 971 033 526	None
6. Rosselkhozbank	4 672 004 684	None
7. Otkritie Bank	3 245 494 960	None
8. Sovcombank	3 007 306 113	None
9. Bank DOM.RF	2 361 924 750	None
10. Rosbank	2 173 517 945	None

Source: compiled by the author

The survey revealed that not all major banks in Russia provide this service. Some banks, such as Otkritie Bank, Sovcombank, and Rosbank, do not offer letters of credit for legal entities. Others, like Alfa-Bank, Moscow Credit Bank, Rosselkhozbank, and Bank DOM.RF, provide letters of credit only for immovable property or for import/export of goods and services. However, Sberbank, VTB Bank, and Gazprombank do offer the required service for legal entities. For clarity in calculations, we have created a table detailing the size of bank commissions (see Table 4).

Table 4. Comparison of bank commissions for opening a letter of credit

Bank	**Fee for opening a letter of credit**	**Amount of financial costs for small business**
Sberbank	0.2% of the letter of credit amount, min. 500 RUB, max. 10 thousand rubles	from 500 rubles to 10 thousand rubles per transaction

VTB Bank	0.15% of the letter of credit amount, min. RUB 16.5 thousand	from RUB 16.5 thousand to RUB 120 thousand per transaction
Gazprombank	0.6% of the letter of credit amount, min. RUB 3 thousand, max. RUR 120 thousand	from RUR 3 thousand to RUR 120 thousand per transaction

Source: compiled by the author

From Table 4, we can conclude that, on average, a small business has to spend between 3,000 and 120,000 rubles to secure each transaction when opening a bank letter of credit. Although this percentage seems small, the costs can accumulate significantly if a firm regularly conducts transactions involving the purchase and sale of products or services. For example, if a small business completes an average of 10 software transactions per year, each averaging 10 million rubles, and 5 larger transactions averaging 50 million rubles, the firm could spend around 1.8 million rubles annually to ensure that counterparties conduct transactions honestly and pay the required amount for delivered software.

Smart contracts, in contrast, help small businesses secure transactions while allowing them to significantly reduce their spending on bank fees. According to the Concept of the Digital Ruble presented by the Bank of Russia on April 8, 2021, transaction fees in digital rubles are planned to be "at a level no higher than in the Fast Payment System." This means that if the aforementioned firm had chosen to utilize a smart contract secured by a digital ruble instead of opening a bank letter of credit, it would spend only 21,500 rubles in commissions—over 80 times less than the commissions for bank letters of credit from commercial banks.

Additionally, the property of smart contracts that prevents dual interpretation will help reduce the burden on arbitration courts. This is particularly relevant given the current overload in the Russian court system. To alleviate this, the government has raised state fees, encouraging firms to resolve disputes in pre-trial proceedings. For example, for claims between 100,000 and 1 million rubles, the state fee will be 10,000 rubles plus 5% of the amount exceeding 100,000 rubles. For claims starting from 50 million rubles, the plaintiff will pay a fee of 725,000 rubles plus 0.5% of the amount that exceeds 50 million rubles.

We believe that increasing state fees is not an effective measure, as pre-trial proceedings often do not lead to favorable outcomes for either party. The introduction of smart contracts could alleviate the judicial system's burden without increasing fees for two reasons:

1) Reduction of Time: Smart contracts will reduce the time spent by arbitration courts on cases due to their lack of dual interpretation. According to Clause 1 of Article 152 of the Arbitration Procedure Code of the Russian Federation (APC RF), a case must be considered within six months from the date of receipt of the application. However, Article 152, paragraph 3, states that time during which proceedings are suspended or postponed is not included in this six-month period. Consequently, a case can take years to be heard due to its complexity and court overload. Smart contracts, being less flexible than traditional contracts, offer fewer loopholes for delaying proceedings.

2) Automatic Fund Transfer: Smart contracts facilitate automatic fund transfers, making payment delays impossible as the system checks the ordering company's account for available funds and freezes them until payment is completed. This feature ensures timely payments in digital ruble transactions.

As previously mentioned, blockchain technology is transparent, and the smart contracts and transactions recorded within it cannot be erased or altered. This property is expected to decrease

the growth of the shadow economy in Russia and simplify law enforcement agencies' efforts to combat public procurement crimes.

Regarding the shadow economy, the state strives to curb the activities of corrupt officials exploiting the lack of transparency in public procurement. However, this task is challenging. The introduction of smart contracts would enhance the transparency of public contracts and their execution. The state, as a service customer, needs to ensure transparency in budget fund usage and guarantee service quality. A.G. Aksakov, head of the State Duma Committee on the Financial Market, believes that the state "can quickly get involved in using the digital ruble to finance state projects, as it allows clearer visibility on how budget funds are allocated for various projects. The state will quickly activate the smart contract to ensure that funds are allocated for projects and state tasks precisely when needed."

Moreover, due to the immutability of smart contracts, it will be impossible to change or erase signed documents and executed contracts from the system. This feature will eliminate opportunities for offenders to destroy evidence, simplifying law enforcement agencies' efforts to apprehend corrupt individuals and organizations and preventing further offenses.

Conclusion

Thus, we can conclude that, despite the digital ruble project currently being in the pilot stage and not yet in mass use, its gradual development and integration into the Russian economy, alongside the formation of an innovative payment infrastructure, will likely lead to a rapid and steady increase in users among both legal entities and individuals. This growth will be driven by the emergence of new financial services, such as smart contracts, which will enable fully secure transactions.

Furthermore, it is anticipated that the state will utilise smart contracts in a proactive manner. The inherent transparency, invariability, and impartiality of these contracts will empower the government to effectively monitor the expenditure of budgetary funds. This, in turn, is expected to contribute to the mitigation of illegal enrichment, a phenomenon that has been observed to arise from the prevailing deficiencies within the public contract system.

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