

# Blockchain Technologies as A Stimulator of Institutional Transformations of the World Financial System

Mikhail Yuryevich Kussy, Viktoriya Viktorovna Pobirchenko, Elena Alekseevna Shutaieva,  
Yevgeny Yuryevich Kakutich

V.I. Vernadsky Crimean Federal University  
Vernadsky Ave., 4, Simferopol, 295007, Russian Federation

## Abstract

This paper briefly presents the recent problems of the world financial system. The analysis of indicators of blockchain technologies has been carried out; their attractive aspects and disadvantages are singled out. Some potential possibilities of using blockchain technologies in various fields of activity are considered. Particular attention is paid to the prospects of application of blockchain technologies in the world financial system, which will allow solving a number of problems of the world financial system itself. The issues (including those of regulatory and institutional nature and predictable social strain as well) that people can face when implementing blockchain technologies in their everyday life, have been noted. The institutional changes in the world financial system that could appear after implementation of blockchain technologies are highlighted.

**Keywords:** *blockchain-technologies, issues, financial system, institutional changes.*

## 1. Introduction

Relevant problems of the world financial system In terms of structural changes in the world economy, the modern global financial system needs significant transformation and, perhaps, even creation of a new international monetary and financial system. These processes undoubtedly affect also the current institutional constraints in the financial sphere. Here are just a few problems that require urgent solutions:

The modern global monetary and financial system has a number of serious shortcomings, primarily related to: the possibility of uncontrolled printing banknotes by central banks, as well as the high volatility of exchange rates of currencies that are included in the basket of national gold and foreign currency reserves (and, as a consequence, high elasticity of prices for imported goods). This, in turn, significantly affects the growth of foreign trade imbalances and the change in cross-boundary commodity and financial flows in favor of developing countries [29];

The gap between the financial and real economy is growing: according to McKinsey Global Institute experts [39], the financial depth of the US economy (the ratio of traditional financial assets to world GDP) increased from 261% in 1990 to 356% in 2010. Wallis and North [49] found that over 45% of the national income of the USA is accounted for by transactions; moreover, in the 20th century, this share grew by 20%. The similar situation is in other countries; some experts of McKinsey Global Institute include shares, various types of state and corporate bonds, and credit obligations among such financial assets.

The dependence of commercial banks on the central bank has become so significant that the banking sector is unable to cover its liquidity need without the help of the central bank [15-16];

There is an increase in the global debt crisis. The global financial crises of the 21st century led to an increase in not only the total public debt (it already exceeds gross domestic product in many countries) but also contributed to a significant increase in debt in the corporate sector; as a result, the shortcomings of the existing international monetary and financial system were revealed [25];

The currency structure of international reserves is increasingly reflecting the changed alignment of economic forces in the world economy: currently, there is a noticeable activation of the processes of internationalization of the Chinese currency. According to Robert Mundell, Nobel Laureate in Economics, whose works were used to develop the euro mechanism, the yuan will almost inevitably become a reserve currency, even if the Chinese government does not do anything for it [2];

There are about 3000 private currencies besides one and a half hundred state ones issued by local emitters and communities: in June 2017, the total capitalization of more than 800 largest privately-owned decentralized cryptocurrencies came close to 100 billion dollars [18]. In particular, the cryptocurrencies have a solid position in the financial markets as an international means of payment along with the fiat currencies issued by central banks. This gave rise to a significant number of problems of the legalization of such nonfiat virtual payment instruments, which are resolved in different ways based on national realities in different countries. In turn, heterogeneity in the approaches to the legalization of cryptocurrencies in various countries leads to the need to create supranational institutions that would promote (or prevent) the spread of payments using cryptocurrency among residents of countries where there are differences in views on the process of legalization of such payments (blockchain manages this, but the problem remains unsolved);

according to [46], the number of new rules and regulations adopted by financial regulators increased from 8,769 in 2008 to 14,215

in 2011 and their number continues to grow (with 57% of such documents in North America and 22% in Europe). This set of institutional constraints significantly reduces the effectiveness of the market mechanisms of the global financial system.

There are a number of other problems of the modern global financial system.

As part of the study, the authors dwelled on the problems associated with the emergence of technologies such as "blockchain", their practical application in the financial sector of the world economy (including the solution of the problems mentioned earlier and, first of all, the problem of reducing transaction costs) and problems of institutional support for the implementation of these technologies.

## 2. Brief Analysis of "Blockchain Technology"

According to a recent survey of the World Economic Forum (WEF), most experts and executives in the ICT sector expected that at least 10% of world GDP would be stored on the blockchain platforms by 2025. Deloitte consultants, on the contrary, believe that the introduction of such technologies will occur much faster since the needs for blockchain applications have already been identified in various fields of activity [10].

Let us consider the definitions of the category "blockchain technology" noted in different studies.

Morgan Stanley [7] defines blockchain as "data sharing across a network of individual computers", or, "computers transferring blocks of records in a chronological chain". As such, it is a "distributed ledger".

According to the experts from the Bank of England, blockchain is "a technology that allows people who don't know each other to trust a shared record of events" [10].

Melan Swan [44] considers blockchain as "decentralized transaction log that is a part of a larger computing infrastructure that also includes storage, communication, file serving, and archiving functions".

In accordance with Parker [36], "a blockchain, at its simplest level, is just a corruption-resistant string of ledger entries shared over a network by multiple parties".

There is one more definition: "blockchain is a technology of distributed databases (registries), based on a constantly renewed chain of records, and is resistant to falsification, revision, hacking and theft of information" [41].

For Levi [31], it is "the first financial instrument of the emerging netocracy: the global environment, where the idea itself is more expensive than the finances necessary for its implementation".

According to Likhachev [32], "Blockchain is "nothing more than a diary of records that can be written together and in which it is impossible to forge old records de facto".

According to the report of the Office of Science of the UK Government [40], this is a "database of assets that can be shared across a network of multiple sites, geographic regions or institutions".

You can find dozens of different authors' definitions of "blockchain" on the Internet. Such heteromorphism (and personalism) in focusing on the essential characteristics of blockchain is simply explained: the technology itself is about 10 years, and its main features have not been studied yet.

Proceeding from the characteristics noted by researchers mentioned above and some others [18, 45], let us distinguish the most significant features of blockchain technologies (authors' note: most of the highlighted features of "blockchain" are considered in clause 3):

lack of a regulator;

anonymity and transparency of transactions;

distribution of the database (register of records) about transactions and their participants. At the same time, users not only have access to the database but also act as a collective notary, which confirms the truth of information in the database; that makes infor-

mation in the database unchanged and practically inaccessible to distortion;

reduction of the intermediary institution in operations to practically zero;

encryption through public keys – a secure way of transferring electronic data;

agreed protocols – verification of the authenticity of new records to prevent incidents of various violations and distortions of information entered in the register;

unchanged and verified data at each stage of transaction;

use of "smart contract" technology;

distributed system of authentication of counterparties to the deals using cryptography and digital signatures for identifying cards: transactions can be traced down to cryptographic identification data, which are theoretically anonymous, but can be attached to real identification data after some engineering analysis (for example, the IT address of the counterparty).

This list (perhaps, not final) is deliberately not put in order by the authors, since there is nothing unimportant (secondary) in blockchain technologies, and technological attributes are synergistically intertwined with institutional ones.

### Advantages and disadvantages of using blockchain technologies

Blockchain technology as a system has both advantages and disadvantages. But its potential expressed in main advantages substantially covers the shortcomings that these technologies still have.

Some researchers [10, 14] have already identified the list of the main advantages of blockchain technologies:

simplicity expressed in the ability to improve the efficiency of processes and systems, such as making transactions, confirming the authenticity of counterparties' intentions; carrying out some administrative procedures, where efficiency through the use of blockchain technologies is increased by reducing costs when implementing business plans; the rejection of duplicate operations, and the lack of verification of the reliability of information;

improving the security of information exchange and ensuring confidentiality for users in a shared environment, which, moreover, reduces the risk of fraud or theft in the IT system and improves the quality, reliability, and availability of IT services in real time;

transparency of information, as it is in the public domain, and can be checked at any time by any user while maintaining its integrity; opportunities for the realization of human rights are expanding: the rights of all users here are equal, and the mathematical model as the basis of blockchain technologies is not affected by fraud, corruption, and other negative human factors;

the opportunity to organize self-government without the need to attract additional intermediaries.

Another advantage of blockchain technologies is the use of smart contracts – solutions that use blockchain technology to create contracts between two (or more) participants, performed in a decentralized environment, where contract terms are implemented by the blockchain system.

Thus, Bigi [3] implemented a decentralized protocol of "smart contracts" using a combination of game theory and formal models as an approach. The authors argue that a decentralized system of intellectual contracts can be a promising technology and deserves to be studied and further developed with the aim of using them in different industries for different purposes.

Kishigami [26] provided a digital content distribution system based on the block system. The analysis showed that the most impressive attribute of the blockchain was the decentralized mechanism of digital rights' management. Nevertheless, the proposed system does not have yet an incentive mechanism for calculating mining, which can make it a difficult task at present.

But, in addition to these remarkable qualities of the considered technologies, a number of researchers have noted their technological and socio-institutional drawbacks. There are some technologic drawbacks of the blockchain [51]:

data throughput: implied throughput in Bitcoin network currently does not exceed 7 tps (transactions per second). As a comparison – VISA (2000 tps) and Twitter (5000 tps). If the transaction frequency increases to similar levels in the blockchain, the pass-through set of blockchain system will need to be improved; blockchain checks every transaction added to the blocked chain to ensure that the input data for the transaction has not been spent earlier, which leads to a significant delay in the transaction and is now a significant problem for the analyzed technologies. To complete the transaction, for example, you need only a few seconds in VISA, which is a huge advantage compared to the blockchain; the existing blockchain interface of applications programming is difficult to use for the development of individual services. It is necessary to develop a more convenient interface of applications' programming for blockchain; the private key is the main element of authentication and self-certification of transaction control in the blockchain. But there are some problems with authentication. For example, a case when the Bitcoin wallet company at Mt. Gox was attacked has come to our notice. While this attack, Mt. Gox store, which contained the private keys of the company's customers, was cleaned. In addition to the case with Mt. Gox, it is shown in [4] that the use of cryptography with an elliptical curve that is used in obtaining addresses for bitcoin users is inadequate and does not have the necessary randomness. The problems of fraud with bitcoins are investigated in [47]: with the help of Ponzi, with mining, fraudulent wallet and fraudulent exchanges. The authors noted that the victims of fraud using blockchain technology from September 2013 to September 2014 were 13,000 people for a total of \$11 million. Lim [33] analyzed the trend of security violation of bitcoins and the available countermeasures. According to these authors, almost all known types of security violation of the blockchain have already been successfully tested.

Among other drawbacks of technologic nature, we should also note the following ones:

the problem of energy efficiency in the field of computer technology is not taken into account now. But in some areas, such as mobile cloud computing, this can be one of the main problems in the future [42, 43]. Today, blockchain requires a lot of energy to conduct transactions and verify their reliability [44]: to increase the efficiency of blockchain technologies, it is necessary to significantly reduce the amount of resources wasted. Some methods for improving the energy efficiency of blockchain technologies are proposed by [13];

the size of the blockchain in the Bitcoin network is about 136 GB (as of mid-October 2017) and is constantly growing [50]. According to [1], there is a limit to the number of transactions that can be processed (an average of 500 transactions in one block). If the blockchain needs additional transactions, breaking VISA ground, it is necessary to solve the problem of increasing its size and throughput.

Blockchain can change the mechanism of transactions in everyday life, as applications of blockchain technologies are not limited to cryptocurrencies: This technology can be applied in various areas where certain forms of transactions are performed. Investigating the possibilities of blockchain applications is certainly interesting for future research, but at present, the blockchain is experiencing difficulties with technical and technological limitations. Anonymity, data integrity and security attributes are the main problems that should be finally resolved.

In addition to the noted technological drawbacks, the blockchain gave us some problems of social and institutional nature. Here are just a few notes that should be mentioned in the study:

cryptocurrencies, the circulation of which blockchain provides, many special services consider as an instrument for financing acts of crime (Islamic State of Iraq and Greater Syria, drug trade, arms trading, prostitution, laundering of fraudulent funds, etc.). Therefore, it is required to solve this problem at the national and interstate levels (including the normative level);

absence of sanctions for offenses in the sphere of circulation of cryptocurrency: the sanction in this case is only general knowledge about the fact that there is a robber, and no one will deal with him in the future (there are no other sanctions in the system of blockchain!). To resolve such contentious issues related to offenses in the field of using blockchain technologies, it will be necessary to create special national and international institutions; in fiscal space, new problems also emerged – in the case of the cryptocurrency, it is very problematic to fund the budget with taxes, because: transactions in cryptocurrency are nonterritorial (it is unclear to which country pay taxes) and anonymous (who is the payer of the tax and what is the basis for taxation). This gives significant opportunities to completely transfer such transactions into the shadow zone (past the fiscal system). In such circumstances, governmental revenue authority cannot fully perform its functions. While there is a government, it is unlikely that cryptocurrency, dissonant with its economic interests, will be able to seriously compete with fiducial (issued by the central bank) means of exchange. But the circulation of cryptocurrency is already taking place; therefore, these problems require institutional and regulatory resolution;

according to the former CEO of Barclays Anthony Jenkins [30], due to the introduction of blockchain technologies for the provision of financial services "over the next 10 years, the number of jobs in the financial sector will decrease by more than 50%. This will lead to a reduction of jobs worldwide, from 26,000 to 66,000". Some experts also believe that the risk of unemployment is likely to be among employees of banks, government authorities, auditors, inspectors, notaries, insurers and record clerks [30]. This social problem also has to be solved as well.

Given the global nature of the problems described above, it will be necessary to develop new institutions that determine the mechanisms for circulation of cryptocurrencies taking into account their supranationalism and the use of blockchain technologies in various segments of national and international economy, as well as the problems associated with the possible inspection of institutions that determine mechanisms in the current global monetary and financial system. It is also necessary to make decisions (at least at the state level) to prevent social tensions related to the projected large-scale unemployment in the provision of various services. The problems of perfecting blockchain technologies are linked with these processes with the aim of adapting them to the changing institutional space.

It came to be understood that the introduction of blockchain technologies into the general practice leads to significant changes in existing intersubject relations and, as a consequence, to the need to transform the existing system of institutional constraints (including legislative order) in these relations.

### 3. Prospects for the Practical Use of Blockchain Technologies

During 2017, investments in blockchain technologies in the world amounted to more than \$3 billion. This is the highest figure in the history of such investments. In 2016, the volume of investments was \$500 million, in 2015 – \$495 million, in 2014 – \$390 million, and in 2013 – \$95 million. Thus, beginning in 2013, various blockchain start-ups raised about \$5.4 billion in investment [17].

Modern practice looks attentively to the possibilities of blockchain technologies. The possibilities of their practical use in various sectors of social and economic nature have already declared.

The blockchain technologies found their application in management [12]; auditing and accounting for different directions, as well as in compliance with KYC standards (a service that allows for user verification and prevents fraud) and AML (prevention of money laundering) [11]; health care [9, 35]; fee-free international commerce [38]; cargo transportation [48]; the notary [23]; customs operations [6]; patent case and issues to be vote [5]; tourism [22]; education [28]; solving logistics problems [34].

The urgency of active implementation of blockchain technologies in the sphere of finance and financial services is growing (with the aim of reducing transaction costs, in particular; for example, [49]. Here, blockchain technology is planned to be used for:

changing the existing procedure for conducting financial transactions in the electricity market: transactional model gradually shifts from the use of a centralized structure (banks, exchange houses, trading platforms, energy companies) to the use of a decentralized system – end users, consumers of electricity [37]. In such systems, independent intermediaries are no longer required since operations can be initiated and conducted directly among net members. This will reduce costs and accelerate transaction processes in the electricity market (many tasks previously performed manually will now be handled automatically using "smart contracts"). Some specialists from the Finnish Institute of Economics have a similar approach to solving the problems of the electricity market with the help of blockchain technology [21];

blockchain technologies have already proved themselves well with the support of transactions in the market of cryptocurrencies. This gives grounds to consider them a potential tool for conducting international currency exchange operations with fiducial money; in the field of joint (joint-stock) investment, blockchain technology is also in demand in accordance with [52];

in the sphere of insurance, according to [27], such giants of the European insurance business as Lloyd's, Allianz, Aegon, Munich Re and Zurich now implement blockchain technologies in their business;

to improve the performance of stock market mechanisms [45]: mechanisms for the issue, circulation, storage and recording of securities and their derivatives are now heavily regulated, which leads to an increase in the term of transaction and the share of the service fee of intermediaries in the cost of revenue of operations in the stock market. In addition, there are still opportunities to carry out unfair acts in the securities market. The blockchain technology can solve these problems;

blockchain technologies are effective in those systems where the authorship of any action is important, and synchronization of data is reliable. These technologies can be used not only to transfer assets but also to store data of any kind and transfer them in an open and safe way. It is these capabilities of blockchain technologies that can be used in payment systems;

in the sphere of bank services, the blockchain technologies take their place as well [20]. In an ideal scenario, the mechanism for implementing blockchain technology in this area can be described in the following simplified way [24]: The modern banking system is a system of accounting books stored in each bank. The blockchain removes a global "accounting book" of transactions out of control of the banking system and places it in a user's computer connected to the network. Financial conglomerates no longer control the system: it is controlled by end users. It is just a comic fantasy of Brian Kelly, for the time being, but tough competition in the banking sector, the increasing demand for Internet payments and other trends related to technological breakthroughs in the 21st century will lead to the need to introduce blockchain-type technologies in the banking sector.

Genkin and Mikheev write that "blockchain could become the largest technological innovation in the financial services industry. It has the potential to connect networks of legally significant accounting in the same way that the Internet connects data and information networks. This would increase the efficiency and speed of settlement of accounts, reduce transaction costs and expand the market" [18].

At the same time, blockchain technologies could replace expensive financial intermediaries in financial markets, which would have strong impact on the entire infrastructure of the industry, making its operation more transparent.

The introduction of blockchain technologies in the financial markets, according to Giancarlo [19], will lead to savings of \$20 billion by financial companies for infrastructure and operating costs

per year reducing the cost of settlement of accounts by one third and reducing the funding requirements by \$120 billion.

However, the use of blockchain technologies in the financial sphere is associated with certain difficulties, primarily of institutional and legal nature, as will be discussed in the next section.

#### 4. Some Regulatory Problems Related To the Introduction of Blockchain Technologies into Our Lives

Let us quote some analysts' forecasts about the consequences of the implementation of blockchain technologies in government control practice: the government itself, the content of its functions and the existing state institutions will require a rethinking (including, if possible/necessary, the decentralization of state power under the influence of the invasion of blockchain technologies in the sphere of public administration). If the government now actively intervenes in the organization and the economy, then when using blockchain technologies, the need to deal with this will significantly decrease, that is, the government will focus on certain functions that enable it to fulfill its mission of protection, social conditions, economic regulation, and protection of conscientious taxpayers. And all the rest will be regulated with the help of blockchain technologies (technology will assume some of the functions of the government), including private initiative, but with some regulation from the government's side. These processes will also affect existing institutional norms and rules. This problem is complicated for the government by the fact that in accordance with [8], it is planned to use blockchain technologies in various spheres of public administration. Thus, the government (as a regulator) should (as a user) force into application some restrictions in the use of blockchain technologies for regulatory purposes: here, once again, there is a conflict of interests of the government as a system. But this is the direction of a separate deep interdisciplinary study.

The blockchain technologies and related concepts (distributed data, "smart contracts", "block chains", etc.) are difficult to fit into the traditional concepts of jurisdiction, responsibility or enforcement. Therefore, according to [8], the consideration of blockchain technologies and related concepts through the prism of jurisdiction will lead to the need to redefine some of the fundamental foundations of law and the reconversion of lawyers, regulators and politicians who will need to acquire new technological skills in order to be able to interpret a new world of decentralized communities managed by automatic relationships with the help of blockchain technologies.

The need for government regulation of blockchain technologies (including the financial sphere) has faced the following problems [50]:

The blockchain is a completely new technology, and, like some others, it is aimed at the technological solution of a number of tasks that were previously solved by state regulation. The problems of double spending, identification of the owner, execution of "smart contracts" – all of them are solved by technological means, and not by legal ones: the action becomes impossible due to asymmetric encryption and the chain of blocks, and not because of legal prohibition and state supervision. Such an approach entails fewer costs but does not take into account extreme situations and does not possess the flexibility inherent in legal regulation.

The blockchain technologies allow cross-boundary and global data exchange. Accordingly, to regulate the blockchain system, the same problems are relevant as for the regulation of global networks in general – primarily the problem of extraterritoriality in cross-boundary intersubject relations. Each state has its own traditions in the legal regulation of information technologies; international regulation in this area is minimal. Partly the regulation of cryptocurrency and blockchain refers to the currency, financial legislation and regulation of the securities market, which tradi-

tionally belonged to the national jurisdiction. The only contiguous sphere, in which strong international cooperation (based on the FATF) operates, is the fight against money laundering, but it will be difficult to achieve any international agreements on blockchain on its basis.

The state cannot effectively replace technological relations with legal regulation, but at the same time does not want to give up regulation altogether. The paradigm shift that is required to effectively solve emerging problems takes time, especially in large, inert legal state systems. Apparently, this explains, in particular, the inefficient regulation of relations on the Internet.

Nevertheless, the use of the blockchain in one way or another involves interaction with the legal system. This interaction occurs [50]:

when the objects of law are compared with their reflection in the detachment and bringing them to the corresponding blockchain state;

in assessing the legal consequences of transactions committed by legal entities using blockchain (taxation of income and profit of entities, accounting for their assets);

in disputing transactions that are partially or completely committed in the blockchain (including cross-boundary transactions);

when investigating offenses committed with the use of a blockchain, etc.

The legal regulation of blockchain technologies should be carried out by describing the legal consequences that entail transactions made with the use of such technologies. This will eliminate the known conflict between the legal system that ensures the functioning of the state and the blockchain intended to exclude the participation of the state in separate relations. And if the relations within the blockchain affect the status of the subject of legal relations or form the content of the offense, these relations should be considered in the context of the system of law.

## 5. Final Provisions

Some of the regulatory and institutional problems described above are already being resolved within the framework of individual national legislation, but most of the problems of implementing blockchain technologies in everyday life are supranational in nature and still await their solution.

The analysis makes it necessary to inspect and, most likely, to transform the existing set of institutional constraints (including regulatory and legal ones) that regulate the processes and systems in which blockchain technologies are implemented or planned for the implementation, given that such implementations essentially change the nature of intersubject relations.

The transformation of the existing institutional base will lead to the emergence of the need for possible adjustments of blockchain technologies toward their adaptation to a transforming set of institutional constraints (including regulatory and legal ones). As a result, we will have to review the institutional constraints again for the "adapted" version of the blockchain...

Such a reflexive process, as a rule, expands time because of its iterative nature. Let us hope that representatives of institutionalism and regulators – with their slowness – will not slow down the processes of introducing these progressive technologies into our daily life.

Although the block system is still a "young" technology, there are quite profound investigations in the direction of its practical application. Additional research will allow making well-considered decisions to overcome the current problems and limitations of blockchain technologies and ensure their speedy implementation (adequate from the institutional point of view) in the practice of the financial sector.

## References

- [1] A.M. Antonopoulos. *Mastering Bitcoin: Unlocking Digital Cryptocurrencies*. Sebastopol, CA: O'Reilly Media Inc., 2014.
- [2] D. Barboza. In China, Tentative Steps toward a Global Currency. *The New York Times*, 2011.
- [3] G. Bigi, A. Bracciali, G. Meacci, E. Tuosto. Validation of Decentralised Smart Contracts through Game Theory and Formal Methods. *Programming Languages with Applications to Biology and Security: Essays Dedicated to Pierpaolo Degano on the Occasion of His 65-th Birthday. Lecture Notes in Computer Science*, 9465, Cham, Switzerland: Springer, 2015, pp. 142-161.
- [4] J.W. Bos, J.A. Halderman, N. Heninger, J. Moore, M. Naehrig, E. Wustrow. Elliptic Curve Cryptography in Practice. In *Financial Cryptography and Data Security – 18th International conference, FC 2014, Christ Church, Barbados. Revised Selected Papers*, 8437, 2014, pp. 157-175. Springer.
- [5] P. Boucher, S. Nascimento, M. Kritikos. How Blockchain Technology Could Change Our Lives: In-Depth Analysis. Brussel: European Parliament. 2017. Available online: [http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS\\_IDA\(2017\)581948\\_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS_IDA(2017)581948_EN.pdf)
- [6] A.I. Bubel. Vozmozhnosti ispolzovaniya blokcheina i virtualnykh tokenov v tamozhennykh operatsiyakh [Possibilities of Using Block and Virtual Tokens in Customs Operations]. *Tamozhennaya politika Rossii na Dalnem Vostoke*, 3(76), 2016, pp. 14-22.
- [7] S. Butcher. 9 Things You Need to Know about Blockchain's Impact on Banking Jobs, by Morgan Stanley. 2016. Available online: <http://news.efinancialcareers.com/my-en/242898/blockchain-technology-impact-on-banking>
- [8] J.S. Cermeño. Blockchain in Financial Services: Regulatory Landscape and Future Challenges for Its Commercial Application. Working paper, 16/20. BBVA Research. 2016. Available online: [https://www.bbvaesearch.com/wp-content/uploads/2016/12/WP\\_16-20.pdf](https://www.bbvaesearch.com/wp-content/uploads/2016/12/WP_16-20.pdf)
- [9] S. Dash, A. Majumdar, P. Gunjkar. Blockchain: A Healthcare Industry View. 2017. Available online: [https://www.capgemini.com/wp-content/uploads/2017/07/blockchain-a-healthcare-industry-view\\_2017\\_web.pdf](https://www.capgemini.com/wp-content/uploads/2017/07/blockchain-a-healthcare-industry-view_2017_web.pdf)
- [10] Deloitte. Blockchain. Enigma, Paradox, Opportunity. London: Deloitte LLP. 2016. Available online: <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/Innovation/deloitte-uk-blockchain-full-report.pdf>
- [11] Deloitte. The Blockchain Practice: A Specialist Team Dedicated to Applying Distributed Ledger Technologies. 2016. Available online: <https://www2.deloitte.com/uk/en/pages/innovation/solutions/deloitte-blockchain-practice.html>
- [12] I.A. Demchenko, N.A. Kolesnikova. Sovremennyye tekhnologii finansovogo menedzhmenta v rossiiskikh kompaniyakh [Modern Technologies of Financial Management in Russian Companies]. In: *Ekonomika i upravlenie v XXI veke: tendentsii razvitiya* [Economics and Management in the 21st Century: Development Trends]. 2016.
- [13] J.A. Dev. Bitcoin Mining Acceleration and Performance Quantification. In: *Electrical and Computer Engineering (CCECE)*, 2014 IEEE 27-th Canadian Conference. 2014. Available online: <http://ieeexplore.ieee.org/document/6900989/?reload=true>
- [14] O.N. Epifanova, D.D. Burkaltseva, A.S. Tyulin. Ispolzovanie tekhnologii blokchein v gosudarstvennom sektore [Use of Blockchain Technology in the Public Sector. Elektronnaya valyuta v svete sovremennykh pravovykh i ekonomicheskikh vyzovov: Sbornik materialov Mezhdunarodnoi nauchno-prakticheskoi konferentsii [Electronic Currency in the Light of Modern Legal and Economic Challenges: Collection of Papers of the International Scientific and Practical Conference]. Moscow: Yurilitinform, 2016.
- [15] M.V. Ershov. Mirovaya finansovaya sistema posle krizisa: tendentsii i problemy razvitiya [The World Financial System after the Crisis: Trends and Development Problems]. *Dengi i kredit*, 1, 2013, pp. 11-18.
- [16] European Central Bank. Monthly Bulletin. 2012. Available online: <https://www.ecb.europa.eu/pub/pdf/mobu/mb201204en.pdf>
- [17] V.V. Fedotova, B.G. Emelyanov, L.M. Tipner. Ponyatie blokchein i vozmozhnosti ego ispolzovaniya [The Blockchain's Concept and the Possibility of Its Using]. *European science*, 1 (33), 2018, pp. 40-48.
- [18] A.S. Genkin, A.A. Mikheev. Blokchein. Kak eto rabotaet i chto zhdet nas zavtra [Blockchain: How It Works and What Awaits Us

- Tomorrow]. Moscow: Alpina, 2018. Available online: <http://books2.me/books10/Blokcheyin.pdf>
- [19] J.C. Giancarlo. Do No Harm to the Blockchain – American Jobs Depend on It. 2016. Available online: <http://observer.com/2016/05/do-no-harm-to-the-blockchain-american-jobs-depend-on-it>
- [20] Y. Guo, C. Liang. Blockchain Application and Outlook in the Banking Industry. Financial Innovation, 2(24), 2016, pp. 12. Available online: <https://link.springer.com/article/10.1186/s40854-016-0034-9>
- [21] Hukkinen, Ju. Mattila, Ju. Iilomäki, T. Seppälä. A Blockchain Application in Energy. ETLA Reports No. 71. The Research Institute of the Finnish Economy. 2017. Available online: <https://www.etla.fi/wp-content/uploads/ETLA-Raportit-Reports-71.pdf>
- [22] M. Izmailov, P. Anderson, A. Lemblé, Ya. Vysoky. Prakticheskoe primeneniye tekhnologii blokchein v industrii turizma [Practical Application of Blockchain Technology in the Tourism Industry]. Winding Tree. Retrieved from: [https://windingtree.com/files/White\\_Paper\\_RU.pdf](https://windingtree.com/files/White_Paper_RU.pdf)
- [23] Z. Kazhmagambetova. Blokchein v notariate: Prezentatsiya KPMG v ramkakh konferentsii "Blockchain Conference Astana" [Blockchain in the Notary. Presentation of KPMG within the Framework of the Conference "Blockchain Conference Astana"]. 2017. Available online: <https://bconference.kz/wp-content/uploads/2017/06/zarina.pdf>
- [24] B. Kelly. The Bitcoin Big Bang: How Alternative Currencies Are about to Change the World. New York: John Wiley & Sons Inc., 2015.
- [25] B.A. Kheifets. Globalnye disbalansy i reforma mirovoi valyutno-finansovoi sistemy [Global Imbalances and Reform of the World Monetary and Financial System]. Dengi i kredit, 7, 2012, pp. 48-56.
- [26] J. Kishigami, S. Fujimura, H. Watanabe, A. Nakadaira, A. Akutsu. The Blockchain-Based Digital Content Distribution System. In: Big Data and Cloud Computing (BDCloud), IEEE Fifth International Conference. 2015. Available online: [https://www.researchgate.net/publication/308861913\\_The\\_Blockchain-Based\\_Digital\\_Content\\_Distribution\\_System](https://www.researchgate.net/publication/308861913_The_Blockchain-Based_Digital_Content_Distribution_System)
- [27] Klimov. Pochemu blokchein v strakhovanii – eto shans dlya predprinimatel'ya? [Why Blockchain in Insurance is a Chance for an Entrepreneur?]. 2017. Available online: <http://www.forbes.ru/tehnologii/344683-pochemu-blokcheyn-v-strakhovanii-eto-shans-dlya-predprinimatel'ya>
- [28] V.A. Kolesov. Ispolzovanie tekhnologii blokchein v uchebnom protsesse dlya zashchity intellektualnoi sobstvennosti [Blockchain Technology's Using in the Educational Process for the Protection of Intellectual Property]. In: Distantionnye obrazovatelnye tekhnologii: Materialy II Vserossiiskoi nauchno-prakticheskoi internet-konferentsii [Remote Educational Technologies. Proceedings of the II All-Russian Scientific and Practical Internet Conference]. 2017.
- [29] D.I. Kondratov. Sovremennaya mirovaya valyutnaya sistema i perspektivy ee razvitiya [Modern World Currency System and Prospects of Its Development]. Belorusskii ekonomicheskii zhurnal, 1, 2016, pp. 42-60.
- [30] Kriptodemokratiya i mikrokredit na obrazovanie: kak blokchein izmenit rynek truda i institut gosudarstva [Cryptodemocracy and Microcredit for Education: How the Blockchain Will Change the Labor Market and the Institution of the State]. 2018. Available online: <https://theoryandpractice.ru/posts/16432-kriptodemokratiya-i-mikrokredit-na-obrazovanie-kak-blokcheyn-izmenit-rynek-truda-i-institut-gosudarstva>
- [31] D.A. Levi. Perspektivy priznaniya i razvitiya kriptovalyut v Evropeiskom Soyuze i stranakh Evropy [Prospects for the Recognition and Development of Cryptocurrencies in the European Union and European Countries]. Upravlencheskoe konsultirovanie, 9, 2016, pp. 148-158.
- [32] N. Likhachev. Samoe ponyatnoe obyasnenie printsipa raboty blokcheina [The Most Understandable Explanation of the Blockchain's Work Principle]. 2017. Available online: <https://tjournal.ru/41306-samoe-ponyatnoe-obyasnenie-principa-raboti-blokcheina>
- [33] I.K. Lim, Y.H. Kim, J.G. Lee, J.P. Lee, H. Nam-Gung, J.K. Lee. The Analysis and Countermeasures on Security Breach of Bitcoin. Computational Science and Its Applications ICCSA 2014, Guimarães, Portugal. Springer International Publishing. 2014. Available online: <https://www.springer.com/us/book/9783319091464>
- [34] Maersk i IBM sozdadut pervuyu v logisticheskoi otrasli blokchein-platformu [Maersk and IBM Will Create the First in the Logistics Industry Blockchain Platform]. TASS. Russian News Agency. 2017. Available online: <http://tass.ru/transport/>
- [35] C. McFarlane, M. Beer, J. Brown, N. Prendergast. Patientory: Odnorangovaya set khraneniya elektronnykh meditsinskikh kart v1.0 [Patientory: Peer-to-Peer Electronic Medical Card Storage Network v1.0]. 2017. Available online: <https://patientory.com/whitepaper-russian.pdf>
- [36] L. Parker. Private versus Public Blockchains: Is there room for both to prevail? 2016. Available online: <https://magnr.com/blog/category/technology/blockchain>
- [37] PwC. Blokchein – novye vozmozhnosti dlya proizvoditelei i potrebitelei elektroenergii? [Blockchain – New Opportunities for Producers and Consumers of Electricity?]. 2016. Available online: [https://www.pwc.ru/ru/publications/blockchain/blockchain\\_opportunity-for-energy-producers%20and-consumers\\_RUS.pdf](https://www.pwc.ru/ru/publications/blockchain/blockchain_opportunity-for-energy-producers%20and-consumers_RUS.pdf)
- [38] S. Raval. Decentralized Applications: Harnessing Bitcoin's Blockchain Technology. O'Reilly Media, 2016.
- [39] Ch. Roxburgh, S. Lund, J. Piotrovski. Mapping Global Capital Markets. McKinsey Global Institute. 2011. Available online: [https://hipinvestor.com/wp-content/uploads/MGI\\_Mapping\\_capital\\_markets\\_update\\_2011.pdf](https://hipinvestor.com/wp-content/uploads/MGI_Mapping_capital_markets_update_2011.pdf)
- [40] Sberbank CIB. Russian Financials. Who Innovates Wins: Lifting the Lid on Fintech in Russia. 2016. Available online: [http://www.vostokemergingfinance.com/content/uploads/2017/05/Sberbank\\_Russian\\_Fintech.pdf](http://www.vostokemergingfinance.com/content/uploads/2017/05/Sberbank_Russian_Fintech.pdf)
- [41] Sberbank vnedrit blokchein v sistemu trgovogo finansirovaniya [Sberbank Will Introduce Blockchain into the System of Trade Financing]. 2016. Available online: <https://lenta.ru/news/2016/09/20/blockchain>
- [42] B. Shepherd, et al. Blockchain in Capital Markets: The Prize and The Journey. 2016. Available online: <http://www.oliverwyman.com/our-expertise/insights/2016/jan/blockchain-in-capital-markets.html>
- [43] M. Shojafar, N. Cordeschi, E. Baccarelli. Energy-Efficient Adaptive Resource Management for Real-Time Vehicular Cloud Services. IEEE Transactions on Cloud Computing, 99, 2016, pp. 1-14. Available online: [https://www.researchgate.net/publication/299595250\\_Energy-efficient\\_Adaptive\\_Resource\\_Management\\_for\\_Real-time\\_Vehicular\\_Cloud\\_Services](https://www.researchgate.net/publication/299595250_Energy-efficient_Adaptive_Resource_Management_for_Real-time_Vehicular_Cloud_Services)
- [44] M. Swan. Blockchain: Blueprint for a New Economy. Sebastopol, CA: O'Reilly Media, Inc., 2015. Available online: <http://w2.blockchain-tec.net/blockchain/blockchain-by-melanie-swan.pdf>
- [45] P. Symons, et al. Blockchain Settlement. Regulation, Innovation and Application. Regulatory and Legal Aspects Related to the Use of Distributed Ledger Technology in Post-Trade Settlement. 2016. Available online: <https://www.febelfin.be/en/blockchain-settlement-regulation-innovation-and-application>
- [46] Thomson Reuters. State of Regulatory Reform 2012. A Special Report. 2012. Available online: [http://thomsonreuters.com/content/press\\_room/legal/543469](http://thomsonreuters.com/content/press_room/legal/543469)
- [47] M. Vasek, T. Moore. There's No Free Lunch, Even Using Bitcoin: Tracking the Popularity and Profits of Virtual Currency Scams. 2015. Available online: [http://fc15.ifca.ai/preproceedings/paper\\_75.pdf](http://fc15.ifca.ai/preproceedings/paper_75.pdf)
- [48] V. Vasipenok, D. Krupnov, S. Sorokin. QUASA – pervaya otкрыtaya blokchein-platforma dlya gruzoperevozok [QUASA – the First Open Blockchain Platform for Cargo Transportation]. Available online: <https://www.quasa.io/src/assets/pdf/whitepaper.pdf>
- [49] J.J. Wallis, D.C. North. Measuring the Transaction Sector in the American Economy, 1870-1970. Long-Term Factors in American Economic Growth. Chicago: University of Chicago Press. 1986. Available online: <http://www.nber.org/chapters/c9679.pdf>
- [50] R.M. Yankovsky. Gosudarstvo i kriptovalyuty: problemy regulirovaniya [State and Cryptocurrencies: Problems of Regulation]. 2017. Available online: <http://zarlaw.ru/papers/blockchain.pdf>
- [51] J. Yli-Huoma, D. Ko, S. Choi, S. Park, K. Smolander. Where Is Current Research on Blockchain Technology? A Systematic Review. PLoS ONE, 11(10): e0163477, 2016. Available online: <http://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0163477&type=printable>
- [52] H. Zhu, Z.Z. Zhou. Analysis and Outlook of Applications of Blockchain Technology to Equity Crowdfunding in China. Financial Innovation, 2(29), 2016 pp. 11. Available online .