THE IMPACT OF BLOCKCHAIN AND DISTRIBUTED LEDGER TECHNOLOGY ON FINANCIAL SERVICES

ВЛИЯНИЕТО НА БЛОКЧЕЙН И ТЕХНОЛОГИЯТА НА СПОДЕЛЕН РЕГИСТЪР ВЪРХУ ФИНАНСОВИТЕ УСЛУГИ

Assoc. prof. Petrov D. PhD
University of Economics - Varna, Bulgaria
e-mail: dpetrov@ue-varna.bg

Abstract: *Blockchain and distributed ledger are terms that were "born" only in the last decade. Their appearance and growing popularity are associated primarily with the rapid development of Bitcoin and other cryptocurrencies. However, the capabilities of blockchain technology based on distributed ledger far outweigh the cryptocurrencies. The new technology is expected to trigger revolutionary changes in the financial services sector. The comparative profile of potential possibilities of and limitations on the application of blockchain in the financial sphere frames the nature of expected changes. Nevertheless, there are still a number of unresolved issues of technological, legal and ethical nature ahead of the mass application of blockchain technology. The formulated conclusions and recommendations provide guidance for successfully overcoming objective barriers to the application of blockchain and summarizing the prerequisites for a possible evolutionary leap in the development of the financial services industry.*

Keywords: BLOCKCHAIN, DISTRIBUTED LEDGER, SMART CONTRACT, FINANCIAL SERVICES, BANKING, FINANCIAL MARKET, PAYMENTS, TRADE FINANCE, INSURANCE, COMPLIANCE

1. Introduction

The effect of the future use of blockchain and distributed ledger technology in the financial industry is often compared to the revolutionary changes in the development of communications brought about by the Internet and social networks [14; 19]. These comparisons are based on the potential of this technology for increased transparency, cost-effectiveness, security and traceability of transactions. Tayeb & Lago define three key drivers for the expected "boom" in the application of blockchain in different sectors of the financial industry: reduction of costs, risk management and regulatory compliance [20]. The purpose of this paper is to clarify the capabilities of the application of blockchain and distributed ledger technology in selected segments of the financial services industry. The methodology of the study is based on an overview of the specialized literature and secondary data, based on which a comparative analysis of the current state and the expected changes from the application of blockchain in the selected segments is carried out. The results of the analysis show unambiguously that the financial services industry needs technological change, and blockchain undoubtedly has the characteristics of a creative technological tool with the potential to make these changes.

2. What are blockchain and distributed ledger and how they work?

There is a very close relationship between the terms Distributed Ledger (DL) and Blockchain, but the two concepts are not quite identical. *Distributed Ledger Technology (DLT)* is associated with an innovative approach to recording, sharing and storing data in multiple registers (ledgers). Moreover, this technology allows for the simultaneous synchronization of recorded and stored data among different users on a shared network. In fact, the idea of a distributed database is not new. "What is new with DLT is that multiple organisations are now further inspired to work together on a shared common, auditable database" [4]. *Blockchain* may be described as a technological data structure, used in some DL, which stores and exchanges data packed in separate blocks and interconnected in a digital chain. At least in theory, not all DL use blockchain technology by default [12]. The functional essence of a blockchain-based DL is that of a shared digital register which maintains identical copies of multiple computers controlled by different users. Blockchain uses encryption and complex mathematical algorithms for irreversible records and data synchronisation, which are protected against subsequent manipulation. In the field of financial services, the responsibility for credibility, confirmation and storage of information about transactions is usually borne by third parties. These are most often institutional intermediaries carrying out clearing and settlement services. They maintain centralized databases with controlled access to information. The idea of using DLT is to make the history and complete chronology of transactions accessible and visible online for all authorized users on the network [3]. Each participant in a transaction has a valid copy of the records on the network, which may for example concern ownership of an asset and the full history of transactions carried out with it. The ledger operates as a fully decentralized system containing chronologically traceable information on each transaction [15]. In practice this means that there is no need for an independent centralized authority or an institutional intermediary to perform clearing, settlement, etc. [24]. Another important advantage of DLT is the accelerated settlement and the shortened time needed to perform transactions. This results in a significant reduction of transaction costs, because "operations are performed peer-to-peer between the corresponding parties rather than indirectly through trusted third parties" [10]. Another important point is the need for reconciliation, when transactions are posted in different ledgers. On this basis alone blockchain could reduce reconciliation and other infrastructure costs by $ 8-12 billion a year among investment banks [1]. A fundamental principle of blockchain/DLT is the shared storage of information, with practically zero risk of data loss. The security of the transactions is achieved through the processes of authorization and encryption. If an individual so-called *node* in the system malfunctions, the information will not be lost irretrievably: it will be preserved in its completeness and integrity, because all other participants possess a copy of the exact same database. Moreover, DL records the chronology of the transactions, not just the end results (e.g. current balances), which protects the system against manipulation or falsification of data. The validity of a transaction is certified by the digital signatures of the parties to it. Signed transactions are arranged in separate blocks, and each block in the chain is assigned a unique *hash-code* generated by computers under a complicated mathematical formula. Any change to a transaction will alter the hash-code of the block where it is stored. Furthermore, such changes are simultaneously reflected in all blocks of the chain. Thus any change is immediately registered and becomes immediately identifiable and traceable by all participants on the network. The automation of the *Know Your Customer* (KYC) process is considered to be one of the most important advantages of using blockchain in the financial industry. Currently the average time spent by financial institutions on KYC-activities and on-boarding of

customers is more than 26 days [21]. This period can be substantially shortened through the use of digitized databases. Participants may conduct KYC activities in real time by establishing the digital identity of the corporation using the functionality of the DL database [11].

The idea of using *smart contracts* in blockchain fits appropriately in financial transactions where there is a link between performance of the contract and performance of real transactions. Nick Szabo coined the term "smart contracts" and used the comparison to a vending machine to illustrate the principle of their operation [18]. In the context of blockchain technology, smart contracts are computer programs recorded on DL, which are executed automatically by nodes on the network. According to Natarajan, Krause & Gradstein, "any instruction that could be executed by a computer could theoretically be run by a smart contract" [12]. What makes the use of smart contracts valuable is the possibility to remove the need for third parties, such as a trustee or an agent, to intermediate between the contracting entities. The combination of blockchain and smart contracts forces execution of transactions in accordance with the terms and conditions of the contract. This minimizes the likelihood of conflicts between the parties and opens the doors wide for automation of payment processes [4]. This autonomy, which lies at the base of smart contracts, allows for their independent operation without the need for routine control on the correct and proper performance of their clauses. Besides autonomous, "smart contracts are self-sufficient, which implies they do not depend on funding from their originator" [23]. From the foregoing it becomes clear that smart contracts constitute a series of self-executing contractual commitments which function by generating computer codes of contractual models of the type "if-then" [2]. One significant advantage is that they provide greater security and traceability of legally valid transactions, which also simplifies the tasks of regulatory authorities [15]. The key features of smart contracts are autonomy, self-sufficiency and decentralization. Along with automated execution of real transactions, the use of smart contracts in DL "seizes" the functions of the central register as there is no need for an intermediation to perform clearing and settlement through independent information confirming the transaction. Instead, smart contracts can be programmed to control the entire cycle: from negotiation to execution of the transaction without human intervention, while regulators receive up-to-date information on the relevant activity.

3. Results and discussion

Which are the areas or segments of the financial industry where there are preconditions for the application of blockchain? Table 1 is an attempt to summarize the criteria for applicability by key characteristics and parameters of the technology.

Table 1: *Preconditions for applying blockchain in various sectors of the financial industry and expected benefits by key criteria*

Key criteria	***Preconditions for applicability***	***Expected benefits***
Intermediaries	The presence of intermediaries is the result of distrust between the parties to the transaction Delays caused by the participation of intermediaries High fees	Removing or reducing the role of intermediaries Accelerating processes Reduced costs
Transparency	More than two parties are involved in the transaction Greater transparency would be beneficial for participants	Records in blockchain are irreversible and prevent manipulation and falsification
Data	The same information is stored in different locations by many participants Synchronization is a problem	Storing data in blockchain ensure the conformity and synchronization of data
Manual processing	The processes require manual data processing High costs for verification of data conformity	Automation of processes reduces manual processing and solves the problem of data identity
Trust	Various participants can change the terms of the transaction There is a risk of fraud and falsification	Smart contracts prevent improper actions by a participant
Paperwork	Paper documents are predominant Burdensome document turnover	Much of the paperwork is rendered unnecessary
Time	Transactions are not executed in real time or require additional processing (settlement, clearing)	Transactions are executed in "near real time" or the time for settlement is shortened

Source: Adopted according to Deloitte (2017) Blockchain in Banking

It is believed that a particular sector of the financial industry has the preconditions for use of blockchain if the defined preconditions exist for most of the selected criteria (in column 2 of Table 1). For example, a segment of the financial market would be suitable as a "field" of application of blockchain, if the following circumstances exist: burdensome document turnover between parties, predominantly manual processing of transactions, slow settlement, possibility for different parties to change the terms of the transactions and lack of transparency in their negotiation. Based on this approach, the following text deals with certain specific segments of the financial industry which are expected to implement blockchain. Table 2 summarises the problem areas in selected sectors of the financial industry, and the positive effects expected from the application of blockchain.

Table 2: *Comparative profile of the current state in selected sectors of financial services and the expected effects of the application of blockchain*

Current state	**With blockchain**
Trade Finance	
Cumbersome procedures Complicated documentation Multiple stakeholders involved Burdensome document turnover between parties Manual processing of transactions	Automation of processes Automatic refreshment of clauses Operational security Reduce time and costs Expedited deliveries Unnecessary intermediaries
Global Payments	
Serviced by a third-party clearing mechanism Heavy procedures: payment initiation, bookkeeping, transaction reconciliation, balance reconciliation High expenses Lengthening the payment process	Track the full transaction history Define the role of all parties involved Reduced operational costs High security processing Faster execution of transactions Greater clarity and transparency
Capital Market	
Many different external clearing and settlement systems High counterparty risk Existence of a chain of intermediaries in some transactions Slow issuance procedures Slow and inefficient reporting of transactions	Speeding up and ease the execution of contracts Reduced counterparty risk Higher efficiency and transparency Conceptual change in issuance, clearing, settlement and reporting More efficient investment management and data storage
Syndicated Loans	
Low degree of transparency concerning the syndicate formation and loan pricing Too slow settlement High costs of servicing Manual processing of documentation Manual synchronization of data	Increased transparency Reducing transaction complexity Increased operating efficiency Automatic compliance with local regulations Enhanced KYC procedures and fighting money laundering
Insurance	
Many stakeholders are involved A complex procedure for declaring damage and paying insurance Heavy document turnover Predominant manual processing of the documentation	Lightening of procedures Use of smart assets Faster movement of the claims Elimination of intermediaries Minimization of insurance fraud Automated payment
Regulations and Compliance	
Growing transfer of information Difficulties to synchronize data Difficulties in AML processing Processing multiple reports from participants is required	Providing up-to-date and reliable information Easy tracking of origin of funds Minimize manual processing and analysis of information

Source: author's construction

Basic *Trade finance* instruments such as Letters of credit, Bills of exchange and Commercial papers currently are characterised by cumbersome procedures, complicated documentation, multiple stakeholders involved, burdensome document turnover between parties and the predominantly manual processing of transactions. The advantages of blockchain in this industry, where short-term bank intermediation in the trade is estimated at 6-8 trillion US dollars, are indisputable [20]. The implementation of blockchain and smart contracts would have a very positive impact on the spending of time and resources, by simplifying procedures through automation. Part of the intermediary chain such as multiple correspondent banks becomes unnecessary, which results in higher operating efficiency and reduced costs [6].

In the field of *Global payments* the advantage of blockchain is the possibility for each participant in the payments to track the full history of a transaction and the role of all parties involved. Current payment systems achieve this at the cost of higher expenses for exchange of unencrypted data and messages between participants in the payment process. Interbank payments currently rely on the services of third party providers of clearing mechanisms. Intermediation in clearing and settlement extends and makes expensive the payment process, as it requires activities such as data storage, coordination, initiation, validation, execution and reporting of transactions, etc. [9]. The process of data exchange in DL is significantly relieved from administrative procedures and manual processing of information, which reduces substantially the operating costs. In addition, the payment process is much safer and faster thanks to the encrypted identification of participants and the inability to deliberately manipulate data.

Modern *capital markets* are based on multiple clearing and settlement systems. A study by Goldman Sachs Investment Research shows that capital markets can save 6 billion US dollars annually through the use of blockchain [7]. The study was limited to four cash instruments, and therefore the real cost savings are expected to be higher. Transactions using blockchain could radically transform capital markets trade, which is built on tools with standardized attributes, such as maturity, nominal value, coupon, payment date, etc., all of which in turn can be components of a smart contract. This will contribute to forcing and facilitating the performance of arrangements and agreements between the parties to the transaction. Derivative contracts are also built on specific parameters, which can be transformed into a smart contract through algorithms for calculation of mark-to-market value, margin, options and conditions for exercise. In the case of swaps and over-the-counter derivatives, where each contract is unique, their specific algorithm can be embedded in certain smart contracts. The use of DL could be appropriate for trade in certain hybrid instruments such as "CoCo" bonds (contingent convertible bonds), which are characterized by a complex structure that combines elements of debt financing and own resource [6]. Blockchain changes conceptually the issuing activity, the processes of notifying and updating current balances, clearing, settlement and reporting, which increases the efficiency of investment management and information storage.

Several studies share the belief that blockchain will find favourable conditions for use in *syndicated loans* [17; 22; 2; 13]. These expectations are based on factors that adversely affect the performance of this market, namely the low level of transparency of the processes of forming a banking syndicate and pricing of loans; the slow settlement procedure and the higher costs for administration and maintenance of syndicated loans [2]. By using the DL architecture of the blockchain technology banks can combine into one block heterogeneous tasks such as local regulations, KYC or prevention of money laundering. The banks in the syndicate will benefit from increased transparency and reduced complexity of transactions, reduced KYC time and costs, as well as compliance with local regulations. Overall, the benefits of blockchain for banks participating in syndicated loans include enhanced security, shortened time for carrying out transactions, lower transaction costs and increased operational efficiency [16].

The application of blockchain in some areas of *insurance* is also possible, as this activity is characterized by the financial risk of loss and damage. This is particularly relevant in the field of property insurance, which currently involves, besides insurer and insured, a variety of other stakeholders such as reinsurers, brokers, supervisory and regulatory authorities and data processing organizations. Verification of submitted data, the presence of intermediaries and the possibility of fraud burdens the process of assessing the amount of damages and payment of the sum insured. The administration of these processes could be eased through the use of smart assets, which through sensors and other external sources can automatically report any damage and lodge claims for compensation. On the other hand, the use of smart contracts would lead to the removal of middlemen in the chain and contribute to the faster administration and processing of claims. Perhaps the most significant advantage of this new technology is minimizing the attempts to commit insurance fraud and falsification. The insurer will have guaranteed access to integrated information sources about all details of the history of the claims and the origin of the insured asset, which is a prerequisite for identification of suspicious behaviour on the part of the insured [11].

Last but not least, blockchain is expected to streamline the activities of the authorities and institutions of the financial market in the field of *Regulations and Compliance*. Maintaining compliance with the standards and regulations has become a daily routine for financial institutions. Audit, tax reports, stress tests and harmonization of activities with regulatory requirements are an important part of the functioning of today's global financial market. The constantly growing transfer of information obtained from various sources, participants and channels hampers its processing and synchronization by regulators. Blockchain could significantly ease the work of regulatory and supervisory authorities by providing them with constantly updated and reliable information about the transactions [8]. One of the greatest socially significant benefits from the introduction of the new technology for the supervisory activity is associated with Anti money laundering (AML). Regulators will be able to easily track the origin of the funds and the history of the transaction in DL, without their having to request and process the numerous statements and reports of the participants in the transaction.

Despite the expected positive effects from the application of blockchain and DLT, some concerns for the disruptive potential of the new technology cause tension among financial intermediaries. For example, the introduction of a new technology such as blockchain, which threatens the status quo of the so-called "systemic" market players, is expected to meet their fierce resistance. There are concerns among financial intermediaries, quite correctly, that the application of blockchain may push them away from the market and result in financial losses and even bankruptcies. In addition, large-scale application of blockchain faces other unresolved issues of technological, legal, regulatory and ethical nature. These challenges can be summarized as follows:

• Although DL records are credible and irreversible, there is still no detailed legal regulation of the matter. If, for example, two financial institutions are in dispute or litigation, it is unclear how this will affect the status of their transactions in DL. The necessary legal framework will also enable regulators to exercise effectively their supervisory functions.

• Automation of KYC activities can be achieved only if the partners reach agreement on the building of a unified rating system.

• The assessment of the costs and benefits of the use of this new technology may substantially differ between different financial players. This may call into question the benefits of cooperation between the participants and the return on investment in technology.

• Many issues of moral and ethical nature concerning the substitution of computer algorithms for the human factor remain unresolved.

4. Conclusions

The financial services industry needs technological changes and blockchain undoubtedly has the potential to make these changes. The specific procedures required by certain complex financial products, which include a chain of intermediaries, and the still prevailing manual processing of documentation, burden the transactions with additional costs and make the process inefficient. The results of the analysis of key functional parameters of blockchain and DLT show that they have gradually transformed from a purely technological tool into a concept of survival and an important part of the development strategies of the financial industry. The comparative profile of the potentials for and the limitations on the application of blockchain in the financial sphere frames the nature of the expected changes. The successful overcoming of obstacles to the application of this technology is a challenge and a prerequisite for an evolutionary leap in the development of the financial services industry. From this point of view, appropriate measures can be taken in the following order:

1) Test pilot projects in real market conditions using DLT in selected segments of the financial industry;

2) Establish the necessary legal and regulatory framework for the functioning of blockchain;

3) Launch initiatives to develop a unified rating system that allows automated KYC process.

Bibliography

1. Accenture, Banking on Blockchain, A Value Analysis for Investment Banks, 2017, Available at: https://www.accenture.com/...Accenture-Banking-on-Blockchain.pdf
2. Anupam, M. et al. Impact of Distributed Ledger Technology on Syndicated Loans, GENPACT, White Paper, 2016.
3. Buitenhek, M. Understanding and Applying Blockchain Technology in Banking: Evolution or Revolution?, Journal of Digital Banking, 2016, 1(2), pp. 111-119.
4. Casey, M. et al. The Impact of Blockchain Technology on Finance: A Catalyst for Change, ICMB, 2018.
5. Deloitte, Blockchain in Banking, 2017. Available at: https://www2.deloitte.com/content/dam/Deloitte/in/Documents/strategy/in-strategy-innovation-blockchain-in-banking-noexp.pdf
6. Deloitte, Over the Horizon: Blockchain and the Future of Financial Infrastructure, 2016. Available at: https://www2.deloitte.com/.../over-horizon-blockchain-future-financial-infrastructure.html
7. Goldman Sachs, Blockchain Tech Could Save Capital Markets $6 Billion a Year, 2016. Available at: https://www.coindesk.com/goldman-sachs-blockchain-tech-save-capital-markets-12-billion/
8. Goldman Sachs, Profiles in Innovations: Blockchain – Putting Theory into Practice, Equity Research, 2016. Available at: https://www.scribd.com/doc/313839001/Profiles-in-Innovation-May-24-2016-1#fullscreen&from_embed
9. Guo, Y., Liang, C. Blockchain Application and Outlook in the Banking Industry, Financial Innovations, 2:24, 2016, p. 6.
10. Infosys Consulting, Blockchain Technology and the Financial Services Market, 2016. Available at: https://www.infosysconsultinginsights.com/insights/blockchain-technology-and-the-financial-services-market/
11. McWaters, R., et al. The Future of Financial Infrastructure, An Ambitious Look at How Blockchain Can Reshape Financial Services, An Industry Project of the Financial Services Community Prepared in collaboration with Deloitte, World Economic Forum, 2016.
12. Natarajan, H., Krause, S., Gradstein, H. Distributed Ledger Technology (DLT) and Blockchain. FinTech note, no. 1. Washington, D.C., World Bank Group, 2017.
13. Padmanabhan, G., Komma, K. Reinventing Syndicated Loan Processing with Distributed Ledger Technology, White Paper, TCS Banking and Financial Services, 2016.
14. Perez, Y. Santander: Blockchain Tech Can Save Banks $20 Billion a Year, CoinDesk, June 16, 2015. Available at: http://www.coindesk.com/santander-blockchain-tech-can-save-banks-20-billion-a-year/ [Accessed 1 February 2019].
15. Petrasic, K., Bomfreund, M. Beyond Bitcoin: The Blockchain Revolution in Financial Services, White & Case, N.Y., 2016.
16. Petrov, D. Blockchain Technology - A Bank Lending (R)evolution: The Case of Syndicated Loans, New Challenges of Economic and Business Development, 2018: Productivity and Economic Growth: Proceedings, Riga, pp. 500 - 511. Available at: https://www.bvef.lu.lv/.../Proceedings_2018.pdf [Accessed 5 August 2018].
17. Rutenberg, S., Wenner, R. Blockchain Technology: A Syndicated Loan Revolution, Financial Technology (FinTech) and Regulation, Polsinelli, July, 2017. Available at: https://sftp.polsinelli.com/.../upd0717fin.pdf [Accessed 2 February 2019].
18. Szabo, N. The Idea of Smart Contracts, 1997. Available at: http://szabo.best.vwh.net/smart_contracts_idea.html
19. Swan, M. Blockchain Blueprint for a New Economy, O'Reilly Media Inc., CA, USA, 2015.
20. Tayeb, S., Lago, F. Blockchain Technology: Between High Hopes and Challenging Implications, The Mena Business Law Review, First Quarter, 2018, pp. 34-43.
21. Thomson Reuters, KYC Challenges in 2017: A Focus on the Impact of Global Regulations in the United States, 2017. Available at: https://risk.thomsonreuters.com/...kyc-challenges-2017-usa.pdf [Accessed 5 December 2018].
22. Turner, E. Blockchain Stands to Disrupt Syndicated Loans, S&P Global Market Intelligence, 2016. Available at: https://www.snl.com/Cache/snlpdf_c2a459c7-d971-425b-8943-5da31b2887c5.pdf [Accessed 4 February 2019].
23. Van Oerle, J., Iemmens, P. Distributed ledger technology for the financial industry, White Paper, ROBECO, 2016.
24. Woods P. et al. Blockchain and Distributed Ledger Technology: Application to the Loan Market, Loan Syndication and Trading Association, Operations Conference, April 4, 2017.