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A NEW DIGITAL AGE IN FINANCE: BLOCKCHAIN AND SMART CONTRACTS

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Abstract

Digitalization in finance is an irreversible process, which manifests itself in many different dimensions. Blockchain is an innovative technology that can significantly increase the operational effectiveness of key processes in the financial services industry by reducing costs, enhancing the security and transparency of transactions, and speeding up the settlement process. The idea of smart contracts' implementation in blockchain is suitable for financial transactions, where a link between fulfilling contractual terms and performing actual transactions is established. The ''blockchain - smart contract'' combination forces the execution of all transactions in accordance with the contract terms and leaves a door, wide open for the automation of key processes. What makes using a 'smart contract' beneficial is its ability to eliminate mediation from third parties, such as agents or trustees. The invasion of digital technology is expected to bring dramatic changes in the nature of financial intermediation. This research paper is focused on assessing the expected degree of blockchain penetration and its impact on selected key segments of the financial industry (e.g. global payments, trade finance, capital market trading, syndicated lending, insurance and compliance). Barriers and challenges to the new application's wide spreading are also analyzed. Based on this research, conclusions about the expected degree of applicability of blockchain in the financial sphere are drawn, and proposals for the initial steps in this direction aremade.

Key words: blockchain, smart contract, distributed ledger, financial services

Introduction

Blockchain technology has legalized its presence in the financial sphere with the appearance of the first decentralized cryptocurrency. The terms "blockchain", "smart contract" and "distributed ledger", completely unheard of until a decade ago, are not only gaining a growing popularity these days, but are also quite daringly changing "the rules of the game" and are seriously threatening the centuries- old foundations of financial intermediation. It is typical for technologies that are still in their embryonic, or early-development stage to be the focus of attention of experts and specialist community. As is the case with every new technology, blockchain capacities have not been fully explored. Research carried out by Janaviciene&Fomin based on data from 58 relevant articles, indicates the growing interest of the scientific community towardsblockchain application in the context of economics, management and finance (Janaviciene & Fomin, 2019, pp. 310-320). The research focus of the present paper covers the following questions: is blockchain able to cause dramatic transformations in the financial service sphere, which segments are likely to be affected and what is the nature of expected changes?

Undoubtedly, the appearance of blockchain technology has generated a surge of high expectations. At present the debate about the future of this innovative technology extends over a wide range of issues – from skepticism concerning inflationary over-expectations to euphoric visions that what is to come will surpass our boldest fantasies. In the spirit of apocalyptic scenarios, DeutscheWelle broadcast a documentary about blockchain technology, with the provocative title "The end of banking as we know it?"(Deutsche Welle, 2019). A publication in the renowned journal "Harvard Business Review" however, proclaims blockchain as the technology that" could slash the cost of transactions and reshape the economy"(Iansiti& Lakhani, 2017). In the "White paper" series of the World Economic Forum in 2018 experts evaluate the effect of blockchain 'spush on global trade over the next decade at the whopping amount of 1 trillion US $ (WEF, 2018, p. 7).The cumulative size of investment in blockchain start-ups exceeded 1.5billion US$ as early as 2017, and forecasts predict that in 2025 the added value of blockchain business will increase to 176billion US$ (Growth of Blockchain Technology…, 2018). Experts expect the new technology will reform the financial services industry, just as the Internet and social networks have transformed the world of communications over the last two decades (Perez, 2015; Swan, 2015). The effectiveness of blockchain

technology has never been questioned, as it "accelerates the movement of assets across the world in seconds and at minimal transaction costs" (EVRY, 2016). Apart from allowing the so-called peer-to-peer transfers, blockchains eliminates the need for intermediaries in performing settlement or clearing (Woods et al.,2017).

Blockchain-smart contracts performance

Blockchain uses encryption and complex mathematical algorithms for irrevocable records and data synchronization protected by eventual manipulation. The functional entity of blockchain can be described as a distributed ledger(DL)with supported identical copies of multiple computers, controlled by various users. What adds to the attraction of DL is the possibility for many users to share a generally accessible and constantly audited database (Casey et al., 2018). In the sphere of financial service industry the concern for credibility, confirmation and storage of information on performed transactions, are usually the responsibility of institutional intermediaries, who carry out clearing and settlement. The database they support is centralized and has a controlled access to information. The idea of using DL is about the history and the comprehensive transaction chronology being accessible and visible on-line by all authorized participants in the network (Buitenhek, 2016, pp.111-119). Every participant in a transaction possesses a valid copy of the records in the network, which may, for example, refer to the ownership of a given asset and the complete chronology of the deals performed with the said asset. The system of functioning of the register is absolutely decentralized and contains information that can be traced over time, about each particular transaction (Petrasic&Bomfreund, 2016). Another important advantage of blockcainis the acceleration of settlement and the time necessary for performing transactions. This results in a substantial reduction of transaction costs, as they are performed directly (peer-to-peer) between corresponding parties, without the need for validation or other type of interference by a trusted third party (Infosys Consulting, 2016).

The underlying principle of a DL-based blockchain is the shared storage of information, which leads to a practically zero-risk data loss. Transaction security is achieved by means of the processes of authorization and encryption. Should a particular node in the system fail, information will not be lost, but will be fully and entirely preserved, as every other participant has a copy of absolutely the same database. Besides, the DL also stores transaction chronology, and not just the closing balances, which protects the system against manipulation or falsification of data. Transaction validity is verified through a digital signature of the transaction participants. Signed transactions are arranged in separate blocks, where each block in the chain is assigned a unique hash code that is computer-generated following a complex mathematical formula. Changes performed on transactions will change the hash- code of the block they are stored. Further, on these changes are simultaneously reflected in all blocks along the chain. Thus, an eventual change will be first immediately registered, and second, instantly detected and traceable by all participants in the network (Petrov, 2019). One of the most substantial advantages to using blockchain in banking is the automation of the Know Your Customer (KYC) process. The average length of performing KYC activities and onboarding clients at present takes credit institutions over 26 days (Thomson Reuters, 2017). This period can be drastically shortened by using a digitized database. Participants can carry out KYC activities in real time, establishing the digital identity of the corporation through the DLT base functionality (McWaters et al.,2016).

Productivity of the technology can be multiplied by the ingenious combination of blockchain and smart contracts. The idea of implanting smart contracts into blockchain fits fine with financial deals where there is an interconnection between executing contractual terms and performing real transactions. It was Nick Szabo who first introduced the term “smart contract” and used the comparison with a vending machine to illustrate the principle of their functioning (Szabo, 1997). In the context of blockchain technology smart contracts are computer programs, recorded in DL, which are automatically performed by all nodes in the network. What makes using smart contracts valuable is the possibility to eliminate third parties– intermediaries such as agents or trustees. The blockchain - smart contract combination speeds up the execution of transactions in accordance with contractual terms. This minimizes the likelihood of conflicts appearing between parties and creates the prerequisites for payment processes automation. The autonomy, built in the basis of smart contracts allows for them to function on their own, without the need for routine control over the proper and correct execution of contract clauses. Apart from being

autonomous, smart contracts are also self- sufficient, which means they do not depend on financing by their issuers (Van Oerle&Iemmens, 2016). From our expose, so far it is clear that a smart contract is a sequence of self-executing contractual engagements, which function through computer-generated codes for contractual terms of the "if-then" type models. A major advantage of theirs is the fact they provide higher security and possibility to track down legally valid transactions, which also considerably facilitates the work of regulatory bodies (Petrasic&Bomfreund, 2016). Apart from automated performance of real transactions, smart contracts "take over" the functions of the central register, as it is not necessary to employ an intermediary agency to perform clearing and settlement by independent information about transaction confirmation. Instead, a smart contract can be programmed to manage the whole cycle – from negotiating to closing the deal without human interference, while at the same time regulators receive up-to-date information about the activities performed.

Results and discussion

In which spheres of the financial service industry are there prerequisites for blockchain application? Based on the analysis of the specific peculiarities of the new technology, it can be claimed that the said technology could find an appropriate field of application in segments which suffer from problems like heavy load of document turnover between participants, predominantly manual transaction processing, delayed settlement, the presence of a chain of intermediaries, existing possibility for various parties to change terms and conditions and lack of transparency in the negotiation process. Following this approach, in the forthcoming text there have been selected certain specific segments of the financial industry, which are expected to be targeted by blockchain. Table 1 synthesizes problematic spheres within the said selected segments and the expected positive effects of blockchain application.

Table 1

Comparative profile of the current state within selected segments and expected effects of blockchain application

Status quo at present	With blockchain application
Trade finance	
Heavy procedures Complicated documentatio n Multiple stakeholders involved Burdensome document turnover between parties Manual transaction processing	Automation of key processes Automatic clause refreshment Operational security Reducing time and costs Accelerated supplies Eliminating superfluous intermediaries
Global payments	

Serviced by a third party clearing mechanism Heavy procedures: initiating payments, accounting, transaction coordination, closing balances High costs Prolonged payment process	Tracing the entire transaction history Clarifying all participants roles Reduced operating costs High degree of security in processing Quicker transaction execution Greater clarity and transparency
Capital market trading	
Availability of various clearing and settlement systems High counterparty risk Availability of a chain of intermediaries with certain transactions Awkward issuance procedures Slow and ineffective transaction reporting	Acceleration and facilitation of contract execution Reduced counterparty risk Higher effectiveness and transparency Conceptual change More effective investment and data storage management
Syndicated lending	
Low degree of transparency in banking syndicate formation Unclear and non-transparent pricing Much too slow settlement High service costs Manual document processing	Increased transparency Reducing transaction procedure complexity Increased operational effectiveness Automating compliance procedures and fighting money laundering Improved KYC procedures

Manual data synchronization	
Compliance	
Difficulties in processing a growing information transfer Difficulties in data synchronization Difficulties in AML processing	Providing reliable up- information Source of asily traced zation of manual data ing

Basic instruments of *trade finance* such as Letters of Credit, Bills of Exchange and Commercial Papers are at present characterized by cumbersome procedures, complicated documentation, multiple engaged stakeholders, heavy document turnover between the parties involved, and predominantly manual transaction processing. The advantages of blockchain in an industry where short-term trade intermediation is evaluated at 6-8 trillion US$ a year are unquestionable (Tayeb& Lago, 2018).The application of blockchain and smart contracts would certainly have a positive impact on time and resource costs by means of procedure simplification through their automation. Part of the chain of intermediaries, such as numerous correspondent banks, becomes superfluous, which results in a higher operational efficiency and cost reduction (Deloitte, 2016).

In the sphere of *global payments* an advantage of blockchain is the possibility for every participant in the payments to trace the entire transaction chronology and the roles of all the parties involved. Contemporary payment systems achieve that at the expense of high costs of uncoded data exchange and messages between participants in the payment process. Interbank payments at present rely on servicing through a clearing mechanism provided by a third party. Clearing and settlement intermediation makes the payment process longer and more expensive, as this requires the performance of activities like data storage, coordination, initiation, confirmation, execution and transaction reporting, etc. (Guo& Liang, 2016). The process of data exchange in DL is considerably alleviated in terms of administrative procedures and manual information processing, which considerably lowers operating costs. In addition, payment process is much more secure and speedy, owing to the encrypted identification of participants and the impossibility for intentional data manipulation.

Contemporary *securities trading* is based on a large number of clearing and settlement systems. A survey by Goldman Sachs Investment

Research (2016) shows that capital markets can save costs of 6 billion US$ a year by applying blockchain. The survey is limited to four cash instruments, therefore the real amount of costs saved is expected to be higher. Transactions using blockchain could radically transform capital markets trade, which is based on standard requisite instruments, i.e. maturity, nominal value, coupon, payment date, etc., which in turn can be a smart contract components. This will bring about revving up and facilitating the execution of negotiated agreements between the parties involved in the deals. Derivative contracts are also built on specific parameters which can be transformed into a smart contract with algorithms for calculating Mark-to-market value, margins, options and conditions for exercising. In the case of swaps and OTC (over-the-counter) derivatives, where every contract is unique, their specific algorithm can be "embedded" in separate smart contracts. The use of DL could be beneficial in trading certain hybrid instruments, such as CoCo type bonds (contingent convertible bonds), which are characterized by a complicated structure, combining elements of debt financing and equity (Deloitte, 2016). Blockchain conceptually changes issuing, the processes of notification and renewal of current balances, balance sheets, clearing, settlement and reporting, which increases the effectiveness of investment management and information storage.

A number of studies seem to share the view that there will be favorable conditions for the application of blockchain in the *syndicated loan market* (Rutenberg&Wenner, 2017; Turner, 2016; Anupam et al., 2016; Padmanabhan&Komma, 2016). These expectations are based on the existence of factors, which at present have a negative impact on the efficiency of the said market, and namely: the low degree of transparency in the processes of bank syndicate formation and loan pricing, the much too slow settlement and high costs of administrating and servicing syndicated loans (Anupam et al., 2016). Using the DL architecture of blockchain technology, banks can combine into single block diverse tasks such as local regulations, KYC or anti-money laundering. Banks within the syndicate will benefit from the increased transparency of deals, reducing deals complexity, cutting the time and costs of researching the customer and compliance with local regulations. In general, the benefits of introducing blockchain for the participant banks in syndicated loans can be summed up in the following components – higher security, reducing the time for transaction execution, lower transaction costs and increased operational effectiveness (Petrov,2018).

Last, but not least, the application of blockchain is expected to rationalize the activities of the authorities and institutions in the sphere of *regulations and compliance.* Maintaining compliance with standards and regulations has turned into a routine for financial institutions. Audit, tax reports, stress- tests and harmonizations of activity with regulatory requirements are an essential part of the functioning of today's financial market. The ever increasing transfer of information, coming from various sources, subjects and channels makes it difficult to process this information and its synchronization by regulatory bodies. Blockchain could substantially alleviate the work of regulatory and supervisory bodies by always providing updated and reliable information about performed transactions (Goldman Sachs, 2016). One of the socially significant benefits for supervision from the implementation of the new technology, is associated with the function of "counteracting money laundering". Regulators will be able to easily trace the origins of funds and transaction history in DL without having to require and process multiple declarations and reports to be submitted by transaction participants.

Conclusions

Despite the expected positive effects blockchain application, there are certain concerns, generated by the disruptive potential of the new technology, which cause some anxiety among financial intermediaries. There are all the reasons for blockchain to be classified among the type of technology, which are able, with an enviable boldness and ease, to change "the rules of the game" and drive the existing major "players" out of the market in today's financial industry. The appearance of disruptive technologies, such as blockchain, could be interpreted as a threat against the status quo of the so called "systemic" market actors and thus meet their fierce resistance. There are other unsolved problems facing the wide-scale application of blockchain, of technological, legal and ethical character. The challenges in this aspect can be summed up as follows:

- A legal framework is necessary, so that regulatory bodies could exercise their supervisory functions more easily;
- Clarity seems to be missing about how conflicts arising between counterparties will be resolved. Although records in DL are credible and irrevocable, should, for example, a dispute occur between two banks, or there is litigation, it is not clear how these will affect the status of their transactions.

- Automation of KYC activities can be achieved if there is mutual understanding and agreement among partners concerning the building of a uniform rating system.
- The cost-benefit assessment of using the technology may vary considerably among financial players. This can question the benefits of cooperation between participants and the return on investment in the technology.
- When computer algorithms replace the human factor, there are many issues of moral and ethical character which remain "hanging".

The successful overcoming of obstacles facing the implementation of the technology is a challenge and a prerequisite for an evolutionary jump in financial services. From this view point, a number of steps can be taken in the following order: test pilot projects in real market conditions within selected segments of the financial service industry; create the necessary legal regulatory infrastructure for blockchain functioning; start initiatives for building a uniform rating system which should allow an automated KYC process.

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