

Assessing the Impact of Supply Chain Financing Using Blockchain Technology on Credit Risks in the Banking Sector of the Russian Federation

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Abstract—Traditional supply chains rely on banks to support the related financing activities and services. With the emergence of blockchain technology, more and more companies in different industries have considered using it to support supply chain finance. Despite the very high interest from international and national financial institutions, and also enterprises from the real sector of the economy demonstrated in the distributed data storage technology, studies on the problems of assessing the use of the supply chain platform potential in the socioeconomic environment, and their theoretical understanding can be met vary rarely. As a rule, existing works reveal either the technical side of the object of study, or the regulatory or legal aspects of the applicability of supply chain technologies in the national economy. This paper attempts to overcome this conditional vacuum of understanding in order to make up for conditions with questions revealing other aspects of the subject of research, for example, such as the economic and social effects of introducing blockchain technologies into the activities of business entities. The banking sector of the national economy of the Russian Federation was chosen as the object of research. The research subject is the relationship built between participants in the financial market on the basis of supply chain technologies and the resulting effects expressed in the potential to reduce the credit risks of banks due to non-fulfilment, untimely or incomplete fulfilment of financial obligations by debtors. In the course of the study, the main directions that reduce the risks under consideration as a result of minimizing opportunistic models of behavior are substantiated and possible economic effects for the Russian banking system as a result of the use of blockchain technologies are identified. The opportunities for supply chain finance offered by possible applications of blockchain technologies in the supply chain and the capacity of this technology to deal with the existing barriers and pain points. The most important result of the work is the developed algorithm

for determining the parameters for reducing the credit risk capital for as a result of the penetration of supply chain technologies into the banking environment.

Keywords— *supply chain technology, blockchain technology, credit risks, financial results, credit requirements, reserves for possible losses, transaction costs, financial system.*

1. Introduction

For the Auto retail industry, participants in the SC (e.g., manufacturers, suppliers, carriers, warehouse, terminal buyers, and funding providers, etc.) had limited peer-to-peer communication with regards to their own concerns in traditional setting [1]. One of the biggest hurdles in information exchange is the “trust”. In addition, there are high risks of tampering while involving in debit notes, contracts, and warehouse receipts. Actually, in a centralized information environment, it is easy to tamper a record [2]. Moreover, it is costly to perform efficient custody, especially difficult to verify the authenticity of an invoice/a receivable [3]. Contrarily, BCT promises honesty and allows secure authentication of logistics and information circulation in a SC network [4]. With the development of BCT, its applications in SC fields are rapidly emerging [5]. This paper implements a Blockchain-driven SCF platform, which aims to ensuring the trust among shareholders and reducing the financing cost for the Auto retailer industry. In the coming years, supply chain technologies may become one of the breakthrough innovations in the financial sector of economy simplifying transaction operations in a number of areas, reducing their cost, and also significantly optimizing operational processes [6]. In this regard, representatives of the financial industry should understand the possible consequences caused by the integration of the technologies under consideration in the activities of credit organizations. Blockchain technologies have a very significant potential for supply chain transformation the established algorithms for the interaction between financial market participants, it is important to

understand what are the boundaries of these changes, what new opportunities are presented by Blockchain technologies and, finally, what are the expected consequences for the development of the financial sector itself and the other sectors of the national economy associated with it.

Given that Blockchain technologies form the potential to reduce resource costs and time for supply chain finance, contribute to lower transaction costs, optimize information resources that ensure the quality of decisions made, etc., financial institutions (banks, exchanges, etc.), as well as enterprises in the real sector of the economy are becoming increasingly interested in this technology.

The most important parameter of supply chain networks is to maximize the factor of trust between its participants based on the rational use of information about them and minimizing the risk of inclusion in their composition of dishonest customers (minimizing credit risk). In fact, this is the most important function of distributed storage technologies. Thus, it is advisable to conduct a study of the emerging effects for the banking sector of the economy precisely through the prism of this functional.

It should be noted that, of course, supply chain technologies are characterized by a much wider range of functional areas and capabilities. In solidarity with the position of [7], it should be noted that the following technological procedures are the most important components in the issue, revealing the features of the functioning efficiency of organizations in the financial sector of the economy (both from the point of view of the cost approach and from the point of view of time consumption):

- 1) Verification of assets;
- 2) Data search, accounting and processing;
- 3) Data confidentiality;
- 4) Transaction costs.

2. METHODS

However, the study of the process on necessity and validity of the transition of the financial industry to supply chain by Blockchain technology will be penetrated in this work by analysis and evaluation of the transformation of one of the above options "Accounting and data processing", which is due to the choice of the subject of study.

It is accepted as the main hypothesis of this study that the introduction of supply chain technologies in the operational activities of the banking sector

of the economy will ensure the reduction or complete elimination of doubtful, non-performing and bad loan debts. When determining the possible effects generated within the framework of the hypothesis under consideration, it is assumed to minimize the indicator "Reserve for possible losses on loans" in accordance with the above defined effects.

Given that bank reserves, in fact, "mothball" the liquidity of financial credit institutions, their creation narrows down lending opportunities, "freezes" working capital and, accordingly, forms the prerequisites for reducing the financial results of the banking sector of the economy. At the same time, it should be noted that, of course, the formation of reserves is undoubtedly one of the mechanisms used by the central regulator that contributes to the sustainable development of the financial sector of the economy in conditions of turbulence in foreign and domestic markets. Without going into details about the reservation rates established by the Central Bank of the Russian Federation for one or another risk of the banking sector, it is unambiguously necessary to state that financial institutions suffer losses as a result of reduced liquidity as part of the "freezing" of assets in the funds being reserved.

In order to detect such dependencies, a model has been constructed that assesses the impact of credit risks on key parameters of the financial results of the banking sector.

$$Y = -437,28 + 0,23X_1 - 0,3X_2 \quad (1)$$

Where

Y - Financial performance of credit organizations, billion rubles

X1 - The volume of loans issued, billion rubles.

X2 - Formed reserve for possible losses on loans

3. RESULTS AND DISCUSSION

The results obtained prove the very significant impact of credit risk reserves on the volume and dynamics of financial results of credit organizations. In this regard, it seems quite obvious that the search for areas that contribute to the reduction of such risks, where the optimization of the portfolio structure of loans issued is a key mechanism.

Given that supply chain by blockchain technologies can largely mitigate such risks, their use is very justified in the banking sector in the system of building and "tuning" activities in the field of credit activities.

At the same time, it is undoubtedly necessary to realize that distributed data storage technologies are not able to eliminate the entire volume of credit risks. At the same time, in solidarity with the position of many foreign experts [8-10], we suggest that their application will in the vast majority of cases reduce them by eliminating opportunistic models of counterparty

behavior, automating business processes, maximizing the congruence of goals and objectives of supply chain network participants, etc.

In connection with the foregoing, our scenario forecasting model of the impact of supply chain technologies on the adjustment of financial results of financial organizations proposes to include those credit risks in the list of the eliminated ones that fall into the categories of “Doubtful”, “Non-performing” and “Bad”. This is justified by the hypothesis that these categories of loan debt are formed in the vast majority of cases in the field of opportunistic models of managing economic agents and unreliable identification of qualitative parameters characterizing the credit ratings of borrowers. The use of supply chain systems within the framework of lending activities will completely eliminate opportunism and set up congruent models of interaction with counterparties.

Guided by the estimates obtained (formula 1) and the conclusions below, we presented scenario calculations that determine the possible effects generated as a result of a decrease in credit risks in the banking sector of the Russian economy and, accordingly, a decrease in the requirements for reserve capital of banks in relation to credit risk (Table 5, 6).

In this case, of course, it is necessary to realize that the formation of overdue accounts payable to banks is based not only within the framework of opportunistic counterparty models, but also within the framework of objective factors caused by the actual financial insolvency of borrowers, for example, as a result of inefficient business organization or other economic operations, and also economic models of economic agents.

In this connection, the scenarios include:

Table 1 - The value of the estimated reserve for classified loans [12]

Quality category	Name of loans	The amount of the estimated reserve of the amount of the principal debt on the loan, in percent
I category of quality (highest)	Standard	0
II category of quality	Non-standard	1 - 20
III category of quality	Doubtful	21-50
IV quality category	Non-performing	51-100
V category of quality (lowest)	Bad	100

In accordance with the parameters presented in table 2, the following table (Table 5) presents estimates of reserves in accordance with the scenarios and effects that are generated by the penetration of supply chain

1. Scenario 1 - an idealized model, according to which such categories of loans as doubtful, non-performing and bad are eliminated as part of the concept on the penetration of supply chain systems into the financial environment.

2. Scenario 2 provides for the “calibration” of decisions of a credit institution on the feasibility of including counterparty into the circle of bank customers based on its reputation in an open supply chain system. In addition to the fact that the use of relations between a bank and its borrower being participants in the supply chain systems helps minimize opportunistic models (in view of the previously stated arguments), the use of distributed data storage technologies will more effectively create KYC procedures, operationalize the interaction processes between participants in a credit transaction (for example, based on the use of “smart” contracts), and formulate conditions for the automation of management decisions, etc.

3. Scenario 3 is based on Scenario 2, taking into account the fact that the use of supply chain technologies in the financial system will reduce doubtful and non-performing loans by 50%.

4. Scenario 4 is based on Scenario 2, taking into account the fact that the use of supply chain technologies in the financial system will reduce doubtful and non-performing loans by 25%.

The calculation of the parameters for the potential on reducing the reserve volume under scenario modelling was carried out on the basis of the Bank of Russia Regulation No. 590-P dated June 28, 2017 “On the Procedure for the Creation by the Credit Institutions of Reserves for Possible Losses on Loans, and also Loan and Equivalent Debts” [7-11]. In accordance with the Regulation, the value of the estimated reserve is based on the data presented in table 1.

technologies into the financial environment (adjusted for the coefficient of the actual amount of reserves).

Table 2 - Scenario parameters of the credit risk capital, billion roubles

	01.01.2017	01.01.2018	01.01.2019
Scenario 1	173,3	187,9	214,7
Scenario 2	3118,5	3654,5	4134,7
Scenario 3	3869,1	4438,9	4923,6
Scenario 4	4244,4	4831,0	5318,1

Further, table 3 presents a scenario analysis of the impact of using supply chain technologies on the parameters for changing the "Reserves for possible losses" indicator on credit risk in relation to the entire

banking sector of the Russian economy (as of 01.01.2019). The calculation is carried out as the deviation of the actual reserves from the scenario value.

Table 3 - Potential for reducing reserves for possible credit risk losses in the banking sector of the Russian economy, billion roubles

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Potential for reducing required reserves for possible credit risk losses	5497,9	1577,9	789,0	394,5

Thus, the implemented calculations built in the framework of using the concept of scenario modelling demonstrate very impressive parameters of the potential for reducing the credit risks of the banking sector of the economy in the process of using supply chain technologies in operating activities in the "Crediting" area. In our opinion, scenario 1 is idealized (due to the exclusion of doubtful, non-performing and bad loans), and therefore it is not advisable to include it in the system of further scenario assessments.

Scenarios 2, 3, 4, in turn, are differentiated on the basis of a different ratio of declining levels of doubtful, non-performing and bad loans. Based on the presented estimates, it can be found that the integration of supply chain technologies in the banking sector is able to provide a reduction in credit risk reserves from 394.5 billion rubles to 1577.9 billion rubles.

In the future, the scenario that generates the minimum possible effects will be used as the base one, thus practically guaranteeing the possible results generated in the banking sector in the area of "Credit activity" within the framework of using supply chain technologies. At the same time, one can undoubtedly admit the possible prospects of using supply chain technologies in the banking sector of the Russian economy relying on the maximum levels of growth potential for financial results.

Returning to the previously constructed regression model (Formula 1), which assesses the relationship between the financial results of the banking sector and the level of reserved capital for credit risks, table 4 shows the calculations of the change in the indicator characterizing the financial results of the banking sector in accordance with the developed scenarios.

Table 4 - Scenario analysis of the impact of supply chain technologies on the parameters of financial efficiency of the banking sector in the Russian economy

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Estimated value of the indicator "Financial results of the activities of credit organizations", billion roubles	2910,7	1730,9	1493,4	1374,7
The absolute deviation of financial results from the baseline - the actually formed value as of 01.01.2019, in billion roubles.	+ 1565,9	+ 386,0	+ 148,6	+ 29,9

4. SUMMARY

The realized scenario estimates demonstrate that, according to the baseline scenario, the use of supply chain technologies in the operating activities of credit institutions creates a potential for growth in the financial results of the banking sector up to 29.9 billion rubles. Meanwhile, the value of this indicator is not limiting and may increase in case of implementation of other considered scenarios.

It is important to note that in accordance with the principles set out by us and the algorithm for determining macroeconomic effects, the penetration of supply chain technologies into the banking sector also forms a number of other opportunities that provide an increase in its financial efficiency. These are a reduction in operational risks, reduction in costs of intermediary services, etc. At the same time, each of the noted areas requires an individual approach to the research process. When limiting ourselves to credit risks, we should note about a very high level of potential for the use of blockchain technologies in supply chain of banking institutions in their operational activities.

In addition, the most important result of assessing the possible consequences of the penetration of supply chain technologies into the banking environment is the potential for a formalized assessment of changes that could potentially occur in the national economic system as a whole. This, in turn, allows us to move on to developing new models of economic growth under the influence of economy digitalization elements (in particular, as a result of the use of blockchain technologies in the financial sector). This will be the subject of our future work.

5. Conclusion

The dominant factor of successful SCF application is to enable enterprises to run together and accelerate cash flow throughout the whole supply chain ecosystem. In conclusion, we prove that the blockchain-supported supply chain incurs a lower level of operational risk than the traditional supply chain. we would like to note that in the same way that digitalization of the socioeconomic environment destroys traditional spheres of supply chain (for example, digital channels have replaced analogue ones), blockchain technologies can significantly transform existing business processes, including in the financial sphere, thereby continuing to develop FinTech paradigm.

Leaders of the financial industry expect that

distributed data storage technology will have a significant impact on its development [13]. According to IBM [14], 66 per cents of banks should deploy large-scale supply chain networks by 2021. Such forecasts and estimates demonstrate that changes are inevitable; the deployment of supply chain technologies in the financial sector of the economy will entail significant changes in operating activities. Willingness to them means not only the synchronization of national economic systems with the unfolding global trends of digitalization. Understanding the possible risks and consequences can ensure the growth of competitiveness of the economy for many decades to come.

ACKNOWLEDGEMENTS

The study was carried out with a grant from the Russian Science Foundation (project No. 19-18-00202).

We express our gratitude to the participants of the scientific project supported by the RFBR No. 18-010-00536 for the help in preparing the paper.

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