Increasing Stability of Economy through Supply Chain Management and the Circular Economy

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***Abstract*—This article presents preliminary propositions concerning implications for the development of what we term 'circular supply chains', defined here as the embodiment of circular economy principles within supply chain management. The economic system in the process of functioning generates positive and negative externalities. Currently, there are exacerbating problems associated with the need to minimize negative externalities, which pose global risks to the global economic system. The most acute risks are associated with ensuring the sustainability of financial systems, and also with environmental pollution, climate change, outbreaks of new types of deadly diseases. It seems promising to introduce elements of a circular economy, based on the use of non-waste technologies that minimize negative externalities. In addition, the solution to the problem of minimizing negative externalities within the framework of the current model of the economic system is associated with the creation of a mechanism for recording externalities and a mechanism for stimulating economic entities to minimize the negative external effects produced by their activities and maximize positive external effects. Tokenization on the supply chain platform creates the possibility of forming this mechanism. The system of tokenizing the externalies includes: (a) the formulation of the target behaviour of economic agents, (b) the creation of a supply chain platform that provides token issuance, (c) the determination of the exchange rate of tokens by economic agents for economic incentives (tax breaks, grants, investments, etc.), (d) an assessment of the effectiveness of economic agents in reducing negative externalities and increasing positive externalities.**

***Keywords*—** *externalities, supply chain, tokens, circular economy, sustainable development, Internet of Things, ecology.*

1. Introduction

This paper explores the implications for supply chain management (SCM) in circular supply chains (CSC) given the considerable rise in interest in the circular economy (CE) by both practitioners and theorists. According to the WEF Global Risks Report, climate disasters, cyber-attacks, and the food crisis are identified as the most serious threats, with the main types of risks are associated with the natural environment (4 risk factors out of the 10 most probable and dangerous), the state of society (4 risk factors), and economic processes (2 factors). [1]

In this regard, there is gaining ground the idea of a circular economy, which, unlike the existing linear models of the economy, is aimed at the use of non-waste technologies in all areas of production and consumption. This implies not only the processing of all waste, but the design and production of only products that are optimized for reuse and subsequent non-waste disposal, as well as the transition to renewable energy sources. [2] In fact, a circular economy eliminates negative externalities and maximizes positive externalities.

Obviously, the transition to such an economic model is a matter of the future, which, among other things, requires the solution of two interrelated tasks:

(1) Creation of a mechanism for accounting positive and negative externalities arising in the economic system;

(2) Creating a system of reinforcing economic agents to reduce the negative consequences of their activities and maximize the positive ones. [3]

Our aim is to first examine links between traditional SCM, sustainable SCM and the CE. We then highlight the sources of value creation in a CE and discuss the implications for SCM in terms of opportunities and challenges in the transition towards CSCs. The aim of our study is to develop elements of a supply chain usage model and, in particular, a token mechanism and a tokenization, which allows us to formulate on the new technological basis the accounting of positive and negative externalities in order to enhance positive external effects and remove the negative effects by economic entities. An important factor of the model is the active participation of society in the control of these aspects of economic activity, as well as a combination

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of both regulatory and market-based instruments of influence on economic entities.

2. Methods

In connection with the growth of global risks, and the volatility of prices for raw materials, there is noteworthy model of a circular economy, in which either non-waste productions or productions for which waste is the primary raw material dominate. [4, 5] In the economy of the linear type of production, the presence of a mass of waste has already been programmed, since the goods are designed in bulk without taking into account the need for their subsequent disposal and recycling. As a result, the manufacturing sectors will inevitably face a constant increase in the cost of raw materials, since a significant part of it after production and consumption as part of their products is in a landfill. As a result, the risks of companies are growing, and the pressure on the environment is increasing.

In a circular economy, any product is designed on the basis of the principle of its subsequent processing, and then its secondary, tertiary and so on use, after which it again goes through the processing-use cycle. In addition, "clean" technologies, mainly of a biological nature, are used to the maximum extent possible, where a product, after its disposal, can be returned back to the biosphere. Those components that are not subject to such return are included in the processing and use cycles. Energy in this model comes only from renewable sources.

At the present stage of economic and social development, we can still speak about individual elements of the circular economy that can be introduced, and also about an increase in the share of green energy in the global energy balance, and about the construction of individual cycles of production chains that operate in closed cycles.

This also raises the problem of externalities, since each product must carry a specific specification indicating who should ensure its reuse and final disposal, how and for whose means. But now there are technological solutions that make it possible to objectively ensure that such external effects are taken into account, in particular, the Internet of Things [6], as well as the token economy [7].

Token economics is a complex system of reinforcing desired behaviour, which was originally developed and used in education and healthcare systems; however, the methods developed within its framework were found to be applicable outside these areas; in particular, it attracts the attention of economists. Based on the latest supply chain and token technologies issued on this platform, the token economy can be used to influence the behaviour of economic entities.

The procedure for the formation of target behaviour within the framework of the token economy model includes the following components: (a) target behaviour, (b) tokens that stimulate economic agents, (c) selection of remuneration in exchange for tokens, (d) token production / emission schedule, (e) a schedule for exchanging tokens for something that is of interest to economic agents (services, privileges, goods), (f) the exchange rate of tokens.

Creating a system within which these elements are integrated will allow launching an effective mechanism to reduce negative externalities and increase the stability of the economy..

3. RESULTS AND DISCUSSION

The components of the token economy are presented in Table 1. Tokens are issued on the supply chain 2.0 platform; tokens are converted by economic agents on the terms of "smart" contracts, or in another way, according to the adopted state regulations for exchanging tokens for tax breaks, grants, investments, etc.

Note that hereinafter, Pigou externalities are understood to be external effects that can be directly quantified, while Coase externalities are those that have qualitative characteristics and are only measurable indirectly. [8, 9]

In the case of Coase's externalities, it is possible to provide a mechanism for the market circulation of tokens, which will compensate for the existing unresolved property rights in the economic system.

Table 1. Basic components of the token economy

Token Economy Components	Result	Indicators
Targeted behaviour of economic agents	Decrease in negative externalities, increase in positive externalities	UN Memorandum on Sustainable Development; WEF Global Risk Report; National projects of the Russian Federation
Tokens that stimulate economic agents	Token-issuing supply chain platform	Internet of Things for evaluating Pigou Externalities; Coase Externalities Public

		Assessment
The choice of rewards in exchange for tokens	Tax breaks, grants, investments	Supply chain regulatory framework
Token Production Schedule	Real time mode	Sensors for monitoring physical parameters (e.g. CO2 content, smoke, noise level); Mobile applications for collecting public opinion
Schedule of exchange of tokens accumulated by economic agents	Monthly, quarterly, annually	Determined by relevant regulatory act
Token exchange rate	Tax breaks, grants, investments	It is determined by the relevant regulatory act. Market circulation of tokens at the token exchange

Token economics is a complex system of reinforcing the desired behaviour of economic agents in order to reduce their negative externalities and increase positive externalities using supply chain technology. This system includes six basic components: (1) the wording / indicators of the target behaviour of economic agents, (2) tokens issued by the supply chain platform and stimulating economic agents, (3) the choice by the economic agents of the remuneration they receive in exchange for tokens, (4) a schedule for the production of tokens, (5) a schedule for exchanging tokens accumulated by economic agents, (6) a token exchange rate.

Consider each of these components.

(1) Determining the target behaviour of economic agents. The result of the functioning of the proposed system should be the behaviour of economic agents, which will reduce the negative external effects they produce and increase positive external effects. Indicators and criteria that economic agents should be guided by are presented in documents of international or national level, such as the UN Memorandum on Sustainable Development [10], Report of the World Economic Forum on Global Risks [1], National projects adopted in the Russian Federation, strategies, government programs, etc. This should also include documents at the regional level, including development strategies and programs, which also contain a set of targets and indicators.

The advantage of the token economy platform is its scalability, both by economic agents, which may be countries, regions, municipalities, companies, etc., and by a set of targeted behavioural scenarios, where an appropriate set of indicators is determined for each person. Supply chain technology allows the reception and storage of such volumes of data. [11]

(2) Tokens that stimulate economic agents. Tokens act as a kind of cryptocurrency emitted on the supply chain platform, but unlike the already classic types of cryptocurrencies, their emission is carried out for specific indicators that reflect targeted changes in externalities. Such a mechanism is necessary to prevent excessive emission of tokens and their inflation. Therefore, a key element of the token economy is accounting for changes in externalities.

(3) Choice of remuneration by economic agents. Tokens received by economic agents should be exchanged for those types of resources that are of the greatest value to them. In fact, it is about creating a cryptocurrency exchange at which economic agents acquire specific assets: tax breaks, grants, and investment resources purposefully provided by the state. At the same time, emitted tokens can be called EMC tokens (Externality-Backed Coins) by analogy with ABC tokens (Asset-Backed Coins).

(4) Schedule for the production of tokens. The issue of tokens on the supply chain platform can be carried out in real time, since it is in this mode that information is collected from various sensors using the IoT protocol. Similarly, on-line supply chain allows us to collect, record and store assessments, and reviews of the population and experts, who evaluate the situation with externalities and transmit them via mobile devices, computers, and public service terminals.

(5) Schedule for the exchange of EBS tokens accumulated by economic agents. The exchange of EBC tokens, unlike ABC tokens, cannot be carried out in an arbitrary mode, since this is connected with the procedures and parameters of the budget process. Depending on what resource the economic agent claims for during the exchange of EBC tokens (tax breaks, grants, investments), they can do this based on the results of monthly, quarterly, or annual financing.

(6) Token exchange rate. There are possible options for a fixed “exchange rate” when an economic agent

receives a fixed amount of resources from the state as reinforcements for a certain number of EBC tokens, or, in order to strengthen the role of market mechanisms, economic entities will be able to exchange stock quotes of EBC tokens depending on demand for them, as well as demand for various types of financial resources. Since these resources must be targeted (for example, investments cannot be used to pay taxes, etc.), the demand for them will be different on the part of economic entities. The mechanism for the exchange quotation of EBC tokens seems more flexible and efficient, allowing optimizing government spending.

The application of this externalities tokenization model can be implemented for starters as a pilot project within the framework of the national environmental program, for example, the Ecology national project implemented in the Russian Federation. This national project provides for a qualitative reduction of externalities associated with a load on the natural environment by 2024. It includes a package of 11 projects aimed at improving quality of water, air, and also forest conservation, and waste management. An analysis of the measures included in the national project shows that it combines indicators that can be attributed to Pigou externalities, that is those having quantitative measurability, and Coase externalities related to qualitative factors.

So, section 2 of the Passport of the Ecology national project [12] contains a list of goals and targets broken down by years to 2024. These indicators are primarily collected at the level of cities and districts, transferred to the regional level and summarized at the federal level, which, given the all-Russian scale of the national project, requires the formation of a rather complex, multi-link management scheme.

At the same time, the described model of using supply chain and tokens eliminates the hierarchy and centralization of traditional management and control loops, makes it decentralized and transparent, with a reliable system for verifying the data it receives and the safety of its storage. The distributed nature of the model makes it possible to provide open access to it, so that the population of cities and regions will be able to personally verify the data stored in the supply chain, evaluate the quality of activities carried out within the framework of the national project, thereby forming an assessment of Coase Externalities.

Tokens issued under the supply chain platform of the national project will be distributed among the participants of the project, including not only enterprises, but also regional and local authorities, activists from among the population, initiative groups, thereby forming a flexible system of supporting actors.

It should also be noted that, as is shown by the MSW disposal system reform process, which is being carried out in a number of pilot regions, the city population is wary of the construction of waste recycling plants, fearing the occurrence of negative externalities, for example, environmental degradation near such plants, unpleasant odours, noise, and increased emissions CO2, etc. Using the described externalities tokenization model allows us to make the implementation of such projects transparent to the public, and to make them full participants in the expert community, which evaluates the level of externalities and their minimization based on the token economy.

4. SUMMARY

According to statistics, only 10% of the total volume of garbage waste in Russia is recycled, the annual volume of those waste is 3.5 billion tons. 3% of waste is incinerated, which in turn damages the environment, 7% is recycled. Slightly more than 200 waste recycling enterprises and about 50 waste sorting complexes operate in the Russian Federation. [13]

On January 1, 2019, amendments to Federal Law No. 503 dated December 31, 2017 “On Amending the Federal Law dated December 31, 2017 “On Production and Consumption Wastes” and Certain Legislative Acts of the Russian Federation” came into force, in accordance with which the large-scale reform of the treatment and disposal of solid waste has been launched. [14] The goal of the reform is to achieve indicators in this area at a level consistent with European indicators. Pilot projects for the construction of four waste recycling plants in Kazan and in the Moscow region should ensure almost one hundred per cent waste recycling in these territories.

Stimulating the implementation of this reform in the pilot regions and beyond them everywhere is possible on the basis of the proposed system of externalities tokenization using a supply chain platform. The implementation of such a project should become part of the Digital Economy national project in the direction of Digital public administration, which is aimed at introducing digital technologies and platform solutions in the areas of public administration and the provision of public services to the population.

5. Conclusion

The main obstacle to the introduction of such a system, along with technical issues, is the unresolved issues of using supply chain technology in the legislative field of the Russian Federation. Given this, the project can be tested in the so-called “legislative sandbox” provided by the Central Bank of Russia to similar projects. One example is the Norilsk Nickel digital platform for issuing and circulating tokens secured by exchange metals. [15] The “legislative sandbox” regime provides for testing financial instruments that are not yet regulated by current legislation, but if this verification would be successful, the Central Bank of Russia may take the legislative initiative to adopt them.

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