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UNCERTAINTY AND RISKINESS OF SMART CONTRACTUAL RELATIONSHIPS IN THE GLOBAL BUSINESS

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Introduction and Objective of the Research. According to the modern economic theory, compliance in the global business and its support occupy a certain, moreover, indefinite place among the heaviest burdens for global business entities. The objective of the article is to cover the issue of *smart contractual relationships (SCR)* as a way to increase the business activity of global business entities by minimizing *compliance risks (CR)*.

Hypothesis of Research Studies. With current technology solutions available today, it is expected that SCR will allow minimizing the burden of global business entities by widespread CR. The most important role among such solutions is played by the latest *distributed ledger technologies (DLT)*. In the medium term, these technologies will reach such a level of development, at which the transition of contractual relationships from ordinary to intelligent ones will not only lead to the decrease in business activity in world markets, but will also contribute to its substantial increase.

Objective. To prove that CR substantially overburden global business processes; to substantiate the urgency of the issue of the transition of the global business to SCR, as a way to a possible lack of CR in the global business environment.

Research Methods:

– theoretical substantiation for proving the significance of CR as factors of the global business environment and the necessity of using DLT in SCR;

– statistical analysis for conducting a normative monetary valuation of CR and representing the degree of awareness by *global business entities (GBE)* of the competitive advantages of SCR over ordinary ones.

Results: the significance of compliance risks in the global business is defined; the importance of smart contractual relationships in the way of eliminating compliance risks essential for entrepreneurship is theoretically grounded. The existence of advantages of the activities of global business entities within one or more sectors according to the cluster principle has been proved:

– the cluster economy is a set of solely smart contractual relationships with the use of blockchain technologies;

– using these technologies, entrepreneurship in the cluster is accompanied by minimal compliance risks.

Conclusions. The article outlines the economic essence of SCR using DLT. Accordingly, theoretically, DLT will promote the spread of SCR to the entire global business environment, since business processes that are not accompanied by CR are possible then. Further research will cover the essence of DLT, due to which all the main advantages, as well as all existing deficiencies of the technology and defects for their active introduction in SCR in the world.

Keywords: compliance risks; risk management; smart contracts; blockchain technologies; cluster business.

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НЕВИЗНАЧЕНІСТЬ ТА РИЗИКОВІСТЬ РОЗУМНИХ КОНТРАКТНИХ ВІДНОСИН У ГЛОБАЛЬНОМУ БІЗНЕСІ

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Вступ і мета дослідження. Згідно сучасної економічної теорії, сумлінність у світовому бізнесі та її підтримка займають певне, до того ж, невизначене місце серед найважчих тягарів для суб'єктів світового бізнесу. Метою статті є розкриття питання *розумних контрактних відносин (РКВ)*, як шляху підвищення ділової активності суб'єктів глобального бізнесу за рахунок мінімізації *ризиків сумлінності (РС)*.

Гіпотеза наукових досліджень. При існуючих у теперішньому часі технологічних рішеннях, очікується, що РКВ даватимуть змогу мінімізувати обтяженість суб'єктів глобального бізнесу повсюдними РС. Істотну роль серед таких рішень відіграють новітні *технології розподілених реєстрів (ТРР)*. У середньостроковій перспективі, дані технології досягнуть такого рівня розвитку, при якому перехід *контрактних відносин (КВ)* від звичайних до розумних не тільки не призводитиме до зниження ділової активності на світових ринках, а й сприятиме її істотному підвищенню.

Мета. Довести, що РС істотно обтяжують глобальні бізнес-процеси; обґрунтувати актуальність питання переходу глобального бізнесу до РКВ, як шляху до можливої відсутності РС у глобальному діловому середовищі.

Методи дослідження:

– теоретичного обґрунтування для доведення істотності РС, як чинників глобального ділового середовища та необхідності використання ТРР у РКВ;
– статистичного аналізу для проведення нормативної грошової оцінки РС та

відображення ступеню усвідомлення суб'єктами глобального бізнесу (СГБ) конкурентних переваг РКВ перед звичайними.

Результати: уточнено значення ризиків сумлінності у глобальному бізнесі; теоретично обґрунтовано важливість розумних контрактних відносин на шляху усунення істотних для підприємницької діяльності ризиків сумлінності. Доведено наявність переваг діяльності суб'єктів глобального бізнесу в рамках однієї чи більше галузей за кластерним принципом:

– економіка кластеру являє собою сукупність виключно розумних контрактних відносин з використанням технологій розподілених реєстрів;

– з використанням цих технологій підприємницька діяльність у кластері супроводжується мінімальними ризиками сумлінності.

Висновки. У статті окреслена економічна сутність РКВ з використанням ТРР. Відповідно, теоретично, ТРР сприятимуть поширенню РКВ на все глобальне ділове середовище, оскільки тоді можливі бізнес-процеси, що не супроводжуються РС. В подальших дослідженнях розкриватиметься сутність ТРР, завдяки чому розкриватимуться усі основні переваги, а також усі існуючі недоліки технології та вади для їх активного запровадження у РКВ в світі.

Ключові слова: ризики сумлінності; управління ризиками; розумні контракти; технології розподілених реєстрів; кластерне підприємництво.

Problem setting. Any economic activity of any GBE is accompanied by risks. A set of CR is of significant importance among the total set of these risks. The global business faced such risks at all stages of its development, and numerous researches on its development are devoted to problems of ensuring compliance, CR management and minimization. If the entire global economy is a set of contractual relationships between its entities, then, according to the modern theory of contracts, all economic operations of GBE are accompanied by CR of a certain degree of influence. The article will focus on the technological factors of ensuring the compliance and CR management in the global business.

Analysis of Recent Researches and Unsolved Part of the Problem. The research of the issue originated from very ancient times - in essence, from the very beginning of the formation and development of economic theory. Among the leading researchers of the present day, we should mention S. J. Grossman [1], J. S. Moore [2], O. Hart [1; 2] and B. Holmström [3; 4] as leading contract theory researchers, N. Szabo [5], S. Nakamoto [6] and V. Buterin [7] as leading researchers in the field of automation of contractual relationships and the development of SCR in the global business. However, all researches of the issue are conducted separately for each aspect. Thus, no attempts were made to theoretically substantiate the need for the transition of global CR from ordinary to smart ones.

Objective of the Article is to reveal the main advantages of SCR in the global business, both from a theoretical and practical point of view.

Main Results. The global business is a set of contractual relationships between its entities. Traditionally, such relationships are understood as the economic relationships, in which two or more parties have achieved *the coincidence of their wants* (from the Latin *consensus ad idem*), their want *to be legally obliged*, and these obligations determined by the parties are secured with legal sanctions. As GBE, enterprises and households enter into contractual relationships, concluding sales contracts, employment contracts, contractor agreements and contracts of any other kinds between themselves.

When entering into a sales contract, an enterprise as the party A (which is defined by the term “*Agent*” (*A*) in the economic contract theory) is legally obliged to produce goods / to render services by quantitative and qualitative characteristics desirable for the households, such as the subject of the contract, and then directly or through intermediaries, to sell the subject of the contract at the cost specified by the parties and ship it to the household as to the final consumer, and a household as the party B (which is defined by the term “*Principal*” (*P*) in the economic contract theory), is judicially obliged to accept from the business the subject of the contract and pay the defined cost to the enterprise. The concluded contract in this case is usually a fiscal sales receipt

that is secured by a legal sanction: if the subject of the contract does not meet the required characteristics, P, retaining the fiscal sales receipt, has the right to return the subject to A and demand the return of the paid cost from it.

The term “smart contract” was proposed for the first time by the cryptologist Nick Szabo in 1996. The author defined the term as follows: “Smart contracts reduce the intellectual costs and transaction costs related to computing resource that are imposed either by principals, or by third parties, or by their means. Contract phases of search, discussion of contractual conditions, conclusion and establishment of commitments, fulfilment of obligations, and resolving disputes are the area of smart contracts. Smart contracts use software protocols and user interfaces to facilitate the process of contractual relationships at all its stages. This opens up new ways to formalize and consolidate digital (contractual) relationships that are much more functional than their inanimate paper ancestors” [5]. Thus, within the framework of the article, SCR will mean *such contractual relationships, the process of which, in order to increase the efficiency of business processes, is as automated as possible and translated into digital format.*

Transaction costs are considered to be GBE’s expenses that arise during its contractual relationship with others. Since the entire global economy and the entire global business eventually consist of contractual relationships, all GBE’s economic costs are transactional. The economic theory of contracts divides the process of contractual relationships and its phases into two groups: the definition and establishment of expected (ex ante) contractual relationships, which include such phases, as contracting parties’ search and negotiation of contractual terms and conditions, and the process of actual (ex post) contractual relationships, which include such phases, as the conclusion and establishing of obligations, the fulfilment of obligations, as well as the resolution of disputes. According to the contract theory, in ex ante and ex post contractual relationships at phases, there are so-called *opportunism risks*, which within the article are synonymous with CR. In ex ante contractual relations, there are two types of such risks.

1. *Hidden knowledge* is also known as *adverse selection risk* – both the Principal and the Agent personally own knowledge that has an impact on contractual relationships and is an incentive for their own strategic actions, and therefore they are not interested in its disclosure.

2. *Hidden actions risk* – both the Principal and the Agent cannot observe some actions by each other, which have an impact on contractual relationships, which gives the Principal and Agent an advantage in it, it will be impossible to establish the contract terms and conditions specific for these actions.

The theoretical issue of eliminating these two risks is called “*Principal’s – Agent’s Tasks*” (*P – A*). In solving these problems, Holmström, together with co-authors, proposed four principles.

1. *Informativeness principle*. Suppose there is an array of data that P and A, as well as third parties, observe and verify. Such data will be called *signals*. Signals are aimed at minimizing *opportunism risks*. On the part of A, guarantees of the quality of goods in commodity markets, or diplomas with honors in labor markets, or insurance in the credit market may be the signals. The *informativeness principle* is that, in the search for optimal contractual relationships, P will take into account only those signals that will determine the characteristics of the performance of contractual obligations on the part of A [3].

2. *Incentive intensity principle*: the Agent's optimal productivity depends on 4 factors: additional profit from the Agent's additional actions and transactions; accuracy of the assessment of the Agent's activities by the Principal; the Agent's resistance to risks under each transaction; the Agent's response to stimulation of its activities [4];

3. *Monitoring intensity principle*: the closer the dependence of the cost of the contract on the actions of A, the greater the expenses of P to monitor these actions. If P cannot observe the fulfilment of obligations of A, this will complicate ensuring the compliance of contractual relationships [4];

4. *Equivalent compensation principle*: as already mentioned, P must, for each transaction of A, take into account 4 factors and, on the basis of such assessment, develop ways of equivalent compensation of the Agent's actions. Contractual relationships, in which the execution of conditions consists of one transaction, practically does not exist, but if there is at least one transaction, in which 2 principle is observed inappropriately, the Agent will be inclined to perform such transaction negligently [4].

If all 4 principles are simultaneously fulfilled, the emergence of CR in such contractual relationships becomes impossible, since the contract then has the name of a *complete contract*. Such a contract will specify the actions of the parties in all foreseeable and unpredictable cases during all their contractual relationships, and any opportunism will to some extent violate the consensus ad idem defined by the parties. Moreover, the mathematical expectation of the economic benefits for the party is less than the expectation of economic harm (all current plus all expected transaction costs) from it to such an extent that opportunism becomes economically impossible, which is the essence of *proactive* measures to ensure the compliance. However, in practice, a complete contract is not feasible, if only because global business processes are somehow ensured by people. Therefore, the Agent's resistance to risk, its reaction to stimulation by the Principal, the accuracy of assessment of its performance by the Principal falls within the influence of the human factor, and therefore they are uncertain and unpredictable. If the contract is incomplete, then in ex post contractual relationships, there is a risk of such opportunism as *extortion* – when one of the parties, after the contract is concluded, refuses to comply with the

actions specified by the contract and requires the revision of the terms and conditions of the contract. Therefore, we showed that, as stated in the Formulation of the Problem, if the entire global economy is a set of contractual relationships between its entities, then, according to the modern contract theory, all GBE's economic transactions are accompanied by CR of a certain degree of influence. The fact that although the impact of CR on GBE is inevitable, the degree of this effect cannot be reliably estimated, and perhaps only approximately, is the most unpleasant, for example, assuming that the existence of some of the transaction costs is mostly conditioned by CR (see Table 1).

Table 1

Some of Transaction Costs that are Most Conditioned by CR

Transaction Cost Name	Normative and Monetary Evaluation of Aggregate TC in the Global Business
Documents circulation costs (paper costs, printing, registration, storage of documents, and protection of them as information files).	3% of all GBE's gross incomes
Losses as a result of fraud	
In the market of Fast Moving Consumer Goods (FMCG).	\$10–15 billion per year
In the Internet marketing services market	\$7.3 billion in 2016
Banks' costs for the infrastructure created for international payments, securities trading, and also ensuring regulatory compliance in the financial system.	\$15–20 billion per year

* *Developed by the author, on the basis of studies of GBE costs associated with ensuring the compliance [8; 9; 10; 11].*

In this case, the question of what the optimal incomplete contract, under which the risks of contractual opportunism are minimized, should be is the most important. S. J. Grossman, J. S. Moore and O. Hart – authors of the same-name model [1; 2] – decided that under such conditions everything depends on the distribution between the parties of the contractual force or the rights of decision-making in the future, which is ensured by the mutual transfer of property rights or control by the firm, or its parts. If we imagine that the parties, having entered into contractual relationships, act as one united firm, then it can be paraphrased as follows: it all depends on what organizational form the contractual relationships between the parties take and what it depends on. According to Szabo, the basis of the theory of smart contracts is that SCR take the form of the organization in which the maximum number of business processes, at a given level of

development of information technology (IT), is placed under control of *artificial intelligence (AI)* of the organization. In the case, SCR is AI of a smart contract, the basis of actions of which is represented on Figure 1 [5]. This artificial intelligence, for the use of proactive measures to ensure fairness, which is the basis for online ensuring of legal sanctions (which consists in the fact that at the same time SCR are ensured with legal sanctions in the event of a breach of a contract, and the need for the parties to apply them is minimized), according to their own possibilities, brings the contract closer to completeness. For this, according to Szabo, it is enough to fulfill two conditions.

1. The maximum possible observation and verifiability of the actions of the parties, which is essentially the most correct, with given opportunities for this, the Holmström's informativeness principle is carried out. While carrying out the first principle, AI of the smart contract will carry out the other three principles of Holmström et al most correctly;

2. No one other than AI of the smart contract and the selected third party may have access to the program protocols of the smart contract, which makes SCR private.

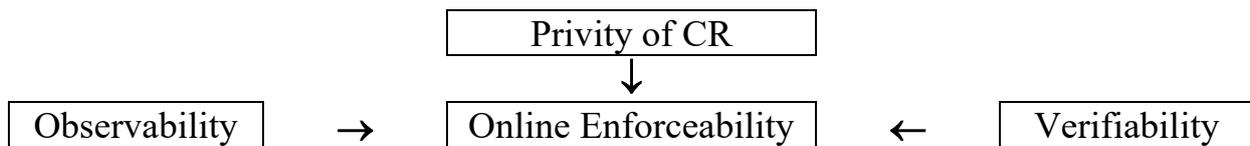


Figure 1. Basis of Proactive Safety Measures in SCR

SCR, in fact, have a long history of development. It is more appropriate to divide the historical development of SCR into 3 stages:

1. *The stage of trade automation.* The appearance and distribution of vending machines;

2. *Period of development of e-commerce payment systems (ECPS);*

3. *Period of symbiotic connection between SCR and the Internet of Things.*

The first stage of trade automation began in the days of Roman Egypt. According to Szabo, trade through them is the first prototype of SCR. Thus, they “within the limits of a limited number of potential losses ... receive coins and, through a simple mechanism, fairly give change and the goods” [5]. At present, vending machines are a significant component of the trade business in the world. Table 2 shows the importance of vending machines in the trade turnover of developed countries.

The second stage dates back to the mid-sixties of the last century, when the first ATMs appeared [15, p. 2]. Table 3 represents to what extent ECPS displace paper money transfers in the developed countries of the world.

The third stage of the development was launched in the 1990's. It was then that enterprises began to actively implement the *enterprise resource planning (ERP) systems, customer relationship management (CRM) systems*, and, in the USA [21, sec. (101.a)] and European countries [22, art. 5], the laws, which gave the same rights to electronic digital signatures as to paper ones, by which they significantly contributed to the development of electronic document management systems (EDMS) in the global business, were adopted.

Table 2

Importance of Vending Machines in the Trade of Some Countries of the World

Country Name	Number of VM (mln pieces)	Business Volume (million US dollars)
Japan	5.5	65.5
USA	5	21.6
Countries of Europe	3.8	16.8

* Developed by the author, on the basis of research on trade using VM [12–14].

Table 3

12 Countries of the World with the Lowest Values of Cash Usage

Country Name	Total Share of Cash in Transfers (% of GDP)	Share of Cash in Transfers by Households (% of GDP)
Japan	4.2	--
Southern Korea	4.5	--
Switzerland	4.5	--
Sweden	5.7	--
France	7.0	28
Netherlands	7.1	27
Finland	7.4	33
Ireland	7.6	49
Great Britain	11.3	15
Australia	11.7	18
Luxembourg	11.8	30
USA	12.7	30

* Developed by the author, on the basis of the research of the value of cash usage in the transfer of funds [16–20].

Currently, ERP and CRM systems, together with EDMS are being complementarily introduced by GBE and form a single IT infrastructure of the business. And if at the beginning of the third historic stage of development of

SCR, the main GBEs' motivation for setting up, support and development of its own IT infrastructure

- Currently large companies annually develop 2 to 3 new products per year, which averagely require 7 to 8 months to be introduced in the market. It is anticipated that this term will be halved from the next decade;

- IT solutions that prevail in the global business will mostly work within CRM systems;

- Cyber security of business will be the main focus of the brand development and customer trust support.

In the near future, this set of tasks will be performed by AI with the built-in function of machine learning, which will be the basis of the IT infrastructure of the future. For this, AI will evolve in 5 areas [23, p. 11–19]:

1. Hybrid cloud technologies (HCT). Such technology solves the problem of the lack of GBE's internal IT resources (private cloud) in its business processes through the use of external resources of the service provider (public cloud), which in the near future should significantly increase the productivity of the infrastructure and the speed of its response (which is especially relevant with the current needs for recording and processing large amounts of data) to the dynamics of the business environment, as well as its control;

2. Edge computing technologies. Its essence lies in the fact that GBE's computing resources are decentralized from one data processing server to those places from which the data flow begins the path. Under the condition of symbiosis of technology with HCT, the objective of efficient and cyberattack resisting processing of large data sets in real time will be achieved;

3. Software robotic automation of business processes. In addition to accounting and data processing, there is a wide range of business processes which it is more appropriate to delegate from person to artificial intelligence, starting from system administration and ending with management of GBE's risks, in particular CR;

4. Refusal from existing IT systems and production funds. Since in the near future, the GBE management will focus on managing customer relationships, enterprises actively discard old IT systems as unsuitable for this, as well as their own fixed assets as sources of unnecessary costs;

5. Business cyber security. In the near future, this will be the object of large investments. In addition to software robotic automation of business processes that ensure cyber security to business, there is another no less significant problem - rebuilding the strategy of cybersecurity from reactive to proactive.

The emergence of so-called *distributed ledger technology (DLT)* has become a significant factor in the development of AI of smart contracts in the current decade. The main economic essence of this technology lies in the fact that players in the global market, for example global grain and grain crops

market (producers, end users, commercial intermediaries, state and international regulatory organizations), are united into a cluster, in which they form the so-called *peer-to-peer network* that keeps accounting records unified for all, and exchanges the most detailed information about their own activities in real time. This allows AI of smart contracts in the cluster to bring these contracts closer to completeness, and the further formation and use of proactive measures to ensure integrity in SCR of the cluster, ideally, reduces the impact of CR to zero. DLT was developed in such a way that the probabilities of opportunism have a negative functional dependence on the degree of decentralization of the network. That is, the more participants in the cluster, the lower the compliance risks of SCR. The impossibility of opportunism in SCR and, accordingly, minimization of CR in the global business will promote the development of business activity in the existing market and open up opportunities for new markets. Since then the enterprise is able to redistribute additionally emerging resources among the tasks aimed at achieving the best economic results. Moreover, if public institutions also become nodes of the network, the cluster members are provided with government support in CR management.

Conclusions and Suggestions for Further Researches.

Based on the principles of the contract theory, it is grounded that ensuring compliance in the global business, provided subject to domination of classical CR in it, is a source of significant financial losses, as each economic operation is accompanied by CR. It is substantiated that the development of SCR enables to effectively overcome the barriers to development in the global business environment, which are related to the incompleteness of contracts in the global business. The use of proactive measures to eliminate CR, with application of which contractual opportunism, which is the basis for CR, becomes economically unprofitable for the existence in the global business, form the basis of SCR.

In order to facilitate the development of SCR in the global business, the article suggests the unification of GBE into clusters, in which the economy consists of SCR with the use of DLT. The unified accounting for all members of the cluster forms the basis of DLT. In further research, it is expedient to disclose the details of DLT: the features of DLT algorithms; since DLT are quite varied today, to distinguish their main types; to reveal the main economic potentials and opportunities of DLT in the global business; to reveal the main disadvantages and defects for the development of SCR with the use of DLT.

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