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RESEARCH ARTICLE

Blockchain and institutional complexity: an extended institutional approach

Daniil Frolov

Faculty of Economics and Management, Volgograd State Technical University, Volgograd, Russia
Corresponding author. Email: ecodev@mail.ru

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Abstract

From a modern institutional economics viewpoint, blockchain is an institutional technology that minimizes transaction costs and greatly reduces intermediation. Through an analysis of blockchain, I demonstrate the possibilities of extended institutional approach – a new generation of complexity-focused methodologies and theories of institutional analysis that complement and expand the standard institutional paradigm. By using the theory of transaction value, I argue blockchain technologies not only will lead to a significant reduction in transaction costs but will also reorient intermediaries toward improving the quality of transactions and expanding the offer of additional transaction services. The theory of institutional assemblages indicates it is impossible to form a homogeneous system of blockchain-based institutions associated exclusively with the principles of decentralization, transparency, and openness. Blockchain-based institutions will be of a hybrid and conflicting nature, combining elements of opposing institutional logics – regulatory and algorithmic law, Ricardian and smart contracts, private and public systems, and uncontrollability and arbitration.

Key words: Blockchain; institutional assemblage; institutional complexity; institutional logics; transaction costs; transaction value

1. Introduction

Blockchain is a public or private distributed ledger or decentralized database technology to create a non-centralized (without the need for a central entity or intermediating party) crypto-secured peer-to-peer electronic transactions. Blockchain technology is based on a consensus protocol: a computer algorithm that provides a reliable record of transaction histories, making this history shared, immutable, and openly available for all participants in the blockchain network. In short, blockchain is a digital technology for maintaining a replicated distributed ledger. It ensures the implementation of transactions in a digital format without the involvement of intermediaries. Typically, blockchain is associated primarily with cryptocurrencies (such as Bitcoin) and their mining. But this technology now goes far beyond the borders of the financial sector and will cover most transactions in the future. Key technologies in the blockchain ecosystem – smart contracts, asset tokenization, and decentralized applications[1] – can cause many alterations to the organization of business processes, the activities of government agencies, and people's daily lives. These changes are mainly related to the decentralization of transactions, their automation (more precisely, algorithmization, since blockchain is based on consensus algorithms), and a drastic decrease in transaction costs.

[1]Smart contracts are automatically executed blockchain-based contracts. Decentralized applications (DApps) – smart contracts outside financial transactions. Tokenization – transfer of ownership of tangible and intangible assets into digital format (tokens).

Distributed ledger technology illustrates obvious limitations and deficiencies of institutional economics in studying highly complex phenomena. Complexity is an insurmountable barrier for modern institutionalism; all the institutional concepts and tools are 'sharpened' for the study of industrial ('pre-network') capitalism's institutional structures. Such structures were characterized by inherent stability, clear boundaries, hierarchies, and intermediaries. They were ultimately replaced by institutions 'constructed around (but not determined by) digital networks of communication' (Castells, 2009: 4). We often forget that theories of transaction costs and institutions as 'rules of the game' were created in the late 1980s and early 1990s (North, 1990; Williamson, 1985), before the widespread proliferation of the Internet,[2] which radically transformed the entire institutional system. These theories are inadequate when analyzing Internet era institutions. In a world with a widely used blockchain, however, they will become positively archaic. Moreover, these theories' failures have only been compounded as a result of the dramatic complication of the reality they describe. These failures are not only generated by changes in institutional environment, but also by internal defects of institutional economics, specifically its one-sidedness.

The main problem is that the institutional theory of blockchain-arising institutions has an explicit one-sided character. On the one hand, as an institutional technology, blockchain is considered only in a Coasian sense, from the point of view of minimizing transaction costs. On the other hand, the system of blockchain-related institutions is regarded as a homogeneous system based on an algorithmization of contracts, 'code-ification' of law, and decentralization of transactions. I argue this is a one-sided and simplistic picture of the blockchain economy. Instead, scholars should move toward using more complex frameworks given an increasingly complex institutional environment.

Furthermore, I show that only studying blockchain through the theory of transaction costs, as Sinclair Davidson, Primavera De Filippi and Jason Potts do, offers a highly distorted view of blockchain; it requires the addition of transaction value theory. After all, the results of blockchain are not only a reduction in transaction costs (as it seems from a Coasian viewpoint) but also the addition of transaction value to actors; that is, an increase in the quality of transactions due to the emergence of new blockchain-led transaction services and innovations. Besides, blockchain-based institutions research suggests applying the institutional assemblages theory approach. This approach will shift the focus to heterogeneity, hybridity, modularity, fragmentation, and fluidity as critical properties of the economic institutions of capitalism today, especially after the pervasive introduction of blockchains. These new theoretical approaches are part of the arsenal of extended institutional approach – the alternative direction of institutional research – revising methodological conventions and dogmas of institutional economics from the standpoint of their adequacy for studying the institutional complexity of modern economic and social systems.[3] I call these approaches extended institutional analysis to emphasize how they move beyond standard institutional methodology. The transaction value approach extends standard transaction-cost economics by focusing on institutions to improve the quality of transactions and to create maximum value for actors. Assemblage theory extends the standard theory of institutional structures, shifting the emphasis to conflicting and re-assembling interrelated institutional logics. In this paper, I demonstrate some analytical capabilities of these approaches using blockchain as an example.

2. Blockchain and transaction value

Similar to any other technology, blockchain should be considered from the standpoint of two influential theoretical paradigms: Schumpeterian and Coasian approaches (Davidson *et al.*, 2018: 640).[4]

[2]The concept of the World Wide Web, which underlies the modern Internet, appeared only in 1989.

[3]The research program, as well as the conceptual framework of extended institutional analysis is still in the formative stage.

[4]The fundamental ideas of Friedrich von Hayek and Elinor Ostrom can also be productively used in the institutional analysis of the blockchain, given its spontaneous and decentralized nature. Recall that Hayek envisioned the emergence of private moneys in an institutional form of privately issued irredeemable moneys (Hayek 1976), a variety of which are essentially blockchain-enabled cryptocurrencies. According to Ostrom's (1990) ideas, blockchain-based institutions are complex

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The Schumpeterian approach includes two big ideas that can be applied to the study of new technologies. The first big idea (I call it the 'Schumpeter-1 approach') gave rise to an abundance of research on the diffusion of radical and disruptive innovations, creative destruction, and changing general-purpose technologies. This has already become a mainstream concept in evolutionary and innovation economics. The second big idea ('Schumpeter-2 approach') concerns seeking out and creating new high value-adding activities.[5] I propose using this idea to study the transaction value of blockchain technologies.

From a traditional Schumpeterian perspective (Schumpeter-1 approach), blockchain is a radical, disruptive innovation and (potentially) a general-purpose technology (GPT). Blockchain's radicalism is associated with its possible transformation of technology, infrastructure, markets, and society. As a disruptive innovation, blockchain will lead to the emergence of new, more efficient models of business, regulation, consumption, and so forth. The result is a new 'blue ocean' (unoccupied market space) (Kim and Mauborgne, 2005), as well as 'blue' seas, bays, lagoons, and lakes: smaller market niches with (as yet) extremely low competition. Blockchain has the characteristics of a GPT (Kane, 2017; Pilkington, 2016), namely, a variety of application areas and compatibility with other technologies (technological complementarity). Since blockchain is a transforming GPT (Lipsey *et al.*, 2005), it is highly likely to create a huge 'hydra' of technology trends and applications. A multi-level ecosystem with a long-term, self-development potential will be formed based on blockchain. This guarantees the emergence of new generations of blockchain technologies and related radical and incremental innovations. In fact, blockchain will increase the cumulative productivity of all factors of production and will create a cascade of creative destruction processes and effects (including indirect and deferred); it will also cause a deep transformation of industries, professions, and institutions.

From a Coasian point of view,[6] blockchain is a regulatory (De Filippi and Hassan, 2016) or, more generally, institutional technology for implementing decentralized transactions without costly intermediaries (Davidson *et al.*, 2018: 641). Blockchain eliminates the need for intermediaries, such as the state, banks, notaries, auditors, brokers, insurers, accountants, and lawyers. As a result, blockchain can radically reduce transaction costs and increase the efficiency of all economic processes and systems, regardless of their scale and specificity. Blockchain will erase 'paper footprints', accelerate the execution of transactions, and facilitate the authentication of assets and the tracking of contract performance. Blockchain causes radical institutional change because it destroys the order of transactions that exist in almost all markets, and implies the existence of intermediaries. From a Coasian point of view, blockchain obviates the need for the system of intermediation in the markets as an institutional fact over the long term. Blockchain ranks with the main economic institutions of capitalism – the market, the firm, and the state (Hodgson, 2015) – and acts as an alternative mode of economic coordination (Davidson *et al.*, 2018: 641). Moreover, it can be stated with a high degree of confidence, the blockchain is an institutional GPT that can create qualitatively new types of transactions, contracts, business models, and institutions. As a result, the blockchain will destroy many of the fundamental elements of the former (pre-digital) institutional order.

Thus, Schumpeter's framework for disruptive innovation (Schumpeter-1 approach) is the standard approach to the study of new technologies among institutional and evolutionary economists. Blockchain, as a new information and communication technology (ICT), is most often interpreted through a Schumpeterian lens of diffusing new innovations and creative destruction. In this sense,

polycentric systems – and the first attempts to apply of Ostrom's polycentric framework to blockchain governance should be considered promising (Shackelford and Myers, 2018). I find (as well Davidson, De Filippi, and Potts), however, it is more important to distinguish between Schumpeterian and Coasian approaches to the analysis of technologies.

[5] I mean 'Schumpeter's original emphasis on creating new value-generating activities as a means of searching for higher profits from innovation, as opposed to statically maximizing profits by appropriating higher rents from an existing income stream' (Cantwell, 2000: 4). This is not so much a clear definition of Schumpeter as an amalgam of various neo-Schumpeterian approaches.

[6] This viewpoint was first proposed in an article 'Blockchains and the economic institutions of capitalism' (Davidson *et al.*, 2018).

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blockchain is 'one of a many Schumpeterian technologies driving economic evolution' (Davidson *et al*., 2018: 655) by increasing total factor productivity. Davidson *et al*. (2018: 646–647) offer a new explanation of the blockchain through a Coasian lens of transaction cost minimization. Blockchain is not considered only as an ICT, but as institutional technology (maybe even an institutional GPT). But is a Coasian (or, broadly, new institutional) approach – focused on minimizing transaction costs – sufficient for understanding the real institutional nature of blockchain and determining its prospects for evolution? My answer is no.

Similar to other effective institutional innovations, blockchain significantly reduces transaction costs (Davidson *et al*., 2018: 648–653). Thus, blockchain has a positive effect on the effectiveness of various types of economic activity and the economy as a whole. This is a conventional view, which is shared by the institutional economics' scientific community. Blockchain has a tremendous potential to reduce transaction costs (PwC, 2017: 17), create numerous opportunities for drastically reducing transaction costs (CPA Canada, AICPA, 2017: 1), significantly reduces the time and costs of transactions (Morabito, 2017: 26), and so on. Blockchain reduces the costs of regulation, verification, ensuring security, storing transactional data, monitoring opportunism, and so forth. With its systematic influence on minimizing transaction costs, blockchain can even be compared to the Protestant work ethic (Hazard *et al*., 2016), which, according to Max Weber, was the catalyst for the formation of capitalist institutions.

But recognition that blockchain reduces transaction costs comprehensively is still not enough to understand its real complexity. Rather than use a Coasian lens of cost minimization, I advocate looking through a Schumpeterian lens of value creation (Schumpeter-2 approach). I argue that blockchain is an institutional technology not only in Coasian terms but also in a Schumpeterian sense: it not only reduces costs of transacting (and therefore is a Coasian institutional technology) but also increases transaction value and improves the quality of transactions (which means it is a Schumpeterian institutional technology).

The theory of transaction value occupies a peripheral position in modern institutional economics.[7] The essence of the transaction value approach is to shift the emphasis from minimizing transaction costs to increasing transaction value (i.e. improving the qualitative parameters of transactions). In line with this approach, I propose to move from the analysis of low-cost (Coasian) institutional technologies to the priority study of value-generating (Schumpeterian) institutional technologies. Low-cost institutional technologies provide economic benefits as a consequence of minimizing per-unit transaction costs. But focusing on only one (cost-minimizing) side of transactions is a serious logical and theoretical error: 'analysing costs only is static and restrictive' (Cartier, 1994: 181). Therefore, the other, value-creating side of transactions, is no less important. The transaction value concept is about improving the quality of transactions, such as speed, convenience, security, transparency, variability, and relevance. The transaction value approach does not deny the importance of transaction cost economizing, but supplements it by improving the quality of transactions, creating transaction benefits and positive effects that are the main reasons for making any transactions, including blockchain-based transactions.

Modern institutionalists consider institutions and institutional technologies exclusively in terms of minimizing transaction costs. At the same time, the transaction value generated by institutions and institutional technologies is usually ignored. Transaction value is a combination of primary and additional positive effects for participants in transactions. The implementation of any transaction leads not only to its primary result (e.g. buying and selling goods and services, obtaining a loan, transferring money, etc.), but also to additional results or effects, which together characterize the quality of the

[7]A pioneering economic article on this issue (Zajac and Olsen, 1993) was devoted to the management of interorganizational interactions and strategies, which did not contribute to its serious perception by institutional theorists. Closely related to the theory of transaction value are influential studies in the field of comparative institutional analysis of international institutions (Komesar, 1994; Sandler and Cauley, 1977) and institutional reforms (Eggertsson, 2005), in which special attention was paid to transaction benefits.

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transaction. The sum costs of a single or complex transaction (total transaction costs) include the costs of obtaining both the primary and additional results. In an institutional system based on intermediation, both the primary and additional results of the vast majority of transactions can be acquired on the market as transaction services of intermediaries: in this sense, 'transaction services are the observable element of transaction costs' (Wallis and North, 1986: 99).[8] Thus, transaction costs are not just friction in economic mechanisms (Williamson, 1985: 19) or 'sand in the gears of the system' (Munger, 2018: 4). These costs are also the productive cost of creating transaction services, which are associated not only with the execution of the trusted third-party function but also with improving the quality of transactions, adding value to transactions. Moreover, the proportions of transaction costs associated with obtaining the primary and additional results of transactions vary depending on their quality: the share of additional results (effects) of transaction costs (i.e. price of transaction services) increases with the quality of transactions. Hence the difference in prices, for example, for standard and premium services of lawyers, realtors, insurers, and other intermediaries. In an institutional system based on blockchain, the primary results of most transactions (contract implementation, money transfer, registering property, etc.) are provided by algorithms, that is, those carried out automatically, without intermediaries. However, additional transaction effects (and related transaction services) that form the quality of transactions cannot always be provided by low-cost blockchain technologies. Such services need high value-adding blockchain technologies.

Blockchain is truly a unique technology, combining the features of Coasian and Schumpeterian institutional technologies. Blockchain makes digital transactions much cheaper and, at the same time, contributes (directly or indirectly) to improving their quality, including creating incentives for blockchain-led transaction innovations.

From a transaction costs theoretical viewpoint, blockchain 'mak[es] intermediary roles played by brokers, lawyers, and bankers, redundant' (Swan *et al*., 2019: 91), since they mainly ensure the achievement of the primary results of transactions. Blockchain's crowding out of many intermediaries – as a 'necessary evil' of a market economy and a source of excessive transaction costs due to the established institutional order – has significant positive consequences.[9] Moreover, the disappearance of intermediation is inevitable, since the costly trusted third party is replaced by free trust in the blockchain protocol (Davidson *et al*., 2018: 644). However, from a transaction value standpoint, the massive drawdown of intermediaries is more of an illusion, although the scope and forms of intermediation will certainly undergo significant change.

Blockchain technology will lead to a sharp drop in demand for many intermediary services related to obtaining the primary results of transactions. Nevertheless, even if blockchain dominates, many intermediaries will be able to add value to participants in transactions, and their additional transaction services can be quite widely demanded. However, this will depend on the ability of intermediaries to add transaction value. Moreover, under the conditions of 'blockchaining' of the primary results of most transactions, it is precisely the additional results (effects) of transactions that will be central to competition.

For example, blockchain competitors in the field of cashless payments, such as Visa and Master Card, offer many additional services: direct discounts, cashback services, cumulative bonuses, special privileges, and offers from partners in various fields (transport services, recruitment, software for business, travel, restaurants, museums, attractions, educational courses, etc.). These examples are ways of creating additional transaction value for users of the cashless payment systems. Key players in the field of distributed (cloud) data storage, such as Google, Apple, Microsoft, Dropbox, and Amazon, also offer additional features. These include unlimited storage, synchronization between devices, recovery

[8]In this regard, Wallis and North pointed to 'a common but erroneous perception among corollary benefit' (Wallis and North, 1988: 654).

[9]Focusing on reducing transaction costs through blockchain ignores blockchain-led qualitative changes in transactions. Many of these changes can be negative – and they entail the emergence of new types of transaction costs and risks (Pesch and Ishmaev, 2019; World Bank, 2017).

of deleted files, setting access levels, using a corporate account for collaboration, file encryption, and so on. These are also elements of transaction value.

In the case of banks and exchanges, which are expected to become the main losers of blockchain, transaction cost theory also reveals its limitations. Of course, if banks are understood as intermediary institutions with the key function of centralized ledger maintenance (MacDonald *et al.*, 2016), then it is obvious that switching to blockchains (i.e. decentralized ledgers of transactions) disrupts modern banking and automatically reduces the demand for traditional banking services. But we should not forget that banks provide many additional services in the area of minimizing risks and improving the quality of transactions. These services include co-branded cards, preferential credit programs, reversibility of transfers, insurance, biometric authentication, customer support systems, tax refunds, cost management, geolocation offers, and interactive interfaces. It is challenging to offer a generalizable legal definition of modern banking (McMillan, 2014: 8) given the variety of additional transaction services. The evolution of banking in the context of blockchain expansion will follow the path of expanding additional transaction services, increasing their comfort and customization (Lipton *et al.*, 2016) to provide '21st century real-time banking experiences' (King, 2018: 183). Banks will turn into increasingly multifunctional digital intermediaries providing advanced blockchain-based services.

The exchanges also offer a set of transaction services besides intermediation and, accordingly, price formation. Thus, post-trade services (clearing, depository and settlement operations, etc.), market analytics, IT-support, and other services now make up 35% of the total income of stock exchanges (OECD, 2016: 123). Such services (and the associated transaction value) are not offered by decentralized exchanges – blockchain-based trading platforms. In addition, pre-trading and post-trading services are an extremely important product of capital market infrastructure providers, such as trading platforms, clearing organizations, inter-dealer brokers, depositories, and specialized service companies (McKinsey and Co., 2017: 4).

The reduction of intermediaries undoubtedly reduces transaction costs, but clearly leads to a drop in the quality of many activities, especially by causing a systemic increase in risks. For example, 'the main limitations of smart securities and derivatives is that blockchains are not clearinghouses and do not provide insurance to market participants' (Quintais *et al.*, 2019: 92). In particular, it will cause a systemic increase in risk. It is not by chance that in 2017, the U.S. Securities and Exchange Commission equated token issuers (attracting investors' capital through ICO)[10] to traditional issuers of equity securities, thereby extending all the norms of current legislation to them (SEC, 2017: 17–18). Such a decision is quite logical, since digitization in the case of ICO affects only the institutional form of transactions, but not their content (investment attraction), while the requirements for the issuer in the case of ICO are minimal. The negative effects of ICO (including the growth of fraud, the increase in the number of obviously unreliable issuers and high-risk projects) clearly outweigh its positive consequences, and are not compensated for by eliminating middlemen. For example, 78% of ICOs held in 2017 were scams, and as of July 2018, more than a thousand cryptoprojects had crashed (Alexandre, 2018).[11]

In the vast majority of markets, the prerequisites for active implementation of blockchain are created by an overproduction of low-quality transaction services related to the achievement of the primary results of market transactions. Therefore, the result of a large-scale 'blockchaining' of the economy will be an optimization (in the sense of reducing) of the transaction sector's scale. This will be achieved at the expense of crowding out archaic and traditional forms of intermediation based on the exploitation of imperfections and defects of market institutions and the sources of excessive, economically unjustified transaction costs for participants in transactions. At the same time,

[10]ICO (initial coin offering) is a way of attracting investments in blockchain projects, which initially did not require compliance with strict regulatory requirements for public companies and is much cheaper than IPO (initial public offering).

[11]However, the current situation is clearly not optimal. Now the legislation in the USA is aimed at protecting investors from ICO scams, but in the future, incentives for blockchain startups should be created. So far, blockchain entrepreneurs have turned out to be the loser: they have, in fact, imposed the costly services of traditional intermediaries (financial advisors) related to fulfilling the legal requirements for issuing digital tokens (Mendelson, 2019: 93).

however, contrary to the forecasts of institutionalists (Davidson *et al.*, 2018: 640, 643–644; Munger, 2018), there will not be a large-scale replacement of intermediary activities with blockchain technologies – most of these activities will be reformatted and reconfigured. We should expect a massive reorientation of intermediaries to improve the quality of transactions and related additional transaction services. In other words, there will be tougher competition among intermediaries in the creation of transaction value, and not in the area of reducing transaction costs. In this new reality, the cost of intermediaries will be extra costs for additional high-quality transaction services that can be knowledge-intensive, highly specialized, and customized.

'The middleman sells reductions in transactions costs' (Munger, 2018: 75) – this is the axiom of the contemporary institutional system of capitalism. But in the blockchain-based future, there will be a new axiom: 'the middleman creates and sells additional transaction value'. It is precisely upon this principle that the economic institutions of digital capitalism will be based.

As a Schumpeterian institutional technology, blockchain will create a powerful impetus for the development of new transaction services and value-adding transaction activities.[12] Traditional intermediaries will actively use blockchain technologies (but not public, open blockchains) that increase the efficiency of transactions without requiring radical restructuring of existing institutions, such as permissioned private blockchains and incorporative blockchain applications. As a result, intermediaries will benefit from the reduction in transaction costs, but will also block the dismantling of the intermediation system as such (McKinsey and Co., 2018: 4–5). The transaction sector will become more compact and efficient, and the volume of excess transaction costs (payments imposed on intermediaries' transaction services) will decline sharply. Intermediaries will be ousted from lower price segments and will (gradually) no longer be perceived as 'system-imposed' sources of transaction costs. Banks and other intermediary institutions will transform their value proposition to ensure high-quality transactions. It is in this direction (creation of additional transaction value) that banking and insurance innovations are now intensified, in particular.

The notary industry is also a good example. According to experts, notaries were supposed to be one of the first 'institutional victims' of the blockchain.[13] The transaction services provided by notaries are primarily associated with the verification of transactions (including identity verification, document and signature validation, making notarized copies of documents, etc.), and this function is easily converted to a blockchain-based format. However, the notary industry is already actively reorienting toward creating additional transaction services, such as examinations of smart contracts, mobile notary services, remote notarization, and services using e-notarization platforms. These services are essentially blockchain-led transaction innovations beyond pure intermediation. As a result, the typical notary ceases to be 'witness of signatures' and becomes a multifunctional digital legal consultant.

Already, a new generation of intermediaries in the financial markets, Fintech companies, are not just reducing transaction costs for their clients, they are offering them additional transaction value: 'Their superior value proposition is based on the argument that they are able operate with an innovation agility that traditional banks are unable to provide, have a better understanding of today's technologies and are able to laser focus on narrow solutions to the exact needs of the customers' (Molnár, 2018: 45). I argue the basis of value propositions of intermediaries in an era of blockchains will be hyper-relevant transaction services associated with continuous, interactive, highly personalized offers based on anticipating the needs of each customer. This will be achieved with the help of digital technologies: predictive analytics, artificial intelligence, and digital assistants (Accenture, 2017). The intermediaries of the new generation will focus on creating additional transaction value for consumers in

[12]Undoubtedly, many institutional economists recognize that intermediaries provide specialized transaction services (see, e.g. Wallis and North, 1986). The emphasis is not on quality, but rather on the cost of these services. In particular, Alchian has found that 'successful intermediaries make their livings by performing their services at lower costs than feasible for the consumers and producers of the purchased goods' (Alchian and Allen, 2018: 85).

[13]Atzori noted that 'the advantage of the blockchain consists of removing the need of a trusted third party (e.g. a notary)' (Atzori 2017: 46). Blockchain 'is similar to the transaction being verified by a notary – only in an electronic way' (Deloitte, 2016: 3). Furthermore, 'it is as if a notary is present at every transaction' (KPMG, 2019: 2).

new areas of customer experience, as well as on building trust capital as a critical factor in hyper-relevance.

In combination with other digital technologies, blockchain creates the most conducive conditions for the development of interactive organizations of a market-like type: platforms. Platforms are multi-actor 'spontaneous organizations' (MacDonald *et al.*, 2016: 286), which are institutional alternatives to traditional organizations. However, from the standpoint of minimizing transaction costs (Martens, 2016: 17), platform analysis only is too narrow. Blockchains do not eliminate transaction costs in general but change their causes and specific forms. In particular, market failures are replaced by no-less destructive platform failures. There are examples of parallel reduction in transaction costs for some actors of platforms and increases for others. Thus, blockchain recruitment platforms simultaneously reduce transaction costs for employers and increase them for freelance workers, who are also delegated the main risks (Drahokoupil and Piasna, 2017). In addition, rating assessment systems based on user feedback often exacerbate the failures of platforms (Querbes, 2018: 641).

It is important to understand that platforms are moderators more than intermediaries (in the traditional sense). They do not just facilitate transactions (reducing their costs), but provide participants with a wide range of transaction services, linking networks of developers and networks of consumers into a single ecosystem of value co-creation. Therefore, in the near future, integrated platforms will become dominant. They will combine the possibilities of transactional, innovation, and investment types of platforms (Evans and Gawer, 2016: 21). Such integrated platforms will allow the rapid formation of networks and communities around new projects, attracting investment, connecting many developers and forming collaborations, creating and promoting new products to the market, and quickly receiving feedback from consumers. But the current rise of platforms is the result not only and not so much of their minimization of transaction costs, as of offering a unique transaction value.

Therefore, when considering blockchain as an institutional GPT, it is necessary to account for not only the reduction of excessive transaction costs but also, above all, the maximization of transaction value provided by blockchain technologies and blockchain-based intermediaries. The blockchain's value proposition varies depending on the types of transactions (and, more broadly, types of economic activities),[14] so its implementation will not lead to the widespread destruction of intermediation, but will inevitably cause its institutional transformations of different depths. In general, intermediaries under pressure from blockchain technologies will have to emphasize the transaction value delivered to customers: additional services that improve the quality of transactions. This trend will affect all intermediaries without exception, from banks, stock exchanges, auditing, and insurance companies to streaming music services.

3. Blockchain as an institutional assemblage

From the standpoint of its institutional complexity, an analysis of blockchain requires revising the fundamental method of institutional economics: a comparative analysis of discrete institutional alternatives. This comparative analysis is based on the assumption that the alternatives being compared are clearly distinguished and essentially unchanged. However, there are many cases where qualitatively different institutions (institutional alternatives) cluster together and co-evolve, but do not become a single institutional hybrid (the middle ground between hierarchy and market). Furthermore, I show that, in principle, a blockchain cannot be systematically described by any discrete institutional alternative separately. Blockchain does not generate a homogeneous institutional system, but rather a multifaceted, heterogeneous, hybrid institutional system. Therefore, another complexity-oriented institutional approach is promising: the theory of institutional assemblages.

The assemblage is a 'roomy' interdisciplinary term introduced by the philosophers Gilles Deleuze and Felix Guattari in the 1970s and 1980s (Deleuze and Guattari, 2005).[15] An assemblage in the most

[14]For example, in the field of commercial real estate, blockchain is best suited for automating short-term rental relations with a large number of tenants (Deloitte, 2017: 14.).

[15]More precisely, it originated in the English translation of the term 'agencement', the key one for the book of Deleuze and Guattari.

general sense is understood as the set of elements of a fundamentally different nature, united by their co-functioning (Deleuze and Parnet, 1977: 52). At the same time, integration into the system does not follow from the internal logic of its elements: as they are interconnected, they remain fairly autonomous. Parts of the assemblage do not form a seamless monolithic or 'organic' whole (DeLanda, 2016), and the assemblage itself does not become a totally integrated unity: after all, assemblages are hybrid and fuzzy systems constructed from heterogeneous parts.

Similar to any other system, assemblages are characterized by synergy (mutual reinforcement of elements, which creates an effect that exceeds the sum of the parts) and emergence, or the presence of system properties not reducible to the properties of the elements. But, unlike standard systems[16] with their unitarity, solidity, and homogenization, assemblages are characterized by other key properties: heterogeneity, redundancy, modularity, interchangeability, multifunctionality, hybridity, fragmentation, entanglement, and plasticity. In this sense, 'assemblage thinking is about relations, heterogeneity, and differences rather than parts, homogeneity, and similarities' (Kamalipour and Peimani, 2015: 404). Instead of identical elements, assemblages contain functionally diverse modules. Modules may be added, interchanged, and replaced by others; while the modules interact, however, they also compete with one another.

The basis of assemblages is a symbiosis of heterogeneous and largely independent elements. A classic example of assemblage is a knight on horseback (Deleuze and Parnet, 1977: 52), which, if we continue this metaphorical line, is fundamentally different from the centaur, which is a totally integrated system.[17] It is not by chance that organismic metaphors are most consistently and severely criticized by the theory of assemblages. Another example of assemblage given by Deleuze and Guattari is a plant and insects pollinating it (Deleuze and Guattari, 2005: 10). Wasps and orchids as heterogeneous elements, are completely different self-sufficient entities belonging to different biological kingdoms, but also form a symbiosis in the process of co-evolution. This symbiotic system is not inseparable: both wasps and orchids can exist completely independently of each other. However, they are interdependent during the pollination period, when orchids receive nectar, and wasps transfer pollen. If in standard systems all elements are connected by logically necessary relations resulting from their nature (and the internal logic of development), then in assemblages these relations can only be relatively obligatory; that is, they become obligatory during co-functioning or co-evolution (DeLanda, 2016: 2–3).

Assemblages are characterized by high adaptability and plasticity, even fluidity. Since assemblages are not organic units and combine intertwining heterogeneous elements, they constantly experience internal tensions and are therefore in a fluid reassembly process. Such a reassembly is a co-evolutionary process of self-organization and self-ordering, 'in which the elements put together are not fixed in shape' (Law, 2004: 42). If we use mechanistic metaphors, then a standard system (even a complex adaptive system) is always a Transformer toy, whose variations are structurally limited and rigidly defined by its internal logic. On the contrary, an assemblage is a 'Lego' in which practically any object can be assembled from a mass of modules (building blocks) of various shapes.

Institutional economists' lack of attention to assemblage themes is an omission that must be corrected.[18] In my definition, institutional assemblages are hypercomplex systems of institutions based on parallel existing institutional logics.[19] Institutional assemblages are hybrid and flexible systems of multifunctional, intertwining, and intersecting institutions governed by alternative principles. For

[16]Standard systems are understood to mean systems whose elements form an inseparable, monolithic whole.

[17]A knight on the horse combines ontologically diverse elements – a rider, a horse, weapons, and equipment (stirrups, harness, horse armor, etc.) – and it is a typical 'assemblage of war' (Deleuze and Parnet, 1977: 52). But this assemblage can be easily disassembled into modules and transformed: for example, the rider is transferred to the infantry, the horse to the quartermaster service, and the weapons and ammunition are redistributed between warriors.

[18]Modularity has been fairly well researched for organizations in the digital economy, including agile enterprises and platforms (Baldwin, 2008; Baldwin and Woodard, 2009; MacCormack *et al.*, 2015). But the modularization of complex institutional structures has not yet been studied.

[19]Institutional logics are the sets of fundamental values, principles, and beliefs that underlie institutions (Thornton *et al.*, 2012).

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institutional assemblages, hybridity, modularity, polycentricity, interactivity, redundancy, fragmentation, plasticity, and fluidity are not only organic properties but above all, competitive advantages.

The confusion of parallel institutional logics, including those that are poorly compatible, fundamentally different, and even alternative, is a source of constitutive features and internal contradictions of institutional assemblages since connections between their elements are created across different domains. But the hybridity of institutional logics does not exhaust the nature of institutional assemblages.[20] This is not just a random or temporary combination of weakly compatible logics. No, in the case of institutional assemblages, the symbiosis of logics is an organic consequence of their nature. This is due to the functional redundancy and modular structure of assemblages: in the seeming conflict of internal logics, in fact, there is a guarantee of the stability of these hypercomplex systems. When the complexity and turbulence of the environment grow rapidly, it is assemblages that have the most adaptive efficiency.

The digital economy (including blockchains) has a pronounced assemblage nature. This is manifested in the mixing and hybridization of elements of the real and virtual, living and inanimate, technical and humanitarian, commercial and non-commercial, industrial and service worlds. But no matter how many of these dissimilar elements are mixed they never form a homogeneous concoction. They remain hybrids, which accounts for the internal inconsistency of digitalization. At the same time, the continuous and ubiquitous fragmentation of value chains and value co-creation ecosystems actually leads to a total modularization of the digital economy. The smallest modules become the units of business: atomized elements of business processes – any activities and even operations that can be functionally distinguished from other activities. Digital technologies allow effective management of these modules, and they (modules) become the basis of the new generation of competitive strategies. For example, Fintech startups successfully attack traditional financial institutions by focusing on 'microscopic' elements – discrete modules – of their business models (Bhatt, 2017: 106–111). The combination of hybridity and modularity in digital technologies and business processes will inevitably affect the specifics of related institutions, making them attractive objects for the theory of institutional assemblages. After all, the study of those areas where any boundaries are absent in principle, requires new, analytically more capacious categories, such as assemblages.

Blockchain inevitably leads to the creation of new economic activities and new ways to enhance the effectiveness of already existing activities. Therefore, new modes of coordinating activities based on blockchains – blockchain-based institutions – are emerging. Institutions related to any technology always reflect its substantial specificity, thereby acquiring similar features. For example, the institutions of the network economy embody the principles of building the Internet and Web 2.0, including social networks and new media; Masahiko Aoki pointed this out, defining institutions as 'cognitive media' (Aoki, 2011). Institutions of an industrial society are best described in terms of mechanisms, tools, friction, and so forth. In the case of blockchain-based institutions, it can be safely assumed these institutions will be much more complex than modern ones, and (apparently) will be a qualitatively new type of institution (Davidson *et al*., 2018: 641, 654). In this sense, the role of the blockchain is not so much to increase the effectiveness of the existing system of capitalist institutions, but rather to increase its quality progressively by the mass introduction of a new type of institution having a blockchain nature and by expanding the diversity of their specific applications.

Institutions based on the blockchain will have pronounced assemblage features and properties. The redundancy associated with functional duplication of modules (nodes) is technologically built into the architecture of decentralized ledgers. Unlike traditional databases, which presuppose centralized storage and governance, a distributed ledger is copied synchronously to all computers of blockchain participants. Such redundancy (or modularity) is a typical and, moreover, constitutive characteristic of assemblages, as well as hybridity.

[20]Absolutization of this property is a weak point of the theory of hybrid organizations, closely adjacent to the theory of institutional assemblages.

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Blockchain is not just introducing a new 'pure' mode of coordination and governance (Davidson *et al.*, 2018: 655). Blockchain-based institutions will be hybrids of conflicting institutional logics.[21] Blockchain will create functionally redundant institutional systems based on parallel alternative modes of coordination. Moreover, these modes of economic coordination will not only adapt to one another but also constantly compete and be in conflict.

Even more important for the systemic understanding of the future of blockchain is another property of institutional assemblages – their fluidity, that is, their continuous variability and non-fixability of boundaries and states; therefore, assemblage systems often look poorly structured, 'loose', fuzzy, blurred, and constantly in flux. It is impossible to define them all, therefore, I explore only a few of the most obvious manifestations of the assemblage nature of blockchain-based institutions.

First of all, blockchain is a symbiosis of regulatory and algorithmic law. Any technology necessarily generates related institutions that determine the modes of coordination of economic activities based on this technology. But each technology also includes institutions integrated into it – technical rules and prescribed practices of technologically conditioned actions – that literally 'tells us what to do and how to do it, often in a more compelling manner than the law does' (Lanzara, 2009: 13). Such technology-integrated institutions will be of increasing importance. It is highly likely blockchain will cause a noticeable institutional shift from legal rules to code-based rules. Such rules, combined into blockchain protocols, are not controlled by actors, but are created, modified, and maintained by decentralized ledgers (De Filippi and Wright, 2018: 7). They may comply or not to comply with legal norms, but code-based rules will form the basis of the institutional order in the digital economy. In fact, this is 'code-ification' of law, the hybridization of legal and technological (algorithmic) law, where smart contracts (i.e. contracts that are self-fulfilling using blockchain algorithms) will be used more often than traditional ones. In essence, blockchain technologies (i.e. the cryptographic algorithms underlying smart contracts) will perform the functions of standard contracts, with the result that the law will be increasingly transformed into code (De Filippi and Hassan, 2016).

But the complete mixing of legal and code rules will still not occur. This contradicts the forecasts of institutionalists who believe that evolution will move toward increasing support of 'the rule of code' and code-based legal systems (De Filippi and Wright, 2018: 193–204) up to the 'death of rules' and their replacements with personalized micro-directives (Casey and Niblett, 2019). I argue this will not be a universal trend of institutional evolution. The reason for this can be found in the assemblage nature of blockchain institutions. Institutional logics underlying blockchain-based institutions are irreducible because they are fundamentally different. But these logics are not antagonistic since they are interdependent and co-evolve together (Kaeseberg, 2019). At the same time, they compete and conflict with one another, introducing a constant discord in the functioning of blockchain-based institutions. This is not a 'fight to the finish', but it is not a merger into a single whole. Therefore, in different economic spheres, blockchain-based and traditional institutions will form specific combinations.

Although it is too simplistic to consider the institutional future of the blockchain as a battle between law (the state) and code (blockchain-cryptographic algorithms), the conflict of institutional logics that underlie the blockchain institutions is already beginning to appear in concrete forms. A good example is the contradiction between declared EU norms of the right to the erasure of personal data and the technical impossibility of erasure in blockchain systems (Herian, 2018). In addition to the technological immutability of distributed ledgers, the institutional logic of the blockchain is explicitly aimed at preventing erasure in order to avoid the influence of third parties. But the information is still brought into decentralized ledgers from the outside, so the blockchain is not an autonomous, isolated system, completely protected from error and manipulation. Do not forget that 'the truth of the data appearing on a blockchain is dependent on processes outside the technology itself' (Walch, 2017: 744). The law has no entry points to the code, but there are many entry points on the border between blockchain and the real, off-chain world (Rodrigues, 2019). Therefore, law-based regulation will be

[21]Therefore, the distinction between spontaneous and constructed orders proposed by Hayek (1967: 96–105) clearly collapses in the case of the blockchain.

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necessary for participants in blockchain transactions – and the domain of the law will increasingly penetrate the domain of the code.

In particular, blockchain will become a 'bundle' of Ricardian and smart contracts. Contract relations in the digital economy will not be fully implemented by smart contracts (i.e. contracts that are self-fulfilling using blockchain algorithms), despite their enormous effectiveness in reducing excessive transaction costs. Smart contracts will most likely be used less often than Ricardian contracts – tools for mediating digital and text contracts – which allows, on the one hand, a 'translation' of a standard legal contract into the 'language' of the blockchain (which can be read by an electronic system), and, on the other hand, gives a smart contract legal force and allows lawyers and counterparties to read it in a standard document format. The combination of Ricardian and smart contracts will become more widespread, integrating blockchain-based institutions into the law-based legal system.

Blockchain is a naturally messy hybrid of decentralization and arbitrage. According to many experts, blockchain is, in its essence, a decentralization technology (Davidson *et al.*, 2018: 649). This is largely a consequence of the hype around Bitcoin, which belongs to decentralized models of blockchain. However, in reality, there is a wide range of technologies of distributed ledgers, involving different levels of centralization and various forms of control and governance (Walport, 2016: 7). The most common are open-access blockchains with free entry. However, in restricted or closed-access systems, administrators can be delegated not only the functions of checking and admitting (or not admitting) new members to the system, but also the exclusive permission to add entries to the ledger, the permission to cancel previously confirmed transactions, and similar actions. Even in open or un-permissioned blockchains, however, there are hidden opportunities for developers to intervene in the system: an example is 'hard fork' (enforcing protocol change overriding previously completed transactions) used by the core developers of the well-known investment blockchain project 'The DAO' after a hacker attack in 2016.

The illusion of disappearing centralized actors replaced by blockchains must be challenged. An example of a governed blockchain is the EOS blockchain platform, which is one of the five leaders in CoinMarketCap's world-ranking of cryptocurrencies, and set a world record for attracting investment through ICO. The platform's main document, the EOS Constitution, introduces an EOS Core Arbitration Forum as a dispute-resolution body and also assigns a significant level of authority to arbitrators. Certification and verification of participants and transactions are especially important for the Internet of Things, such as international and wholesale trade, where there are clear prospects for hybrid models of blockchain.

According to modern institutionalists, blockchain technologies will lead to the creation of a new type of economic institution: a decentralized collaborative organization (DCO)[22] (Davidson *et al.*, 2018: 654). In a DCO, there is no hierarchy (as opposed to traditional firms). DCOs also engage in both exchange and production (as opposed to markets). The power in a DCO belongs to the many owners of tokens, while all employees are engaged in project work through smart contracts. In addition, employees have a rating determined by other owners of tokens, and reaching its minimum threshold results in automatic dismissal. However, institutionalists only tell half the story. For example, they refer to the paper of Marcella Atzori only in part of the positive assessment of the DCO, keeping silent about the fears and risks expressed in the same research. In particular, the fears and risks relate to hidden and veiled forms of centralization of power in the DCO, which is gradually becoming more common. This is not only about speculation, information asymmetry, and opacity in blockchain systems, but also about a new elite of code developers and an oligarchy of blockchain platforms' owners (Atzori, 2017: 57–59). These trends fundamentally undermine the idea of blockchain's egalitarian nature.

In blockchain systems, the dominant players who may well abuse their status have already become a reality. The likelihood of such actions is high, because 'whoever controls mining also controls the protocol' (Kritikos, 2018: 2), i.e. certification of the validity of transactions. Although the blockchain (like the

[22]In essence, this is an analog of the term 'decentralized autonomous organization', which is widely used in modern blockchain practice.

Internet) was originally created as a non-mediated technology, a number of third parties have emerged in the modern blockchain ecosystem. They are engaged in a profitable business on intermediary services: for example, software developers, cryptocurrency wallet providers, Blockchain-as-a-Service providers, and also oracles (intermediaries who enter information into blockchains).

The decentralization technologically embedded in blockchain is already combined with an active concentration of power. This process is manifested in a variety of institutional forms. In 2020, long-running disagreements in the Ethereum community led to its actual split due to a series of controversial rule changes implemented by core developers. In particular, the activation of the ProgPow code, which dramatically changes the mining algorithm, indicates a *de facto* rejection of the principles of decentralization. According to experts, Bitcoin has already become a highly centralized system: its mining capacity in 2020 is controlled by several of the largest mining pools (TokenAnalyst, 2020). The EOS platform is also characterized by high centralization, non-transparency of decision-making, and uneven control; the high consolidation of voting rights among major players *de facto* the largest holders of tokens or the so-called 'EOS whales' is an example (Binance Research, 2020). In the Lisk cryptocurrency blockchain system, power has been seized by two cartels ('Elite' and 'GDT'), which control 85% of the entire block production. These cartels actually change the rules in their favor, and their members vote for each other in the blockchain. Experts even compare these cartels with the Italian Mafia (Günther, 2018).

Therefore, institutional ideas about the blockchain should be recognized as naïve, high-tech versions of libertarian utopias. As institutional assemblages, DCOs will never be completely horizontal and will inevitably include significant hierarchical features. They will not create a new economic order associated with dis-intermediated peer-to-peer interactions based on automatic enforcement of rules through smart contracts. Anonymity will be partial, equality will be undermined by new elites, and blockchain's 'invisible hand' will get out of hand.

4. Conclusion

Blockchain is a complex digital technology that is the basis of fundamentally new ways of coordinating transactions and economic activities. Blockchain can rightfully be considered an institutional technology that can create radical innovations to the current system of economic institutions of capitalism. However, modern institutional theory offers a rather simplified toolkit for understanding blockchain's real institutional complexity. As a result, institutional economists who study blockchain arrive at one-sided and often idealistic conclusions, such as predicting the elimination of intermediation and total decentralization. These conclusions are a consequence of the moral obsolescence of new institutionalism. But these conclusions also serve as an impetus to develop a new generation of institutional theories, overcoming the built-in limitations of institutional methodology. I combine such alternatives to new institutionalism under the term 'extended institutional approach'.

Through an analysis of blockchain, this paper presented two particular complexity-focused institutional theories: the theory of transaction value (which complements the institutional theory of transaction costs) and the theory of institutional assemblages, which is contrast to the analysis of standard institutional systems.

The standard institutional point of view is that blockchain is a substitute for traditional intermediaries (banks, exchanges, notaries, lawyers, insurers, etc.), replacing these third parties in transactions with technological solutions that minimize transaction costs. However, this conclusion is extremely one-sided (since it focuses only on transaction-cost minimizing), and the underlying Coasian paradigm must incorporate transaction value. Blockchain offers cheaper institutional solutions, but the quality of transactions is relegated to the background. Transaction value includes not only the direct result of the transaction but also a lot of additional transaction services. Intermediaries will actively (and successfully) compete with the blockchain precisely by expanding the range of such services and improving the quality of transactions. This conclusion could not have been reached from a traditional approach to the theory of transaction costs.

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Modern institutionalists predict the formation of a homogeneous system of blockchain-based institutions, ensuring total elimination of control, decentralization of transactions, and dominance of public ledgers. From a theory of institutional assemblages viewpoint, this scenario is unrealistic. The hypercomplex institutional systems (assemblages) arising in blockchain contain – and will always contain – a multiple institutional logics conflict. For example, it is a conflict between technological logic (striving for optimal functionality of software solutions) and bureaucratic logic (aimed at creating restrictions and retaining control). It is a conflict between libertarian logic (anonymity, decentralization, and elimination of intermediaries) and ethical logic (reduced potential for illegal activities of varying degrees). Therefore, it is important to proceed from the fundamental impossibility of the convergence of alternative institutional logics and orders. Blockchain-based institutions will inevitably be heterogeneous: for example, they will combine models of regulation of public and private, open and closed blockchains. The understanding of organic hybridity, internal conflict, high fragmentation, and fluidity of blockchain-based institutions is a consequence of the application of the theory of institutional assemblages, leading to the abandonment of idealistic forecasts and scenarios of the future blockchain.

The methodology and theoretical guidelines of the new institutional economics are becoming less and less adequate for the study of institutions of modern digital capitalism. The intensive growth of the economy and society's institutional complexity requires a new generation of methodologies and theories of institutional analysis that are extended-institutional in relation to new institutionalism. Instead of the institutionalist mantra on the importance of institutions, an extended (complexity-centered) institutional approach proposes a new motto: 'Institutional complexity matters!' An extended institutional research program is still being developed, but it is clear that the development of methodologies and theories for analyzing institutional complexity is a top priority and a critical challenge for all institutional economists.

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