CRYPTO–DEMOCRACY: IMPLICATIONS OF THE BLOCKCHAIN TECHNOLOGY ON THE DEMOCRATIC CHOICE

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CRYPTO-DEMOCRACY: IMPLICATIONS OF THE BLOCKCHAIN TECHNOLOGY ON THE DEMOCRATIC CHOICE

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Abstract: *Deciding by the majority is the simplest way of voting on the issues of public interest. Over time, the legitimacy of this system has been widely accepted and became the dominant form of government and public decision-making. However, global democracies are in decline due to the pressure of the multiple global challenges, and Blockchain technology is the possible solution. This paper aims to systematize and identify the potential implications of the Blockchain on the decentralization and the economy of collective decision-making. Methodological individualism and the Institutional Possibility Frontier (IPF) framework, applied to the model of the constitutional democracy, provide a logical foundation for the comprehensive analysis of the possibilities and limitations of blockchain implementation in democratic voting systems. The results show that blockchain technology provides significant benefits and cost reduction in any form of institutional decision making. Furthermore, crypto-democracy provides a decentralized, transparent, and reliable decision-making system which transforms traditional geographical constituencies into an unbundled agency system, which ensures that the individual opinion is reflected in the public choice. The study indicates that the research on the institutional application of blockchain technology is in the early stages. Therefore, recommends the careful but optimistic introduction of the presented system into the existing voting mechanisms.*

Keywords: *Crypto-democracy, Blockchain, Public Choice, Transaction Costs*

JEL Classification: *D02, D7, O17, O30*

INTRODUCTION

Deciding by majority represents the simplest form of decision making concerning the public choice. In the historical and philosophical context, majority decision evolved as a means through which a social group makes collective choices among alternatives when the consensus among the individuals comprising the group cannot be attained (Buchanan, 1954, p. 118). Since the 16th century, this exact form of decision making is known as a democracy (Merriam-Webster, 2020).

Democracy is a dominant governmental system in the world. However, the beginning of the 21st century brought forth the understanding of democratic states as fragile and vulnerable systems. The ability to cope with increasingly pronounced problems and challenges of these systems, such as growing inequality, migration, and pronounced globalization, is in question (IDEA, 2017). At present, the construction of an adequate and functional democratic system is hampered by the presence of the aforementioned external phenomena and complex problems present in all countries of the world, such as manipulating the electoral process and restricting human rights. This dynamic environment has resulted in some countries advancing in the democratic process, while others are declining due to the negative impact on the independent media, judiciary, and education (Bermeo, 2016).

The solution for the mentioned decline is sought in the fourth industrial revolution's modern technological advancements. Blockchain technology was introduced to the world in 2009 as a technological platform for Bitcoin. However, according to its creator, Nakamoto (2008), Blockchain is meant to be the platform for comprehensive socio-economic liberalization and decentralization. Due to the benefits promised by Blockchain, such as safety, security, efficiency, and speed, many governments worldwide embraced this technology through various projects regarding the public sector (Killmeyer et al. 2017).

Over the last decade, many authors tried to understand Blockchain's effects on the different aspects of public interest and collective choice. Swan (2015) gave a comprehensive analysis of this technology's potential impact, including its potential for the state administration and election process. In light of rising interest in Blockchain's importance for social development and its decentralized nature, Atzori (2015) discussed the need for a centralized government in modern states. Davidson et al. (2016) emphasized a twofold approach to the Blockchain analysis, the innovation-centered, on the one hand, and the government-centered aspect, while the latter enables the creation and realization of the new organizational forms based on the new institutional economics and public choice.

The main body of work regarding Blockchain's use in the election process in democratic systems and the possibility for its improvement was established in the last five years. Allen et al. (2017) have systematically addressed the economic aspects of crypto-democracy, emphasizing negotiation costs, informing, and maintaining contracts. Other authors discussed the decentralized system based on Blockchain (Srivastava et al. 2017; Liu & Wang, 2017) and the effects that this could have on trust and transparency (Berg et al. 2018).

This paper aims to introduce a unique, encompassing view on Blockchain technology's impact on the decentralization of collective decision making and optimization of related costs in democratic systems by analyzing the current theoretical and empirical work in the field.

DEMOCRACY – THE CONCEPT AND RELATED COSTS

Democracy can be conceptually defined as the rule of the people, i.e., the majority's rule. In addition to this general definition, democracy can be defined as "a government in which the supreme power is vested in the people and exercised directly or indirectly by the people through a system of representatives that

usually includes periodic free elections" (Merriam-Webster, 2020). However, despite the single starting point, approaches to democracy significantly differ.

Charles Tilly (2007) concluded that, regardless of all the differences, there are four general approaches in defining democratic systems: constitutional, procedural, substantive, and process-oriented. *The constitutional approach* has a constitution as the main distinction between democracy and other systems, and among the four, it provides the most clarity in differentiation. *The procedural approach* points out that political freedom has the highest importance in building genuinely democratic systems. The modern democratic procedures are built on equal rights for every individual to participate in social decisions through fair elections (Saffon, 2013). *The substantive approach* is based on evaluating the living conditions and governmental policy to determine whether the system has genuinely democratic qualities. Finally, *the process-oriented approach* requires both the existence of processes and the minimum functionality to claim the existence of democracy (Tilly, 2007). Dahl (1978) gave five criteria for the evaluation of real democracy:

- Effective participation – means that all citizens have the right to disclose their opinion on the social matters before the decision is reached;
- Equality in voting – means that all citizens have the same opportunities and possibilities for voting under the same conditions;
- Gaining an enlightened understanding – means that all citizens need to have the same opportunities to assess different policies under reasonable limitations;
- Exercising final control over the agenda – means that all citizens can decide what will be placed on the agenda;
- Inclusion of adults – means that all residents should have the same rights implied in the first four criteria

Having in mind previous approaches and criteria, we can see numerous modalities of modern democratic systems. However, most of them share certain common characteristics. Based on individual rights and being the highest state act that limits governmental power, the Constitution defines 21st-century democracies (Berggren & Karlson, 2003). The second defining feature of modern democracies is that most of them are representative democracies. Therefore, the decision-making process concerning the people is indirect. Prokopijević (2000) claimed that these two elements, combined with fair rules and respect of the principles of liberalism, can form good constitutional democracy, which will be used as a model in the following discussion.

Understanding constitutional democracy means understanding the concepts of separation of power, decision-making costs, rationality, and public well-*being*. Initially introduced by Montesquieu (1989), who proposed the differentiation between legislative, executive, and judiciary power, the separation of power was further discussed and improved over time, resulting in the fully formed concept of the separated power system in democratic states. This system is based on the independent judiciary system, guaranteed individual rights, generality principle, independently elected representatives, and the undeniable possibility of a referendum.

The concept of costs in collective decision making is significant because it is assumed that if an individual does not want to let his fate to uncertain, he is exposed to additional costs, which he does not bear when making private decisions (Prokopijević, 2000). Even though multiple different categories of costs are discussed in the literature, this paper focuses on transaction costs determined by established institutions and available technology (Berggren & Karlson, 2003). Citizens lack the skills, capacity, time, and inclination to implement government policies to delegate decision-making and implementation to public figures (Berg, 2017). Constitutional democracy is characterized by the transfer of responsibilities

between different government levels, which by its nature, incurs costs for maintaining the system functioning. These costs that occur when making social decisions are called transaction costs.

Rationality has been a starting point in many economic theories and must be found to analyze the assumptions and preconditions of constitutional democracy. There are different views on how constitutional rules can induce rationality. However, the instrumental approach under rationality implies actions oriented towards the fulfillment of a specific goal. Therefore, rationality can be linked to the ability to react and the transaction costs, which have a divergent direction in a mathematical context.

Finally, the public interest is another concept that is at the core of a democratic state system. Riker (1988) pointed out that the differentiation of private and public interest is often a topic of discussion; however, the definition of these terms rarely appears in the literature. The public interest in the framework of this paper will mean a situation in which the long-term preferences of the majority of citizens are met within the defined legal framework (Berggren & Karlson, 2003), and we will not analyze the opposing views that inevitably appear in the literature (Riker, 1988).

Considering the literature tackling the connection between modern technologies, public interest, and democracy (Swan, 2015; Tapscott & Tapscott, 2016; Berg, 2017; Allen et al. 2017; Berg et al. 2018) in addition to the positive changes and challenges, this paper will mainly focus on the transaction costs. Starting from previous considerations that indicate that these costs tend to fall with improved information and available technologies. We will show that blockchain technology has a significant impact and multiple benefits for democracy successfully implemented.

BLOCKCHAIN – FUNDAMENTAL CONCEPTS

Blockchain is a set of decentralized technologies that combine asymmetric cryptography, networking (peer-to-peer), a consensus-based voting mechanism, and a data processing apparatus that combined creates an immutable decentralized public ledger for storing and transferring property rights (Berg, 2018). Created to realize Bitcoin cryptocurrency, it attracts significant attention and is the initiator of many projects in various industries. Since the conception of the idea in 2008, interest in this technology has steadily grown. The potential benefits of adopting blockchain technology in the private sector have been analyzed by both the scientific community and large companies. However, the analysis of this technology's implications in the public sector is in the early stages. Blockchain technology can be used for any form of the register of tangible and intangible assets, stocks, and exchanges in different areas, making it suitable for transforming a wide range of social activities (Swan, 2015).
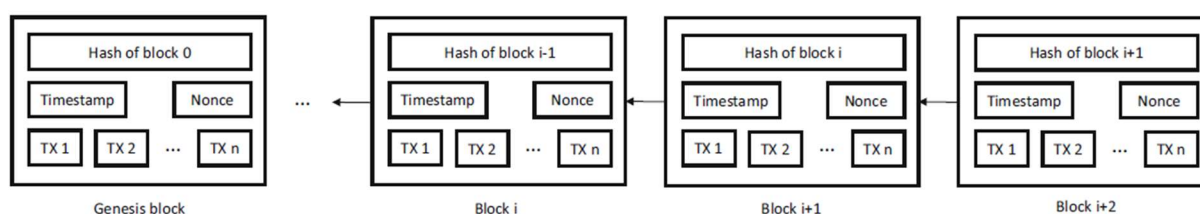

Figure 1 Typical example of Blockchain

Source: Zheng Z, Xie S, Dai HN, Wang H (2016) *Blockchain Challenges and Opportunities: A Survey.*Work Pap

Blockchain consists of the digital ledger in which, based on the predetermined set of mathematical rules, are all transactions recorded — this way, all illegal corrections, and changes are prevented. This technology operates through peer-to-peer networks based on the thousands of nods all over the world. Nods can freely join or leave the network (Nakamoto, 2008). New nods are created through the mining

process, and all of them operate anonymously, working together on the solutions of mathematical problems, through which they add new blocks.

A Blockchain consists of data sets whose structure consists of a chain of data packets (blocks), and each block contains a large number of transactions (TX1-n). This Blockchain is extended by adding each new block and representing a complete record of the transaction history. Block validation is performed by cryptography.

The Blockchain allows the disintermediation and decentralization of all transactions of any type between all parties on a global basis (Swan, 2015, p. x). This technology is an opponent of centralized and hierarchical organizations, such as companies and governments, which functionally implies that blockchain technology is a fundamental technology for creating new decentralized institutions (Davidson et al. 2016) and encourages groups of institutions to collaborate to create new growth opportunities resulting in better performance (Arun et al. 2016). Walport (2016) points out that governments can benefit significantly from multiple potential applications of distributed ledger technology, while Berg et al. (2018) believe that governments can be critical in adopting and developing this through regulation, legislation, and public investment technological innovation.

Given the popularity of Blockchain, it is essential to understand the three main pillars that brought it on. These three main pillars are (Rosic, 2020):

- Decentralization,
- Transparency, and
- Immutability.

Before the advent of blockchain technology, most systems in the world were based on a centralized architecture. Blockchain technology has challenged the functionality of centralized systems such as banks, government, large companies, and forced them to incorporate this technology into their day-to-day operations. In a decentralized system, information is not stored in one place, but each network member has information. In such systems, if one user wants to communicate with another user, he does not have to use an intermediary, and this principle is embodied in Bitcoin, which means that sending money between users is possible without the bank's mediation.
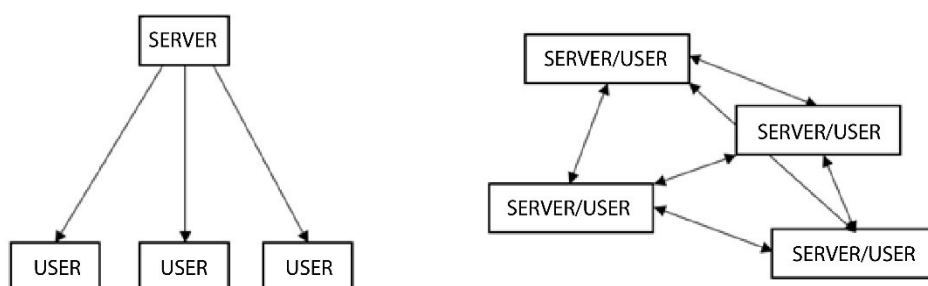

Figure 2 Comparison of organization systems

Source: Rosic, A., Blockgeeks. (2020). What is Blockchain Technology? A Step-by-Step Guide For Beginners. Accessed May 5th, .2020. at: https://blockgeeks.com/guides/what-is-blockchain-technology/

Transparency means that traditionally public distributed ledgers, based on blockchain technology, are visible to all network members (Walch, 2016). There is often confusion regarding transparency because the privacy provided by this technology is often emphasized. Transparency means that all data is visible to all network members, but their identity is cryptographically protected, yet this transparency level has never existed before.

Immutability means that a distributed Blockchain-based ledger is unchangeable. In theory, this means that once a change is posted, it cannot be changed or removed, and this fact is especially important for participants in the financial sector because they can rely on the correctness of the data in the ledger and can expect that there will be no corrections and changes in the future (Walch, 2016). This feature is also vital for the public sector because it ensures data consistency and the entire system's resilience.

These features are three pillars upon which the exceptional reliability of Blockchain technology is built. A reliable and transparent system of records, resistant to the risks inherent in the modern age, favors developing a system that will adequately replace or improve the existing election mechanisms in democratic societies.

CRYPTO-DEMOCRACY: DEMOCRACY GOING DIGITAL

To the extent that efficient institutions' development explains modern economic growth, Blockchain can prove to be a universal general-purpose institutional technology that affects many sectors and industries (Allen et al. 2017). Although its original purpose was to democratize the financial system, blockchain technology plays a significant role in further decentralization and improved transparency of a democratic system. Despite the focus on online voting, due to concerns that the platforms are subject to fraud, corruption, and sabotage, it has not been adopted worldwide (Daniel, 2020). Originally applied forms of internet voting in Estonia and Norway have faced serious omissions and shortcomings, but a growing number of political organizations and technology startups are experimenting with secure digital voting systems based on blockchain technology. This application of blockchain technology is called crypto-democracy (Davidson et al. 2016). The world is facing a new trend of declining democracy, especially in fair and democratic elections. Under the ruling regimes' influence, the electoral process seemingly allows for competition, while fraud, coercion, and circumvention become increasingly pronounced. It is a crypto-democracy that can solve some of the most pronounced problems facing democracies worldwide.

The crypto-democracy analyzed in the following segment is based on blockchain technology and the previously presented system of constitutional democracy. Although there are notions in the literature of the possibility to use Blockchain technology in completely changed systems such as direct democracy or even the newly introduced "liquid" democracy (Swan, 2015; Tapscott & Tapscott, 2016; Berg, 2017a), it is much more likely and acceptable to gradually transform the existing democratic system by implementing specific technological solutions. Tapscott & Tapscott (2016) point out that public discourse and the greater involvement and interest of citizens in the decision-making process should be distinguished from direct democracy. Citizens are not interested and do not have the expertise and time to be informed and decide on each issue, so a legal framework is needed to enable discussion, specification, and problem-solving.

Multiple authors have presented blockchain technology as a potentially effective selection mechanism (Daniel, 2015; Barnes et al. 2016). However, to determine the potential effects of implementing this system, existing electoral system institutions must be compared with the solutions after introducing the Blockchain. Djankov (2003) provided a suitable instrument for analyzing the spectrum of institutional possibilities. Using the Institutional Possibility Frontier (IPF), we can monitor how different institutional possibilities affect the presented disorder costs and dictatorship costs.

Given that modern constitutional democracies are most often representative democracies, representatives' elections are among the most critical issues. High decision-making costs are an argument for representative democracy because time, interest, and information make decision-making

on every issue very expensive for an individual. Crypto-democracy provides a new delegation mechanism. Instead of treating representation as a grouping problem, crypto-democracy allows it to be treated as a matching problem.
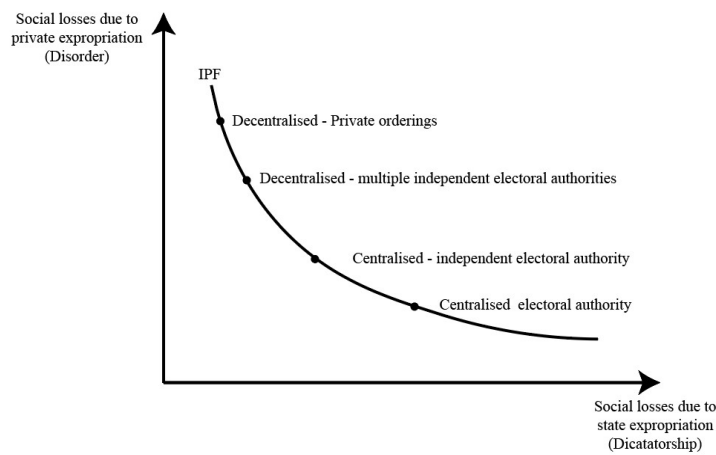

Figure 3 Institutional Possibility Frontier

Source: Djankov, S., Glaeser, E., La Porta, R., Lopez-de-Silanes, F., Shleifer, A. (2003) *The new comparative economics. Journal of comparative economics.* 31 (4), 595-619

The traditional electoral system geographically groups voters into electorates. The choice of representatives for each electorate depends on the consistency of opinion within the electorate. Crypto-democracy opens up other possibilities in the form of proposals to group voters according to opinion consistency rather than geographical location. The proposed system is shown in Figure 4 on the example of Parliamentary elections.
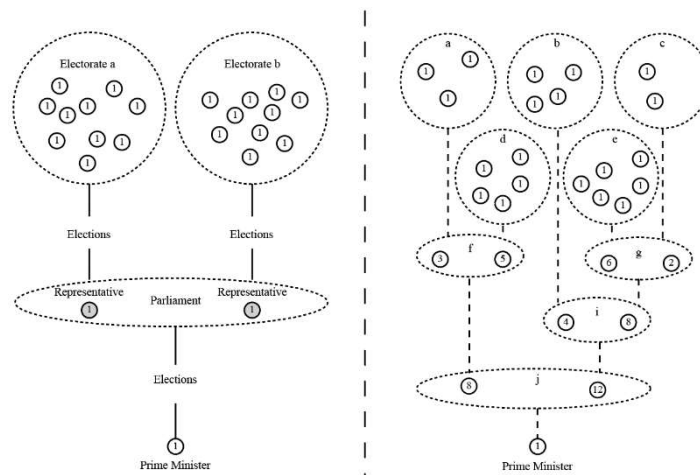

Figure 4 Election systems Traditional vs. Crypto-democracy

Source: Berg, C. (2017) *Delegation and Unbundling in a Crypto-Democracy.* Available at: http://dx.doi.org/10.2139/ssrn.3001585

Elections in a constitutional democracy usually require the opinion harmonization of many individual voters, leading to increased transaction costs and the time required for making a final decision. In crypto-democracy, this kind of harmonization is not required. Voters can rely on system transparency and find like-minded people, and delegate agents who, based on the number of votes cast, will negotiate with other agents until the decision is made. Although the system is transparent and harmonization of

opinions is more straightforward and faster, Blockchain technology does not eliminate transaction costs. When delegating an agent to each subsequent level, certain compromises must be made, which distances individual voters from their optimal decision.

The choice of agents in a crypto-democracy is one of the essential issues. Delegation to agents is also done under the influence of transaction costs. Citizens who think that the costs of decision-making are too high for them will delegate their vote to one of the agents, and depending on their risk appetite and ability to bear the growth of costs, they will have the opportunity to participate in the election process until the very end.

The analysis of the effects of transforming the system of representative democracy into crypto-democracy can be observed through the presented model of the Institutional Possibilities Frontier (IPF). As there is not only one institution for managing the electoral process, it is possible to observe several institutional forms in the spectrum of institutional possibilities (Figure 3). Djankov et al. (2003) expressed that in institutional choice, society faces a compromise between the costs of disorder and dictatorship costs, while the IPF represents different forms of electoral institutions minimizing these costs.

Centralized institutions minimize the cost of riots by unified voter register management and full power to conduct elections, reducing duplication costs but increasing the costs of dictatorship. There is a risk that civil servants who favor a particular political option will manipulate the whole process. On the other hand, decentralized institutions limit the costs of dictatorship by providing competition and choosing between competencies, but at the same time increase the potential costs of disorder because individuals gain greater powers and decisions rely on private collective decision-making (Djankov et al. 2003).

Through this model, Allen et al. (2017) presented Blockchain's impact on the institutional environment in which elections occur. This technology theoretically reduces the costs of consensus, information coordination, and contract enforcement and maintenance, and in the context of the IPF model, Blockchain reduces the costs of dictatorship and disorder while providing compactness, anonymity, and transparency. Although its potential for decentralization is primarily emphasized, Blockchain can also be applied in centralized systems, and its implementation in the electoral system can be represented by moving the IPF inward (Figure 5).
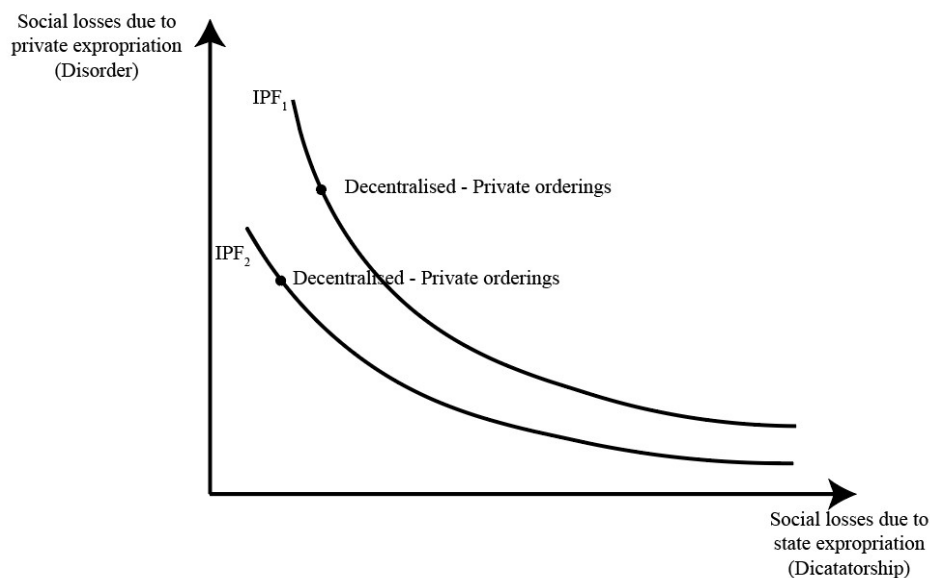

Figure 5 Implementation of Blockchain in Democracy

Source: Allen, DW., Berg, C., Lane, A.M., Potts, J. (2017) The Economics of Crypto-Democracy. Available at: http://dx.doi.org/10.2139/ssrn.2973050

Shifting the IPF inward shows increased efficiency due to Blockchain's application in the electoral process and leaves room for entrepreneurial activity within the institutional limit of opportunity and creating solutions to broader democracy problems (Allen & Berg, 2016).

Blockchain technology, as presented, can have wide institutional applications. Crypto-democracy as a form of "democracy on steroids" cannot be classified into any particular form of democratic organization. However, based on the previously presented IPF, it is feasible to see the positive effects of blockchain technology in any form of the electoral process.

CONCLUSIONS AND RECOMMENDATIONS

This paper presents an introductory consideration of Blockchain technology's potential use to facilitate the electoral process and realize a new democratic organization. It contributes to the systematization of Blockchain's effects in the socio-economic systems, i.e., crypto-democracy, but it does not introduce novelties in the system's design itself.

This paper points out that Blockchain technology represents a significant potential for both the private and public sectors. Its characteristics are incredibly conducive to developing democracy and decentralized government forms, which will enjoy citizens' greater trust and reflect their wishes and thoughts more accurately. Crypto-democracy, as a presented form of the decentralized governmental system, can reduce transaction costs, improve efficiency, and create a more open environment for entrepreneurial activity in collective decision-making systems and mechanisms.

Considering that theoretical and empirical research in this field is in its infancy, and practical implementation is in the early phases, it is impossible to claim certain benefits from the Blockchain use in democratic systems. Additionally, the scale of potential socio-economic changes and social experiments' history makes it even more challenging to project these systems' future development. Thus the research provides only notions of perceived benefits, based on the logical analysis of inherent characteristics of critical elements of crypto-democracy.

This research reflects current advancements in the very narrow overlapping field of information technology, economics, and democracy. However, this paper considers only possible improvements without considering concerns and limitations regarding rapid technological advancements in the field due to time and volume constraints. Therefore, future research in the field and the generation of empirical evidence of Blockchain's potential benefits in a democracy should provide a practical framework for its implementation and assess the negative aspects and security concerns inherent in digital systems.

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