THE NEXUS OF BLOCKCHAIN AND GOVERNANCE: A USE CASE OF BLOCKCHAIN ON TRADE FINANCE

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Abstract

Having both opportunities and threats, blockchain is a game-changer disruptive innovation in our time. It keeps penetrating a wide scope of areas including banking, insurance, supply chain, trade finance, agriculture, etc. We explore this multifaceted technology as the first building block of our study. As a second building block, we focus on the governance concept and then we analyze the nexus of blockchain and governance. Our study contributes to the extant scarce literature by covering the recent developments on the subject. Following Liu, Lu, Yu, Paik, and Zhu (2022) we conduct our study through several steps. The literature review of our study is based on Web of Science and Google Scholar academic databases. Studies are selected according to the predefined inclusion and exclusion criteria. The review period of the study is the last five years. According to our analysis, we detect a literature gap between on-chain and off-chain governance. We believe our study contributes to filling this gap. We propose a recipe to the argument of Kaufman, Heister, and Yuthas (2021) that suggest blockchain technology has failed to produce promised benefits for enterprise networks despite its potential. Considering the increasing importance of trade finance especially during and afterward the COVID-19 pandemic, we bring forward our solution by employing a real use case of trade finance. During this effort, we explore XinFin and XinFin Digital Contract (XDC) as an example that can create added value from micro and macroeconomic perspectives simultaneously. Our future research will base on blockchain governance practices in specific sectors.

Keywords: Blockchain Governance, On-Chain Governance, Off-Chain Governance, Public Blockchain, Private Blockchain, Consortium Blockchain, Hybrid Blockchain, XinFin, XDC

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1. INTRODUCTION

Tapscott (2014), being the first to coin the term "digital economy" emphasized that the digital economy explains not only the networking of technology but the networking of humans through technology that combine several factors such as intelligence, knowledge, and creativity. After analyzing numerous definitions that have arisen over time, Bukht and Heeks (2017) conclude that at the core of the digital economy there are ITs/ICTs (information and communication technologies) that produce foundational digital goods and services, but at the widest scope, the digital economy is the use of ICTs in all economic fields.

The digital economy has accelerated the shift of traditional approaches and processes in terms of business structures, firm interactions, consumer behaviors, information, goods, and services, especially since the onset of Industry 4.0. which refers to the technological transformation from embedded to cyber-physical systems.

Bitcoin is accepted as the first financial instrument of the digital economy although it has several predecessors such as B-Money and Bit Gold. It was invented by a person or a group using the name Satoshi Nakamoto, in 2008. In his white paper, Nakamoto (2008) offers an electronic payment system based on cryptographic proof instead of a trusted third party. The system promises lower transaction fees than traditional online payment systems. It is not backed by a government decree. There is no centralized authority in charge of its supply. It has a network of nodes covering the entire system.

Being the foundation of Bitcoin, blockchain technology is the first building block of our study. It builds upon cryptography, mathematics, consensus algorithms, and economic models (Niranjanamurthy, Nithya, & Jagannatha, 2019). Proof of Work (PoW) and Proof of Stake (PoS) are the leading consensus algorithms that are used to confirm transactions and add new blocks to the blockchain. The most important functions of consensus algorithms are to prevent double blockchain creation and double expenditure (Zheng, Xie, Dai, Chen, & Wang, 2017).

Blockchain as a form of public ledger records the history of each transaction. It is executed by participating nodes that verify transactions in chunks called "blocks". They then relay them across the network (Pagliery, 2014). Each block is chained to the previous block in a sequence and is immutably recorded across a peer-to-peer network.

All participants maintain an encrypted record of each transaction within a decentralized, scalable and resilient recording mechanism (https://www.oracle.com/). Key characteristics of blockchain technology can be listed as decentralization, immutability, security, efficiency, and anonymity (Atlam & Wills, 2019). With these properties, it can function as a cost-saving and efficiency-improving game changer.

There are three types of blockchains that are generally agreed on in the blockchain literature as: public blockchain, private blockchain, and consortium blockchain. Each blockchain is open-source software with a source code that determines the implementation of a protocol (Maddrey, 2018). The software protocol includes the details on how processes will be implemented, at what speed new blocks will be added, what will be the block size, difficulty, nonce, etc. (Hacker, 2019).

Public blockchains like bitcoin and ethereum have fully open, permissionless, and distributed networks. Anyone can be a participant in the network with the right to read and write data. Joining and leaving the consensus process anytime is possible. Besides the advantages of security, openness, immutability, and transparency, this type has some disadvantages as well. High transaction cost, high energy consumption, low transaction speed, low efficiency, and scalability concerns are some of them (Cong & He, 2019).

Being the second type, private blockchains such as quorum are suitable for smaller networks and closed systems where all nodes are fully trusted. In private blockchains, authorized nodes are responsible for the consensus process. Admin has the highest authority to control the system. Depending on the organizational structure of the company, reading and writing transactions can be allowed by the admin. While there are some advantages such as lower transaction cost, faster transaction speed, lower energy consumption, higher efficiency, and scalability there are some disadvantages such as the need for trust, potential manipulation/hacking/stealing of data, and a centralized network structure which is in contrast with the essence of the blockchain (Khan et al., 2019).

As a third type, consortium blockchains are almost a hybrid of public and private blockchains. In this type, a group of organizations or companies with equal power have control of the network. These organizations have complete authority to make necessary changes in the processes for the smoothness of the network (Sajana, Sindhu, & Sethumadhavan, 2018). The limited nodes in the consortium blockchains could validate the transactions so pre-selected nodes take control after consensus. By this means, the system does not allow a strange random entity to enter the chain. It has high scalability, more security, medium transaction cost, medium transaction speed, and partial decentralization. Nevertheless, it has less transparency and is prone to hacking and manipulation. Consortium blockchains are broadly used in the banking and financial sector (Viriyasitavat & Hoonsopon, 2019). While it is generally accepted as the last type, we'll bring forward another type of blockchain in the fifth section of our study.

There are several participants in a blockchain network that contribute to the governance mechanism in different layers. Governance becomes more of an issue as transactions in the centralized environment shift more to the decentralized side as technology advances. Governance is the second building block of our study. Although there is abundant literature focused on the subject of "governance by blockchain", there are only a few studies on "governance of blockchain". This study aims to shed light on the nexus of blockchain and governance by distinguishing "governance by blockchain" and "governance of blockchain", stakeholders of blockchain, competing interests between stakeholders of blockchain, and how blockchain can create added value from micro and macroeconomic perspectives simultaneously by presenting a real use case.

The study proceeds as follows: Section 2 analyzes the literature review, Section 3 introduces the research methodology, and Section 4 shares the results of the study. Discussion and conclusion are presented in Section 5 and Section 6, respectively.

2. LITERATURE REVIEW

Due to its decentralized nature, the governance of blockchain differs from the existing governance mechanisms of centralized structures. In a blockchain project, implementation of the project does not require a top executive officer but a globally distributed network of developers that wrote a software protocol and distribute the power among the blockchain stakeholders (Hsieh, Vergne, & Wang, 2017). In this structure, it is important to try to understand who are the stakeholders that govern the blockchain network and how blockchain governance works. Liu, Lu, Zhu, Paik, and Staples (2021) covered several aspects of blockchain governance such as the definitions, motivation, stakeholders, and implementation of the governance mechanism. By summarizing the definitions of analyzed studies, they came up with a new definition. It refers to the structures (architecture) and processes (development processes) that are designed to ensure the development and use of blockchain which is compliant with legal regulations and ethical responsibilities. This definition has three dimensions namely decision rights, accountability, and incentives which are all aligned with the decentralization level of deployed blockchain.

Decision rights denote authority, responsibility, and capability of participants, how decisions are made and monitored, which stakeholder interest should be prioritized and if collective power is possible. Accountability suggests those who are responsible for different phases of the blockchain lifecycle that should be identifiable and questionable for their decisions and the outcomes of the blockchain. Governance can ensure the efficient use of resources and monitor the overall performance of the blockchain platform. Incentive mechanisms can be designed to influence the behavior of network participants. They can be either positive or negative (rewards for contributions, or sanctions for malicious operations) (Beck, Müller-Bloch, & King, 2018). Allen and Berg (2020) define blockchain governance as the processes by which stakeholders (including token holders, network validators such as miners and economic full nodes, core and application developers, and founders) exercise bargaining power over the network. They point out several conflicting goals of stakeholders who share a distributed network but pursue different goals. For example, token-holders may wish for increasing prices relative to fiat currency while application developers may look for stable prices to use tokens as a utility in their applications. Similar to the requirement of a consensus mechanism among nodes, a consensus mechanism is required among stakeholders during a change/update in the laws and processes of the network as well.

In a decentralized network, this duty will be conducted by innovative governance mechanisms via on-chain and off-chain governance. These roles are highlighted by Ølnes, Ubacht, and Janssen (2017). In the first role, technology provides a supporting role to improve the existing governance processes. In the latter, it identifies the development, adaptation, and maintenance of the blockchain technology itself. De Filippi and McMullen (2018) associate "governance by blockchain" with "on-chain governance". Hereof, "on-chain governance" refers to a system of rules that are encoded directly into the underlying technological framework responsible for enforcing them. Instead, they link "governance of blockchain" to "off-chain governance". It consists of all other types of rules that may affect the operation and future of these systems.

On-chain governance rules are more formal, strict, predictable, and efficient than off-chain governance rules since they are clearly codified and automatically enforced according to defined processes. With these features, they are more auditable and verifiable but they are less adjustable to changing or unexpected circumstances. Distributed autonomous organization (DAO) attack that is explained in Section 4 is a crucial example of "on-chain" governance. Decision-making processes that are implemented via staking or through a transaction on the blockchain are examples of "on-chain governance". It generally takes place on the PoS blockchains in the form of a vote. The more the user has the blockchain's coin which is called a "governance token" the more he can participate in the governance of the blockchain. Stakeholders of this governance type generally include users, developers, and transaction validators.

Off-chain governance rules are on the other hand generally executed via informal discussions and improvement proposals. They are more unstructured and more complex to monitor and control. "Off-chain governance" processes are generally employed by PoW blockchains. Core stakeholders in this type of governance are users, node operators, developers, and miners. Protocol changes or update proposals take place at conferences, online forums, mailing lists, etc. When a consensus cannot be reached within the network, it is subject to a fork like the case of Bitcoin and Bitcoin cash.

Cao et al. (2021), suggest an integrated "on-chain" and "off-chain" governance mechanism that should be developed with stakeholders. Authors suggest that off-chain governance can complement the weaknesses of on-chain governance. With an integrated mechanism, they intend to maintain transparency and efficiency of on-chain governance and also balance the differing needs of stakeholders via off-chain governance. Off-chain governance encapsulates both endogenous and exogenous rules (Reijers & Coeckelbergh, 2018). Endogenous rules are implemented by a specific group to guarantee the proper functioning and development of a blockchain-based system. They consist of social norms, customs, and other governance structures developed or accepted by the group in order to ease the coordination within the group. Conversely, exogenous rules are imposed by a third party to affect the activities of the group such as national laws, regulations, contractual agreements, and technology standards. Reijers et al. (2021) note that in most cases on-chain governance rules are adopted in blockchain-based systems. Only when on-chain governance fails or is unable to process a certain decision then off-chain governance is implemented. Chao (2020) proposes a centralized hybrid governance method of blockchain to complete the decision-making process of the chain, sending the governance results to the blockchain for automatic execution, effectively completing the governance of blockchain, and avoiding governance drawbacks such as less methodology, non-transparency, inefficiency and split-prone structure.

Abedin (2021) considers the case from a different angle. Assuming that there is no best single way to maximize the explainability of artificial intelligence (AI), he tries to apply the contingency theory to AI with the effort to use environmental, organizational, and individual factors in a balanced manner. Based on this, Li and Zhou (2021) attempt to find the interactions between on-chain and off-chain governance of blockchain. The contingency theory of Fiedler (1964) opposes the traditional management theory's suggestion that there is just one best way of doing things. It states that a task may be conducted differently in different organizations depending on the environmental and contextual factors surrounding it (Galbraith, 1973). Tosi and Slocum (1984) emphasized that the balance of profitability, satisfaction, and social responsibility are the key factors that should be considered.

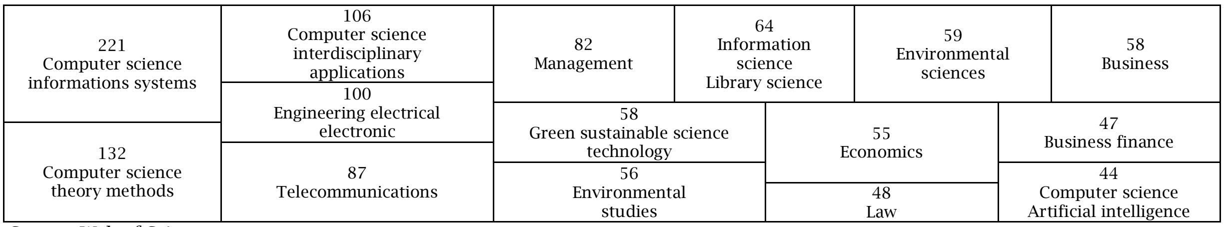
In view of these facts, Li and Zhou (2021) emphasized that the advancement of technology and the advent of novel situations in governance require a flexible and adaptable understanding of not only the infrastructure but also the social environment and its implications. As a result, they suggest a consortium blockchain that combines both methods to create a reciprocal structure. Blockchain consortia are complex structures where partners must collaborate on the aim, operations, and expected outcomes of a potential project. Partners and consortium as a whole is expected to match their skills and attitudes. While there is an ongoing discussion on the ideal type of governance Kaufman, Heister, and Yuthas (2021) attract attention to the fact that blockchain is typically treated as a technology issue so the business capabilities required for a successful consortia are not widely recognized and discussed. They infer that despite its potential, blockchain technology has failed to produce promised benefits for enterprise networks.

3. RESEARCH METHODOLOGY

Following Liu, Lu, Yu, Paik, and Zhu (2022) we conduct the study through several steps. First, a literature review was performed using the Web of Science academic database. Our research includes results for the terms "governance" and "blockchain". Since blockchain governance is a new and quickly evolving field of study, results cover the period of the last five years. According to the results, we get 868 publications from the Web of Science. Among them, 256 studies were published in 2021 while 145 papers are available during the first half of 2022. According to publication type, 589 of 868 studies are articles and 207 are proceeding papers.

Blockchain governance is of interest to a diverse set of academic disciplines. As stated by Kaufman et al. (2021), an overwhelming amount of study is conducted by the disciplines with a technical perspective. The results of our study are associated with computer science, electrical and electronic engineering, telecommunications, management, economics, law, business finance, and public administration. Figure 1 aggregates research results into a visualization comparing the number of results by discipline.

Figure 1. Number of results by discipline



Source: Web of Science.

According to the aim of this study, we focus on features of blockchain, types of blockchain, the difference between the governance of blockchain and governance through blockchain, and a use case of blockchain that creates added value from micro and macroeconomic perspectives simultaneously. Following the research methodologies implemented by other systematic reviews, we follow a strategy that is based on inclusion and exclusion criteria. We eliminate studies focusing purely on the technical features of governance of blockchain. We also eliminate studies that are not written in English, studies that are out of the selected time period, and papers that cannot be accessed. We also benefit from the Google Scholar database and websites related to our research.

For alternative research methods, Liu et al. (2021) and Liu et al. (2022) can be reviewed. To understand the state-of-the-art of blockchain governance, the authors conduct a systematic literature review with 37 primary studies. The literature review consists of four main steps including keyword search, selection of studies based on predefined criteria, backward and forward snowballing, data extraction, and synthesis.

As an alternative study, Valdivia and Balcell (2022) reviewed blockchain governance in distributed energy transitions by addressing a number of boolean expressions clustered into the fields of study that have been consulted through the Scopus (Elsevier), IEEE Xplore, ProQuest, Web of Science, EBSCO, and Emerald Insight databases. During the analysis, they reviewed articles for 1) governance of energy transitions, 2) blockchain applications in the energy sector and finally, 3) blockchain governance.

4. RESULTS

The innovation behind Bitcoin is extended by the launch of ethereum in 2013. One of the most important features of ethereum is the concept of smart contracts which are programs that automatically execute an action when a certain event occurs. It allows defining rules and conditions.

If conditions are met, it automatically triggers other actions such as receiving funds or executing other smart contracts. This opportunity provided by smart contracts enables the shift of centralized finance (Ce-Fi) to blockchain networks (decentralized finance, De-Fi) gradually.

In this regard, De-Fi, as a sub-field of blockchain started to gain ground. De-Fi specializes in advancing financial technologies and services on top of smart contract-enabled ledgers where the rules and conditions of execution are warranted by the network itself. Most De-Fi projects are built on the ethereum network but there are other blockchain networks that allow De-Fi applications as well. Having distinguished features, De-Fi both can mirror traditional applications of Ce-Fi and provides some more complex products compared to Ce-Fi. Stablecoins, decentralized exchanges, lending and borrowing, insurance, derivatives, and yield farming are some areas currently covered under De-Fi (Keller & Stolzenberg, 2021).

Although blockchains show a lot of promise, they are still not exempt from attacks, hacks, theft, and manipulation. In 2016, the ethereum blockchain was exposed to an attack when a hacker found a vulnerability in the code of the DAO which was a smart contract built on top of the ethereum blockchain. This attack led to the theft of Ether equivalent to $50 million (Hacker, 2019). Core developers of ethereum decided to proceed with a solution of returning the stolen Ether through a hard fork. Nevertheless, not all the participants of the network agree with this decision which led to the forking of the ethereum blockchain into two different versions. As codes are written by humans, several vulnerabilities may arise at any time. As an alternative way, potential malicious codes might be embedded in the software that might be hidden from outside observers, as well (Werbach, 2018).

In 2018, the bitcoin community was involved in a long discussion on bitcoin's block size as some of them asked for an increase in its block size to enhance its capacity. The community could not come to an agreement on the issue and a hard fork emerged which led to the creation of Bitcoin cash besides Bitcoin.

TerraUSD (UST) is another example of how governance can be a vital issue in De-Fi. Terra is a blockchain protocol that backs algorithmic stablecoins. Stablecoins are preferred by investors in order to protect themselves from the volatility in the crypto-asset market. Stablecoins can be pegged in several ways. In this case, when the stablecoin trades above its pegged value, more tokens are created and the price falls. When the stablecoin trades below the peg, more tokens are taken out of circulation, and the price increases. A sister token with a volatile price must be involved in this mechanism. It is the sister token, Luna, whose price was set by the market. Since 1 UST was defined as being equal to $1 worth of Luna, this means that a holder of $1 in UST would always get $1 in value back. First of all, an unknown user exchanged roughly $84 million worth of UST for USD Coin in May 2022. The Fed's interest rate cut led more UST depositors to withdraw their stablecoins from the anchor, as well. A huge number of transactions hit UST of its $1 peg. That led more UST holders to try to get their money out of the system. But since one of the main ways to exit from UST was through Luna, which was already falling in value due to investors' loss of confidence as well as an overall down market, that worsened the situation. According to the UST-Luna exchange mechanism, the massive UST withdrawals led to a vast expansion in the supply of Luna, decreasing its value even further. Finally, prices fell to zero, and market values decreased by $60 billion Terracoins. Luna has abandoned and remained as the old chain while terra launched a new chain — Luna 2.0. (https://www.bloomberg.com).

Organizations develop their own applications on the blockchain or join an existing blockchain network for improving the efficiency of their businesses. To do this, they need to see trustworthy and realistic governance and maintenance where economic incentives between different stakeholders are aligned and updates to the blockchain are coordinated carefully (van Deventer, Brewster, & Everts, 2017). Nevertheless, there is no specific list of stakeholders.

Liu et al. (2021), list a wide group of stakeholders that are involved in blockchain governance such as the project team, node operator, user, application provider, regulator, media, researcher, and environmentalist. In such an environment, competing interests among stakeholders will not be surprising. For example, it is important to understand whether voting on which transactions to include in a block is in line with democratic principles as in the case of PoW or if it inclines toward plutocracy since competitors acquire tokens to accumulate voting power as in the case of PoS (De Filippi & McMullen, 2018). Projects should be implemented both by maximizing the efficiency of digital opportunities and by considering stakeholders' competing interests under the scope of governance.

In 1970 Friedman famously stated that the only social responsibility of a firm is to increase its profits, now known as the shareholder model of business (Friedman, 1970). Bowen (2013) connected the responsibility of the firm to society and argued that a wider group and interest should be taken into consideration by the management while operating. What was the equivalent of this wider group?

The earliest definition of stakeholder is often credited to Stanford Research Institute in 1963 but the concept seems to be present in the business world even before (Ramakrishnan, 2019). According to Dodd (1932), General Electric Company had identified four main groups that they had to deal with as: shareholders, employees, customers, and the general public. Associated with Freeman (2010), the stakeholder model highlighted the responsibilities of the firm to society. Freeman defined the stakeholder as any individual or group who can affect or can be affected by the achievement of the organization's objectives. As listed by Donaldson and Preston (1995), since the publication of Freeman's landmark book, many books, and papers with primary emphasis on stakeholder concepts have appeared (Alkhafaji, 1989; Anderson, 1989; Brummer, 1991; Brenner & Cochran, 1991; Clarkson, 1991; Goodpaster, 1991; Hill & Jones, 1992; Wood, 1991a, 1991b). The authors built their organization definition as an entity that accommodates diverse participants to accomplish multiple purposes where participants do not always have to share a completely parallel view. Where this is the traditional approach to the Ce-Fi, it is hard to see the same in the De-Fi since the De-Fi environment keeps evolving with new structures, tools, and, stakeholders. Still, a successful governance mechanism that will be implemented on the De-Fi side has the potential to maximize the benefits of both micro and macroeconomic players simultaneously. But dealing overwhelmingly with the technical side cannot provide a balance between the two governance structures that are the building blocks of the blockchain. As expressed in different cases above, governance of blockchain requires measures on nontechnical issues as well. Under these nontechnical issues, monitoring stakeholders' actions, internal control of stakeholders, and ethics should also be highlighted. If success can be achieved on the De-Fi governance this would have repercussions on the Ce-Fi side as well.

5. DISCUSSION

Despite the general classification, there is one other type of blockchain, namely hybrid blockchain. Unlike consortium blockchain, hybrid blockchain is completely the mid-point between public and private blockchain that blends the features of these kinds. As we have highlighted in the introduction section, both public and private blockchains have some advantages and disadvantages. So hybrid blockchain aims to bring advantages of these types and eliminate their drawbacks. Our concern is whether blockchain can simultaneously create added value for micro and macroeconomic players. Or the case as underlined by Kaufman et al. (2021) is valid? As a practice, where we can see the simultaneous value-added effect, we choose to analyze a real-world implication of hybrid blockchain in trade finance.

Exchange Infinite (XinFin) is the first hybrid blockchain that combines the features of public and private blockchains with interoperable smart contracts. XinFin developed its hybrid structure by merging ethereum (public blockchain) and quorum (private blockchain). The XinFin Digital Contract (XDC) token is the underlying utility token that powers XinFin's hybrid blockchain.

Table 1. Comparison of payment tools

Comparison criteria	***1st generation***	***2nd generation***	***3rd generation***
	Bitcoin BTC	*Ethereum ETH*	*XinFin XDC*
Transaction per second (TPS)	3–6 TPS	12–16 TPS	2000+ TPS
Average fee	15 USD	10 USD	0.00001 USD
Transaction confirmation	10–60 minutes	10–20 seconds	2 seconds
Smart contract support	No	Yes	Yes
Energy consumption (Terawatt-hour)	71.12 TWh	20.61 TWhH	0.0000074 TWh

Source: https://xinfin.org/index

XDC operates as a settlement tool for decentralized applications (DApps) built on the blockchain. There are several use cases built around XinFin's token but we choose to explain the case of TradeFinex since the global trade finance gap is a growing problem for the world economy. It grew to an all-time high of $1.7 trillion in 2020, which is almost 10 percent of the global trade (https://www.adb.org). COVID-19 skyrocketed macroeconomic uncertainties and eroded global trade till the first quarter of 2020. Besides that, inflation pressures, increasing global food, and energy prices, and microeconomic threats such as increased financing costs of small and medium-sized enterprises (SMEs), and weaker balance sheets make trade finance a very crucial issue for world economies. We have already expressed that blockchain provides solutions to a wide spectrum of fields such as fintech, insuretech, public, health, microfinance, agriculture, supply chain, etc. (Atici, 2020). But in our case, we will analyze how the hybrid blockchain provides a solution to local and global trade finance.

TradeFinex is a peer-to-peer decentralized platform for trade finance originators to distribute deals to a wide range of bank and non-bank funders. This network aims to reduce friction among a complex group of actors in trade finance and expands access to trade financing for SMEs while creating yield opportunities for investors (https://www.blockdata.tech/). The interoperable blockchain network enables digitization, tokenization, and instant settlement of trade transactions, increasing efficiency while reducing reliance on complex foreign exchange infrastructures.

In a traditional centralized system, trade finance requires a complicated process that comprises enterprises, local and foreign financial institutions, credit insurance companies, credit rating agencies, underwriters, etc. It also necessitates a massive amount of paperwork during these transactions. In the decentralized practice, standardized documents and agreements are moved to smart contracts so transactions are aimed to be settled faster. It provides an example of a digitized and decentralized way of managing invoices, letters of credit, bills of lading, payments, guarantees, and all other trade documents. It also brings all the stakeholders such as originators, special purpose vehicles, digital custodians, and funders on the same network. Hybrid blockchain network takes the advantage of private blockchain in terms of data privacy and public blockchain in the transaction verification on a shared public ledger (https://xinfin.org/).

6. CONCLUSION

Blockchain is a niche and ever-progressing technology that necessitates a multidisciplinary look. Its heterogenous feature requires the involvement of several interrelated fields of study such as engineering, economics, management, law, finance, etc. In this study, we address the nexus of blockchain and governance. We note that traditional governance mechanisms implemented on centralized systems are gradually shifting to the decentralized digital environment in parallel to the advancing technology. What can we expect from this shift? Can we expect decreasing transaction costs, protected property rights, increasing positive externalities, transparent transactions, and maximized social welfare? Processes of centralized systems cannot be swiftly and one hundred percent mirrored on the decentralized digitized side because it is not subject fully to the standards, laws, regulations, and audit processes of the centralized system. Malicious attacks/hacks/fraud etc. are still an important issue on decentralized networks. Moreover, in these networks, there are a large number of stakeholders that should be managed digitally.

In this study, we could not focus just on the governance concept due to the multifaceted structure of the subject. We make a literature review based on Web of Science and Google Scholar databases. We selected studies according to our inclusion and exclusion criteria. We also benefited from web sources related to the concept.

We try to make a synthesis of the extant literature by balancing two facets of blockchain governance. During our research, we realize that there is a considerable research gap between on-chain governance which focuses on technological issues and, off-chain governance which is related to issues other than that. Accumulated literature overwhelmingly places emphasis on the technical and technological aspects of the concept.

We analyze the subject by clarifying the types and features of blockchain. Each type of blockchain has its own advantages and disadvantages. Although blockchains have promising features they are not exempt from attacks. Besides, as there are several stakeholders that pursue their own interests depending on the type of blockchain, there is competing interest among stakeholders. In such an environment, the governance of blockchain becomes crucial. We did not especially focus on public and private blockchains but on a structure that is similar to both. So we present the features of consortium and hybrid blockchains as a way to optimize the micro and macroeconomic benefits of this technology simultaneously.

Based on our analysis we infer that the best type of blockchain is a hybrid type of blockchain that stands between the public and private blockchain. Moreover, hybrid blockchain may optimize gains from this technology by equally encapsulating on-chain and off-chain governance rules. The reason that we give so much emphasis to the nexus of blockchain and governance is the promising future of blockchain in terms of creating added value both from micro and macroeconomic perspectives simultaneously. Since the COVID-19 pandemic, trade finance becomes more than an ever-important case for economies. With this in mind, we support our argument with a real use case of trade finance. At this point, we should again note that governance in De-Fi must be processed in balance. Both on-chain and off-chain governance must be given the same importance by public and private sectors, academics, local and global standardizing institutions, legislators, etc.

Our study has some limitations. The first is the scarce literature on "off-chain" governance. The second is the ever-evolving concepts, tools, and implications specific to this technology. The third is the literature that lags behind the practice. The fourth is the scarce real use cases. The final is the one-legged arguments that are far from a multidisciplinary approach.

Despite these limitations, this paper contributes to the extant scarce literature by trying to fill the gap between on-chain and off-chain governance literature. Our study is important for future studies as it questions and tries to answer which type of blockchain can create added value and how it can create this value from micro and macroeconomic perspectives simultaneously in a digitized and decentralized environment by covering both on-chain and off-chain governance rules.

Our future research will base on blockchain governance practices in specific sectors.

REFERENCES

1. Abedin, B. (2021). Managing the tension between opposing effects of explainability of artificial intelligence: A contingency theory perspective. In *Proceedings of the 6th International Conference on Sustainable Information Engineering and Technology*. https://doi.org/10.1145/3479645.3479709
2. Alkhafaji, A. F. (1989). *A stakeholder approach to corporate governance: Managing in a dynamic environment*. Westport, CT: Praeger.
3. Allen, D. W. E., & Berg, C. (2020). Blockchain governance: What we can learn from the economics of corporate governance. *The Journal of The British Blockchain Association, 3*(1). https://doi.org/10.31585/jbba-3-1-(8)2020
4. Anderson, J. W., Jr. (1989). *Corporate social responsibility: Guidelines for top management*. Santa Barbara, CA: ABC-Clio.
5. Asian Development Bank. (2021, October 12). *Global trade finance gap widened to $1.7 trillion in 2020*. Retrieved from https://www.adb.org/news/global-trade-finance-gap-widened-17-trillion-2020
6. Atici, G. (2020). Digital and digitalized economy in EMs: A focus on Turkey. In V. Bobek, & C.-H. Quah (Eds.), *Emerging markets*. https://doi.org/10.5772/intechopen.94494
7. Atlam, H. F., & Wills, G. B. (2019). Technical aspects of blockchain and IoT. In S. Kim, G. C. Deka, & P. Zhang (Eds.), *Advances in computers* (Vol. 115, pp. 1–39). https://doi.org/10.1016/bs.adcom.2018.10.006
8. Beck, R., Müller-Bloch, C., & King, J. L. (2018). Governance in the blockchain economy: A framework and research agenda. *Journal of the Association for Information Systems*, *19*(10). https://doi.org/10.17705/1jais.00518
9. Bowen, H. R. (2013). *Social responsibilities of the businessman*. University of Iowa Press. https://doi.org/10.2307/j.ctt20q1w8f
10. Brenner, S. N., & Cochran, P. (1991). The stakeholder theory of the firm: Implications for business and society theory and research. In *Proceedings of the International Association for Business and Society* (Vol. 2, pp. 897–933). https://doi.org/10.5840/iabsproc1991235
11. Brummer, J. J. (1991). *Corporate responsibility and legitimacy: An interdisciplinary analysis*. New York, NY: Greenwood Press.
12. Bukht, R., & Heeks, R. (2017). *Defining, conceptualising and measuring the digital economy* (Development Informatics Working Paper No. 68). https://doi.org/10.2139/ssrn.3431732

13. Cao, S., Miller, T., Foth, M., Powell, W., Boyen, X., & Turner-Morris, C. (2021). Integrating on-chain and off-chain governance for supply chain transparency and integrity. In *Proceeding of the 5th Symposium on Distributed Ledger Technology*. https://doi.org/10.48550/arXiv.2111.08455
14. Chao, Z. (2020). Research on mechanism and method of blockchain governance. *Journal of Information Security Research, 6*(11), 972–981. Retrieved from http://www.sicris.cn/EN/abstract/abstract847.shtml
15. Clarkson, M. B. E. (1991). Defining, evaluating, and managing corporate social performance: The stakeholder management model. In J. E. Post (Ed.), *Research in corporate social performance and policy* (Vol. 12, pp. 331–358). Greenwich, CT: JAI Press.
16. Cong, L. W., & He, Z. (2019). Blockchain disruption and smart contracts. *The Review of Financial Studies, 32*(5), 1754–1797. https://doi.org/10.1093/rfs/hhz007
17. De Filippi, P., & McMullen, G. (2018). *Governance of blockchain systems: Governance of and by distributed infrastructure* (Doctoral dissertation, Blockchain Research Institute and COALA). Retrieved from https://hal.archives-ouvertes.fr/hal-02046787/document
18. Dodd, E. M., Jr. (1932). For whom are corporate managers trustees? *Harvard Law Review, 45*(7), 1145–1163. https://doi.org/10.2307/1331697
19. Donaldson, T., & Preston, L. E. (1995). The stakeholder theory of the corporation: Concepts, evidence, and implications. *Academy of Management Review, 20*(1), 65–91. https://doi.org/10.5465/amr.1995.9503271992
20. Fiedler, F. E. (1964). A contingency model of leadership effectiveness. *Advances in Experimental Social Psychology, 1*, 149–190. https://doi.org/10.1016/S0065-2601(08)60051-9
21. Freeman, R. E. (2010). *Strategic management: A stakeholder approach*. Cambridge University Press. https://doi.org/10.1017/CBO9781139192675
22. Friedman, M. (1970, September 13). A Friedman doctrine — The social responsibility of business is to increase its profits. *The New York Times*. Retrieved from https://static1.squarespace.com/static/56b7a300356fb06478dcea5a/t/5fb99036957a3511df281e4a/1605996599044/A+Friedman+doctrine%E2%80%90-+The+Social+Responsibility+Of+Business+Is+to+Increase+Its+Profits+-+The+New+York+Times.pdf
23. Galbraith, J. R. (1973). *Designing complex organizations*. Reading, MA: Addison-Wesley.
24. Goodpaster, K. E. (1991). Business ethics and stakeholder analysis. *Business Ethics Quarterly, 1*(1), 53–73. https://doi.org/10.2307/3857592
25. Hacker, P. (2019). Corporate governance for complex cryptocurrencies? A framework for stability and decision making in blockchain-based organizations. In P. Hacker, I. Lianos, G. Dimitropoulos, & S. Eich (Eds.), *Regulating blockchain: Techno-social and legal challenges* (pp. 140–166). https://doi.org/10.1093/oso/9780198842187.003.0008
26. Hill, C. W. L., & Jones, T. M. (1992). Stakeholder-agency theory. *Journal of Management Studies, 29*(2), 131–154. https://doi.org/10.1111/j.1467-6486.1992.tb00657.x
27. Hsieh, Y.-Y., Vergne, J.-P., & Wang, S. (2017). The internal and external governance of blockchain-based organizations: Evidence from cryptocurrencies. In M. Campbell-Verduyn (Ed.), *Bitcoin and beyond* (pp. 48–68). https://doi.org/10.4324/9781315211909-3
28. Kaufman, M., Heister, S., & Yuthas, K. (2021). Consortium capabilities for enterprise blockchain success. *The Journal of The British Blockchain Association, 4*(2). https://doi.org/10.31585/jbba-4-2-(4)2021
29. Keller, A., & Stolzenberg, B. (2021). *Decentralized finance: Defining the future of finance* (PwC Report). Retrieved from https://www.pwc.ch/en/insights/digital/defi-defining-the-future-of-finance.html
30. Khan, A. G., Zahid, A. H., Hussain, M., Farooq, M., Riaz, U., & Alam, T. M. (2019). A journey of WEB and Blockchain towards the Industry 4.0: An overview. In *2019 International Conference on Innovative Computing (ICIC)* (pp. 1–7). https://doi.org/10.1109/ICIC48496.2019.8966700
31. Li, Y., & Zhou, Y. (2021). Research on the reciprocal mechanism of hybrid governance in blockchain. *Journal of Economics & Management Research, 2*(1), 1–5. https://doi.org/10.47363/JESMR/2021(2)121
32. Liu, Y., Lu, Q., Yu, G., Paik, H.-Y., & Zhu, L. (2022). Defining blockchain governance principles: A comprehensive framework. *Information Systems, 109*, 102090. https://doi.org/10.1016/j.is.2022.102090
33. Liu, Y., Lu, Q., Zhu, L., Paik, H.-Y., & Staples, M. (2021). A systematic literature review on blockchain governance. https://doi.org/10.2139/ssrn.3981282
34. Maddrey, N. (2018, August 23). The three branches of blockchain governance [Blog post]. Retrieved from https://medium.com/digitalassetresearch/the-three-branches-of-blockchain-governance-75a29bf98880
35. Nakamoto, S. (2008). *Bitcoin: A peer-to-peer electronic cash system*. Retrieved from https://bitcoin.org/bitcoin.pdf
36. Niranjanamurthy, M., Nithya, B. N., & Jagannatha, S. (2019). Analysis of blockchain technology: Pros, cons and SWOT. *Cluster Computing, 22*(6), 14743–14757. https://doi.org/10.1007/s10586-018-2387-5
37. Ølnes, S., Ubacht, J., & Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Government Information Quarterly, 34*(3), 355–364. https://doi.org/10.1016/j.giq.2017.09.007
38. Pagliery, J. (2014). *Bitcoin: And the future of money*. Chicago, IL: Triumph Books.
39. Ramakrishnan, R. (2019). *Theories of stakeholder management*. Retrieved from https://www.researchgate.net/publication/339857108_Theories_of_Stakeholder_Management
40. Reijers, W., & Coeckelbergh, M. (2018). The blockchain as a narrative technology: Investigating the social ontology and normative configurations of cryptocurrencies. *Philosophy & Technology, 31*(1), 103–130. https://doi.org/10.1007/s13347-016-0239-x
41. Reijers, W., Wuisman, I., Mannan, M., De Filippi, P., Wray, C., Rae-Looi, V., ... Orgad, L. (2021). Now the code runs itself: On-chain and off-chain governance of blockchain technologies. *Topoi, 40*(4), 821–831. https://doi.org/10.1007/s11245-018-9626-5
42. Sajana, P., Sindhu, M., & Sethumadhavan, M. (2018). On blockchain applications: Hyperledger Fabric and Ethereum. *International Journal of Pure and Applied Mathematics, 118*(18), 2965–2970. Retrieved from https://acadpubl.eu/jsi/2018-118-18/articles/18c/84.pdf
43. Shen, M. (2022, May 21). How $60 billion in terra coins went up in algorithmic smoke. *Bloomberg*. Retrieved from https://www.bloomberg.com/graphics/2022-crypto-luna-terra-stablecoin-explainer/
44. Tapscott, D. (2014). *The digital economy anniversary edition: Rethinking promise and peril in the age of networked intelligence*. New York, NY: McGraw-Hill.

45. Tosi, H. L., Jr., & Slocum, J. W., Jr. (1984). Contingency theory: Some suggested directions. *Journal of Management*, *10*(1), 9–26. https://doi.org/10.1177/014920638401000103
46. Valdivia, A. D., & Balcell, M. P. (2022). Connecting the grids: A review of blockchain governance in distributed energy transitions. *Energy Research & Social Science*, *84*, 102383. https://doi.org/10.1016/j.erss.2021.102383
47. van Deventer, M. O., Brewster, C., & Everts, M. (2017). *Governance and business models of blockchain technologies and networks* (TNO Paper No. 776936). Retrieved from https://repository.tudelft.nl/view/tno/uuid:a593f6d3-6c67-4fb1-908b-4ac7662b9b7f
48. Viriyasitavat, W., & Hoonsopon, D. (2019). Blockchain characteristics and consensus in modern business processes. *Journal of Industrial Information Integration, 13*, 32–39. https://doi.org/10.1016/j.jii.2018.07.004
49. Werbach, K (2018). *The blockchain and the new architecture of trust.* https://doi.org/10.7551/mitpress/11449.001.0001
50. Wood, D. J. (1991a). Corporate social performance revisited. *Academy of Management Review, 16*(4), 691–718. https://doi.org/10.5465/amr.1991.4279616
51. Wood, D. J. (1991b). Social issues in management: Theory and research in corporate social performance. *Journal of Management, 17*(2), 383–406. https://doi.org/10.1177/014920639101700206
52. Zheng, Z., Xie, S., Dai, H., Chen, X., & Wang, H. (2017). An overview of blockchain technology: Architecture, consensus, and future trends. In *Proceedings of the 2017 IEEE International Congress on Big Data (BigData Congress)* (pp. 557–564). https://doi.org/10.1109/BigDataCongress.2017.85