Why blockchains need the law

Secondary rules as the missing piece of blockchain governance

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ABSTRACT

Governance issues limit blockchains' ability to evolve and face unforeseen challenges. It seems possible to argue that this impasse is because most blockchains lack meta-rules. This work considers blockchains as a socio-technical system of rules, in order to draw a comparison with legal systems. Following the comparison, one finds that most blockchains lack what, in legal theory, are considered secondary rules. That is, the meta-rule of the system.

This works examines the relevant concepts and provides their definitions, then proceeds to outline concrete example of the failure of governance among popular blockchains before drawing the parallelism with legal systems and argue that secondary rules might solve some of the issues of the governance of blockchains.

Secondary rules are the necessary infrastructure for building sound governance structures and a necessary condition for blockchains to succeed as a new mode of governance. The conclusion provides future research directions.

CONCEPTS

• Applied computing~Law, social and behavioral sciences • Networks

KEYWORDS

Blockchain, governance, secondary rules, meta-rules, DAO, Bitcoin, Ethereum.

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1 Introduction

Nakamoto proposed the blockchain architecture in 2008 as the underlining data structure of Bitcoin [1]. Blockchains architectures solve two longstanding problems in the field of digital cash: double spending and Byzantine fault tolerance [2, 3]. Blockchains are systems based on "peer-to-peer principles rather than central authority and rely on cryptography for network-wide verification (by consensus) of systems states" [4]. Generally, blockchains enable the decentralized transfer of digital (or tokenized) assets, mostly in the form of cryptocurrencies.

Blockchain technology is one of the last developments in peer-to-peer (P2P) architectures. It enables the "short route" typical of P2P systems in new scenarios, such as online payments [5].

Since its inception, the interest in blockchain technology has grown exponentially, with several authors suggesting new applications beyond cryptocurrencies [6-9]. It is useful to conceptualize blockchains as systems of rules that enable cooperation and coordination among mutually distrusting parties. As such, there seems to be a natural overlap with the study of concurring rule systems as, for example, the law [10]. This abstraction explains the use of legal terminology within the blockchain space, think, for example of the case of smart contracts or the shared political ontology of blockchain communities and States as shown by Reijers et al. [11].

The objective of this study is the governance of blockchains. It seems that the governance structures of blockchains determined both their successes and failures. Hence, it is hardly a surprise that the issue of governance has gained prominence in the blockchain space [12]. This work contributes to the discussion on the governance of blockchains by leveraging the distinction between primary and secondary rules of law as established by legal theorists with respect to modern legal systems.

Since much of the relevant discourse occurs outside academic circles this work integrates, out of necessity, sources, and insights from the 'grey literature.' Moreover, it does not take into consideration permissioned or closed blockchains [13]. Closed blockchains implement a centralized identity layer or – root authority - in order to allow only selected nodes to perform specific network functions, such as write/read from the ledger. Hyperledger Fabric and Corda – among others – belong to this category. The focus, then, is placed on permissionless/open blockchain systems.

This work develops as follows; the next section defines fundamental notions relevant for the analysis. Section 3 provides a brief literature review while section 4 outlines practical examples. Section 5, then, introduces the notion of primary and secondary rules of law and applies it to blockchain systems. Section 6 concludes.

2 Definitions

Blockchains as rule-systems enable different modalities of governance as shown by Malcolm Campbell-Verduyn [14]. A critical distinction is between governance by blockchains, governance with blockchains and governance of blockchains. The focus of this work is the governance of blockchains.

Examples of the three modalities of governance are the following. Governance with blockchain instantiates rules that determine the validity of events, or state changes within the software. Therefore, Bitcoin's algorithm rule for the validity of blocks:

$$f\_d\ (c, x) \rightarrow SHA256(SHA256(c \mid x)) < 2\text{^}224/d$$

Where c is the challenge, x the nonce[1] and d is the difficulty[2] is an example of governance with blockchains [15].

Instead, the issuance scheme of Bitcoin is an example of governance by the blockchain network. In particular, the protocol provides that the number of bitcoins generated per block decreases geometrically, with a 50% reduction every 210.000 blocks until the total number of bitcoins generated will not exceed 21 million.

On the other hand, the governance of blockchains determines the governance by and with blockchains. Vlad Zamfir defines the governance of blockchains as "the decision-making processes for coordination to determine the future of shared common resources.[3]" On the contrary, Gavin Wood considers governance as a mechanism to preserve the cohesion of an economic system: "governance is what changes a multiparty system into a moral person […] it is what keeps people together"[4].

In this study, governance of blockchains is defined as the formal or informal processes that determine changes to the software protocol and/or to the legal entities which manage each system. One need not indulge in the difference between on/off chain governance for the purpose of this work is to show the absence of meta-rules which applies to both cases.

As it stands blockchain governance includes but it is not limited to improvement proposals procedures (IPs)[16]. IPs only determine the rules and provide guidelines on how to submit proposals but do not determine the whole decision process. Also, IPs do not seem to allow for influencing the legal entities behind some blockchain projects.

In general, the governance of blockchains unfolds in the following fashion:

1. A proposal is presented, or an unexpected event occurs.
2. Some stakeholders coordinate through community channels[5].
3. The development team implements the proposed changes/fixes.
4. Nodes operators signal support or lack thereof[6].
5. Miners decide to support the changes, or not.

It seems fair to contend that the governance of most blockchains is not robust enough to ensure that their development unfolds satisfactorily. Empirically, it is manifested by the multitude of hard-forks.

3 The governance of blockchains in the literature

The following brief literature review highlights some critical issues of the governance of blockchains.

Sclavounis rightly recognizes that "The promise of governance by the network – a techno-institutional solution to solving the problems of cooperation and coordination – can only work if the governance of the network is robust, fair and predictable" [17].

Along the same line, Lehdonvirta argues that thinking about blockchains in terms of their potential to change the very way economies are organized turns out to be a naïve understanding of the technology since the real issue lies in who sets the rules that the network enforces [18].

Another Author notes how focusing on the issue of governance by/with blockchain shows the pre-political nature of the discourse: "contrary to the claims of some blockchain advocates, the final outcome would be the general disempowerment of individuals, the "deification of the market and the triumph of anti-politics"[19].

Chiefly, the governance by/with blockchains is incomplete with respect to other modalities of governance; hence, it seems not to be a "new mode of governance that competes with other economic institutions of capitalism, namely firms, markets, networks, relational contracting and governments" [20].

Other authors have described possible solutions to address the shortcomings of the governance of blockchains. Abramowicz introduces the concept of cryptocurrency-based law, that is, a P2P decision-making method based on tacit coordination games. He suggests that such a method might be used to "determine whether to make changes to the Bitcoin reference code" [21]. Moreover, he

[1] That is an arbitrary number that can be used just once in a cryptographic function.
[2] The measure of the probability of calculating a hash below a given target.
[3] Definition adapted from https://www.zeroknowledge.fm/52?t=225
[4] WEB3 Summit Governance panel 2018, available here: https://www.youtube.com/watch?v=eO3fG_1YrE4
[5] Such as IRC channels, slack and telegram groups, social media etc.
[6] As for example, the case of user-activated soft forks (UASF) in Bitcoin.

correctly notes that Bitcoin uses P2P governance for transactions and not for changes to the rules themselves.

A different strand of the literature addresses the issue of governance of blockchains by comparing it with the governance of the internet. Two articles examine the issues with different theoretical lenses but end up with a similar conclusion.

On the one hand, De Filippi and Loveluck examine the governance of the Bitcoin system and find a highly technocratic power structure[7] [16]. They entertain the opportunity to establish a body similar to ICANN and then reject it: "A centralized governance body […] would obviously fail to obtain any kind of legitimacy from within the Bitcoin community […] since eliminating the need for a fiduciary institutions, or other centralized authorities was the very purpose of the Bitcoin network" [16].

On the other hand, Hacker argues for the application of corporate governance rules to blockchain applications through legal intervention. On this basis, he suggests that an "ICANN for blockchains" may eventually arise if "permissionless blockchains, and the cryptocurrencies and token-based ventures they give rise to, become more interconnected" [23].

Leaving aside the legitimacy issues of an ICAAN for blockchains, one argument does not seem to support the analogy of the internet and blockchains. ICAAN arose from the implementation of a centralized layer (the DNS system) on top of the internet's distributed architecture (TCP/IP). On the contrary, blockchains do not (yet) operate under a centralized layer such as the DNS. Thus, the comparison between blockchains and the internet may be unwarranted, as the extension of a part of the internet governance framework to blockchains.

Zamfir contends that five alternatives for the governance of blockchains are possible, yet not determined [24]:

a) autonomous blockchains;

b) blockchain governance capture;

c) internet censorship;

d) governance with public international law or diplomacy;

e) governance with international private cooperation.

As many contributions on the topic, these solutions do not seem to acknowledge critical aspects of sound governance structures. More precisely, the governance of blockchains lacks meta-rules on how to from other rules. Hence, this work aims to theorize this problem by resorting to one conceptualization developed within the legal theory. For now, the next section exposes some examples of the failures of the blockchain governance which can be explained by the lack of meta-rules.

5.1 Bitcoin software update from 0.7 to 0.8

March 2013, the Bitcoin core developers rolled out an update to the Bitcoin core software in order to fix some issues and vulnerabilities: regular maintenance work. Due to a bug in the update, the new version of the software was incompatible with the older one. The core developers persuaded two of the biggest mining operators to roll back to the previous version of the software for the sake of Bitcoin's integrity [25]. In a matter of hours, the blockchain running the version 0.7 caught up the one running the new software thus solving the issue. In this instance, the informal and opaque mode of governance manifested itself; a few people resolved the issue by coordinating without informing the relevant stakeholders. Arguably, this event confronted the ecosystem with the problem of unexpected events and the lack of proper procedures to deal with the unexpected, a task which is usually allocated to meta-rules.

5.2 The Bitcoin block-size debate

Most blockchain systems have scalability issues; for instance, the throughput of the Bitcoin network is in the order of 6-7 transaction per second. Some members of the community along with some prominent developers (namely, Gavin Andreessen and Mike Hearn) proposed to expand the block size in Bitcoin to accommodate more transactions per block thereby increasing throughput[8], others disagreed. The controversy culminated with the launch of – among others - Bitcoin Cash and Bitcoin Gold in 2017, different versions of Bitcoin where the block size is not limited to 1mb[9]. Interestingly both sides claimed to represent the accurate vision of Nakamoto [27]. More importantly, the block-size discussion resulted in a loss of trust in Bitcoin's ability to adapt, evolve, and put forward a lack of legitimacy of the decisions made without a procedural framework, once more a matter of the lack of secondary rules [14].

5.3 The DAO

The DAO[10] was a "failed experiment in algorithmic governance" intended to act as a decentralized crowdsourced investment vehicle deployed on the Ethereum blockchain [28]. In the funding phase, the DAO collected the equivalent of 150 million dollars in Ether. After the launch, a hacker drained more than 30% of the funds exploiting a vulnerability in the code. A vivid debate arose in the Ethereum community, which decided to amend the Ethereum blockchain to restore the lost funds. The much-heralded immutability of the blockchain was gone. Part of the community forked and gave birth to Ethereum Classic due to the perceived illegitimacy of the decision. In this case, meta-rules could have been adopted to regulate how the DAO was intended to operate, thereby helping to legitimize the community's decision.

[7] This is consistent with a recent quantitative study that also find the same to be true for the Ethereum and Bitcoin systems [22].

[8] From a technical perspective the increase of the block size seem to be supported by empirical research on the topic [26] A. E. Gencer, S. Basu, I. Eyal, R. van Renesse, and E. G. Sirer, "Decentralization in Bitcoin and Ethereum Networks," *arXiv preprint arXiv:1801.03998,* 2018.

[9] A full list of Bitcoin hard forks can be found here: https://www.forks.net/list/Bitcoin//1/2017-01-01/2020-01-01

[10] Decentralized Autonomous Organization

5.4 GDPR's right to be forgotten and public blockchains

One would not struggle to identify areas of friction between blockchains and the law [29-33]. For the sake of illustration, this section examines the clash between blockchains' immutability and GDPR's art. 17, rubricated right to erasure [34].

Art. 17 states that "the data subject shall have the right to obtain from the controller the erasure of personal data concerning him or her without undue delay [...]" if specific grounds apply. Let us assume that blockchains store personal data, that irreversible encryption is not feasible for all personal data[11], and that the ground rules (a) and (b) of art. 17 apply and that art. 17.3 does not. Therefore, under the GDPR, a data subject whose personal data have been stored on a blockchain has the right to obtain the erasure of her personal data. Putting aside several issues in determining the controller(s) and the processor(s), it seems that current blockchains appear inherently incompatible with the regulatory framework of the European Union [37].

Since it seems that several technical solutions to the problem exist [12], if one further assumes that the jurisdictional fragmentation of blockchains is undesirable, then, the problem becomes how blockchains can or should attempt to comply with an injunction to erase personal data. As it stands, blockchains do not have rules of recognition to comply with regulators or judicial rulings. Recognition is, again a function usually carried out by meta-rules.

It is now time to define the notion of meta-rules. Legal philosophers, namely Hart and Pagallo, provide a useful description within the domain of law which can be extended to blockchains considered as a socio-technical system of rules.

6 Secondary rules of law as meta-rules

Hart introduced the concepts of primary and secondary rules of law in the '60. However, this work draws on the recent conceptualization by Pagallo [40-42]. According to Pagallo's perspective, primary rules of law aim to govern social and individual behavior, while secondary rules of law dictate recognition, adjudication, and change.

More precisely, rules of change regulate the creation, modification, and suppression of primary rules. As explained by Pagallo secondary rules are "meta-rules by which all other rules of the system are identified and understood as valid, i.e., that which counts as valid law within that system" [41]. At one level, secondary rules include meta-rules of procedural regularity to ascertain whether a decisional process conforms to a given value, and consequently, if it is to be regarded as legitimate [53-[43].

In the legal domain, the existence of secondary rules is essential for the completeness of a system of rules, because, without them, there would be no grounds upon which one could recognize primary rules both in terms of validity and procedural regularity. Were this the case, stakeholders within a rule system with no secondary rules would be left at the whims of a hidden pool of decision-makers. More importantly, secondary rules also provide the resilience and integrity of legal systems by ensuring their ability to cope with changes and to evolve according to the demands of the society. Secondary rules of law are the core infrastructure for the governance of legal systems. Without secondary rules, stakeholders in blockchains communities are left in the dark as to what procedures and values are valid within their systems.

Blockchains that lack meta-rules on how to make on/off chain rules (a) do not escape the blockchain governance paradox (b) remain a pre-political tool, (c) make complying with judicial decisions and new regulation a daunting task, and (d) fail to deliver on the old promise of the P2P movement by fostering an opaque, techno-hierarchical governance structure.

Chiefly, secondary off-chain rules do not restrict the ability of blockchains to experiment with governance models. However, they provide the infrastructure for whichever governance model one decides to implement, for it seems that there is no one-size-fits-all solution when it comes to the landscape of blockchain systems.

Arguably, secondary rules could prevent hard-forks that stem from ex-post solution to unforeseen events by improving legitimacy, involvement, transparency, and accessibility to key decision processes.

Yet, the role of secondary rules could go as far as ensure that the social experimentation and the development brought about by blockchain technology evolves in a way that is conducive to human flourishing, enriches human interactions by opening ways of sound collaboration, and facilitates, among other things, what is morally right [45, 46].

7 Conclusion

It seems that the governance of most blockchains is missing a crucial part: meta-rules. In the legal theory, meta-rules of change, adjudication and recognition provide the infrastructure for the governance of legal systems. Therefore, they are the building blocks upon which modern governance structures are built.

As it stands, most open blockchains are primary rule systems without meta-rules, thus they cannot compete with other modes of governance. This conclusion explains the recent adoption of off-chain quasi-meta-rules by newer systems such as EOS, Decred,

[11] It is unclear how this technical workaround could operate with consideration to arbitrary data stored in blockchains such as Bitcoin and Ethereum

[12] As suggested by some research on the issue [38] G. Ateniese, B. Magri, D. Venturi, and E. Andrade, "Redactable blockchain–or–rewriting history in bitcoin and friends," in *Security and Privacy (EuroS&P), 2017 IEEE European Symposium on*, 2017, pp. 111-126: IEEE, [39] K. Rajasekhar, S. H. Yalavarthy, S. Mullapudi, and M. Gowtham, "Redactable blockchain and it's implementation in bitcoin," *International Journal of Engineering & Technology*, vol. 7, no. 1.1, pp. 401-405, 2018.

and Tezos. While the discussion of these systems of meta-rules lies beyond the scope of this work, it is a welcomed development.

A future research direction points to the study of the method and the design of meta-rules for blockchains inspired by a deliberative and iterative process in which relevant stakeholders can express their opinions. A further research avenue comprises the study of core values that blockchains should establish within secondary rules to develop in a desirable direction.

The potential of blockchains for inclusion, transparency, and improvement is palpable, yet, blockchains with no meta-rules are likely stuck and unable to fulfill their true potential.

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