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# Blockchain Technology: Toward a Decentralized Governance of Digital Platforms?

*Primavera De Filippi and Xavier Lavayssière*

## 1. Introduction

Over the past few decades, technological advances and, in particular, the development of modern information and communication technologies (ICT) have enhanced our capabilities to communicate and exchange information on a global scale. The advent of the Internet and digital technologies marked a shift from centralized communication systems (*one-to-many*) towards a more distributed and decentralized communication network (*many-to-many*), which has radically changed the way we work and organize ourselves. Originally designed as a resilient telecommunication network that could resist a nuclear attack,<sup>1</sup> the decentralized structure of the Internet has also been found to be a key requisite to ensure the scalability and flexibility of the network.<sup>2</sup>

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1 Paul Baran, *On Distributed Communications: I. Introduction to Distributed Communications Networks* (Santa Monica: Rand Corporation, 1964).

2 Manuel Castells, *The Internet Galaxy: Reflections on the Internet, Business, and Society* (Oxford: Oxford University Press, 2002).

As the Internet grew, it evolved into an open ecosystem for permissionless innovation, with a variety of new players deploying projects and initiatives that significantly disrupted the status quo.<sup>3</sup> On the one hand, the Internet provided new tools for companies and startups to experiment with innovative business models and economic practices that challenged the operations of established market players. On the other hand, it supported the emergence of commons-based communities relying on alternative legal regimes and new participatory models to promote openness and distributed collaboration.

Over time, as the Internet gained mainstream adoption, some companies and corporations established themselves as dominant players in this emergent ecosystem. While the building blocks of the Internet still consist, for the most part, of open and standardized protocols (e.g., TCP/IP, HTTP, SMTP) and open source software projects (e.g., Firefox, Linux, Apache, MySQL), services built on top of these protocols are mostly made up of centralized platforms and proprietary applications. Today, a few large online operators (e.g., Google, Facebook, Amazon) effectively dominate the Internet landscape by controlling the key online infrastructures through which users and companies interact with the network.

More recently, a new technology has emerged, together with a whole new set of promises for decentralization and disintermediation. By combining peer-to-peer technologies, game theory, and cryptographic primitives, blockchain technology<sup>4</sup>

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3 Clark Gilbert, "The Disruption Opportunity," *MIT Sloan Management Review* 44, no. 4 (2003): 27–33.

4 Blockchain technology refers to a broader category of technologies (sometimes referred to as Distributed Ledger Technologies) that rely on a distributed ledger or database running on top of a peer-to-peer network. Following a particular protocol, nodes in the network can record transactions into a data structure (commonly, a series of data "blocks" which are linked to each other through cryptographic references forming a "chain"). The integrity of these transactional records is secured through cryptographic primitives and economic incentives designed to guarantee the tamper-resistance of the networked database. As a general rule, the technology can be used both for the deployment of public and open net-

makes it possible for people to experiment with new forms of peer-production and decentralized collaboration. Just as the Internet enabled users to communicate on a peer-to-peer basis, bypassing traditional intermediaries, Bitcoin and other blockchain-based applications enable users to exchange value directly with one another, relying on economic models and incentivization schemes that do not require the intervention of any trusted authority or intermediary middleman.

Yet, despite its promise to establish a more decentralized society with a novel economic order,<sup>5</sup> many of the blockchain-based networks or applications implemented thus far ultimately rely on market dynamics and economic incentives for distributed coordination. Indeed, consensus, in a large majority of existing blockchain-based networks, is established — at the protocol level — through a combination of code-based rules and game theoretical mechanisms that ultimately replicate the current economic order. This type of *governance by the infrastructure* has already shown its shortcomings, especially when it comes to promoting or preserving decentralization, mostly due to its inability to account for external political and economic forces that exist outside of a blockchain-based platform. We claim that, in order to ensure that these platforms cannot be co-opted by these external forces, a more comprehensive governance model must be elaborated — one that extends beyond the realm of pure algorithmically verifiable actions, and that supports or facilitates the *governance of the infrastructure*.

After providing a general overview of how the decentralized nature of the Internet enabled different models of innovation to emerge — in terms of both market-driven innovation (2.a) and distributed commons-based collaboration (2.b) — we will look

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works (public blockchains) or for the creation of networks that are made available only to a restricted number of participants (permissioned blockchains). We will focus here on the former category of blockchains, insofar as they constitute a more relevant platform for permissionless innovation and peer-to-peer coordination.

- 5 Marcella Atzori, “Blockchain Technology and Decentralized Governance: Is the State Still Necessary?” *SSRN* (January 2, 2016).

at the potential for blockchain technology to incentivize new forms of decentralized collaboration (3.a) and to enable new distributed governance models (3.b). Finally, we will conclude by focusing on how the characteristics of blockchain-based platforms may benefit existing commons-based projects and initiatives, by providing new and more sustainable economic schemes (4.a) while ensuring a greater degree of control over shared digital platforms (4.b). Our thesis is that a carefully designed integration of blockchain technology with the operations of various commons-based initiatives — and in particular those related to the notions of the *sharing economy*<sup>6</sup> and *platform cooperativism*<sup>7</sup> — could significantly contribute to improving the governance and long-term sustainability of these projects. This could potentially lead to the establishment of a collaborative economy characterized by direct interactions among a disparate network of peers, without the need to rely on any trusted authority or intermediary middleman.

## 2. Internet and Permissionless Innovation

The advent of the Internet and digital technology marked the beginning of a digital revolution that led to significant social, economic, and cultural changes in modern societies. At the outset, the development of early Internet protocols was, for the most part, publicly funded through governmental initiatives, military projects and academic research.<sup>8</sup> Yet, the disruption brought about by the widespread deployment of the Internet network has been shaped by two different, yet interrelated, driving forces. On the one hand, a large variety of new companies and startups have been launched with a view to challenging the status quo, disrupting existing institutions and former incum-

6 Danielle Sacks, “The Sharing Economy,” *Fast Company* 155 (May 2011): 88–93.

7 Trebor Scholz, *Platform Cooperativism: Challenging the Corporate Sharing Economy* (New York: Rosa Luxemburg Stiftung, 2016).

8 David D. Clark, “The Design Philosophy of the DARPA Internet Protocols,” *ACM SIGCOMM Computer Communication Review* 18, no. 4 (1988): 106–14.

bents by using innovative services and novel business models. On the other hand, a series of commons-based initiatives has leveraged the power of this global communication network to build open ecosystems of distributed collaboration. Not only have some of these initiatives succeeded in challenging the status quo, they also inaugurated an entirely new paradigm of social organization based on peer-to-peer production and distributed collaboration.<sup>9</sup>

### *2.a Market-Driven Innovation*

The Internet and modern information and telecommunication technologies have contributed to a significant shift in economic power from traditional “brick and mortar” to new companies that operate, almost exclusively, online. As a global infrastructure that comprises a series of open and standardized protocols, the Internet makes it possible for anyone to innovate on a worldwide digital platform without having to ask for permission from anyone.<sup>10</sup> New market players have been leveraging this new platform for “permissionless innovation,”<sup>11</sup> experimenting with new business models and managerial practices<sup>12</sup> that challenge the operations of traditional and more rigid incumbents.

Many Internet startups rely on specific business models designed to leverage network effects, gathering large user-bases by offering free, freemium, or low-cost services that often do not cover the costs of providing these services. In order to grow rapidly, these startups need to raise capital, often relying on competitive strategies and exclusionary practices in order to

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9 Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven: Yale University Press, 2006).

10 Adam Thierer, *Permissionless Innovation: The Continuing Case for Comprehensive Technological Freedom* (Macon: Mercatus Center at George Mason University, 2016).

11 Vinton G. Cerf, “Dynamics of Disruptive Innovations,” *Journal on Telecommunications and High Technology Law* 10 (2012): 21–31, at 21.

12 See, e.g., the “lean startup” methodology adopted by many early-stage Internet companies: Steve Blank, “Why the Lean Start-up Changes Everything,” *Harvard Business Review* 91, no. 5 (2013): 63–72.

demonstrate their business model to investors. For instance, intellectual property (including patents and proprietary software) has often been weaponized to raise barriers to entry and undercut competition.<sup>13</sup> Moreover, because of the proprietary nature of these platforms — with limited interoperability and data portability — users find themselves locked into walled gardens, unable to shift from one platform to another without losing access their own data<sup>14</sup> or incurring other switching costs<sup>15</sup>. Finally, and perhaps most importantly, if many online platforms do not monetize their services directly by requiring users to pay a fee to access the platform, they do so indirectly, by monetizing their user-base through more personalized and targeted advertising campaigns.<sup>16</sup> With the emergence of increasingly large datasets, the development of new data-mining techniques, and the use of machine learning, the concentration of information into a few data centers controlled by a small number of large corporations has become a critical issue, jeopardizing privacy, individual autonomy, and, ultimately, competition.

Major players, such as Google and Twitter, are attempting to recreate an ecosystem for open innovation, by releasing open source libraries and APIs for third parties to build applications on top of their own platforms.<sup>17</sup> Yet, while this opens new pos-

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13 Amar Bhidé, “The Venturesome Economy: How Innovation Sustains Prosperity in a More Connected World,” *Journal of Applied Corporate Finance* 21, no. 1 (2009): 8–23.

14 Salil K. Mehra, “Paradise Is a Walled Garden? Trust, Antitrust and User Dynamism,” *George Mason Law Review* 18 (2011): 889–952.

15 For instance, while some platforms might provide a mechanism for users to retrieve their data, data portability might nonetheless be limited because of a lack of standardization in data formats. See Janis Wong and Tristan Henderson, “The Right to Data Portability in Practice: Exploring the Implications of the Technologically Neutral GDPR,” *International Data Privacy Law* 9, no. 3 (2019): 173–91.

16 As popularly put by Andrew Lewis, “if you are not paying for it, you are not the customer, you are the product being sold” (comment to “User-driven Discontent,” *MetaFilter*, August 26, 2010, <http://www.metafilter.com/95152/Userdriven-discontent#3256046>).

17 Robert Bodle, “Regimes of Sharing: Open APIs, Interoperability, and Facebook,” *Information, Communication and Society* 14, no. 3 (2011): 320–37.

sibilities for small players to enter into the market, these online operators ultimately seek to reinforce their dominant position by encouraging companies and developers to deploy new services or applications onto their platforms.

Similar issues lie at the core of the new “crowdsourcing” practices adopted by platforms such as Facebook, YouTube, Uber, and Airbnb. This new model of distributed production creates incentives for users to contribute value (e.g., by creating content or pooling their resources into a network) for the ultimate benefit of the platform operators. Under this model, users are not just passive consumers but rather become active contributors to a third-party platform. For instance, most of the content available on social networks such as Facebook or Twitter is not produced by platform operators but rather by companies and individuals interacting on top of these platforms. Operators rely on the production of their user base in order to offer a valuable service to the public at large. However, despite the significant value they provide to the platform, users are generally not remunerated for their contributions,<sup>18</sup> nor are they granted any kind of control or governance rights over the manner in which the platform will operate and evolve. On the contrary, because of the network effects inherent in these services, these platforms have grown increasingly centralized, with a few operators in charge of coordinating the contributions and activities of a large number of individual users. These operators are responsible for matching offer and demand (e.g., buyers and sellers, content producers and consumers), often collecting a rent — in the form of user data or a monetary fee — for every transaction

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18 One notable exception is video sharing networks such as YouTube, where popular creators can gain revenues, which could be partially explained by the costs associated with video production. Still, the model nonetheless relies on an asymmetric relationship between content creators and platform operators. For more details, see Sonia Y. Song and Steven. S. Wildman, “Evolution of Strategy and Commercial Relationships for Social Media Platforms: The Case of YouTube,” in *Handbook of Social Media Management*, eds. Mike Friedrichsen and Wolfgang Muhl-Benninghaus (Berlin and Heidelberg: Springer, 2013), 619–32.



they intermediate. Hence, this new model of production — often referred to via the misnomer of the *sharing* or *collaborative economy*<sup>19</sup> — has not significantly contributed to the establishment of a new economic order. Rather, it has turned out to be an even stronger instantiation of the capitalist mindset.<sup>20</sup>

### 2.b: Commons-Based Innovation

At the same time, a different kind of innovation has been taking place over the Internet, leveraging the new opportunities provided by this global communication network in order to create new platforms and applications, which are also meant to disrupt the status quo, albeit with a slightly different approach. Initiatives like GNU/Linux, the Apache HTTP server, and many other open source software projects were developed by a community of researchers and software engineers with the intention of creating a pool of shared resources that could complement or even replace some of the dominant proprietary platforms at the time. The same is true for large collaborative online projects, such as Wikipedia, OpenStreetMap, or other crowd-sourcing projects<sup>21</sup> designed to create a common and shared resource that remains available to all.

Commons-based innovation is concerned with maximizing the utility of software applications and online platforms built and operated by the community and for the community. Rather than trying to undercut the monopoly rents collected by dominant market players, these initiatives leverage the power of digital technologies to promote peer-to-peer collaboration through the creation of platforms and tools designed to further the needs

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19 Sacks, “The Sharing Economy.”

20 Chris J. Martin, “The Sharing Economy: A Pathway to Sustainability or a Nightmarish Form of Neoliberal Capitalism?” *Ecological Economics* 121 (2016): 149–59.

21 Planetary astronomy, for instance, increasingly relies on information provided by large number of amateurs cooperating online. See O. Mousis et al., “Instrumental Methods for Professional and Amateur Collaborations in Planetary Astronomy,” *Experimental Astronomy* 38, nos. 1–2 (2014): 91–191.

of specific communities and the public at large. As opposed to most of the market-driven initiatives described above, this new form of innovation — sometimes described as *commons-based peer-production*<sup>22</sup> — operates according to a more open and cooperative approach, which is grounded on the principles of free and open source software.<sup>23</sup> In particular, in an endeavor to reduce the effects of monopoly rents on information established by intellectual property laws, and to ensure that information remains a common good accessible to all, early commons-based communities have elaborated new legal means of innovation, including free and open source licenses for software (see e.g., GNU General Public License, MIT License, BSD License, etc) and a suite of Creative Commons licenses<sup>24</sup> for creative works. The resources released under these licenses are not the exclusive property of one specific actor or intermediary operator. Rather, they are shared resources which are held in common by all community members and made available to the public at large.

While most commons-based initiatives are born out of grassroots community efforts,<sup>25</sup> some initiatives stem from the efforts of an industry's collective action<sup>26</sup> or of single privately-held

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22 Benkler, *The Wealth of Networks*.

23 Eric S. Raymond, "The Cathedral and the Bazaar," *Philosophy & Technology* 12, no. 3 (1999): 23–32.

24 Creative Commons licenses are public copyright license, inspired from the Free and Open Source software licences, that enable the free distribution and reproduction of creative works, under specific conditions. They constitute a shift from the "all right reserved" default of copyright law, towards a more permissive regime of "certain rights reserved". For more details, see Lawrence Lessig, *Free Culture* (New York: Penguin Press, 2004).

25 See, e.g., the Apache HTTP server project, initiated by a collective of webmasters: Audris Mockus, Roy T. Fielding, and James D. Herbsleb, "Two Case Studies of Open Source Software Development: Apache and Mozilla," *ACM Transactions on Software Engineering and Methodology (TOSEM)* 11, no. 3 (2003): 309–46.

26 The Genivi Alliance, for instance, was founded in 2009 by BMW Group, Delphi, GM, Intel, Magneti-Marelli, PSA Peugeot Citroën, and Visteon in order to build open source infotainment software for vehicles.

companies.<sup>27</sup> Most community-driven initiatives are initially stewarded by one or more charismatic leaders<sup>28</sup> who establish the overall vision and *modus operandi* of the initiative, along with a small group of core contributors responsible for bootstrapping the project. It is only at a later stage of development — once a larger community has grown around the initiative — that the development and maintenance of these commons-based projects requires a more formalized and inclusive governance structure to manage the contributions of a large and distributed network of peers collaborating towards the production of a common resource. In the case of leading projects — such as GNU/Linux or the Apache HTTP server — which attract considerable interest from the industry, or in the case of projects initiated by private companies — such as ZEA partners or MySQL — a foundation is sometimes created around the project in order to receive and manage sponsorship or other forms of revenue with generally limited control over the development process.<sup>29</sup>

Indeed, as a general rule, the governance of commons-based communities is more open and participatory than that of many Internet startups, as the leaders or managers of commons-based initiatives only enjoy as much power as the community gives them. Specifically, the governance structure adopted by most of these initiatives has a strong meritocratic flavor, whereby those who contribute the most to the community are given the op-

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27 For instance, MySQL was originated by the privately held MySQL AB Swedish company, whereas the Mozilla web browser emerged following the open source licensing of the Netscape browser's code. See Frank Hecker, "Setting Up Shop: The Business of Open-Source Software," *IEEE Software* (January–February 1998): 45–51; Eric von Hippel and Georg von Krogh, "Open Source Software and the 'Private-Collective' Innovation Model: Issues for Organization Science," *Organization Science* 14, no. 2 (2003): 209–23.

28 These charismatic leaders are sometimes described as "benevolent dictators": Jan Ljungberg, "Open Source Movements as a Model for Organising," *European Journal of Information Systems* 9, no. 4 (2000): 208–16 — such as Richard Stallman for the GNU project or Linus Torvald for the Linux kernel.

29 Paul B. De Laat, "Governance of Open Source Software: State of the Art," *Journal of Management & Governance* 11, no. 2 (2007): 165–77.

portunity to participate in the governance thereof. And if the managers were to abuse their powers or simply lead the project in a direction that is not in the best interests of the community, the community could simply “fork” the project into an alternative community operated according to different rules.<sup>30</sup>

Perhaps one of the biggest differences between market-driven and commons-based innovation lies in the economic models that underpin the two. While the former is mainly driven by the logic of profit maximization, the latter is driven by a combination of ideological values, a desire to maximize the utility of the products or services provided to the community and an expectation of individual returns or compensation (financial or otherwise). Nevertheless, although profits are not the main drivers for a large majority of commons-based initiatives, the ability to raise money and attract human resources remains an important precondition for their long-term sustainability. In that regard, many open source software projects secure funding through donations, and sometimes manage to earn a substantial amount of funds with related activities, such as product customization and support (e.g., RedHat), consulting (e.g., IBM), or connected cloud services (e.g., Wordpress). Software developers and engineers are also incentivized to contribute to these projects as a result of the informal benefits they might acquire through cooperation,<sup>31</sup> including new skills and visibility that may greatly enhance their position on the job market.

There are, however, many limitations to an open source approach. In particular, despite the relative success of the open source community and the predominance of open source software projects in the lower protocol layers of the Internet stack, commons-based peer-production suffers from a general lack of incentives and difficulty in coordination. First and

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30 Such a fork, the reuse of code or content into a new project, is generally perceived as a healthy and intended process that enables people to build upon and adapt code to a different purpose, and has already happened in several open source communities and software projects; see, e.g., OpenOffice/LibreOffice, Debian/Ubuntu/Mint Linux, XFree86/XOrg.

31 Raymond, “The Cathedral and the Bazaar.”

foremost, because of the open and non-proprietary character of these platforms, most of these initiatives are unable to raise funds from venture-capital firms and other sources. As a result, these projects are often under-funded, especially in their initial phases. Because of the lower economic incentives they provide, they sometimes do not manage to attract a sufficient number of contributors, in contrast to their more commercial and profit-driven counterparts. Secondly, even the most successful projects that have acquired mainstream adoption (e.g., GNU/Linux, Apache, Mozilla Firefox, etc.) suffer from the additional complexity of managing and coordinating a distributed network of contributors.

### 3. Blockchains and Distributed Coordination

Just as was the case with the Internet in the early 1990s, with the advent of Bitcoin in 2009, blockchain technologies have spurred a new wave of permissionless innovation and experimentation. The combination of existing technologies (including decentralized peer-to-peer networks and cryptographic primitives such as public-private key cryptography and cryptographic hash functions) has given rise to a new decentralized infrastructure for secure peer-to-peer transactions and distributed coordination.

As such, blockchain-based platforms are perceived by some to be a way to further the ideals of freedom and autonomy that the Internet ultimately failed to promote.<sup>32</sup> In light of the principles of decentralization and disintermediation that underpin the design of blockchain-based networks, a number of engineers, computer scientists, and entrepreneurs have begun to experiment with these new technologies, eager to implement decentralized applications that would operate, to a large extent, autonomously. Indeed, as opposed to traditional online platforms, administered by centralized operators or trusted authorities, Bitcoin and other blockchain-based applications operate in

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32 Atzori, "Blockchain Technology and Decentralized Governance."

a more distributed manner, independently of any government or middlemen,<sup>33</sup> through a combination of novel incentivization schemes and distributed governance models. And because they are administered by a large number of peers located all over the globe, they are generally less affected by jurisdictional constraints than are their centralized counterparts.<sup>34</sup>

### 3.a Novel Incentivization Schemes

Born in the midst of the financial crisis of 2008, Bitcoin was the first decentralized payment system and virtual currency implemented on top of a blockchain-based network. The network was carefully designed to secure the scarcity of digital assets—the Bitcoin cryptocurrency—without relying on any trusted authority or centralized clearinghouse.<sup>35</sup>

Bitcoin was originally conceived by a pseudonymous entity, Satoshi Nakamoto, out of a desire to circumvent existing institutions—such as banks and other governmental institutions—which were seen as failing to protect the interests of regular citizens.<sup>36</sup> Most of the early Bitcoin adopters shared similar ideals, identifying themselves as “cypherpunks”<sup>37</sup> or as part of a specific breed of anarchism or libertarianism known as “crypto-anarchists” or “crypto-libertarians.”<sup>38</sup>

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33 Joseph Bonneau, Andrew Miller, Jeremy Clark, Arvind Narayanan, Joshua A. Kroll, and Edward W. Felten, “SoK: Research Perspectives and Challenges for Bitcoin and Cryptocurrencies,” *2015 IEEE Symposium on Security and Privacy (SP)* (2015): 104.

34 Primavera De Filippi, “Bitcoin: A Regulatory Nightmare to a Libertarian Dream,” *Internet Policy Review* 3, no. 2 (2014).

35 Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System* (2008), <http://www.bitcoin.org/bitcoin.pdf>.

36 The first block of the Bitcoin blockchain contains the following quote: “The Times 03/Jan/2009 Chancellor on brink of second bailout for banks,” possibly as an attempt to comment on the risks caused by fractional-reserve banking.

37 Jeremiah Bohr and Masooda M. Bashir, “Who Uses Bitcoin? An Exploration of the Bitcoin Community,” *2014 IEEE Twelfth Annual International Conference on Privacy, Security and Trust (PST)* (2014): 94–101.

38 Henrik Karlström, “Do Libertarians Dream of Electric Coins? The Material Embeddedness of Bitcoin,” *Distinktion: Scandinavian Journal of Social*

Of course, despite the strong ideology surrounding the Bitcoin project, a significant number of people were motivated by more pragmatic reasons—trying to benefit from lower transactions costs for international transfers and reduced regulatory or corporate control over money transmission. But what really caused the system to take off and reach a much broader audience were the immediate gains provided by Bitcoin and other cryptocurrencies. The rapid increase in the value of these virtual currencies—whose price has increased, in the course of a few years, from a few dollar cents to hundreds or thousands of dollars<sup>39</sup>—has attracted new market players, including large corporations, startup entrepreneurs, speculators and “mining pools.”<sup>40</sup> Mining operations, in particular, scaled from a hobby to large corporations investing in specialized equipment (e.g., ASIC computers<sup>41</sup>) and facilities to support the operations of

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*Theory* 15, no. 1 (2014): 23–46.

- 39 In 2010, two pizzas were bought for 10,000 bitcoins, worth around than \$40 at the time; whereas as of August 2017, one Bitcoin was valued above \$4,000. Similarly, Ether, the native cryptocurrency on the Ethereum network was initially valued at \$0.25 and was valued above \$300 in August 2017.
- 40 A miner is a network node that not only verifies the validity of transactions executed on a blockchain-based network but also aggregates them into a “block” of transactions that will be append to the existing blockchain. On Proof-of-Work networks (such as Bitcoin and Ethereum), the mining process is used as a mechanism to ensure that no-one can coopt the network, unless they control more than 50% of the overall computational power of the network. Indeed, before publishing a block to the blockchain, miners need to find the solution to a cryptographic puzzle that requires a large amount of computational resources to solve, but that is relatively straightforward to verify, once found. Whenever a new block is published to the network, the miner of that block is rewarded with a fixed allotment of bitcoins, which halves every four years (today, the block reward amounts to 12.5 bitcoins per block). Miners are thus competing with each other, in order to be the first to find the solution to this cryptographic puzzle, and consequently to acquire the newly minted bitcoins associated with that block.
- 41 ASICs (Application-Specific Integrated Circuit Chip) are microchips specifically designed to perform a task, in this context, the hashing algorithm needed to successfully mine blocks on a Proof-of-Work blockchain.

these blockchain-based networks, receiving fixed allotments of virtual currency — the so-called *block reward* — in return.<sup>42</sup>

More recently, a few projects and initiatives have experimented with a new way of raising funds by selling blockchain-based tokens to the public at large. This practice — commonly referred to as a “token sale” or “Initial Coin Offering” (ICO) — has acquired considerable popularity in the last few years, reaching a cumulative investment of over 30 billion USD by the end of 2020.<sup>43</sup> The advantage of the ICO approach over the more traditional equity-based fundraising models is that it makes it possible for teams to raise funds without diluting control over a company or organization (as would normally happen through the sale of equity or shares). These new fundraising techniques make it possible to tap into a large pool of non-accredited investors who would not otherwise be able to invest in such early stage projects for both practical<sup>44</sup> and legal reasons.<sup>45</sup>

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42 Whenever a block is published to the network, along with the solution to the cryptographic puzzle associated with that block, a fixed amount of cryptocurrency is created and attributed to the address of the miner of that block. Miners also collect the fees of each transaction included into the block.

43 Shadi Samieifar and Dirk G. Baur. “Read Me If You Can! An Analysis of ICO White Papers.” *Finance Research Letters* (2020): 101427. N.B., this number might be difficult to evaluate as many ICOs management teams inflate their results for marketing purposes while other ICOs are not reported.

44 In addition to the obvious barriers to entry concerning the availability of funds, substantial complexity is involved in the process of deal-matching according to specific investment criteria, and the negotiation of acceptable investment terms. See Colin M. Mason and Richard T. Harrison, “Barriers to Investment in the Informal Venture Capital Sector,” *Entrepreneurship & Regional Development* 14, no. 3 (2002): 271–87.

45 In the US for instance, under the Securities Act of 1933, a company that wants to issue securities to the public must register with the US Securities and Exchange Commission (SEC). An exception is introduced in Rule 501 of Regulation D, which allows for the sale of unregistered securities to accredited investors, who are considered able to bear the economic risk of investing in these securities.



The caveat is that the legal uncertainty surrounding these token sales<sup>46</sup> created a high degree of legal uncertainty — both for token issuers, who might be found liable for the infringement of specific rules or regulations<sup>47</sup> — and for investors, who might fall into an unregulated ecosystem full of dubious projects and claims.<sup>48</sup> However, legal clarity has improved over time through law enforcement<sup>49</sup> and the enactment of new legal frameworks<sup>50</sup>. Besides, the volatility in the market price of these virtual currencies — some of which witnessed a value increase of over 10x in the period of just a the space of few months<sup>51</sup> — has attracted a

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46 Token issuers might market these tokens in different ways, such as: “utility tokens,” “asset-based tokens,” “membership tokens,” etc. Yet, regardless of the way they are defined by the token issuers, these tokens might be construed as different asset classes under different bodies of law. See, for the instance, the report of the SEC on the legal qualification of the DAO tokens as securities, available at <https://www.sec.gov/litigation/investreport/34-81207.pdf>.

47 In China, for instance, following the ban on tokens sales by the People’s Bank of China (see notice of April 9, 2017 available at <http://www.pbc.gov.cn/goutongjiaoliu/113456/113469/3374222/index.html>), several projects had to cancel or halt their operations. Similarly, following the issuance of the SEC report concerning the legal qualification of the DAO tokens (cf. *supra*), the Protostarr project was contacted by the SEC for an investigation of an alleged case of unregistered securities issuance. After consultation with multiple lawyers, the team decided to cease further operations and to refund all Ether collected to the original investors.

48 While these token sales represent a new opportunity for projects or initiatives to raise the necessary capital to bootstrap themselves, they often operate in a regulatory gray area. While there are important benefits to the ability for non-accredited investors to participate in the economy of these projects, there are also significant concerns to the extent that unsophisticated retail investors run the risk of being defrauded or harmed by these highly risky and speculative instruments.

49 E.g., in the US, *Securities and Exchange Commission v. Telegram Group Inc. et al*, 19-cv-09439-PKC (S.D.N.Y. Oct 11, 2019).

50 E.g., in France, Loi n° 2019-486 du 22 mai 2019 relative à la croissance et la transformation des entreprises, available at <https://www.legifrance.gouv.fr/eli/loi/2019/5/22/2019-486/jo/texte>.

51 The value of cryptocurrencies has increased dramatically during the year of 2017. For instance, Bitcoin’s value went from \$1,200 in April 2017 to up to \$4,800 in September 2017; Ethereum went from being worth less than \$100 in May 2017 to being worth over \$400 in June 2017; Ripple went from

large number of investors, traders, and speculators, who entered the game with an expectation of immediate returns, through a series of high-risk, high-profit investments. Most of these investors are not interested in the products or services associated with these tokens; they are merely speculating on the future value of the tokens, acquiring them for the sole purpose of subsequently reselling them on the market at a much higher price.

Blockchain technology thus provides new avenues for traditional market players, startups and commons-based initiatives to access new forms of capital and to engage in a variety of profit-making activities. Yet, in spite of the new opportunities it might provide to small players, a large part of the blockchain ecosystem — as it stands today — is an instantiation of a free-market economy built around game theoretical incentives and speculative dynamics, and devoid of any form of regulation or consumer protection. Besides, looking at how the blockchain ecosystem has evolved over the past few years, we witness an increasing number of financial institutions (including banks, investment firms, and insurance companies), a variety of large companies, firms, and corporations (such as Microsoft, IBM, and Samsung, amongst others) entering the space and leveraging the power of blockchain technology to further their own financial interests.

### *3.b Governance of Blockchain-Based Networks*

The decentralization inherent in the design of most blockchain-based networks is a crucial element of disintermediation, which, however, also makes it more difficult to govern or regulate these platforms. By relying on the notion of “distributed consensus” as a new mechanism of distributed coordination, blockchain technology makes it possible to coordinate a large number of contributors without passing through a centralized intermediary or middleman. Yet, without any intermediary operator in charge of managing and administering the network, it becomes crucial to

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\$0.03 in April 2017 to \$0.4 in May 2017; Litecoin went from \$10 in April 2017 to over \$80 in September 2017.

identify and analyze the different governance structures that can be (and have been) deployed on top of these distributed infrastructures and to examine how these can contribute to ensuring their resiliency and long-term sustainability.

The governance of blockchain-based networks can be distinguished into two different but interrelated categories: *on-chain* governance or *off-chain* governance. The former is done by encoding specific governance rules directly into the protocol that governs a particular blockchain-based network, so that these rules are automatically enforced by the technology itself (*governance by the infrastructure*). The latter is done by establishing a procedure for decision-making that operates outside of the network protocol (*governance of the infrastructure*).

At the protocol level, most blockchain-based networks have adopted a governance structure that relies on a combination of market-driven mechanisms and consensus protocols. In protocols that follow the Nakamoto consensus<sup>52</sup> the influence of each member of the network ultimately depends on their level of investment in a particular set of resources. This is the case, for instance, of the Proof-of-Work mechanism<sup>53</sup> adopted by Bitcoin and Ethereum, where decisions regarding the next block to be included into the chain are based on the quantity of computing power invested into the network, or the Proof-of-Stake mechanism adopted by other blockchain-based networks such as Peercoin or NXT, where voting power is based on the quantity of tokens held by a particular agent.<sup>54</sup> Network participants can

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52 Chenxing Li, Peilun Li, Dong Zhou, Wei Xu, Fan Long, Andrew Yao, “Scaling Nakamoto Consensus to Thousands of Transactions per Second.” *arXiv* preprint arXiv:1805.03870 (2018).

53 Nakamoto, *Bitcoin*.

54 In both types of blockchains, miners produce blocks and submit them to the network, which — after ensuring the validity of each block — will append them to the existing chain of blocks. Yet, not everyone is entitled to submit a new block to a blockchain-based network. The protocol is such that whoever is entitled to submit the next block will be determined according to either the amount of computing power they each have invested into the network (Proof-of-Work) or the number of tokens they hold (Proof-of-Stake).

also exercise a certain degree of decision-making power by accepting only (or rejecting) blocks that meet (or do not meet) certain criteria.<sup>55</sup>

A similar type of plutocratic governance can also be observed in the models adopted by a large number of blockchain-based applications — such as, most notably, the decentralized investment fund known as the DAO,<sup>56</sup> whose governance is structured around the number of tokens that each individual holds. Some blockchain-based networks — such as, for instance, Tezos<sup>57</sup> and Dfinity<sup>58</sup> — even went as far as implementing specific *on-chain* governance mechanisms allowing for token holders to vote for changes on the protocol of the blockchain itself.

Such a market-driven approach to governance makes sense — at least theoretically — because free market logics are, indeed, a powerful mechanism of indirect coordination that operate in accordance with the blockchain's logics of rough “distributed consensus” The game-theoretical models implemented

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55 While only miners have the ability to forge and publish blocks to the network, full-node operators can also participate in specific on-chain voting mechanisms, e.g., by committing only to accept a specific type of blocks. Such a technique was used in 2017 to enable a user-activated Soft Fork of the Bitcoin blockchain, leading to the adoption of the SegWit improvement proposal.

56 Muhammad Mehar, Charlie Shier, Alana Giambattista, Elgar Gong, Gabrielle Fletcher, Ryan Sanayhie, Henry Kim, and Marek Laskowski, “Understanding a Revolutionary and Flawed Grand Experiment in Blockchain: The DAO Attack,” *Journal of Cases on Information Technology* 21, no. 1 (2017): 19–32.

57 Tezos is a new decentralized blockchain that governs itself by establishing a true digital commonwealth — i.e., a group of people that chooses to be linked together because of their shared goals and interests. Tezos aims to have their token holders make decisions together to govern the platform and improve it over time. For more details, see <http://www.tezos.com>.

58 Dfinity is a blockchain protocol designed to enable decentralized networks to host high performance virtual computers of infinite capacity, with the aim of creating a “decentralized cloud” where smart contract software can be used to recreate a wide variety of systems. In contrast to other blockchain, Dfinity introduces the fundamental difference of governance by a novel decentralized decision-making system called the “Blockchain Nervous System” (or “BNS”). For more details, see <http://dfinity.org>.

into a blockchain protocol are of a strongly market-driven individualistic nature, as every individual is expected to behave in a rational manner in order to maximize individual utility and economic returns. Yet, these protocols rarely account for the fact that the ideal of a perfectly competitive market remains just an ideal; and that, in practice, markets can be easily manipulated by powerful actors, leading to collusion and market concentration.<sup>59</sup> Similarly, when left to the invisible hand of the market, blockchain-based applications are likely to evolve into increasingly centralized platforms, with the emergence of new intermediary operators and new potential incumbents.

Of course, not every rule and procedure can be transposed into a formal language and encoded into a set of protocol rules. Even where there is a formalized governance system implemented within the protocol of particular blockchain-based applications, there is always a point at which one needs to move away from the protocol in order to decide upon something that had not been accounted for within the protocol itself. For most blockchain-based networks, any decision regarding possible changes to the network's protocol has to be taken through an external decision-making process. Because most existing blockchain-based networks do not implement any formalized mechanism for *off-chain* governance, the process is generally done informally, in an ad-hoc manner. As a result, invisible powers emerge,<sup>60</sup> with decisions being made by a small handful of people with strong technical expertise, market power or charisma.<sup>61</sup>

In the case of Bitcoin, for instance, the long-standing scaling debate was dominated by a few software engineers and tech-

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59 Georg J. Stigler, *The Organization of Industry* (Homewood: Irwin, 1968).

60 Primavera De Filippi and Benjamin Loveluck, "The Invisible Politics of Bitcoin: Governance Crisis of a Decentralized Infrastructure," *Internet Policy Review* 5, no. 3 (2016): 1–32.

61 Philipp Hacker, "Corporate Governance for Complex Cryptocurrencies? A Framework for Stability and Decision Making in Blockchain-Based Monetary Systems," in *Regulating Blockchain: Techno-Social and Legal Challenges*, eds. Philipp Hacker, Ioannis Lianos, Georgios Dimitropoulos, and Stefan Eich (Oxford: Oxford University Press, 2019), 140–66.

savvy individuals proposing alternative implementations and possible protocol changes to the underlying blockchain-based network.<sup>62</sup> Prominent figures in the debate also included a small number of highly influential individuals with strong visibility within the community, as well as several miners and mining-pools, which incurred substantial investments in specialized hardware devices for the mining of Bitcoin.<sup>63</sup>

Similarly, following the loss of over \$50 million USD due to a vulnerability in the code of the DAO,<sup>64</sup> the Ethereum community had to take coordinated action to decide whether—and how—to fork the Ethereum network (i.e., whether or not to update its underlying protocol) in order to recover the funds. Yet, due to the lack of a formalized governance structure within the Ethereum community, it took several weeks for the community to agree on a coordinated course of action.<sup>65</sup> Ultimately, as it

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62 Because the Bitcoin protocol only supports a limited number of transactions per block, increasing the scalability of the network ultimately requires a change in the protocol. The issue generated a long and heated debate (the so-called *scaling debate*), with different groups fighting over what would be the best way to allow for the Bitcoin network to process more transactions per second. Proposed solutions were to either increase the maximal size of a block or to provide new ways for a larger number of transactions to be settled into a block. In August 2017, inability to reach consensus as to the possible solutions to scalability resulted in a fork of the Bitcoin network into two separate networks: one increasing the block size limit from 1 to 8 MB (Bitcoin Cash) and the other implementing changes in the protocol to support scalability solutions such as the Lightning Network (through Segregated Witness modification). While the latter received vast support both before and after the fork, the Bitcoin scaling debate is, today, still an ongoing debate.

63 De Filippi and Loveluck, “The Invisible Politics of Bitcoin.”

64 Shier et al., “Understanding a Revolutionary and Flawed Grand Experiment in Blockchain.”

65 Quinn DuPont, “Experiments in Algorithmic Governance: A History and Ethnography of ‘The DAO,’ A Failed Decentralized Autonomous Organization,” in *Bitcoin and Beyond (Open Access): Cryptocurrencies, Blockchains and Global Governance*, ed. Malcolm Campbell-Verduyn (London: Routledge, 2017), 157–77. Some actors from the Ethereum community attempted to gauge public opinion through a series of debates and discussions on online forums and social networks, largely led by the most prominent blockchain architects, software developers and early adopter in

became increasingly clear that the general consensus within the broader Ethereum community had converged towards the fork,<sup>66</sup> a new client was released with the relevant protocol changes and a specific activation schedule for the protocol change. While the fork was ultimately successful, the decision created significant controversy within the Ethereum community, which eventually led to the creation of an alternative version of the Ethereum network (*Ethereum Classic*) that still persists today.

These are just two examples of the difficulties encountered in the context of many blockchain-based networks when it comes to reaching consensus on issues related to changing the protocol or the infrastructure of these networks. Given the lack of a formalized governance structure, off-chain governance is generally much harder to achieve in a decentralized system than it is in the context of standard hierarchical systems. Moreover, because there are no formalized decision-making procedures in place, the system can easily be co-opted by established powers operating “behind the scenes.”<sup>67</sup> As a result, there is often no transparency as to how decisions are made and little accountability as to who is responsible for their implementation.<sup>68</sup>

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the Ethereum ecosystem. Others tried to refine their understanding about the degree of community support for the fork proposal via a more formal procedure mediated by an ad-hoc voting platform (CarbonVote) enabling Ethereum users to vote with their tokens.

66 Note that while the fork proposal was approved via CarbonVote by a significant majority (89% of the voters), this is not an accurate representation of the whole Ethereum community, because only a small percentage of Ether holders actually voted on the platform. Besides, even CarbonVote was only used as an informal signaling tool. Given the different stakeholders involved in the Ethereum community (each holding significantly different amounts of Ether), it is unclear whether the “one-Ether, one-vote” approach adopted in this case was the most appropriate tool to gauge public opinion.

67 De Filippi and Loveluck, “The Invisible Politics of Bitcoin.”

68 Wessel Reijers, Iris Wuisman, Morshed Mannan, Primavera De Filippi, Christopher Wray, Vienna Rae-Looi, Angela Cubillos Vélez, and Liav Orgad, “Now the Code Runs Itself: On-Chain and Off-Chain Governance of Blockchain Technologies,” *Topoi* (2018): 1–11.

Ultimately, these two models of governance — governance by the infrastructure through formalized market-based mechanisms, and *governance of the infrastructure* through a variety of ad-hoc decision-making mechanisms — significantly challenge the decentralized properties of existing blockchain-based networks. On the one hand, market-driven mechanisms are likely to lead to a centralization of power to those who engage in the accumulation of scarce resources. On the other hand, hidden power dynamics are likely to emerge from informal ad-hoc governance systems, characterized by a few (and sometimes concealed) “elite” members who can influence the system.<sup>69</sup> By removing the figure of the intermediary (e.g., the state or other centralized authority), these decentralized systems are providing new means for people to coordinate themselves in a distributed manner, but they are also foregoing the protective mechanisms that could ensure that these decentralized systems do not evolve, over time, into centralized or oligopolistic systems.

#### 4. Blockchains for Digital Commons

Blockchain technologies were born and have grown at the confluence of various commons-based communities such as the free and open source software movement and, more recently, the platform cooperativism movement.<sup>70</sup> The starting point, as noted above, was the public release of a white paper by the pseudonymous Satoshi Nakamoto presenting Bitcoin and its properties<sup>71</sup> — followed, a few months later, by the release of an open source implementation of the Bitcoin client<sup>72</sup>. Today, many

69 Jo Freeman, “The Tyranny of Structurelessness,” *Berkeley Journal of Sociology* 17 (1972–73): 151–64.

70 Platform cooperativism is a movement tackling the limitation of the current sharing (i.e., micro-rental) economy by designing and offering alternative platforms owned and controlled by users. For more details, see Scholz, Platform Cooperativism.

71 Nakamoto, *Bitcoin*.

72 Bitcoin uses the MIT licence, available at <https://github.com/bitcoin/bitcoin/blob/master/COPYING>.



more blockchain-based projects have come into being, most of which are released under a free or an open source license. Yet, blockchain technology presents specific characteristics when compared to traditional open source projects. On the one hand, it offers a built-in incentivization system that rewards contributors for their participation in the network. On the other hand, it provides the underlying infrastructure to incorporate specific governance rules into code, so as to manage community assets in a more automated and decentralized manner. This section will consider whether — and how — open source communities and other commons-based initiatives might benefit from these emergent technologies in order to support their operations and ensure their long-term sustainability.

#### *4.a New Range of Economic Opportunities*

The economic sustainability of common-based initiatives presents significant discrepancies, depending on their visibility, popularity and on the viability of their related business models.<sup>73</sup> While flagship projects — such as Linux and Mozilla Firefox<sup>74</sup> — receive reasonable amounts of funding, smaller projects or communities often lack mechanisms to compensate developers and contributors for their work. Because they are underfunded, these projects often fail to retain sufficient expertise to ensure the quality and maintenance of core Internet protocol

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73 Brian Fitzgerald, “The Transformation of Open Source Software,” *MIS Quarterly* 30, no. 3 (2006): 587–98.

74 The GNU/Linux project for instance is backed by a consortium of industry players (Linux Foundation 2015), while the Firefox browser received most of its funds from partnerships with search engines — mainly Google — which finance the development of the web browser in exchange for being listed as default choices for Internet search. Arrah-Marie Jo, “The Effect of Competition Intensity on Software Security: An Empirical Analysis of Security Patch Release on the Web Browser Market,” *The Economics of Digitization: Proceedings of the 16th Annual Workshop on the Economics of Information Security*, 2017. This model is however precarious, as demonstrated by recent layoffs, see Mitchell Baker, “Readying for the Future at Mozilla,” *The Mozilla Blog*, January 15, 2020, <https://blog.mozilla.org/blog/2020/01/15/readying-for-the-future-at-mozilla/>.

and related software.<sup>75</sup> In this section, we analyze how projects intend to leverage blockchain technology to offer new possibilities for funding and incentivizing users' contributions in commons-based projects.

As noted above, the Bitcoin network makes it possible for people to trade digital currency without passing through any intermediary operator. In order to ensure the long-term sustainability of the network, Bitcoin introduced the Proof-of-Work system that compensates users with digital currency proportionally to the utility they provide to the network. This inspired the design of many other blockchain-based networks, which all incorporate a similar incentivization scheme, using their own native digital currency to reward those who contribute resources to the network. As the value of these digital currencies is tied to the value of the services provided by the underlying blockchain-based platform, all network participants (including miners, developers, entrepreneurs, token holders, and speculators) have strong incentives to promote and enhance the utility of the platform.

Commons-based initiatives can leverage the characteristics of blockchain technology in order to sustain a growing community of contributors over time.<sup>76</sup> Indeed, by rewarding people with cryptocurrency and other blockchain-based tokens, commons-based initiatives have the opportunity to scale up and attract a larger pool of contributors — especially those who are not ideologically aligned with the underlying mission or objectives of the project, or who are not sufficiently satisfied with existing non-economic returns.

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75 This is illustrated by the Heartbleed bug, a critical vulnerability found in 2014 in the Open SSL library which is at the core of securing most online communications.

76 Primavera De Filippi, "Translating Commons-Based Peer Production Values into Metrics: Toward Commons-Based Cryptocurrencies," in *Handbook of Digital Currency: Bitcoin, Innovation, Financial Instruments, and Big Data*, ed. David Lee Kuo Chuen (Amsterdam: Elsevier, 2015), 463–83.

For the sake of illustration, let us look at the various online platforms available for storing and sharing digital files. Up until now, users could either rely on centralized services provided by large cloud providers (like Dropbox or Google Drive) offering a basic service for free and requiring a premium for extra bandwidth or storage capacity; or they could participate in decentralized peer-to-peer networks (such as BitTorrent, for instance) without paying a fee<sup>77</sup> but without any guarantee as to the availability of their files. Projects such as the Inter-Planetary File System (IPFS)<sup>78</sup> offer an alternative solution for the storage and sharing of digital files in a secure and decentralized manner. IPFS is a peer-to-peer file system that comes with a specific incentivization system relying on a blockchain-based token (Filecoin) to reward network participants in proportion to the storage capacity they dedicate to the network. The system thus provides users with the possibility to pay extra in order to incentivize more network participants to host a specific file, thereby increasing the overall reliability of the system.

A similar model could be implemented, at a more generic level, to reward people who contribute value to a particular community, with specific digital currency or blockchain-based tokens that can be used to interact with that community.<sup>79</sup> While the value of these tokens might initially be very low, over time, as the community grows into a more structured project or initiative with an actual value proposition, early contributors can

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77 Note that certain peer-to-peer applications actually require users to pay for the use of their software (e.g., Resilio).

78 IPFS is a decentralized file system whereby files are identified by their cryptographic hash and shared among participants in the network. Participants connected to the network can then retrieve files from any other participant using the hash as an address.

79 This is the case, for instance, with the Backfeed model, which relies on the notion of “Proof-of-Value” (as opposed to “Proof-of-Work”) to reward people in proportion to the value they have brought to a particular community. For more details, see Alex Pazaitis, Primavera De Filippi, and Vasilis Kostakis, “Blockchain and Value Systems in the Sharing Economy: The Illustrative Case of Backfeed,” *Technological Forecasting and Social Change* 125 (2017): 105–15.

spend these tokens in order to access the goods or services provided by the community, or — alternatively — they can sell these tokens on the secondary market, to whomever did not contribute to the community but would nonetheless like to access some of its goods and services. Such a model creates a positive incentive for people to contribute to a commons-based project on an ongoing basis because the more successful the project is, the greater utility (and value) these tokens will have.

However, despite the advantages that these models provide, one should be wary of the fact that, especially in the context of commons-based projects or initiatives, measuring and rewarding contributions can introduce biases in some of the participants' motivations. For instance, in most open source projects and peer-to-peer file-sharing networks, the motivations for users to contribute time and resources to these projects currently rely on non-monetary factors, mostly related to ideological values, social capital, or principles of reciprocity.<sup>80</sup> Indeed, for major commons-based initiatives like Wikipedia, Khan Academy, and Project Gutenberg, the lack of direct economic incentives does not actually hinder the success of the project. On the contrary, it could be argued that the introduction of market-driven mechanisms could actually jeopardize the established dynamics of peer-production, replacing them with an excessive degree of transactionality that might actually end up hindering, rather than supporting the long-term sustainability of the initiative.<sup>81</sup>

Even if one were to decide not to reward community members on a contribution basis, blockchain technologies can nonetheless be leveraged in order to raise the necessary funds to build and maintain a commons-based project or initiative. For instance, Bitcoin and its underlying blockchain protocol

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80 Karim R. Lakhani and Robert G. Wolf, "Why Hackers Do What They Do: Understanding Motivation and Effort in Free/Open Source Software Projects," in *Perspectives on Free and Open Source Software*, eds. J. Feller, B. Fitzgerald, S. Hissam, and K.R. Lakhani (Cambridge: MIT Press, 2005).

81 Xiaoquan Zhang and Fen Zhu, "Intrinsic Motivation of Open Content Contributors: The Case of Wikipedia," *Workshop on Information Systems and Economics* 10 (January 2006): 4.

was originally developed and maintained by a small number of passionate developers, driven by an ideology — i.e., disrupting the current financial system — and by many of the same motivational drivers that characterize traditional open source software projects.<sup>82</sup> Over time, as the Bitcoin network has gained in popularity and adoption, the efforts of the initial contributors have been rewarded — albeit indirectly — through the appreciation in value of the Bitcoin digital currency. And because the value of Bitcoin is to a large extent correlated with the value of the Bitcoin network, token holders have an incentive to contribute to building or maintaining the network in order to increase its overall utility.<sup>83</sup>

The establishment of the token-sale model as a new funding mechanism emerged from the realization that, as a general rule, the digital tokens issued on a blockchain-based platform can be used as a means to fund the development and maintenance of that platform. Over the past years, a growing number of initiatives have been selling digital tokens or cryptocurrency to finance the development and growth of a particular blockchain-based platform or application. For instance, in July-August 2014, the Ethereum Foundation sold a large portion of the Ethereum native currency (Ether) in a public token sale, raising over USD 18 million worth of bitcoins at the time. The Foundation allocated the funds to a variety of people — including researchers, software developers, and marketers — in charge of ensuring the development, maintenance, and promotion of the Ethereum platform. Subsequently, the same model has been used by a large number of initiatives around the world, many of

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82 Studies have identified various factors, but agree on the priority of non-monetary motivations such as a sense of creativity, intellectual stimulation, and learning. For more details, see: Lakhani and Wolf, “Why Hackers Do What They Do.”

83 Recent projects have also adopted a similar soft launch such as Grin, an implementation of the Mimblewimble protocol, available at <https://github.com/mimblewimble/grin/>.

which have largely surpassed the amounts of traditional early-stage investment funding.<sup>84</sup>

The combination of token sales and internal incentivization systems offers interesting possibilities for bootstrapping, launching and sustaining the operations of certain commons-based platforms. While a token-based model is particularly suited to platforms managing scarce digital resources (such as digital currencies), it also applies in the context of collaborative platforms characterized by strong network effects, such as those coordinating individual workforce members, or managing the sharing of resources (such as flats, cars, or other personal items) amongst individual users. In these contexts, people can purchase digital tokens as a means to access specific resources, or they can share their resources within a community in order to earn tokens as a reward.

Nevertheless, despite these apparent benefits, financing a commons-based initiative through a token sale or by incentivizing contributors through the issuance of blockchain-based tokens presents several drawbacks in the long run. First — as opposed to the open source model adopted by many commons-based projects, which generally promote openness and inclusivity — *tokenization*<sup>85</sup> requires the adoption of an “exclusionary” model in order to assign an effective utility to the token. Second, many token sales rely on extensive marketing campaigns to increase the appeal of the project, creating strong expectations for the token holders with regard both to the future usability of the platform and to potential returns on investment — even if most of these projects are highly experimental, both technically

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84 Perhaps the most notorious token sale was that of the DAO, launched in April 2016, which raised over USD 150 million’s worth of ether in 28 days, making it the most successful crowdsale at the time. Among other examples, the Basic Attention Token (BAT) founded by Brendan Eich raised \$35 million in a few seconds, Tezos raised \$232 million, Bancor \$153 million.

85 Tokenization refers to the process by which an ecosystem or a platform is organized to use a token, on a blockchain-based network, to exchange, measure, and store value.

and commercially.<sup>86</sup> Finally, the utility associated with these blockchain-based tokens might vary—ranging from profit or revenue sharing to specific governance or voting rights, in addition to the future ability to use these tokens to access a given product or service. Regardless of the economic model adopted, commons-based initiatives might thus be incentivized to promote market-driven dynamics, at the expense of their internal principles and ideological values.<sup>87</sup>

#### *4.b New Tools for Commons-Based Governance*

In order to succeed as a collaborative endeavor, commons-based platforms must come up with a specific governance model that accounts for the interests of all relevant stakeholders. Many commons-based projects and initiatives have established a set of social norms and community rules, mostly enforced as a result of individual stewardship, peer pressure, and other forms of social interaction. When the community grows beyond a certain point it becomes necessary to implement a more formalized governance structure, with a legal entity (e.g., a foundation) responsible for allocating resources and representing the community to the external world. While they are meant to serve the interests of all community members, such entities might end up prioritizing the interests of board members, eventually shifting the aims of the project and progressively losing community support.<sup>88</sup>

Moreover, centralized control over critical assets can impinge upon the values and long-term sustainability of many collaborative commons-based projects. Ownership of a particular website or domain name, access rights to a particular code repository in the case of open source software, or control over a publicly recognized brand or trademark, are all crucial to the proper operations of commons-based projects. Similarly, finan-

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86 Indeed, a large majority of these projects are, at the time of the sale, more prototypes that serve an almost non-existent user base.

87 Arun Sundararajan, *The Sharing Economy: The End of Employment and the Rise of Crowd-based Capitalism* (Cambridge: MIT Press, 2016).

88 De Laat, "Governance of Open Source Software."

cial control over the way funds can be effectively disbursed plays a key role in the governance of these projects. Regardless of the governance structure adopted by each project, the party controlling these critical assets has the ability to leverage its position to increase its influence within the community.

One of the dangers associated with these elements of centralized governance is the risk of “corporate capture”<sup>89</sup> which might lead to a progressive “commodification” of the platforms<sup>90</sup> — as happened in the case of Couchsurfing after the non-profit organization was turned into a for-profit corporation.<sup>91</sup> A platform whose infrastructure relies on a decentralized blockchain-based network, with a clear on-chain and off-chain governance structure, could provide a solution to that problem, by ensuring that commons-based communities retain full control over the platforms they use. Indeed, because a blockchain-based platform is not owned or controlled by anyone, but is rather administered collectively by a distributed network of peers, the technology ensures that no one can take over control over these platforms after they have been deployed on a blockchain.

Another danger may stem from the inability to maintain a coherent and aligned vision within a community, leading to growing discontentment and potential opposition against the centralized authority managing a commons-based project. This could ultimately result in a “fork” — i.e., the community split-

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89 Corporate capture generally refers to the means by which powerful economic actors exert undue influence over domestic and international decision-makers and public institutions. In this context, we refer to the situation in which market players might try to privatize a commons or influence the operations of existing commons-based initiatives, in order to bring them more in line with their commercial interests. For more details on the commodification of information commons, see Primavera De Filippi and Miguel S. Vieira, “The Commodification of Information Commons: The Case of Cloud Computing,” *The Columbia Science and Technology Law Review* 16 (2014): 102–43.

90 Ibid.

91 Michel Bauwens, Nicolas Mendoza, and Franco Iacomella, *Synthetic Overview of the Collaborative Economy* (P2P Foundation, 2012), <https://p2pfoundation.net/wp-content/uploads/2018/02/Synthetic-overview-of-the-collaborative-economy.pdf>.



ting into two separate projects,<sup>92</sup> with a necessary reallocation of resources and assets between the two. Again, blockchain technologies could mitigate that risk by providing an open and shared infrastructure that anyone can use. As a result, even if the community were to disagree with a particular course of action, it could, for instance, trigger a vote or split into multiple communities operating according to their own value systems, but nonetheless interfacing with the same underlying technological platform.

As such, blockchain technologies create new opportunities for commons-based communities to experiment with new governance structures<sup>93</sup>. Indeed, although they require the contribution of multiple people to operate the network, blockchain-based platforms can be designed in a way that does not require an intermediary to manage the flow of contributions. By eliminating the need for any middleman, blockchain technology enables the creation of new community-driven blockchain-based organizations — commonly referred to as “decentralized collaborative organizations” — which are operated *by* the community and *for* the community and where every community member is simultaneously a contributor and an actual shareholder in the organization. While these organizations might be led by a charismatic leader in charge of stewardship of the organization, they are no longer subject to the whims of a benevolent dictator because they operate according to an infrastructure which is decentralized by design.<sup>94</sup>

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92 While generally positive (*supra* note 29), forks are sometimes the result of a contentious issue or a simple failure in leadership. For instance, the OpenOffice project was forked — after having been neglected for a long time by Sun Microsystems and after having been repurchased by Oracle — to give birth to a new project (LibreOffice) built from the same code, and mostly with the same developers, but with an entirely different management structure.

93 Samer Hassan and Primavera De Filippi, “The Expansion of Algorithmic Governance: From Code Is Law to Law Is Code.” *Field Actions Science Reports* 17 (2017): 88–90.

94 As opposed to traditional online platforms, which are managed and maintained by a centralized operator, decentralized blockchain-based

Yet, this is only a partial solution. While blockchain technology has strong potential, an important gap still needs to be filled to ensure the long-term sustainability of commons-based projects and initiatives. As described earlier, most of the decentralized blockchain-based applications deployed thus far ultimately rely on a series of distributed governance systems built around game-theoretical mechanisms and market-driven incentives. Due to the decentralization inherent in these systems — without an institution protecting them — they can be easily co-opted by established powers, accumulating the necessary resources (in terms of, for example, hashing power or tokens) to acquire more power and influence in the system. Major events and incidents such as the DAO’s hack or the Bitcoin Cash fork also constitute an opportunity to reflect on the power mechanics resulting from the specific technical design of these decentralized infrastructures.

The blockchain ecosystem as a whole is currently exploring ways in which the governance of decentralized blockchain-based networks can be implemented in such a manner as to preclude the emergence of new intermediaries or centralized power dynamics. Yet, as the technology matures and spreads into the mainstream, the blockchain ecosystem is rapidly being occupied by small and large investors, speculators, and entrepreneurs — with very different interests and ideologies from the early adopters who belonged to the *cypherpunk* and *hacktivist* communities. In fact, rather than focusing on decentralization and disintermediation, these new players are mostly interested in capital accumulation and profit maximization. Hence, for

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applications are both managed and maintained by a distributed network of peers, none of which has the ability to change or influence the operations of these blockchain-based systems, unless this is specifically provided for in the underlying protocol. Hence, by encoding a decentralized governance structure directly into the fabric of a blockchain-based system, it becomes difficult for any single party to unilaterally intervene in order to change the current and future operations thereof. See Sinclair Davidson, Primavera De Filippi, and Jason Potts, “Disrupting Governance: The New Institutional Economics of Distributed Ledger Technology,” *SSRN*, July 22, 2016.

common-based projects or initiatives to thrive in this new environment, they need to experiment with alternative governance models that do not suffer from the same problems and drawbacks as many of the existing market-driven approaches.

We propose here a hybrid solution that might resolve some of the problems identified thus far. By combining a blockchain-based platform with existing instruments—such as institutional design, community-driven governance, and legal protections—common-based projects could leverage the power of blockchain technologies, while benefiting from the accumulated insights and experience of more traditional governance tools. Specifically, not only can blockchain-based networks support and facilitate the collective administration of any digital platform without a centralized point of control, they can also be used to create and manage a variety of activities or relationships that would otherwise require significant legal overhead. And because they already come with their own governance system, existing commons-based communities could transpose part of their current community rules and social norms into a set of code-based rules, incorporated directly into the underlying code of a blockchain-based applications. In doing so, they could shift some of their *off-chain* governance into a system of *on-chain* governance that is more transparent and no longer requires any third-party or centralized enforcement—because these rules are automatically enforced by the underlying technical infrastructure.<sup>95</sup>

Particularly relevant in this regard are the principles of *platform cooperativism*<sup>96</sup> for the establishment of collaborative plat-

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95 On that point, it might be useful to distinguish between the governance of decentralized blockchain-based networks (usually governed through a Proof-of-Work or Proof-of-Stake protocol) and the governance of decentralized blockchain-based applications (or DApps) deployed on top of these platforms. Accordingly, while the underlying blockchain network might be governed through a series of market-driven mechanisms, the applications they run can feature their own governance models that operate according to completely different logics.

96 Those principle, as summarized by Scholz (in *Platform Cooperativism*), include participatory ownership, decent income and job security, transpar-

forms with more cooperative governance and more balanced revenue-sharing models than those currently adopted by many of the platforms of the “sharing economy.” Shared ownership and democratic governance are, for instance, two key principles that are regarded as a prerequisite to ensure that everyone can reap the fruits of their own labor.<sup>97</sup> While their implementation might require extensive legal work and organizational overhead in a traditional context, both of these principles can be implemented through a blockchain-based platform that rewards contributors with tokens, decision-making power, and possibly even ownership rights in the platform.<sup>98</sup> Instead of relying on traditional legal means, and on the necessary processes that come along with them, the governance of these blockchain-based organizations could be done partially *on-chain*, through a transparent and self-executing system of rules. If properly designed, these systems could facilitate the move from the current crowdsourcing model, where large operators are in charge of a few centralized online platforms, towards a more cooperative model, where community members have a say in how these platforms should operate, and can benefit—in proportion to their individual contribution—from the economic returns generated by these platforms.

Yet, in order to operate properly, commons-based communities must retain the ability to rely on off-chain governance mechanisms for everything that cannot be properly transposed into code. First, organizations do not exist in a vacuum. While it might be possible to encode specific rules and regulations directly into a blockchain-based network, commons-based communities nonetheless need to interface with other organizations, market players and governmental institutions through off-chain interactions. Second, some norms require a particular degree of

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ency and data portability, appreciation and acknowledgment of contributions, protective legal framework and worker protections against arbitrary behaviour, excessive workplace surveillance, and the right to log off.

97 Scholz, *Platform Cooperativism*.

98 Pazaitis, De Filippi, and Kostakis, “Blockchain and Value Systems in the Sharing Economy.”

flexibility and ambiguity that cannot be provided by the formal language of code.<sup>99</sup> In particular, commons-based communities often need to account for a multiplicity of interests, promoting a particular vision of the general good while encouraging collaboration and trust among community members — none of which can be easily transposed into code. Lastly, as opposed to traditional blockchain-based networks, which are built around game-theoretical protocols and market-driven governance systems, commons-based communities also need to implement off-chain governance mechanisms necessary to preserve the coherence, values and long-term sustainability of the projects they support. Indeed, even if off-chain governance is, in many instances, much slower and more complicated to deal with than a system of automated on-chain code-based rules, it is almost always necessary to protect the system from external forces trying to use or bend the rules to their own advantage. In that regard, by delegating some of their off-chain governance to established institutions in the commons-based ecosystem (such as, for instance, the Free Software Foundation or the Mozilla Foundation), commons-based communities have been trying to ensure that no one can co-opt the system — whether from inside or outside the organization.

Hence, while blockchain technology provides the underlying architecture to decentralize the governance of many commons-based communities or platforms, the ultimate governance structure for these platforms should ideally include a mixture of on-chain governance rules (with regard to shared ownership and democratic governance) and off-chain protocols (with regard to institutional governance) to ensure the peaceful and orderly conduct of a large variety of commons-based projects or initiatives within the larger ecosystem.<sup>100</sup> Only then will it be

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99 Primavera De Filippi and Samer Hassan, “Blockchain Technology as a Regulatory Technology: From Code Is Law to Law Is Code,” *First Monday* 21, no. 12 (2016), <https://firstmonday.org/article/view/7113/5657>

100 Primavera De Filippi and Greg McMullen, “Governance of Blockchain Systems: Governance of and by the Infrastructure,” *HAL*, February 22, 2019, <https://hal.archives-ouvertes.fr/hal-02046787/document>.

possible to build a more efficient, scalable, and resilient ecosystem that benefits from the best of both worlds: the transparency and accountability of decentralized blockchain-based systems on the one hand, and the flexibility, solidarity, and trust of social interactions and human collaboration on the other.

## 5. Conclusion

Over the years, the implementation of a global and decentralized telecommunication network has grown from a preliminary research project to become the main and most significant information system in the world. While the Internet, as a platform for permissionless innovation, has given rise to a great deal of innovation—in terms of information and communication technologies, novel economic models, and new mechanisms for social organization and coordination—the combination of market dynamics and network effects have led to a concentration of market power in the hands of a few operators, eventually turning the Internet into a network controlled and administered by a small number of incumbents.

Similarly, following the advent of Bitcoin in 2009, blockchain technology has enabled a new wave of innovation, empowering individuals and digital communities with an unprecedented tool for decentralized collaboration that comes along with built-in incentivization and reward mechanisms. While Bitcoin was created with the ambition of supplanting the current financial system, more generally, the decentralized nature of many blockchain-based applications has the potential to disrupt the business model of existing incumbents, both online and offline. Yet, most of the blockchain-based applications implemented thus far incorporate game theoretical protocols and market-driven incentives that actually exacerbate—rather than disrupt—existing dynamics of capital accumulation and speculation. The early, ideologically-driven individuals and communities that were originally responsible for building the blockchain ecosystem have thus progressively been supplanted by old and new

market players, mostly driven by commercial gain and opportunistic motives.

Accordingly, it appears that, in the case of both the Internet and blockchain technology, recurring cycles of innovation have led to a temporary disruption in the status quo, only to replace it with a new set of incumbents that operate according to the same logics as before. Nevertheless, in addition to market-driven innovation, the Internet has also led to the emergence of radically new models of distributed production and collaboration — such as open source projects and other commons-based initiatives — operating according to a new set of principles and governance models, and which eventually succeeded in their desire to innovate beyond the current social and economic model.

In the same way, blockchain technology has enabled the emergence of new projects and initiatives designed around the principles of decentralization and disintermediation, providing a new platform for large-scale experimentation in the design of new economic and organizational structures. Yet, to be really transformative, these initiatives need to transcend the current models of protocol-based governance and game-theoretical incentives — which can easily be co-opted by powerful actors or lead to dissensus — and to come up with new governance models combining both *on-chain* and *off-chain* governance rules. The former can be used to support mechanisms of regulation by code, incentivization schemes and ownership over digital assets, whereas the latter are necessary to promote the vision, and facilitate the interaction of commons-based projects and initiatives with the existing legal and societal framework. Ultimately, whether or not blockchain technology will lead to the rise of a new economic order is not — solely — a technical matter; it is, first and foremost, a political question that requires an in-depth understanding of the social, economic, and political implications that different governance structures will bring to society.