Blockchain technology : toward a decentralized governance of digital platforms?

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Introduction

Over the last two decades, technological advances and, in particular, the development of modern information and communication technologies contributed to enhancing our capabilities to communicate and exchange information on a global scale. The advent of Internet and digital technologies marked a shift from centralized communication systems (*one-to-many*) toward distributed and decentralized communication networks (*many-to-many*), which radically changed the way we work and organize ourselves. The Internet was originally designed as a resilient telecommunication network that could resist a nuclear attack (Baran, 1964). Its decentralized structure was a regarded as a key requisite to ensure the scalability and flexibility of the network (Castells 2002).

As the Internet grew, it evolved into an open ecosystem for innovation, with a variety of new players deploying projects that disrupted the *status quo* (Gilbert 2003). On the one hand, the Internet provided new tools for companies and startups to experiment with new 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 Internet gained mainstream adoption, some companies established themselves as dominant players on 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 of centralized platforms and proprietary applications. Today, a few large online operators (e.g. Google, Facebook, Amazon) 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 came about, 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[1] makes it possible for people to experiment with new forms of peer-production and distributed collaboration[2]. Just like 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 operator.

Yet, despite its promises to establish a more decentralized society with a novel economic order (Atzori 2015), many of the blockchain-based networks or applications implemented thus far ultimately rely on market dynamics and economic incentives[3] 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 subsist 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 on how the decentralized nature of the Internet enabled different models of innovation to emerge—in terms of both market-driven innovation (I.A) and distributed commons-based collaboration (I.B)—we will look at the potential for blockchain technology to incentivize new forms of decentralized collaboration (II.A) and to enable new distributed governance models (II.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 (III.A) while ensuring a greater degree of control over shared digital platforms *(III.B).* Our thesis is that a carefully designed integration of blockchain technology with the operations of various common-based initiatives—and in particular those related to the notions of the *sharing economy* (Sacks, 2011) and *platform cooperativism* (Scholtz, 2016)—could significantly contribute to improving the governance and long-term sustainability of these projects. This could potentially lead to the establishment of a new economy characterized by direct interactions among a disparate network of peers, without the need to rely on any trusted authority or intermediary middleman.

[1] Blockchain technology can be used both for the deployment of public and open networks (public blockchains) or for the creation of networks which are only made available 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.

[2] By enabling people to communicate directly with one another, the Internet has facilitated the emergence of new forms of decentralized collaboration which do not rely on any centralized operator or middleman, but rather on the spontaneous contributions of a distributed network of peers. For more details on these new forms of peer-to-peer collaboration, see Raymond (1999) and Benkler (2006).

[3] Although there are many different types of economic incentives, the term is used here to refer mostly to financial and monetary incentives.

I. Internet and permissionless innovation

The advent of the Internet and digital technology 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 (Clark, 1988). Yet, the disruption that subsequently came about has been shaped by two different, yet interrelated, driving forces. On the one hand, a large variety of new companies and startups have been challenging the *status quo*, disrupting existing institutions and former incumbents with innovative services and novel business models. On the other hand, a series of commons-based initiatives leveraged the power of this global communication network to build open ecosystems of distributed collaboration. Not only did some these initiatives succeed in challenging the *status quo,* they also marked the beginning of an entirely new paradigm of social organization (Benkler, 2006).

A. Market-driven innovation

The Internet and modern information and communication technologies have contributed to a significant shift in economic power from traditional 'brick and mortar' to new companies or 'startups' 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 permission to anyone (Thierer, 2016). New market players have been leveraging this new platform for "permissionless innovation" (Cerf, 2012), experimenting with new business models and managerial practices[4] which challenged the operations of traditional and more rigid incumbents.

Many Internet startups rely on specific business model designed to leverage network effects. These startups try to collect a large user-base by offering free, freemium or low-cost services that often do not cover the costs of providing these services. In order to grow rapidly, they need to raise capital, implementing competitive strategies and exclusionary practices to prove their competitive advantage to investors. For instance, intellectual property (including patents and proprietary software) has often been weaponized to raise barriers to entry and undercut competition (Bhidé, 2009). Moreover, because of the proprietary nature of those platforms—with limited interoperability and–data portability—users find themselves locked into walled gardens, unable to shift from one platform to another without losing the ability to access their own data (Merha, 2011). 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 personalised and targeted advertising campaigns.[5] With the emergence of increasingly large datasets, the development of new data mining techniques and the use of machine learning for the purposes of profiling, 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.

[4] See, e.g., the "lean startup" methodology adopted by many early stage Internet companies (Blank, 2013)

[5] As popularly put by Andrew Lewis, "*if you are not paying for it, you are not the customer, you are the product being sold*" (Metafilter weblog, available at http://www.metafilter.com/95152/Userdriven-discontent#3256046)

Major players, like Facebook and Twitter, are attempting to recreate an ecosystem for open innovation, by releasing open source libraries and Application Programming Interfaces (APIs) for third parties to build applications on top of their own platforms (Bodle, 2011). Yet, while this opens new possibilities for small players to enter 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, or 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 the users interacting on top of these platforms.

Many online 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,[6] nor are they granted any kind of control or governance rights over the manner in which the platform will operate and evolve. Quite to 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 they intermediate. Hence, this new model of production—often referred to via the misnomer of the *sharing* or *collaborative economy* (Sacks, 2011)—did not significantly contribute to the establishment of a new economic order. Rather, it turned out to be an even stronger instantiation of the capitalist mindset (Martin, 2016).

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 promote large-scale and distributed collaboration (von Hippel, 2005; Benkler, 2006). For instance, initiatives like GNU/Linux, the Apache HTTP server or many other free and open source software projects were developed by a community of researchers and software engineers to create a pool of shared resources that could complement—or even replace—some of the dominant proprietary platforms of that time. The same is true for large collaborative online projects, such as Wikipedia, OpenStreetMap, or other crowd-sourcing projects[7] designed to create a common and shared resource that remains available to all.

[6] One notable exception are 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 Song & Wildman (2013).

[7] Planetary astronomy, for instance, increasingly relies on information provided by large number of amateurs cooperating online. See Mousis & al, 2014

This particular type of innovation—which we refer to as *commons-based innovation*—is mainly concerned with maximizing the utility of specific software applications and online platforms, operated *by* the community and *for* 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 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*[8] (Benkler, 2006)—operates according to a more open and cooperative approach, which is grounded on the principles of Free software and Open Source (Raymond, 1999). 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 the free and open source licenses for software (see e.g., GNU General Public License, MIT License, BSD License, etc) and the suite of Creative Commons licenses[9] 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 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,[10] some initiatives stem from the efforts of an industry's collective action[11] or single privately-held companies [12] (von Hippel & Von Krogh 2009). Most community-driven initiatives are initially stewarded by one or more charismatic leaders[13] 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 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 revenues with generally a limited control over the development process (De Laat 2007).

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[8] Commons based peer production (CBPP) is a new form of social innovation that is becoming ever more important in the information society. Current examples include Wikipedia, Open source software projects such as Drupal and Moodle, and open hardware projects such as Arduino and Raspberry Pi.

[9] 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 Lessig (2004)

[10] See e.g. the Apache HTTP server project, initiated by a collective of webmasters (Mockus, Fielding & Herbsleb 2002)

[11] 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 vehicules.

[12] 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 Heckert (1998).

[13] These charismatic leaders are sometimes described as "benevolent dictators" (Ljungberg, 2000)—like Richard Stallman for the GNU project or Linus Torvald for the Linux kernel.

Indeed, as a general rule, the governance of commons-based communities is more open and participatory than that of many Internet startups.[14] 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 opportunity 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 (Kostakis, 2010).[15]

Perhaps one of the biggest difference between market-driven and commons-based innovation lies in the economic model that surrounds these two type of innovations. While the former is 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 expectations of individual returns or compensation (financial or otherwise). Nevertheless, although profits are not the main drivers for a large majority of commons-based initiatives (Benkler & Nissenbaum, 2006), the ability to raise money and attract human resources remains an important precondition for the long-term sustainability of these projects. On 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 (Raymond 1999), including new skills and visibility that may greatly enhance their position on the job market.

There are, however, many limitations to such approaches. 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 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. As a result, these projects are often under-funded especially in their initial phases. Because of the lower economic incentives they provide, they only manage to attract a limited 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 to manage and coordinate a distributed networks of contributors, without relying on standard governance practices based on formalized hierarchies and control mechanisms.

[14] Indeed, while both commons-based communities and Internet startups might assign to specific individuals the task of managing resources and coordinating a particular type of activities, in the context of commons-based initiatives, these individuals remain fully accountable to the community. As opposed to traditional companies, where employees must obey to the directives given by the management, commons-based communities remains free to act as they best see fit, regardless of what the management says.

[15] Such a fork, the reuse of code or content into a new project, is generally perceived as a healthy and intended process that enable 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.

II. Blockchains and distributed coordination

Just like the Internet did in the early 1990's, with the advent of Bitcoin in 2009, blockchain technology has 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 hashing 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 as a way to further the ideals of freedom and autonomy that the Internet ultimately failed to promote (Atzori, 2015). 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 a distributed manner, independently of any government or middlemen (Bonneau & al., 2015). Through a combination of novel incentivization schemes and distributed governance models, they aggregate the contribution of multiple people without relying on any intermediary figure or trusted authority. And because they are administered by a large number of peers located all over the globe, these applications are generally less affected by jurisdictional constraints than their centralized counterparts (De Filippi, 2014)

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 (Nakamoto, 2008).

Bitcoin was originally conceived by a pseudonymous entity, *Satoshi Nakamoto*, out of a desire to circumvent existing institutions—like banks and other governmental institutions—which allegedly failed to protect the interests of regular citizens.[16] Most of the early Bitcoin adopters shared similar ideals, identifying themselves as "cypherpunks" (Bohr & Bashir, 2014) or as part of a specific breed of anarchism or libertarianism known as "crypto-anarchists" or "crypto-libertarians" (Karlstrøm, 2014).

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 control over money transmission. But what really brought the system to take off and reach a much broader audience was the perspective of 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

[16] 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.

hundreds or thousands of dollars[17]—has brought new market players (known as "miners"[18]) to invest in the purchase of specialized equipment (e.g. ASIC computers[19]) to support the operations of these blockchain-based networks, and receive fixed allotments of virtual currency (the so-called *block reward*) in return for their contribution to the network.[20]

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 months, reaching a cumulative investment of over 1 billion USD in 2017.[21] 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 it 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[22] and legal reasons.[23]

The caveat is that the legal uncertainty surrounding these token sales[24] creates a high degree of uncertainty for both token issuers, who might be found liable for the infringement of specific rules or regulations,[25] and investors who might fall into an unregulated ecosystem full of dubious projects

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[17] In 2010, two pizzas were bought for 10,000 bitcoins, worth around than $40 at the time; whereas as of august 2017, one Bitcoin is valued above $4000. Similarly, Ether, the native cryptocurrency on the Ethereum network was initially valued at $0.25 and is valued above $300 in august 2017.

[18] A miner is a network participant that verifies the transactions of a blockchain-based network and aggregates them into a "block" of transactions. On Proof-of-Work networks (such as Bitcoin and Ethereum), before publishing a block to the blockchain, miners need to find the solution to cryptographic puzzle that requires a large amount of computational resources to solve.

[19] 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.

[20] Whenever a block is published to the network, along with the solution to the cryptographic puzzle associated to that block, a fixed number 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.

[21] According to CoinDesk's ICO tracker, between January and September 2017, there has been more than $1.7 billion raised by token sales. See https://www.coindesk.com/ico-tracker/

[22] 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 Mason & Harrison (2002).

[23] 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 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.

[24] 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 U.S. Securities and Exchange Commission (SEC) on the legal qualification of *The DAO* tokens as securities, available at: https://www.sec.gov/litigation/investreport/34-81207.pdf

[25] In China, for instance, following the ban on tokens sales by the People's Bank of China (see notice of the 09/04/2017 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 refund all Ether collected to the original investors.

and claims.[26] Besides, the volatility in the market price of these virtual currencies—some of which have witnessed a value increase of over 10x in just a few months[27]—has attracted a 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 over the future value of these tokens, acquiring them for the sole purpose of subsequently reselling them on the market at a much higher price.

Blockchain technology thus provide new avenues for traditional market players, startups and commons-based initiatives to access new forms of capital and engage in a variety of profit-making activities. Yet, in spite of the new opportunities it might provide to small players, the blockchain ecosystem—as it stands today—is an instantiation of capitalism at its worst: 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 can witness an increasing amount 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) along with new market players (e.g. miners, virtual currency exchanges, and speculators) entering the space and leveraging the power of blockchain technology to further their own purely financial interests.

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

The governance of blockchain-based networks can be distinguished in 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).*

[26] 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.

[27] Over the past few months, the value of cryptocurrencies has increased dramatically. For instance, Bitcoin's value has gone from $1200 in April 2017 to up to $4800 in September 2017; Ethereum has gone from being worth less than $100 in May 2017 to over $400 in June 2017; Ripple has gone from $0.03 in April 2017 to $0.4 in May 2017; Litecoin went from $10 in April 2017 to over $80 in September 2017.

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 rely on a combination of market-driven mechanisms and consensus protocols, whereby the influence of each community member ultimately depends on their level of investment in a particular set of resources. This is the case, for instance, of the *Proof-of-Work* consensus algorithm (Nakamoto 2008) 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* algorithm 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.[28] Network participants can also exercise a certain degree of decision-making power by only accepting (or rejecting) blocks that meet (or do not meet) certain criteria.[29]

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 (*Shier & al., 2017*)* whose governance was structured around the number of tokens that each individual holds. Some blockchain-based networks—such as, for instance, *Tezos*[30] and *Dfinity* [31]—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 the free market is, indeed, a powerful mechanism of indirect coordination (through a mechanism akin to the notion of "distributed consensus" that permeates the blockchain space). Yet, the game theoretical structures implemented into these protocols are of highly individualistic nature, whereby every individual is expected to behave in a rational manner in order to maximize its individual utility and economic returns. Oftentimes, the protocol does not account for the fact that markets can be easily manipulated by powerful actors, which might lead to collusion and market concentration (Stiegler 1968). Accordingly, 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.

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[28] 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).

[29] 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 to only 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.

[30] 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

[31] 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. As opposed 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

Of course, not every rules and procedures 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 a particular blockchain-based applications, there is always a point in 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 of the 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 (De Filippi & Loveluck 2016), with decisions being made by a small handful of people with strong technical expertise, market power or charisma (Hacker 2017).

In the case of Bitcoin, for instance, the long-standing scaling debate was dominated by a few software engineers and tech-savvy individuals proposing alternative implementations and possible protocol changes to the underlying blockchain-based network.[32] Prominent figures in the debate also included a small number of highly influential individuals with strong visibility within the community, as well a several miners and mining-pools who incurred substantial investments in specialized hardware devices for the mining of Bitcoin (De Filippi & Loveluck, 2016).

Similarly, following the loss of over $50 million USD due to a vulnerability in the code of *The DAO* (Shier & al., 2017), the Ethereum community had to take a 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 (DuPont, 2017).[33]Ultimately, as it became increasingly clear that the general consensus within the broader Ethereum community had converged towards the fork,[34] a new client was released with the relevant protocol upgrades and a specific activation schedule for the protocol change. While the fork was ultimately successful, the decision created significant controversy within the Ethereum

[32] 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 generates a long and heated debate (the so-called *scaling debate*) with different groups fighting over what could be the best way to allow for the Bitcoin network to process more transactions per second.l Thus far, proposed solutions are to either increase the maximal size of a block or to provide news 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 megabyte (*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.

[33] 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 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.

[34] 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.

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 who operate "behind the scenes" (De Filippi & Loveluck 2016). As a result, there is often no transparency as to how decisions are made and little accountability as to who is responsible for the implementation of these decisions.

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. One 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" who can influence the system (Freeman, 1972). By removing the figure of the intermediary (e.g. the State or other centralized authority), these decentralized system 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.

III. Blockchains for digital commons

Blockchain technology was born and has 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.[35] The starting point was the public release of a white paper (Nakamoto, 2008) by the pseudonymous *Satoshi Nakamoto* presenting Bitcoin and its properties—followed, a few months later, by the release of an open source implementation of the Bitcoin client. Today, many more blockchain-based projects have come into being, most of which are released under 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 incentivisation system that rewards contributors for their participation to the network. One 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

[35] Platform cooperativism is a movement tackling the limitation of the current sharing economy by designing and offering alternative platforms owned and controlled by users. For more details, see Sholz, 2016.

from these emergent technologies in order to support their operations and ensure their long-term sustainability.

A. New range of economic opportunities

The economic sustainability of common-based initiatives presents significant discrepancies, depending on their visibility, popularity and the viability of their related business models (Fitzgerald 2006). While flagship projects—such as Linux and Mozilla Firefox[36]—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 and related software.[37] In this section, we analyse how blockchain technology could offer new possibilities for funding and incentivizing users contribution in commons-based projects.

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 to compensate users with digital currency proportionally to the utility they provide to the network (defined by the amount of hashing power they each contributed). 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 could leverage the characteristics of blockchain technology in order sustain a growing community of contributors over time. 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.

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[38] but without any

[36] The GNU/Linux project for instance is backed by industry players (Linux Foundation 2015), while the Firefox browser received most of its funds from partnerships with search engines, Google until 2014 and Yahoo since, which finance the development of the web browser in exchange for being listed as default choices for Internet search. (Jo, 2017)

[37] 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.

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

guarantee as to the availability of their files. Projects such as the Inter-Planetary File System (IPFS)[39] 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 the a specific digital currency or blockchain-based tokens that can be used to interact with that community.[40] While the value of these tokens might be initially very low, over time, as the community grows into a more structured project or initiative with an actual value proposition, early contributors can spend these tokens in order to access the goods or service provided by the community, or—alternatively—they can sell these tokens on the secondary market, to whoever 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 (Lakhani & Wolf 2013). Indeed, for major commons-based initiatives like Wikipedia, Linux and Firefox, the lack of direct economic incentives does not actually hinder the success of the project. Quite to the contrary, it could be argued that the introduction of market-driven mechanisms into a project like Wikipedia 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 (Zhang & Zhu, 2006).

Even if one decide not to reward community members on a contribution-basis, blockchain technology 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 was originally developed and maintained by a small number of passionate developers, driven by an ideology, on the one hand—i.e. disrupting the current financial system—and, on the other hand, by

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

[40] This is the case, for instance, of the Backfeed model that relies on the notion of "proof of value" (as opposed of "proof of work") to reward people in proportion to the value they have brought to a particular community. For more details, see Pazaitis & al., 2017

many of the same motivational drivers that characterize traditional open source software projects.[41] Over time, as the Bitcoin network gained in popularity and adoption, the efforts of these initial contributors have been rewarded—albeit indirectly—through the 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.

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 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 the Ethereum native currency (*Ether*) in a public token sale, raising over USD 18 millions 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 which largely surpassed the amounts of traditional early-stage investment funding.[42]

The combination of token sales and internal incentivization systems offer interesting possibilities for bootstrapping the launch 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, 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 incentivising contributors through the issuance of blockchain-based tokens present 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*[43] 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 to both the future usability of the platform and potential returns on investment—even if most of these projects are highly

[41] 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, 2003.

[42] Perhaps the most notorious token sale sale was that of *The DAO*, launched in April 2016, which raised over USD 150 millions 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 Millions in a few seconds, Tezos raised $232 Millions, Bancor $153 Millions ...

[43] *Tokenisation* 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.

experimental, both technically and commercially.[44] 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 token 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 expenses of their more inner principles and ideological values (Sundararajan, 2016).

B. New tools for commons-based governance

In order to succeed as a collaborative endeavor, common-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 interactions. Only when the community grows beyond a certain point does it become 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, they might end up prioritizing the interests of board members, eventually shifting the aims of the project and progressively losing community support. (De Laat, 2007).

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, financial control over the way funds can be effectively disbursed plays an 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 those elements of centralized governance is the risk of "corporate capture"[45] which might lead to a progressive "commodification" of these platforms (De Filippi & Vieira, 2014)—as it happened in the case of *Couchsurfing*, after the non-profit organization was turned into a for-profit corporation (Bauwens & al., 2012). Decentralized blockchain-based applications could provide a solution to that problem, guaranteeing that commons-based communities retain full control over the platforms they use. Indeed, because a blockchain-based

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

[45] 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 De Filippi & Vieira, 2014.

platform is not owned nor controlled by anyone, but is rather administered collectively by a distributed network of peers, the technology ensure 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 a growing discontentment and potential opposition against the centralized authority managing a commons-based project. This could ultimately result into a "fork"—i.e. the community splitting into two separate projects[46], with a necessary reallocation of resources and assets amongst the two. Again, blockchain technology 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 system, but nonetheless interfacing with the same underlying technological platform.

As such, blockchain technology creates new opportunities for commons-based communities to experiment with new governance structures which are less hierarchical and more transparent than those adopted in most of today's organizations. 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 operator to manage the flow of contribution. By eliminating the figure of the 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 share-holder in the organization. While these organizations might be led by a charismatic leader in charge of stewardship for 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 (Davidson & al., 2016).

Yet, this is only a partial solution. While blockchain technology has a strong potential, an important gap still needs to be filled to ensure the long-term sustainability of commons-based projects or initiatives. As described in section II, 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 may be easily co-opted by established powers, accumulating the necessary resources (in terms of e.g. hashing power or tokens) to acquire more power and influence into 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.

[46] While generally positive (cf. *supra* footnote n°11), 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 developpers, but with an entirely different management structure

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 than the early adopters from 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 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 technology, 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 .[47]

Particularly relevant in this regard are the principles of *platform cooperativism*[48] for the establishment of collaborative platforms with a 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 which are regarded as a prerequisite to ensure that everyone can reap the fruits of their own labor (Scholz 2016). 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–(Pazaitis & al., 2017). Instead of relying on traditional legal means, and the necessary

[47] 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 which operate according to completely different logics.

[48] Those principle, as summarized by Scholz (2016), include participatory ownership, decent income and job security, transparency 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.

processes that comes along with it, 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 flexibility and ambiguity that cannot be provided by the formal language of code (De Filippi & Hassan, 2016). In particular, common-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. On 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—neither from inside nor 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. Only then will it be possible to build a more efficient, scalable and resilient ecosystem that benefits from the best of both world: 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.

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 organisation and coordination—the combination of market dynamics and network effects have led to a concentration of market power in the hand 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 to supplant 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 gains 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, 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 to the principles of decentralization and disintermediation, providing a new platform for large-scale experimentation in the design of new economic and organisational 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, and come up with new governance models combining both *on-chain* and *off-chain* governance rules. The former can be used to support new mechanisms of regulation by code, novel incentivization schemes and a new sense of 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.

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