Blockchain technology:
a new (r)evolution in the digital economy

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Remember the world, back in the 90's? Before the Internet had invaded pretty much every aspect of our lives? It was back then quite difficult —if not impossible— to foresee that one day, not too far away, people would be able to communicate directly with one another, that they would be able to broadcast themselves to the world and interact in a peer-to-peer fashion, bypassing most of the intermediaries of that time. This marked the beginning of a new paradigm shift in the way people communicate — the beginning of a digital revolution characterised by a process of decentralization and disintermediation. With the Internet, traditional media operators, such as publishers and broadcasters, have been progressively displaced by a more distributed network of players, relying on emerging information and communication technologies in order to provide new opportunities for people to receive and impart information.

But the Internet was only the beginning of a much larger paradigm shift. Today, a new technology is emerging —the blockchain— which might push the process of decentralization and disintermediation one step further.

The blockchain is a new coordination technology that relies on a decentralized network of computers in order to coordinate the action of many individuals interacting through a common (shared) database that is both unrepudiable and tamperproof. Blockchain technology enables people that do not know or trust each other to coordinate themselves and interact on a peer-to-peer basis, without relying on any centralized authority or middlemen. In other words, what the Internet has done to enable global and interpersonal communication, the blockchain could do to achieve global and systematic cooperation —without intermediation.

Decentralization as a means of disintermediation

So far, the most popular use of the blockchain has been in the context of financial transactions. Bitcoin was the first virtual currency deployed on the top of the blockchain that operates independently of any government or central bank. As such, Bitcoin has shown that it is possible to create a decentralized payment system that does not require any centralized entity or clearinghouse to authenticate and validate financial transactions. On the Bitcoin network, transactions are validated in a decentralized manner by every peer in the network and valid transactions are subsequently recorded onto a distributed ledger, whose integrity is ensured by cryptographic primitives. Bitcoin thus makes it possible for people to transact directly with one another, on a peer-to-peer-basis, thereby decreasing people's reliance on banks and other financial institutions.

And yet, Bitcoin is only one out of many possible applications of blockchain technologies. After the initial success of Bitcoin, many alternative cryptocurrencies have emerged (e.g. Peercoin, Primecoin, Dogecoin, etc.), for the most part replicating the same model as Bitcoin, albeit with some minor differences in the protocol. But it soon became obvious to people that the technology underpinning Bitcoin —the blockchain— had much greater potential. This new coordination technology can be used for many other type of applications, whose impact on society might extend to new domains situated way beyond the realm of financial transactions and payment systems.

The first non-financial blockchain-based application was Namecoin, a decentralized registry and management system using blockchain technology for the registration and transfer of .bit domain names. Alternative applications of blockchain technologies also emerged as a result of initiatives such as Mastercoin and Counterparty, introducing an additional metadata-layer on top of the Bitcoin blockchain, in order to assign new meanings to any blockchain transaction. But the inherent limitations of the Bitcoin blockchain (originally intended for mere financial transactions) eventually led people to develop new and more sophisticated systems (e.g. Ethereum, Eris) with the ability to store and execute computer code in a distributed manner —effectively turning the blockchain into a decentralized computer or operative system.

Today, thanks to these new technological advances, many new blockchain-based applications are being deployed, ranging from distributed cloud storage (e.g. Storj.io, Maidsafe.net, IPFS.io) to decentralized marketplaces (e.g. OpenBazaar.org), or even decentralized social networks (e.g. Synereo). The potential for disintermediation is huge, as blockchain technologies promise to provide a decentralized alternative to many of today's centralized platforms. And in fact, some are already experimenting with new ways of disrupting some of the key players of the sharing economy —this is the case, for instance, of LaZooz: a blockchain-based real time ridesharing application which presents itself as an alternative to Uber.

Hence, beyond their financial applications, blockchain technologies have the potential to affect (and disrupt) many other sectors of activities. If Bitcoin has shown that it is now possible to exchange value on a peer-to-peer basis, bypassing most of the traditional financial intermediaries, new blockchain-based applications are pushing the concept of disintermediation to a whole new level, introducing the ability for

people to transfer or exchange value in a perfectly trustless environment —*i.e.* an environment where there is no need for trust amongst parties.

Decentralization as a tool for organisations

Beyond their potential for disintermediation, blockchain technologies can also be used to enhance or optimize existing organisational structures. Indeed, operational costs can be significantly lowered by the use of blockchain technologies, which could be used by a variety of firms and organisations in order to support or complement many of their daily functions and activities.

Most relevant in that regard is the use of the blockchain to deploy self-enforcing agreements (a.k.a. smart contracts) which differ from traditional contracts to the extent that they both computable and automated. This makes it possible to integrate smart contracts directly within the logistics and management of an organization. By incorporating contractual obligations into computer code, traditional paper-based contracts can be turned into computable contracts, interconnected with transactional data. It thus becomes possible to parse and process this data, in an automated way, as it is today possible to process any other kind of data. Advanced data analysis techniques can therefore be used to extract substantive information concerning the operations of a firm or organization which can be used at the operational level —*e.g.* managing the whole supply chain by simply looking at the nature and content of incoming and outgoing transactions.

In addition to the efficiency gains that smart contracts entail when it comes to reducing transactions costs and logistics overhead, the use of blockchain technologies to support the operations of an organisation also facilitates recording and accounting tasks within that organisation. While traditional organizations need to keep a log of all their transactions in order to abide to generally accepted accounting principles, blockchain technologies are such that every transaction is automatically (and necessarily) recorded chronologically, in an persistent and non-repudiable way, on a shared database. This creates an auditable trail of all relevant transactions, which can subsequently be used for accounting purposes. Indeed, by simply looking at the records on a blockchain, it is possible to retrieve the whole history of transactions that the organization has emitted or received through its lifetime —without the need for an organization to engage into the expensive and time-consuming process of book keeping.

But the revolutionary character of the blockchain also stems from its unprecedented mix of openness and decentralisation which ensures a fair degree of transparency and accountability, while reducing the risk of corruption and centralized control. Indeed, as a public and distributed ledger, the blockchain provides greater degrees of transparency and accountability to any organisation whose governance system has been encoded into that ledger.

On the one hand, the blockchain makes it possible to record, in a tamper-proof manner, all relevant transactions on a secure and distributed database. This makes the process of auditing an organization (*e.g.* auditing a company or a firm for financial compliance) much more accurate and easier to achieve —and

this for two main reasons. Firstly, given the lower costs of accessing the information that is stored into the blockchain, audits can be done on the totality of transactions, as opposed to a small sample of them. Secondly, given that all records stored into the blockchain are automatically updated by the transactions themselves, the auditing process can be done on an on-going basis, as opposed only at specific points in time.

On the other hand, by encoding the bylaws of an organisation into self-executing code, the blockchain can reduce not only the amount of bureaucracy, but also the likelihood of corruption, while simultaneously increasing the degree of procedural justice or due process. This characteristic of transparency is especially valuable as a counterweight to today's "blackbox society" (Pasquale, 2015) where an increasing number of online platforms operate as impenetrable fortresses with no way for users to see what is happening behind the scenes.

Decentralization as a means for collaboration

Existing organisations are only one part of the story. The blockchain opens the way for the establishment of new organisational structures characterised by open and free collaboration —a shift away from the exclusivity of today's walled gardens, towards a more cooperative and inclusive ecosystem where everyone can benefit from the contributions of others.

Collective action and cooperation are powerful forces that generate value, and that well-coordinated groups of individuals can accomplish more together than the sum of what they can do as individuals alone. Hence, whenever we need to achieve a complex task that requires the participation of multiple people, we constantly organize ourselves —either informally, through the establishment of specific interest groups and communities, or more formally, with the creation of specialized organisations, companies or associations.

Depending on the scale and complexity of the task to be achieved, people might favor one type of governance over the other. On a small scale, coordination can be achieved more easily by means of rough consensus and social norms, without the need to rely on any formalized structure. Conversely, large-scale organizations generally operate through rigid hierarchical structures, which serve as an efficient coordination mechanism —although they often come at the expense of flexibility, creativity, and generative capacity.

The organisational structure also affects the redistribution of wealth within an organisation. With the exception of certain types of cooperative organisations, most companies or corporations do not always redistribute the value generated by the organisation as a whole to its participating members in portions that are justly representative of each individual's contributions and assumed risks. In many cases, the interests of those at the top of the management are not fully aligned with the interests of those at the base of the organisation —as the work of the latter contributes to increasing the profits of the former, often without a proportionate redistribution of wealth.

In this regard, one of the greatest promise of blockchain technology lies in its potential to enable and support new organisational structures that significantly differ from traditional top-down, hierarchical organisations. Blockchain technology constitutes a means for individuals to coordinate themselves in a much more open and decentralized manner, enabling the creation of agile, lean and more dynamic organisations which do not depend on the existence of a centralized or formalized structure, but rather on the spontaneous contributions of many individual actors, eager to cooperate towards achieving one goal.

The Internet has already shown us that free and systematic cooperation is possible on a global scale. Think of Wikipedia, Linux, OpenStreetMap, Arduino, etc. —all these initiatives emerge from the spontaneous contribution of many individuals collaborating towards a common goal in an open, cooperative and non-hierarchical manner.

Open source communities (including the free culture and open data movements) are extremely interesting in that regard, in that they have shown that free and decentralized collaboration can be achieved on a large-scale, without any central entity in charge of managing the flow of contributions. However, the open source model of collaboration was originally designed around the production of information goods in a digital format —these goods are both non-rival (*i.e.* the consumption of information by one person does not prevent the consumption of the same information by another person) and abundant, in that can be reproduced in no time and at virtually no cost. It is unclear, at the moment, whether the same model can be successfully (and systematically) applied to other sectors of activity.

Nonetheless, the success of this collaborative mode of production has inspired a variety of economic players to experiment with new business models that rely on the power of the crowds in order to produce value —a practice that is now commonly referred to as "crowdsourcing".

Companies such as Uber or AirBnb were initially praised for their innovative approach and their disruptive impact on the hospitality and local transportation industry. Regarded by many as key players in the sharing economy, they promoted a whole new way of doing business, by connecting individuals together so that they can transact directly with one another. Of course, these are far from being real peer-to-peer transactions. Every one of these transactions is mediated through a centralized platform, which is in charge of coordinating the actions of all individual users. Besides, as opposed to the open source model, where everyone contributing to a common project equally benefits from that project, in most of these commercial cases, the value produced by the crowd is not shared equally between the platform and the contributors —it is instead concentrated into the hands of a few large intermediaries, such as Facebook, Uber, AirBnb or other large centralized crowdsourcing platforms.

Today, with blockchain technologies, things can be different. As a secure and non-corruptible database, the blockchain can be used to implement new decentralized organisational structures, along with distributed decision-making procedures and value distribution systems, so as to ultimately support and promote the collaboration of multiple individuals that do not necessarily know (or trust) each other.

Blockchain technologies provide the basic building blocks for the development of collaborative platforms which are not owned or controlled by any given entity —but rather by the network as a whole. This

enables the creation of truly open and decentralized organisations that rely on the spontaneous contributions of hundreds or thousands of people eager to interact and cooperate on a peer-to-peer basis, without the need for any central authority or intermediary operator.

The decentralization aspect of these new technologies is important, because it is closely coupled with the concept of open participation. Most of today's platforms for distributed collaboration (e.g. Facebook, Twitter, Reddit, or Wikipedia) are open for all to contribute. Yet, these platforms rely on a centralized, often hierarchical structure, where a few operators have the power to censor certain contributions and/or exclude certain contributors from the platform. Conversely, in view of their decentralized nature, blockchain-based platforms are, by definition, open for everyone to join and contribute —people can collaborate to a common project out of their own free will, and without incurring the risk of censorship or exclusion by any given third party.

This has important repercussions on the way people can organise themselves, especially in the context of grassroots initiatives or communities that did not (want to) adopt a more formalized structure. With the blockchain, not only does open, distributed and bottom-up collaboration become possible, it also can become sustainable at a large scale, as it presents a compelling alternative to the current models of corporate and community governance.

Just like in many open source communities, with the blockchain, disparate networks of people are free to contribute resources to a community or an organisation as they see the most fit. Yet, as opposed to most open source communities which do not provide any economic rewards to their contributors, in the case of many decentralized blockchain-based organisations, contributors can be rewarded —according to the value that they have brought to the community— through the distribution of crypto-tokens (a.k.a. crypto-equity) which represent an actual share in the organisation. Initiatives of this kind already exist (see e.g. Backfeed.cc) aiming at providing tools of distributed governance and value distribution systems for decentralized communities. These tools make it possible for communities to coordinate, manage and remunerate a variety of collective efforts (e.g. content creation, fundraising, or social networking) in a distributed manner. And to the extent that every contributor has the potential to become an actual shareholder in the organisation, the alignment of interest between every contributor becomes much stronger, since they all seek to maximize the value of the organisation they belong to.

For a more general overview on how blockchain technologies can enable new forms of distributed large-scale collaboration, see my TEDx "From Competition to Cooperation".