



Blockchain and value systems in the sharing economy: The illustrative case of Backfeed



Alex Pazaitis^{a,*}, Primavera De Filippi^{b,c}, Vasilis Kostakis^a

^a Ragnar Nurkse Department of Innovation and Governance, Tallinn University of Technology, 3 Akadeemia Street, 12618 Tallinn, Estonia

^b CERSA/CNRS/Université Paris II (Pantheon-Assas), 10 Rue Thénard, 75005 Paris, France

^c Berkman Klein Center for Internet and Society, Harvard University, 23 Everett Street, 02138 Cambridge, MA, United States

ARTICLE INFO

Keywords:

Blockchain

Theory of value

Information economy

Backfeed

ABSTRACT

This article explores the potential of blockchain technology in enabling a new system of value that will better support the dynamics of social sharing. Our study begins with a discussion of the evolution of value perceptions in the history of economic thought. Starting with a view on value as a coordination mechanism that defines meaningful action within a certain context, we associate the price system with the establishment of capitalism and the industrial economy. We then discuss its relevance to the information economy, exhibited as the techno-economic context of the sharing economy, and identify new modalities of value creation that better reflect the social relations of sharing. Through the illustrative case of Backfeed, a new system of value is envisioned, comprising three layers: (a) production of value; (b) record of value; and (c) actualisation of value. In this framework, we discuss the solutions featured by Backfeed and describe a conceptual economic model of blockchain-based decentralised cooperation. We conclude with a tentative scenario for blockchain technology that can enable the creation of commons-oriented ecosystems in a sharing economy.

1. Introduction

Sharing is a perennial element found in human relations with varied significance and meaning. Whether it concerns tangible goods, such as food and water, or services, such as accommodation and transportation, sharing has always been a momentous practice determining different forms of sociality and political organisation. Nonetheless, the term ‘sharing’ has been rare in economics literature (Benkler, 2004), while the ‘sharing economy’ constitutes numerous contradictions in its purported functions and objectives, even claimed to be an oxymoron conceptually (Slee, 2016). Indeed, in the conventional understanding of the economy driven by rational action in pursuit of utility maximisation, the practice of sharing seems at least irrational and is restrained in the margins.

However, the Information and Communication Technology (ICT) revolution (Perez, 2002) has enabled new capacities for communication and sharing. For the first time, loosely affiliated individuals can self-organise on a project-specific or ad hoc basis and make voluntary contributions of their productive capacity. Starting from intangible contributions, like in Free and Open-Source Software and Wikipedia, to the sharing of rival material resources, such as computational power, lodging and automobiles, people started to create ‘large-scale, effective

systems for the provisioning of goods, services and resources’ (Benkler, 2004: 276).

This has provided the context for the ‘sharing economy’ to attain a certain drift, with reference to a stream of business models where individuals allow for the temporary usage of goods or services, facilitated by collaborative platforms (EC, 2016). The success of the sharing economy gives eminence to discussions over a great potential for innovation, growth and employment. A new world of opportunities opens up in response to the modern social and ecological issues (Kostakis et al., 2016a,b). Nevertheless, certain infelicities become evident with regards to privacy and misuse of data, (Slee, 2016); labour rights and conditions (Fuchs, 2010; Webster and Randle, 2016) and numerous legal and regulatory challenges (EC, 2016).

The creation of value in the sharing economy takes place in a collaborative environment and includes a wide variety of small-scale contributions. However, the created value is often channelled in the financial markets (Arvidsson and Colleoni, 2012). Although the creation of value is decentralised to the crowd, sometimes (e.g. as in Facebook or AirBnB) it is centralised command and control that determines the distribution of the rewards, in the form of rents, dividends and/or wages (if any) (Kostakis and Bauwens, 2014).

But, following Benkler (2004), shareable goods, actions and services

* Corresponding author.

E-mail address: alex.pazaitis@gmail.com (A. Pazaitis).

have characteristics that make them indivisible and coarsely correlated with supply and demand, which poses many challenges to the market price system. On the contrary, non-market relations of social sharing provide a more efficient framework for their provision and exchange. Sharing is thus associated with economic production that is based on social relations. In turn, the sharing economy concerns the production of goods or services that are valued through mechanisms of social sharing.

From this perspective, this article seeks to answer one question: How can value, which is created through mechanisms of social sharing, be assessed and distributed? We approach this question from a normative perspective. Our inquiry does not concern value in the current successful ventures of the so-called ‘sharing economy’. Rather we approach the sharing economy within the wider transformation of the ICT-driven techno-economic paradigm (Perez, 2002) and hypothesise a new system of value that better reflects the dynamics of social sharing. For this purpose, the main body of the paper is structured in three parts: (a) perceptions of value in the economy; (b) the techno-economic context of the sharing economy; and (c) transition to a new system of value. Each of these parts is briefly described in the following paragraphs.

For the first part (Section 2), we review perceptions of value in the economics literature. Our starting point is a perception of value stripped from its economic notion, viewed as a social coordination mechanism through which ‘actions become meaningful to the actors by being incorporated in some larger social totality’ (Graeber, 2001: XII). Industrialisation has been a historical milestone for humanity, providing the means to solve the contemporary agonising issues, including famine and plague. The industrial modality of production has been the foundation of such a ‘social totality’, determining the way in which actions had become meaningful, i.e. valuable. It is to a large extent based on this construct that the price system is justified as the single standard for value until today. We take a historical approach on theories of value to unveil the relative causations underneath this relation.

In the second part (Section 3) we examine the information economy, as the new modality of organising productive resources. We adhere to the definition of Castells (2010) pointing out to ‘a specific form of social organisation in which information generation, processing, and transmission become the fundamental sources of productivity and power because of new technological conditions’ (Castells, 2010: 21). We do not suggest that a new social order is technologically determined, but ICTs have set the conditions for sharing to become effective as an economic activity (Benkler, 2004). The sharing economy has thus strum from the information society, which is now the new social construct determining meaningful action. We investigate the techno-economic dynamics of the information economy and identify the current limitations for the sharing economy.

In the third part (Section 4), we synthesise the previous expositions to an analytical framework that serves to explore the transition to a new system of value from the industrial to the information society. Our suggested framework is structured on three layers: (a) production of value; (b) record of value; and (c) actualisation of value. Based on this framework, we palpate a new system of value through the exploration of a case study.

We have selected an illustrative case from the emerging ecosystem of the blockchain. Blockchain technology has been raising enthusiasm over a variety of disciplines, from information technology and finance, to law and economics. As the underlying technology of Bitcoin, the blockchain has been mostly discussed as a case of ICT revolutionising the financial and money sector. Nevertheless, it could be better understood as a (r)evolution in institutions, organisation and governance (Davidson et al., 2016:1). Its pervasive nature poses significant challenges to existing institutions and enhances the feasibility of a form of ‘distributed social governance’ (Veitas and Weinbaum, in press:10), while blockchain has been presented as the first native digital medium for value (Ito, 2016; Tapscott and Tapscott, 2016).

More specifically, the selected case is the project named ‘Backfeed’, which features a blockchain-based technological solution supporting decentralised social relations. Backfeed’s social protocol helps people, who contribute to a common effort, evaluate each contribution and achieve consensus on the produced value and the distribution of rewards. The blockchain infrastructure keeps a permanent record of the evaluations ensuring transparency and security from corruption. We argue that Backfeed exemplifies a system of value that can unleash the full potential of the sharing economy, as it is more apt for social relations-based production.

The overall aim of the paper is to shed light on the potential of the blockchain in enabling more meritocratic and participatory governance models that may support sharing and commons-oriented communities to scale and become sustainable. Our approach is focusing on the modality of production, attempting to unveil certain trade-offs with value systems and the way they are interpreted in the broader socio-institutional sphere to establish a viable political economy.

2. Value in the history of economic thought

Our position is that the perception of value, within a certain techno-economic context, is instrumental to unlock the potential for societies to prosper. A historical approach is taken to rediscover the roots of the price system, which is understood as the currently dominant system to determine value. For this, we explore the main approaches on value in the economic thought at the turning point of industrialisation, as capitalism started to take off as a mode of production.

Before the establishment of capitalism as the dominant economic system, various philosophical and practical traditions had been elaborating on the concept of value. In antiquity, the Greeks had a normative perspective in relation to wealth focusing on what constitutes a ‘good life’. The economy was considered as subordinate to political and ethical issues and economic phenomena were not investigated for their own sake (Sewall, 1901). This, however, did not hinder the development of very sophisticated approaches in economics.

Aristotle (1897) in *Ethics* suggested that value is expressed almost exclusively in the exchange of two things. However, he implied a distinction between value in use and value in exchange, arguing that the latter is subordinate to the former, as it is the usability of any good that makes someone desire it in an exchange. Aristotle understood people’s demand for each other’s goods or services as a standard of measurement of their value. In turn, representation of demand in money serves to equate the different types of labour applied to produce different types of things, so that they can be exchanged (Sewall, 1901).

The Christian theologians and the scholastics of the 13th century, led by Albert the Great and Thomas Aquinas, incorporated the Aristotelian theory of justice and economic exchange to crystallise the doctrine of the ‘just price’, which reflected the true value of commodities in exchange (Baldwin, 1959; Sewall, 1901). Overall, the unifying element of the approaches of antiquity and the medieval philosophy was that value serves a broader social necessity, bound to ethical and legal considerations rather than being a rational economic aim (Sewall, 1901). Analytical approaches were fundamentally normative and economics were considered to be part of justice and moral philosophy (Baldwin, 1959).

The following centuries were marked by the emergence of the nation state and the development of industrialisation and international trade. Smith in the *Wealth of Nations* (1776) arguably provided the first complete theory of value in modern economics. He explicitly stated and explored the basic dichotomy between ‘value in use’ and ‘value in exchange’, but, in contrast to Aristotle, Smith claimed that the first is not a determinant of the latter, neither necessary nor a prerequisite and refers to the famous water/ diamonds paradox to underpin his argument (Smith, 1776: IV). With his interest being in the principles that regulate commodity exchange, he studied the real measure for value in exchange and the real price for all commodities.

A key point for Smith's comprehension for value is the division of labour. In a society with developed division of labour individuals produce only a small fraction of the goods or services that are necessary to satisfy their needs. Therefore, they have to exchange the products of their own labour to those of other people's labour. In this sense, Smith defined the value of any commodity as 'equal to the quantity of labour which it enables [the person who possesses it] to purchase or command' (1776: IV). For Smith the real price of everything was the toil and trouble of acquiring it, understood as the deposition of a specific portion of one's ease, liberty and happiness. Subsequently, the real price of every commodity exchanged for another one is the toil and trouble which it can save its possessor and which it can impose on other people (ibid: IV).

Labour thus represents this toil and trouble, 'the first price that was ever paid for all things' and the origin of all the wealth of the world (ibid: V). This price is always the same, assuming an ordinary physical and mental state and is not varying in its own value. Therefore, Smith argued that labour alone can function as 'the ultimate and real standard by which the value of all commodities can at all times and places be estimated and compared. It is the real price of commodities; money is their nominal price only' (ibid: IV).

To place this perception into context, Smith's era was not the first time when the practice of exchange and the money economy appeared in human societies. But it was the first time that a certain techno-economic logic, based on the division of labour and industrial production, rationalised the prominence of trade as a crucial function for societies. In turn, the price system institutionalised exchange markets as the determinants of the value of things. Smith, recognised this function of the price system by assuming a 'natural price', at which commodities are sold *precisely* for what they are worth (ibid: VII). A price that would provide an accurate compensation covering rent for land, wages for labour and profit for capital. Economics started to transform as a scientific discipline and shifted away from the medieval pursuit of the 'just price', towards the discovery of a divine-like 'natural' order, assumed to be achieved by the efficient and precise function of markets.

Later theories made this relation even clearer. Ricardo (1821) developed his theory of value in the third edition of *Principles*, at first, as a critique on Smith. Ricardo accepted the distinction between use and exchange value, but explicitly regarded the latter as the only one concerning economic analysis, while he was the first one to associate exchange value with scarcity (Hollander, 1904). Ricardo was also the last classical political economist to adhere to the labour theory of value. Mill (1848) completely dismissed the labour theory of value and argued for a measurement of value of anything as the 'command its possession gives over purchasable commodities in general' (1848: Part III.1.5). Later on, Jevons (1871) developed the concept of marginal utility, giving rise to a whole new generation of economists, including L. Walras, C. Menger, A. Marshall and V. Pareto, as well as M. Friedman and neoliberal scholars of the 20th century. These views have completed the shift in economic thought. They dismiss any material embodiments of value and overemphasise the efficacy of free markets in coordinating any sort of meaningful action in societies, based on generalised assumptions, such as utility-maximisation and equilibrium (Marshall, 1890; Walras, 1874).

The historical conditions influenced the gradual transformation of the perception of value, so as to efficiently coordinate human sociality towards what has been generally perceived as beneficial. The industrial revolution has effectuated the key factors that distinguish a new economic system, which Sombart (1902) would later call *capitalism*: 'a particular economic system, recognisable as an organisation of trade, consisting invariably of two collaborating sections of population, the owners of the means of production, who also manage them, and property-less workers, bound to the markets which they serve' (Sombart, 1902 in Gibson et al., 1996: 3). An economic system that by its foundation was increasingly dependent on trade has led to a perception of value as exchange power inevitably dominating the

economic thought (Sewall, 1901). Money became the primary commodity acquiring exchange value and the concept of value became almost interchangeable with price. Global governance has been to a large extent focusing on regulation of international trade, with supranational institutions like the General Agreement on Tariffs and Trade (1947) and the European common market initiatives, starting with the European Coal and Steel Community (1951) that evolved to the European Union.

But markets require precision, cost effectiveness and a rational pursue of profit maximisation, aspects that are hard-wired in the capitalist business spirit. The art of systematic bookkeeping, born in the commercial centres of the Italian city states in the 14th century, provided this framework for the advance of trade (Yamey, 1949). Sombart (1902) has eloquently emphasised the role of double-entry bookkeeping in stimulating and intensifying the capitalist spirit (Yamey, 1964). Capitalism and double-entry for Sombart are so intimately connected, that it is difficult to tell which one was the cause and which one the effect. On one hand, capitalism has procured in double-entry bookkeeping a tool which activates its forces, while on the other hand, the latter has accentuated capitalism out of its own spirit.

Double-entry bookkeeping allowed for the standardised quantification of the results of all business activities and the reduction of assets and equities to numerical abstractions. It has thus provided a rational basis for strategic decisions and resource allocation and clarified business aims through a simple representation of win or loss (Gibson et al., 1996; Yamey, 1964). This systematic organisation of all business aims propelled discipline, control, practicality and depersonalisation into the logic of enterprise. The gradual dismissal of the labour theory of value in the evolution of economic thought has been only indicative of this abstraction of the social productive relations to the mathematical logic of double-entry bookkeeping.

Elaborating on this element of abstraction, Marx offered a different interpretation on value. In the first volume of *The Capital* (1867), Marx distinguished the 'capitalist mode of production' from simple commodity production, as studied by classical political economists (King and McLure, 2015). Whereas in pre-capitalist conditions commodities would be valued in exchange according to the labour expended in their production, capitalist production, he argued, 'is not merely the production of commodities, it is essentially the production of surplus-value' (1867:359). In capitalism the fundamental aspect of goods is their quantitative relation with money, which allows them to exchange as commodities (Fuchs, 2010).

In this sense, for Marx exchange value in capitalism is rather a manifestation of the structural relations than a direct result of labour. It is a property that the products of labour acquire, which is only actualised in the market through their exchangeability as commodities (Milios et al., 2002). Therefore, the production for exchange and profit in capitalism leads to an expression of value as a product of 'homogenised labour processes', what Marx encapsulated to the concept of 'abstract labour' (1867:39).

Marx, much like the classical economists, distinguished use value and exchange value. However, he identified a qualitative and quantitative element in the two forms. He held that in capitalist production there are two processes of labour identified: First, concrete labour, which produces use values, the qualitative element of goods, representing 'the everlasting nature-imposed condition of human existence' (Marx, 1867:130); and second, abstract labour, which creates exchange value expressed in a quantitative relation with money (Fuchs, 2010, 2012; Milios et al., 2002). Hence, for Marx the value of commodities does not hold any connection with their material substance or usability.

It becomes evident how a particular modality of production has organically transformed the perception of value, in the sense of defining meaningful action within a broader social totality (Graeber, 2001). The production processes in the capitalist mode of production have shifted away from the production of goods that have actual usability, towards the production of goods that can be exchanged for other ones.

Subsequently, the system of value has to fulfil the purpose of making commodities commensurable, as they embody different types and amounts of labour, so that the exchange could take place.

The classical political economists, even though they acknowledged the problem of incommensurability of labours, assumed a natural order imposed by market mechanisms that would achieve the type of precision required for exchange (Meikle, 1995). Marx, on the contrary, argued that resolving incommensurability in exchange results in stripping the products of labour of their qualitative characteristics. The value of things is divorced from their usability and the labour they embody turns to 'labour of equal quality', or abstract labour (Marx, 1867:40; Milios et al., 2002). While this has been fulfilling a practical necessity in the industrial economy, in the context of the information economy it can be associated with certain discrepancies, as we examine in the following section.

3. Value in the information economy

The term 'information economy' generally connotes an economy in which production is associated with knowledge, communication and information, as opposed to other kinds of activities (Porat, 1977). The term has been elsewhere referred as 'post-industrial economy' or 'knowledge economy' (Bell, 1973; Drucker, 1968; Machlup, 1962), which alludes to a deeper transformation, than a simple protrusion of information in the productive processes. Information, in its broader sense, has been an important element in the development of all societies. In the information economy, however, the difference lies in the new technological conditions that result to a new form of social organisation, where 'information generation, processing, and transmission become the fundamental sources of productivity and power' (Castells, 2010: 21).

Those ICT-driven conditions have enabled the practice of social sharing to gain economic significance. The sharing economy has thus been actuated in the information economy and within this framework we explore its dynamics. Likewise, the concerns over the sharing economy can be interpreted within a wider reformation, as a series of riddles that have 'techno-economic origin and socio-institutional solution' (Perez, 2004: 1).

The first riddle concerns the transformation of work and the nature of labour. Wealth creation in the information economy depends on socialised productive processes (Arvidsson and Colleoni, 2012; Rullani, 2004). Value is increasingly created in collaborative processes by a 'multitude' (Hardt and Negri, 2004) of diverse actors, and thus labour is less susceptible to control and measurement. Labour becomes immaterial (Hardt and Negri, 2000), that is more qualitative and ever more complex, while intangible assets gain significance in corporate value assessment (Arvidsson and Colleoni, 2012).

The immeasurability of value (Hardt and Negri, 2000) poses strong challenges for the conventional practices of management and accounting (Toms, 2008). The rationality of the price system is decreasing. This 'value beyond measure' (Hardt and Negri, 2000: 355) is more or less directly channelled to financial markets, whereas the latter 'are not so much rational as they are affective' (Arvidsson and Colleoni, 2012:141). The importance of financial markets in the information economy is associated with an evaluation system based on sentimental projections of future earnings.

The second riddle concerns the nature of information as a product of human sociality. Rigi and Prey (2015) advocate that informational content alone does not possess any exchange value, as it is non-rivalrous and it can be reproduced at negligible cost and time. The value of commodities has been traditionally associated with scarcity, while information production operates in the logic of abundance. Hence, the produced information does not classify as a commodity but rather as universal commons. Bollier (2014) defines the commons as a shared resource, co-governed by its community of users according to their rules and norms. Information production refers to the digital commons

of software, knowledge, design and culture. Nonetheless, as Castells' (2010) definition implies, the information commons represents mutualised productive resources that are central to the capacity for any kind of production, including physical goods.

The interest in the commons is not restrained on the management of the resources, but it also concerns the accompanying social practice of working together on equal footing for a common purpose, referred to as 'commoning' (Bollier, 2016). Commoning goes beyond the management of 'common-pool resources' (Ostrom, 1990). Rather it is also connected to new forms of governance and provisioning of goods and services. In the information economy, the commoning dynamic is exemplified by the myriads of Free and Open-Source Software projects or the free encyclopaedia Wikipedia. It is related to a new mode of production, different from private for-profit or public state-owned production, which Benkler (2006) called commons-based peer production (CBPP). Its product primarily possesses use value for a community of users/producers. Those are self-organised in productive structures, beyond traditional hierarchy and central coordination, and deploy common property regimes to make use value freely accessible (Bauwens, 2005).

However, the socio-institutional arrangements that govern today's economy are still to a large extent associated with the capitalist mode of production. Marx (1867) unveiled an antagonistic relation of use value and exchange value in capitalist production: The first serves the collective social interest, whereas the second the individual private objectives. This relation is further eradicated in the context of information, due to its non-rivalry form. With exchange value being the one dominating economic affairs, it is imposed on the information commons through artificial scarcity and enclosure. In turn, the market value extracted constitutes a form of monopoly rent (Rigi and Prey, 2015).

Therefore, the Marxist analysis of concrete and abstract labour remains relevant in the information economy (Fuchs, 2012). For instance, the activity of Facebook users is concrete labour that produces 'informational content' that embodies use value (Fuchs, 2012:187). This content is then commodified and exchanged to media advertisers, and the control of this process is in the hands of the owners of the infrastructure (Kostakis and Bauwens, 2014). The users are also the audience for advertising and their attention is also commodity that is actually measurable in terms of aggregated time of social labour (Fuchs, 2012).

On the contrary, CBPP unseals a political economy that goes beyond the Marxian framework of critique and negates the conventional canons of value altogether (Rigi and Prey, 2015). It inaugurates forms of governance indigenous to the information economy that encapsulate its transformative dynamics. Nevertheless, as long as CBPP remains subsumed under the rules of the markets and the abstracted logic of capitalism, it will still fall within the reach of Marx's analysis (Rigi and Prey, 2015). Admittedly, the best possible development in the Marxian theory of value is to be made obsolete by a radical change in the productive relations beyond capitalism.

The commons could function as the fabric of such a transformation. Helfrich offers an interpretation of the commons as 'an important form of transpersonal rationality and coordination; a new category that describes the individual-in-relation-with-others' (in Bollier, 2016: 20). Similarly, sharing is a different form of coordination of human sociality that makes sense within a certain techno-economic context. The same way that the industrial economy and the capitalist mode of production rationalised production for exchange, the information economy and CBPP rationalise production for sharing. It is hence within the sphere of CBPP that we are to seek a genuine sharing economy (Kostakis and Bauwens, 2014).

In this perception, the term 'sharing economy' infers something more than simply sharing becoming an economically relevant practice, in terms of becoming rational within a certain economic system. It portrays a new system of value in which sharing is the common sense that guides human behaviour towards what is perceived as the greater

good. In the following section we pursue this particular exploration through the case of Backfeed. We attempt to address our main research question, by framing the logic of a system of value, in which the value of sharing could be determined.

4. Backfeed and decentralised cooperation

Value is understood as an abstraction of human relations. It is a coordination mechanism that operates on a cognitive level, guiding individual and collective behaviour. It only becomes real at the end of this process, when the effect of this collective intelligence becomes evident. The system of value thus provides the locus of this process, determining how human action is formed, motivated and interpreted.

We suggest that this relation can be observed in three interrelated layers: (a) production of value; (b) record of value; and (c) actualisation of value. The first one refers to the modality of production, which rationalises a particular form of action as a meaningful contribution to the societal needs. The capitalist mode of production has been associated with exclusive ownership and control of the means of production, hierarchical command of labour and the production of surplus value. Respectively, CBPP is characterised by collective ownership and management of resources, horizontal coordination, self-identified and permissionless contributions and the production of social value.

The second layer concerns a systematisation of coordinated assessment, which provides the means to motivate and nourish such meaningful action, allowing the system to scale and become sustainable. This layer contains the method used to track and record the produced value, which to a large extent crystallises the logic of the established economic system. We saw the role of the double-entry bookkeeping system in unleashing and stimulating the business activities of capitalism. Double-entry bookkeeping had conveyed the logic of mathematical precision and abstraction to business operations and hard-wired it into the price system. It had been born as a practice of merchants and has thus been endemic to trade, the engine of the capitalist mode of production. Likewise, it has been argued that the first native digital medium for value is the blockchain (Ito, 2016; Tapscott and Tapscott, 2016). As a technology it has sprung from a combination of ICTs with the purpose of documenting peer-to-peer operations. The blockchain could be the medium that would support the polycentricity, fluid coordination and multiplicity of contributions found in CBPP.

The third layer includes the development of a common sense that rationalises meaningful action within the logic of an economic system. It is where value becomes real in an economic system, justifying people's choices and struggles. In capitalism, as we saw earlier, the value of commodities is a property that they carry on from their production, but is only actualised in markets, through their exchange for other commodities. This value is interpreted through a nominal representation in monetary units, determining both the means and the ends of the productive process. Accordingly, in the information economy, sharing represents the type of social relations that make the use value of information commons perceptible. It is where an economic system is materialised, which rationalises people's capacity to share, in the sense of contributing to and benefiting from the commons.

The sharing economy is arguably where the real value of shareable goods is actualised, through the efficient provisioning of the socially produced use value. It is the final layer of a new system of value that effectively attributes to the social productive relations their qualitative elements.

In the following sections an in-depth presentation of Backfeed is provided. We use the above described framework to discuss how the three layers of value operate in the ecosystem envisioned from Backfeed, illustrating a new system of value.

4.1. The blockchain (r)evolution

Backfeed is a social operating system for decentralised

organisations. It builds upon blockchain technology to develop a distributed governance model for decentralised value creation and distribution (Davidson et al., 2016). Before presenting the Backfeed model, we introduce its technological backbone: blockchain technology and the practices associated with it. As most existing implementations of the blockchain are to a large extent on an experimental phase, there is still no definite terminology to describe the relevant concepts.

A blockchain is a distributed ledger or database of transactions recorded in a distributed manner, by a network of computers (Wright and De Filippi, 2015:6). As the name implies, it is organised in a linear sequence of smaller encrypted datasets called 'blocks', which contain timestamped batches of transactions. Each block contains a reference to its precedent block and an answer to a complex mathematical puzzle, which serves to validate the transactions it contains. The innovation behind the blockchain emerges from a combination of existing technologies: peer-to-peer networks; cryptographic algorithms; distributed data storage and decentralised consensus mechanisms (Wright and De Filippi, 2015). As a general purpose technology (Davidson et al., 2016), the blockchain serves as a means to record, in a secure and verifiable manner, a particular state of affairs which has been agreed upon by the network (Wright and De Filippi, 2015). As such, the blockchain can be used in any system that comprises valuable information, including money, titles, deeds, intellectual property rights and even votes or identity register data (Davidson et al., 2016; Tapscott and Tapscott, 2016).

Blockchain was first introduced as the underlying technology of the crypto-currency Bitcoin (Swan, 2015). Trying to solve the problem of double-spending within a peer-to-peer electronic cash system (Nakamoto, 2008), Bitcoin introduced two innovative solutions: (a) the blockchain, a decentralised, immutable and incorruptible public ledger shared by all network nodes; and (b) the 'Proof-of-Work' consensus protocol, a method used to decide on the validity of the transactions recorded on the blockchain (Davidson et al., 2016). The Proof-of-Work mechanism comes as a complement to the blockchain. It improves its security by requiring network nodes to solve computationally-intensive mathematical problems before they can validate a particular block of transactions. A new block is added to the blockchain only after the network has reached consensus about the validity of all the transactions contained into that block (Wright and De Filippi, 2015). New Bitcoin tokens are simultaneously awarded by the network to the first user that solves the mathematical problem related to any given block. This process, called 'mining', is designed to reward people for contributing computational power to the Bitcoin network, to secure the network whilst supporting its growth.

Bitcoin is the first concrete example of a distributed network with an intrinsic incentive mechanism (Van Valkenburgh et al., 2014). Following Bitcoin's innovation, there has been an increasing interest to explore the potential of blockchain technology in other fields of human activity. New applications have been developed with the blockchain, including digital currencies, self-executing smart contracts platforms, along with many financial and non-financial services (Wright and De Filippi, 2015).

4.2. Justification and methods

Backfeed presents a conceptual model that makes the case for a new form of governance with an incentivisation system implemented on the blockchain. There are many online communities that cooperate in a decentralised manner, as in the case of Free and Open-Source Software, Wikipedia, OpenStreetMaps, CouchSurfing or WikiHouse. Such communities aggregate smaller and larger contributions from a large number of people cooperating for the achievement of a common goal.

Yet, while some of these communities have acquired a sufficient degree of visibility to become self-sustainable, the majority of such communities operate on a very small scale, often on a local territory or in a niche area. These communities usually comprise a small handful of

highly motivated contributors, and a slightly larger number of people who contribute on an ad hoc basis (Fuster Morell et al., 2014). Because they do not have a proper incentivisation system inherent into their governance structure, these communities are often having a hard time attracting new contributors beyond the highly intrinsically motivated individuals (Arvidsson et al., 2016).

Hence, scaling up for these communities usually means formalising into a more rigid hierarchical structure and adopting a market-oriented approach. The community starts to turn into a company or other legal entity to accumulate necessary funds and reward contributors with economic returns. This approach often conflicts with the original intentions of the community, which is generally focused towards building social relations and promoting cooperation among a distributed network of peers, rather than increasing profits. This issue was very well illustrated by the shift of CouchSurfing from a non-profit to a for-profit corporation, which led to the gradual dissipation of the community members, who could no longer reflect themselves into the value system of the new entity (Bauwens, 2011; Johnson, 2011).

The Backfeed model represents a potential solution to these problems. It enables a type of governance that reflects the decentralised approach seen in most of these communities, as well as a reward system based on the perceived value of every contribution. Backfeed intends to support a dynamic governance structure that does not focus on a set of predefined roles and tasks, but rather on an open and meritocratic model, where everyone is free to contribute to a particular community in the way they see most fit. In turn they are rewarded with reputation that reflects their influence in the governance of the community. Also, they receive an economic compensation in the form of digital tokens, which can be used to benefit from the services offered by the community, but also represent an actual (equity) share in the organisation.

This is especially relevant for the sharing economy, which mostly relies on a centralised crowd-sourcing model, where people contribute to a platform but do not actually benefit from its success. With Backfeed, every community member is simultaneously a contributor and an actual shareholder in the service provided by the community. Hence, everyone has an incentive to maximise the value of that service, as the most successful it is, the greater the potential benefits will be.

In terms of methods, Backfeed is approached as an intrinsic case study (Stake, 1994). The main motivation is to develop a deeper understanding of this particular case for its own sake, as it is of particular interest with regard to the employment of blockchain technology in relation to value systems. Moreover, the authors adopted a participatory approach to case-study research, where internal participants of the case contribute to the research, thus providing better insight of the underlying processes of the issue within its contextual setting (Reilly, 2010). One of the authors is among the instigators of Backfeed, while the other two authors have provided critical checks and balances against bias or predisposition towards verification of the examined notions.

The adoption of the participatory approach serves to present certain insights and issues that are significant to the people involved in the case, who also participate as co-researchers (Reilly, 2010; Reason & Bradbury, 2008). In participatory research the primary purpose is to produce practical knowledge that is useful to the interested social groups and to create new forms of knowledge from a particular setting (Reason & Bradbury, 2008). The outcome of participatory research is a change or improvement of the investigated case, rather than reproducible and generalisable findings. Therefore, an objective and positive approach is not the most suitable, while critical subjectivity and reflexivity offer more value. In turn, researchers benefit from the better insights by engaging an equal partner with insider view and knowledge, while gaining confidence in the interpretation of the data, since they are founded on authentic experiences (Reilly, 2010).

The Backfeed model is mostly theoretical and based on a superficial understanding of how it could apply in practice to real-world communities. Given the early stage of the technology, there is no robust

empirical evidence with regard to the practical implementation of this model. Nevertheless, the case is supported by data collected from an early experimental trial. The Backfeed protocol has been tested with the OuisShare community, a network of researchers, activists and entrepreneurs from the sharing economy, who were eager to experiment with a more decentralised system to deal with the organisation of the OuisShare festival in Paris, 2015. The experiment began with a kick-off meeting in October 2015 and had been going on over the course of the following six months preceding the start of the festival (May 2016).

The participatory approach was adopted in the experiment as well. Selected participants from the OuisShare community were engaged in the research to contribute with a deeper understanding of the collaborative dynamics, which came into play within this particular setting. The people behind the Backfeed project, including one of the authors, had several in-person meetings with the members of the OuisShare community that participated in the trial. The goal was to collect direct feedback on the issues that were encountered with the platform, and react expediently to fix these issues. Overall, the experiment did not work as well as originally expected, but it had provided important insights on how to tweak and refine the Backfeed protocol so as to better suit the needs of this community.

In the rest of this section we first present the conceptual model of Backfeed and then we discuss it in connection with the theoretical framework. Finally, we summarise the main takeaways from the OuisShare experiment, along with the main limitations of the model. The primary aim is to understand how Backfeed is potentially related to a new system of value that could support the operations and long-term sustainability of CBPP.

4.3. The case of Backfeed

Bitcoin has marked the beginning of a nascent industry of distributed applications with the issuance of tokens on a blockchain (Van Valkenburgh et al., 2014). These tokens represent a generic and measurable unit of value, imbued with the rules of the network that issued them. Most of these applications implement a specific protocol for the issuance of these tokens. Typically, they provide incentives for users to commit resources to the network and, thus, secure transactions without the need of a trusted intermediary. As long as people trust the underlying technological infrastructure, it is possible for them to engage in peer-to-peer transactions. But when it comes to more complex social relationships, involving sharing of resources and assets, blockchain technology alone does not suffice for people to develop trusted interactions.

To address this issue, Backfeed has developed an additional trust layer, based on human relations, which enables people to engage in secure and decentralised trusted interactions on top of the 'trustless' blockchain technology. For the purposes of this presentation we introduce a new type of organisational structure called 'Decentralised Cooperation' (DC). The DC encapsulates any type of structure that allows autonomous agents to collaborate and achieve a common goal, by making spontaneous contributions with no central coordination or ruling authority.

The inspiration for Backfeed has been 'stigmergy': a form of indirect coordination encountered in certain species of animals (such as ants, termites and birds), where individual agents leave trace in their environment, so as to inform the actions of other agents (Davidson et al., 2016; Marsh and Onof, 2007). Backfeed builds on blockchain technology to replicate the same model in the context of spontaneously emerging networks of peers. This is achieved through a social operating system, representing a generic protocol layer that sits in-between the blockchain infrastructure and the actual applications that are deployed on the blockchain. This layer makes it possible for people to effectively manage, coordinate and reward contributions, while they collectively develop and deploy applications on the blockchain.

In order to establish the value contributed to a DC, Backfeed

elaborated a new consensus protocol named 'Proof-of-Value' (PoV), which consists of two components: (a) a peer-to-peer evaluation system used to determine the perceived value of the various contributions; and (b) a reputation system that allocates influence according to the value contributed and the alignment with the overall perception of value of the community (Davidson et al., 2016). Without getting into too many technical details, we describe how these components of the Backfeed protocol are put into practice in a potential DC. Subsequently, we portray the interaction in a hypothetical ecosystem comprising different DCs.

4.4. The Backfeed protocol: interaction within a DC

Agents in a DC can contribute freely and in a spontaneous manner to the community's goal. An agent can be an individual or one facet of an individual (as an individual can be split into multiple agents), as well as a group of individuals, or any other entity that can act as an independent unit (e.g. a DC can be an agent in another DC). Agents are pseudonymous and they may choose what types of information they disclose about their identity. However, all agents in a DC have a unique account that tracks the record of actions (i.e. a historical log of contributions and evaluations) and record of equity (i.e. their balance of tokens and reputation score over time). This way, the information on the activity of any agent is shared with everyone in the network.

A contribution can consist of any action with potential value, tangible or intangible, for the DC. For instance it may be a new piece of code, a design, an idea or a service. The value of each contribution is determined through a participatory evaluation process, where agents evaluate contributions (including their own) in accordance to a reputation score. This process indicates their influence within the organisation.

Whenever a contribution is positively evaluated within the DC community, a reward is distributed to the contributor. The reward consists of a specified amount of economic tokens and reputation. Token distribution serves to incentivise agents to make contributions to the DC, while the reputation score indicates their alignment with the value system of a community. The overall evaluation of a specific contribution is calculated by the system based on the reputation score. The amount of tokens distributed to the contributor depends on the median value of all weighted evaluations, accounting for the total reputation of the DC and not just that of the evaluators. Tokens are issued after a minimum of 50% of the DC community's reputation took part in the evaluation of a certain contribution.

Tokens in a DC serve as transferable value-carrying units that can be used as items of reward, media of exchange, means of payment and measure for wealth. They simply indicate that value has been created, so they do not provide a link to the individual that they were initially issued. Hence, they may be transferred and exchanged similarly to most currencies. Conversely, reputation indicates the level of alignment an individual has to the DC's value system. As such, reputation may not be transferred as it is linked to the agent who has earned it.

The reputation score can increase in two ways: (a) through a contribution that is perceived as valuable by (all or a part of) the community; and (b) through a useful evaluation of others' contributions, meaning an evaluation that is retrospectively aligned with the evaluations of the rest of the community. Thus, the objects of evaluation are not only the contributions to the organisation, but also the alignment of these evaluations with respect to the overall value system of the organisation. Reputation is issued to contributors whenever the median value of their respective contributions reaches a positive value, i.e. when more than 50% of the DC reputation considers that a contribution is valuable. Therefore, new reputation cannot be issued without consensus within the community. The precise amount of reputation to be issued for each evaluation is specifically defined, on a case-by-case basis, for each individual DC, based on the chosen evaluation set (i.e. the set of possible values with which a person can evaluate a

contribution, e.g. on a scale from 1 to 5).

To make an evaluation, agents need to put some of their reputation at stake, meaning that a certain fraction of the evaluator's reputation is deducted from its overall reputation upon making an evaluation. The protocol encourages people to evaluate contributions at an early stage. This is achieved by reallocating the reputation stake of each evaluation to all the evaluators that have been aligned earlier. Hence, the earlier an evaluation is made, the greater are the potential rewards to be earned. Eventually, as others evaluate the same contribution with a similar evaluation, those who are the most in line with the overall community's evaluation will be able to retrieve the reputation they lost, and often gain more reputation than they initially had.

4.5. The Backfeed ecosystem: interaction among DCs and the market

Backfeed suggests that every DC can set up its own tokens that function as transferable and exchangeable units of value. Each DC may feature a unique value system that organically emerges through its evolution, placing emphasis on the elements that its purpose or vision values the most. In this sense, every set of DC tokens is an expression of the specific conceptions of value that characterise the DC, which will determine the issuance and distribution of tokens within the DC. As described previously, on this level tokens represent equity share in the DC and new tokens are issued whenever new value is created or added. In turn, people can collect tokens by making valuable contributions to the DC operations.

At the same time, DC tokens represent the value provided by the DC within a broader ecosystem, as tokens can be exchanged for the products or services that a DC provides. In this case tokens acquire market value, which is then determined by the perceived value of the DC's products or services. In case the DC reaches a specific level of maturity with a stable user-base, the token value can be crystallised into a more steady value against other tokens or even fiat currency. People who do not contribute to the DC can then purchase tokens from the DC or other token holders.

Hence, we can imagine an ecosystem made up of several DCs, where a multiplicity of value systems emerge out of their interaction. Mutually interacting DCs are the constitutive elements of this ecosystem and support each other according to the extent at which they need each other's products or services. For instance, let's imagine two DCs, a community engaged in organic farming (DC1) and a FabLab (DC2). At some point DC1 may need the services of DC2 to build certain farming tools. For this, DC1 would have to acquire a number of DC2 tokens to get access to their services. Therefore, DC1 would either have to contribute to DC2 operations to acquire tokens as a reward, or invest in the purchase of DC2 tokens, thus indirectly increasing the market value of these tokens.

Similarly, the same options would be available if a conventional business (not of DC-type) or a local municipality needed the services of the FabLab. Likewise, local citizens could enjoy organic products from the organic farming community by either contributing to their production or by purchasing tokens. The DC ecosystem is thus not isolated and DCs can also liaise with the market and the public sector. They can use their impact to engage more agents into their productive processes, but also share their vision and social mission.

4.6. Discussion

The innovation of Bitcoin disrupted the global financial system, by featuring a decentralised digital currency and payment system that is governed by no government or financial institution. However, the value system encoded in the Bitcoin protocol is not much different from the conventional price system. It thus lacks the agility to effectively respond to the dynamics of sharing. On the contrary, the PoV protocol does not rely on a predefined perception of value that is then merely quantitatively represented in some sort of currency. It rather encapsulates a

multiplicity of different perceptions of value. By generalising the process of mining, Backfeed is inclusive to a much wider variety of contributions: anything that is believed to bring value to the community. The PoV protocol shifts the focus from algorithms to human relations and rewards active participation and meaningful contributions in line with the community values.

In relation to the three layers of value described earlier, the DC represents the core of value creation with regards to the first layer. Backfeed rationalises the dynamics of CBPP, by incentivising people to make meaningful contributions to a common goal. The contributors are engaged with no predefined roles and tasks and permissionlessly share their creative energy or other resources with the community. Productive communities may create commons embodying use value that is managed and utilised according to the rules of the community.

On the second layer, Backfeed deploys one of the most promising functions of the blockchain: a decentralised record of value with the ability to encapsulate qualitatively different contributions. The PoV protocol offers a mechanism for decentralised consensus that determines the value of each contribution. Simultaneously, a reputation system promotes merit within the community, in correlation with the level of engagement in its common goal and alignment with its values. It thus systematises a perception of value that is attached to meaningful collaboration. Eventually, Backfeed arguably supports greater pluralism in the variety of contributions and polycentricity in the governance of social relations.

Finally, in relation to the third layer, a model for a new type of economy is envisioned, where value reflects people's capacity to engage in sharing, in terms of contributing to and benefiting from a collaborative process. This is achievable through the function of tokens, which is connected with active participation and actual interest in the operation of a DC. The value of tokens becomes real for the people by allowing them to benefit from the products and services produced in the DC ecosystem. This way, the tokens of a DC are quanta of value that represent, not only the perceived usability of the respective products or services, but also the more general benefit for the broader ecosystem.

The interrelation of Backfeed with the three layers of value is graphically presented in Fig. 1 below.

More importantly, the system of value effectuated by Backfeed facilitates the viability of a new business logic, where the community of users/producers is in control of the productive processes. Hierarchical

command and control is less relevant, as individuals benefit from the mutualised resources of the community, based on their merit and the perceived value of their contributions. Moreover, through the exchange of tokens they can support and engage in transactions with other communities, but also co-exist and remain interoperable with traditional market-oriented entities and government institutions.

Backfeed thus illustrates a potential application of the blockchain for more open and meritocratic governance. Whereas 'open', with reference to the open-source mindset, is understood as enabling people's capacity to participate on equal footing; and 'meritocratic' is related to a fair distribution of power, based on merit as perceived in the sense of the greater good. It should be clarified that open participation and meritocracy are not considered goals within themselves, while it can be argued that these principles alone do not necessarily determine a better vision for the society. They are, however, closely associated with the dynamics of social sharing and have been exemplified in numerous communities that produce commons. In this view, blockchain technology poses some significant opportunities for the sharing economy and its potential for societies to efficiently allocate their resources in a more fair and sustainable fashion.

However, in practice there are certainly many limitations for the proposed model. Backfeed is merely a technological solution and even the most sophisticated mathematical model might fail in the face of unexpected events or external dynamics. Bitcoin actually gives a clear example of that. Launched in 2009, it was designed as a perfectly decentralised system, combining distributed network technologies, cryptography and game theory to build a secure peer-to-peer payment system. After 7 years of operations, even though the Bitcoin protocol is theoretically still decentralised, in practice the Bitcoin network is operated by a small number of mining pools, which together control over 75% of the network (Blockchain.info, 2017). Hence, while the model was theoretically viable, it failed to take into account the possibility of external economic and political forces intervening into the system undermining its decentralised character.

In contrast, Wikipedia illustrates the opposite case. People often fail to comprehend how the particular model of Wikipedia works in theory, yet it does work in practice. The reason is that, although there is no formal economic model that can explain why people contribute to it, a series of social and political dynamics make the system work. For instance, for the majority of Wikipedia editors the primary reasons to

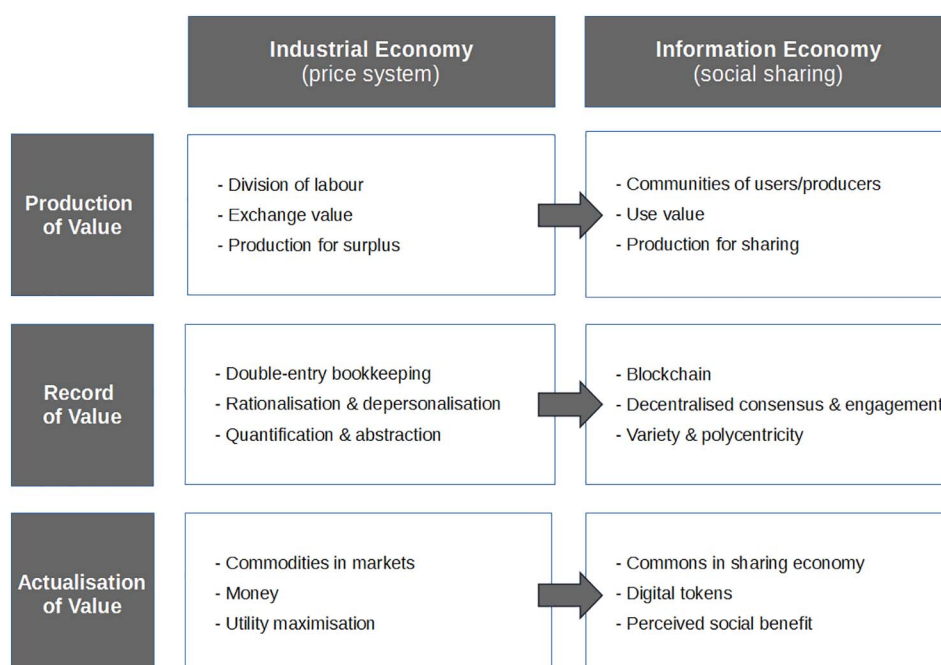


Fig. 1. The transition from the industrial economy to the information economy and the associated systems of value. Retrieved from: Authors' own work. Licensed under CC-BY-SA 4.0.

contribute to articles was the idea of volunteering and sharing knowledge about a subject they have significant expertise (Wikimedia Foundation, 2011). At the same time, the people who contribute to Wikipedia are also the ones most likely to make donations (Khanna, 2012). Furthermore, even though Wikipedia has not been particularly designed to attribute credit to its contributors, this appears to be happening indirectly within certain communities (Forte and Bruckman, 2005). Hence, regardless of the accuracy of the theoretical model, empirical analysis is always required in order to assess and validate it.

In the case of Backfeed, it is too early to say whether its model is socially viable or not. The experiment with OuiShare has pointed out the main limitations to the model. Most notably a degree of reluctance has been identified by certain community members in recording their contributions and in actually defining the scope of these contributions. The Backfeed model also failed to take into account the feelings that emerged when people had to evaluate the contributions of others, or, even worse, to have their contributions evaluated by others.

Most importantly, the OuiShare experiment has shown that many community members were actually afraid that the use of an evaluation system, like the one proposed by Backfeed, would actually reduce many social relations and human interactions into mere transactions in a market-driven economy, whereby every action needs to be registered, assessed, and evaluated by the community. This generated a sense of discomfort among a few members of the OuiShare community, who thought that some interactions – especially those related to emotional attachment and care for others – should remain into the realm of social connections, and not be contaminated by any quantitative or qualitative evaluation process.

Furthermore, we do not suggest that Backfeed or blockchain technology can alone resolve issues concerning power relations, excessive influence or greed. A technological infrastructure cannot simply code-away the problems that are inherent in human relations. It also cannot profoundly determine the governance model that will eventually be enacted in an organisation. It could, however, facilitate and enhance the types of productive relations that are identified as the most meaningful in an organisation, enabling it to develop and scale. For this a conscious and continuous effort by each member is required, so as to maintain conflicts under control and make the system viable and sustainable.

These concerns, more than anything, illustrate a more general limitation regarding blockchain technology. While the applicability of the technology seems relevant to many aspects of human interaction, its implementation at scale is yet to be seen. The technology is indeed pervasive and resilient, nevertheless it still cannot operate outside the sphere of computation. Whether tokens or monetary units, the logic is, to a large extent, still one of quantification. Just as double-entry bookkeeping developed vis-a-vis the abstracted, rationalised and impersonal logic of the capitalist spirit, both in practice and in economic scholarship, the blockchain could as well be associated with a machine-like responsiveness and predictability overwhelming the economic affairs.

Technology can facilitate distributed systems to scale and become viable; however it is the genuine dynamics of sharing and the underlying human sociality that should guide the design and deployment of technological solutions. To this direction, there is a high duty for an interdisciplinary and inclusive approach, involving ICT along with social sciences, as well as philosophy and ethics, so as to avoid getting locked in narrow theoretical and empirical perspectives.

5. Conclusions

The main motivation of this article was to explore an ongoing transformation in the economy, in response to technological changes. We focused on the role of value systems in relation to the wider logic that determines actions as meaningful within a certain context. The object of study was the sharing economy, and the main research

question concerned how value could be assessed and distributed, based on the dynamics of social sharing.

We began our theoretical inquiry with a historical account of value in the economic thought. A set of arrangements were identified that established capitalism as a dominant mode of production and determined exchange power as the main expression of value. Afterwards, we examined the context of the information economy, insofar it improves our understanding of the factors that have spawned the sharing economy as a new modality of resource allocation and exchange in societies. The transformation of productive relations was examined focusing on the changing conditions of labour and the nature of information. In response, a new modality of production, namely commons-based peer production (CBPP), was identified as the sphere within which a genuine sharing economy could function. Finally, the potential of blockchain technology was discussed as a medium of value that could crystallise the dynamics of CBPP, as the dominant rationality of a new economic system.

Three interrelated layers associated with value were elaborated to decipher the components that would integrate a new system of value. The first layer, production of value, is related to the dynamics of CBPP and the sharing of use values, with the communities of contributors at the core. For the second layer, we examined blockchain technology as a medium for value record that could effectively determine the value of contributions to CBPP. We introduced a mechanism for decentralised consensus through the case of Backfeed, which relies on participatory evaluations and reputation-based influence. Finally, a token-based economic model was presented, which tentatively integrates this new system of value, providing the final layer of value actualisation. The tokens issued through collaborative processes represent a fair share of the created value and a reward for the contributors, and simultaneously they reflect the perceived value of the products and services they produce. Certain opportunities and limitations have been identified in relation to Backfeed and blockchain technology.

On one hand, the Backfeed protocol can help productive communities, which engage in social sharing to create commons, to enact their own systems of value, through an inclusive, consensus-based approach. Simultaneously, it allows them to interface with one another and the market, and eventually scale and become sustainable. It thus can help us envision an ecosystem composed by a variety of value systems that fuel the circulation of commons in a sharing economy. In such an ecosystem value would become perceptible in a way that it shifts away from the logic of utility maximisation, towards the general benefit for the society.

On the other hand, the application of Backfeed, and in fact any similar system of evaluation, poses certain challenges to the internal relations in productive communities, related to trust, reciprocity and intrinsic motives. Moreover, the technology is still at a very early stage and more empirical data are necessary to support its real life application. More generally, there are well-justified doubts on the extent that the blockchain alone can help communities solve issues concerning power and influence. At the same time, with the technology yet to reach a dominant design, it is too early to predict how it would operate on large scale. In any case, regardless of the development of blockchain technology or the eventual success of Backfeed as a project, its conceptual model allegedly presents an interesting scenario for the sharing economy and the role the latter can play in societies.

Funding

Vasilis Kostakis and Alex Pazaitis acknowledge financial support from the Estonian Ministry of Education and Research [grant numbers: B52, IUT (19-13)].

All the authors acknowledge financial support from the European Commission Framework programme FP7-ICT-2013-10 [grant number.: 610961].

Acknowledgement

Section 4 (case study) is based on two white-papers conducted to present the ideas underpinning Backfeed, namely: ‘Technical Summary’ and ‘Economic Model’, authored by (in alphabetical order): Primavera De Filippi, Matan Field and Elad Shitlerman.

References

- Aristotle, 1897. *The Nicomachean Ethics*. Translated by J. E. C. Welldon London.
- Arvidsson, A., Colleoni, E., 2012. Value in informational capitalism and on the Internet. *Inf. Soc.* 28 (3), 135–150.
- Arvidsson, A., Fuster Morell, M., Berlinguer, M., Caliendo, A., Cossu, A., Deka, M., Gandini, A., Luise, V., Orria, B., Salcedo, J., Anselmi, G., 2016. Value in CBPP. Deliverable 4.3, P2Pvalue: techno-social platform for sustainable models and value generation in commons-based peer production in the future Internet. FP7-ICT-2013-10 (project: 610961). Available from: https://p2pvalue.eu/wp-content/uploads/2013/07/Deliverable_4.3.pdf (Accessed: 15.01.2017).
- Baldwin, J.W., 1959. *The Medieval Theories of the Just Price: Romanists, Canonists, and Theologians in the 12th and 13th Centuries*. American Philosophical Society, Philadelphia.
- Bauwens, M., 2005. The Political Economy of Peer Production. *CTheory Journal*. available at: <http://www.ctheory.net/articles.aspx?id=499> (accessed: 11 July 2016).
- Bauwens, M., 2011. On Couchsurfing becoming a B corporation: The controversy. In: P2P Foundation Blog, . available at: <https://blog.p2pfoundation.net/on-couchsurfing-becoming-a-b-corporation-the-controversy/2011/09/02>, (accessed: 15 January 2017).
- Bell, D., 1973. *The Coming of Post-Industrial Society: A Venture in Social Forecasting*. Basic Books, New York.
- Benkler, Y., 2004. “Sharing nicely”: on shareable goods and the emergence of sharing as a modality of economic production. *Yale Law J.* 114, 273–398.
- Benkler, Y., 2006. *The Wealth of Networks: How Social Production Transforms Markets and Freedom*. Yale University Press, New Haven, CT.
- Blockchain.info, 2017. Bitcoin hashrate distribution: an estimation of hashrate distribution amongst the largest mining pools. available at: <https://blockchain.info/pools> (accessed: 15 January 2017).
- Bollier, D., 2014. The commons as a template for transformation. Great transition initiative. available at: <http://www.greattransition.org/document/the-commons-as-a-template-for-transformation> (accessed: 15 January 2017).
- Bollier, D., 2016. State Power and Commoning. A Report on a Deep Dive Workshop Convened by the Commons Strategies Group in Cooperation with the Heinrich Böll Foundation, 28 Feb–01 Mar 2016, Berlin Commons Strategies Group. available at: <http://cdn8.commonstrategies.org/wp-content/uploads/2016/07/State-Power-and-Commoning.pdf>. (accessed: 15 January 2017).
- Castells, M., 2010. *The Rise of the Network Society*. Blackwell, Oxford.
- Davidson, S., De Filippi, P., Potts, J., 2016. Economics of Blockchain. SSRN. URL: <http://ssrn.com/abstract=2744751>. [or http://dx.doi.org/10.2139/ssrn.2744751](http://dx.doi.org/10.2139/ssrn.2744751), (accessed: 11 July 2016).
- Drucker, P., 1968. *The Age of Discontinuity: Guidelines to Our Changing Society*. Harper and Row, New York.
- European Commission, 2016. A European agenda for the collaborative economy. In: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM (2016) 356 final, Ref. Ares(2016)2562059.
- Forté, A., Bruckman, A., 2005. Why do people write for Wikipedia? Incentives to contribute to open-content publishing. position paper. In: GROUP 05 Workshop: Sustaining Community: The Role and Design of Incentive Mechanisms in Online Systems. Sanibel Island, FL.
- Fuchs, C., 2010. Labor in informational capitalism and on the Internet. *Inf. Soc.* 26 (3), 179–196.
- Fuchs, C., 2012. With or without Marx? With or without capitalism?: a re-joinder to Adam Arvidsson and Eleanor Colleoni. *TripleC* 10 (2), 633–645.
- Fuster Morell, M., De Rosnay, M.D., Musiani, F., Capdevila, I., Berlinguer, M., Salcedo, J., Tebbens, W., Arvidsson, A., Caliendo, A., Gandini, A., Rosas, D., 2014. Theoretical synthesis: final theoretical synthesis of WP1, including research reports on data collection. Deliverable 1.2, P2Pvalue: techno-social platform for sustainable models and value generation in commons-based peer production in the future Internet. FP7-ICT-2013-10 (project: 610961). Available from: [https://p2pvalue.eu/wp-content/uploads/legacy/files/u28/D12_31July_TheoreticalFindingsA%20\(1\).pdf](https://p2pvalue.eu/wp-content/uploads/legacy/files/u28/D12_31July_TheoreticalFindingsA%20(1).pdf) (Accessed: 15.01.2017).
- Gibson, R.W., Carnegie, G.D., Wolnizer, P.W. (Eds.), 1996. *Accounting History Newsletter, 1980–1989 and Accounting History, 1989–1994: A Tribute to Robert William Gibson*. Taylor & Francis, Abingdon.
- Graeber, D., 2001. *Toward an anthropological theory of value: The False Coin of Our Own Dreams*. Palgrave, New York.
- Hardt, M., Negri, A., 2000. *Empire*. Harvard University Press, Cambridge, Mass.
- Hardt, M., Negri, A., 2004. *Multitude: War and Democracy in the Age of Empire*. Penguin, London.
- Hollander, J.H., 1904. The development of Ricardo's theory of value. *Q. J. Econ.* 18 (4), 455–491.
- Ito, J., 2016. In: Ito, Joi (Ed.), *Reinventing Bookkeeping and Accounting (in Search of Certainty)*, Apr 26, 2016. URL: <http://joi.ito.com/weblog/2016/04/26/reinventing-book.html> (accessed: 11 July 2016).
- Jevons, W.S., 1871. *Theory of Political Economy*. Macmillan, London.
- Johnson, B., 2011. After going for-profit, CouchSurfing faces user revolt. In: Gigaom.com, (Available from: <https://gigaom.com/2011/09/01/after-going-for-profit-couchsurfing-faces-user-revolt>. Accessed: 15.01.2017).
- Khanna, A., 2012. Who are Wikipedia's donors? Answers from the readers study. In: *blog.wikimedia.org*, (Available from: <https://blog.wikimedia.org/2012/02/05/who-are-wikipedias-donors>. Accessed: 15.01.2017).
- King, J.E., McLure, M., 2015. Value: history of the concept. In: Wright, J. (Ed.), *International Encyclopedia of the Social & Behavioral Sciences*, second ed. Elsevier, pp. 7–13.
- Kostakis, V., Bauwens, M., 2014. *Network Society and Futures Scenarios for a Collaborative Economy*. Palgrave Macmillan, Basingstoke.
- Kostakis, V., Roos, A., Bauwens, M., 2016a. Towards a political ecology of the digital economy: socio-environmental implications of two competing value models. *Environ. Innov. Soc. Trans.* 18, 82–100.
- Kostakis, V., Latoufis, K., Liarokapis, M., Bauwens, M., 2016b. The convergence of digital commons with local manufacturing from a degrowth perspective: two illustrative cases. *J. Clean. Prod.* <http://dx.doi.org/10.1016/j.jclepro.2016.09.077>.
- Machlup, F., 1962. *The Production and Distribution of Knowledge in the United States*. Princeton University Press, New Jersey.
- Marsh, L., Onof, C., 2007. Stigmatic epistemology, stigmatic cognition. *Cogn. Syst. Res.* 9 (1/2), 136–149.
- Marshall, A., 1890. *Principles of Economics*, eighth ed. Macmillan, London.
- Marx, K., 1976. *Capital*, vol. I, 1867. Penguin, London.
- Meikle, S., 1995. *Aristotle's Economic Thought*. Clarendon Press, Oxford.
- Milios, J., Dimoulis, D., Economakis, G., 2002. Karl Marx and the Classics: An Essay on Value, Crises and the Capitalist Mode of Production. Ashgate, Burlington.
- Mill, J. S. 1848. *Principles of Political Economy with some of their Applications to Social Philosophy*, (7th edition). Edited by Ashley, J. (1909). London; Longmans: Green.
- Nakamoto, S., 2008. Bitcoin: a peer-to-peer electronic cash system. URL: <https://bitcoin.org/bitcoin.pdf> (accessed: 11 July 2016).
- Ostrom, E., 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press, Cambridge.
- Perez, C., 2002. *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Edward Elgar Pub, Cheltenham.
- Perez, C., 2004. Technological revolutions, paradigm shifts and socio-institutional change. In: Reinert, E.S. (Ed.), *Globalization, Economic Development and Inequality: An Alternative Perspective*. Edward Elgar Pub, Cheltenham, pp. 217–242.
- Porat M., *The Information Economy: Definition and Measurement*, Washington, DC: US Department of Commerce, Office of Telecommunications, Publication, 1977, 77-12 (1)
- Reilly, R., 2010. Participatory case study. In: Mills, A., Durepos, G., Wiebe, E. (Eds.), *Encyclopedia of Case Study Research*. Sage Publications, Thousand Oaks, CA, pp. 658–661.
- Reason, P., Bradbury, H., 2008. *The SAGE Handbook of Action Research*, second ed. Sage Publications, Thousand Oaks, CA.
- Ricardo, D., 1821. *On the Principles of Political Economy and Taxation*, third ed. Cambridge University Press, Cambridge (1951).
- Rigi, J., Prey, R., 2015. Value, rent, and the political economy of social media. *Inf. Soc.* 31 (5), 392–406.
- Rullani, E., 2004. *Economia della conoscenza. Creatività e valore nel capitalismo delle reti*. Carocci, Rome.
- Sewall, H.R., 1901. *The Theory of Value before Adam Smith*. Published for the American Economic Association. Macmillan, New York.
- Slee, T., 2016. *What's Yours is Mine – Against the Sharing Economy*. OR Books, New York.
- Smith, A., 1776. In: Cannan, E. (Ed.), *An Inquiry into the Nature and Causes of the Wealth of Nations*. 1790 London: Methuen.
- Sombart, W., 1902. *Der Moderne Kapitalismus*, Bd. 1: Die Genesis des Kapitalismus. Duncker & Humblot, Leipzig.
- Stake, R.E., 1994. Case studies. In: Denzin, N.K., Lincoln, Y.S. (Eds.), *Handbook of Qualitative Research*. Sage Publications, Thousand Oaks, pp. 236–247.
- Swan, M., 2015. *Blockchain: Blueprint for a New Economy*. O'Reilly Media, Sebastopol.
- Tapscott, D., Tapscott, A., 2016. *Blockchain Revolution: How the Technology behind Bitcoin is Changing Money, Business, and the World*. Penguin, New York.
- Toms, S., 2008. Immeasurability: a critique of Hardt and Negri. *Ephemera Theory Polit. Organ.* 8 (4), 433–446.
- Van Valkenburgh, P., Dietz, J., De Filippi, P., Shabad, H., Xethalis, G., Bollier, D., 2014. *Distributed Collaborative Organisations: Distributed Networks & Regulatory Frameworks*. Coin Center.
- Veitas, V., Weinbaum, D., 2017. Living cognitive society: a ‘digital’ world of views. *Technol. Forecast. Soc. Chang.* 114, 16–26.
- Walras, L., 1874. *Elements of Pure Economics*. Irwin, Homewood, IL (1954).
- Webster, J., Randle, K., 2016. *Virtual Workers and the Global Labour Market*. Palgrave Macmillan, Basingstoke.
- Wikimedia Foundation, 2011. *Wikipedia Editors Survey*. Wikimedia Foundation (April 2012). Available from: https://meta.wikimedia.org/wiki/Research:Wikipedia_Editors_Survey_2011_April#Download_the_Editor_Survey_2011_report. Accessed: 15.01.2017).
- Wright, A., De Filippi, P., 2015. Decentralized Blockchain technology and the rise of Lex Cryptographia. Available from: <http://ssrn.com/abstract=2580664> (accessed: 11 July 2016).
- Yamey, B.S., 1949. Scientific Bookkeeping and the Rise of Capitalism. *The Economic History Review*, Second Series I(2&3), pp. 99–113.
- Yamey, B.S., 1964. Accounting and the rise of capitalism: further notes on a theme by Sombart. *J. Account. Res.* 2 (2), 117–136.

Alexandros (Alex) Pazaitis is Research Fellow at P2P Lab, an interdisciplinary research hub, community-driven makerspace and spin-off of the Ragnar Nurkse Department of Innovation and Governance, Tallinn University of Technology and the P2P Foundation. Alex is participating in numerous research activities, including authoring of scholarly papers and participation in research and innovation projects. He has professional experience in project management and has worked as a consultant for private and public organizations. His research interests include technology governance; innovation policy and sustainability; distributed manufacturing; commons, open cooperativism and blockchain-based collaboration.

Primavera De Filippi is permanent researcher at the National Center of Scientific Research (CNRS) in Paris and faculty associate at the Berkman Center for Internet & Society at Harvard Law School, where she is investigating the concept of

“governance-by-design” in relation to online distributed architectures. Her research focuses on the legal challenges raised by emergent decentralised technologies - such as Bitcoin, Ethereum and other blockchain-based applications - and how these technologies could be used to design new governance models capable of supporting large-scale decentralised collaboration and more participatory decision-making. Furthermore, she is co-founder of the Tel Aviv-based start-up Backfeed.

Vasilis Kostakis is Senior Research Fellow at the Ragnar Nurkse Department of Innovation and Governance, Tallinn University of Technology, as well as visiting Research Fellow at the Department of Social and Cultural Anthropology, VU University Amsterdam and visiting Scholar at the Institute of Environmental Science and Technology, Autonomous University of Barcelona. Moreover, he is Founder of the interdisciplinary research hub P2P Lab.