The Future of Money and Further Applications of the Blockchain[1]

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Introduces theme of Special Issue, summarizes contributions and indicates directions for future research.
Blockchain technology provides exciting application space for innovation in diverse domains but threatens disintermediation for organisations providing a trusted and auditable account of ownership and transactions.
Need for regulation to keep pace with technological developments.
Technology remains very young, akin to the internet in the early 1990s, use cases, practical demonstrators, standards and lexical consistency are urgently required.

The internet allows the digitisation and global transfer of information, but has lacked a trustworthy mechanism to securely transfer assets without the mediation of third parties. Satoshi Nakamoto (2008), in his original and highly accessible white paper '*Bitcoin: A Peer-to-Peer Electronic Cash System'*, proposed "a system for electronic transactions without relying on trust". The paper proposed solutions to two fundamental challenges, double-spending (which had plagued previous attempts at virtual currencies) and the Byzantine Generals' problem, (ensuring the security and actionability of transmitted messages) thus making digital currencies realistically feasible. The system proposed a *cryptographically enabled distributed ledger* popularly referred to as the Bitcoin-developed "blockchain". This is a disintermediating and decentralizing proposition, with no reliance on a trusted third-party to guarantee counterparties or transactions, relying on consensus for authentication. As such it was a purely technical paper, but increasingly Bitcoin the currency is being seen as R&D for blockchain, the revolutionary enabler. As the logical ramifications of implementation and adoption are worked through, the blockchain, more than digital currencies themselves, promises to be an innovation *at least* as disruptive and transformative as the internet has been. This special issue examines contexts and implications of the disruptive potential of blockchain for incumbent and start-up organisations via contributions from authors actively engaged in the field. The contributors, from both academia and practice, reflect on the question, 'what are new technologies like Bitcoin and blockchain for?'

The technical innovation that the blockchain represents is focused on distributed, decentralized data architecture: it enables a shift from central authority to community consensus, from controlling hand to community management. Blockchains are designed to be a tamper-proof record of transactions held and maintained in a distributed fashion by the community such that it is owned and controlled by no one individual.

Decentralized models have the potential to reorganise all manner of human activity (Foroglou and Tsilidou, 2015), with potentially wide implications including: commerce, government, freedom, jurisdiction, censorship and regulation. Just as the internet has provided real-time

[1] JEL classification codes: D02; G20; L20; O32; O35; P11; Q55

settlement of information, so the blockchain can provide real-time settlement of worth (or value-in-exchange). Currently, worth is predominantly identified and measured in the form of money, but in future it is envisaged that a diverse range of tangible and intangible asset types will be transacted. The music industry is currently promoting the use of blockchain technology and cryptocurrencies as new royalty-distribution mechanisms to manage and track intellectual property and online payments (Rethink Music, 2015). In another case, Provenance.org is using the blockchain to enable supply chain transparency and secure traceability for materials, ingredients and products, providing product authentication as well as value-adding appended product stories. The work presented here seeks to provide much greater depth of explanation as to the developments.

The disruption that the blockchain poses may play out in human-to-human, human-to-machine, and machine-to-machine transactions, prompting the emergence of a difficult-to-envisage novel structuration and operation of society as established power relationships and hierarchies lose their utility (Swan, 2015). Further, these technological developments pose significant ethical questions in their design and use (Bergstra and de Leeuw, 2013) derived, for example, from developers' and adherents' underlying political and economic philosophies which may be closer to anarchy than accepted order (Godsiff, 2015). As 'machines become smarter' we will face the unintended consequences of evolution or irresponsible use (Ahmed, 2015). This is not an uncommon situation with IT and internet developments and most research to date has focused on technical challenges such as cryptography. Given the current interest and growth in cryptocurrencies and distributed ledger technologies, more practical and research work is needed in non-technical areas. In order that we have the answers in place well ahead of time immediate consideration must be given to legal and ethical issues and practices being "designed in" rather than retrofitted later (Edwards, 2013; Kwecka *et al.*, 2014). A "mixed reality" is emerging where virtual and real worlds are increasingly conjoined and confounded. Should online or real world legislation be the better guide to rights over data and property (Michailaki, 2014)? The *TheDAO* hack (see Voshmgir, this issue) and the subsequent reconstitution of the blockchain poses questions as to whether or not code, perceived intent, or some higher form of "moral" authority should be paramount. In a trustless system who or what (e.g. some form or arbitrating deus ex machina) do you (need to) trust?

It can be argued that industry, outside the narrow confines of early adopters, remains confused about the potential uses of blockchain[2]. There is clearly an education piece to be done by both researchers and practitioners if the potential benefits of this new technology are to be properly exploited. One solution will be to form more consortia; not to prevent originality, but to prevent duplication and encourage experimentation leading to faster innovation.

Better understanding of the economic, social, organisational, environmental and governmental benefits and drawbacks of blockchain technologies is required. This will not be a straightforward task; early adherents and followers of Satoshi described the need for an iterative process to develop understanding (Smith 2014). The UK Government Office for Science report, "Distributed Ledger Technology: beyond blockchain" (Walport 2016) provides one starting point, providing explanation and laying out future pathways to blockchain exploitation.

The purpose of this special issue is to further address the need to share understanding of the current applications in development, and by doing so contribute to this journal's mission, to close

[2] http://www.cnbc.com/2016/12/14/2017-challenge-for-blockchain-executives-obstacles-regulation.html

"information gaps (between) academic thinking and empirical interpretation", by including "experiences gained from the practitioner's field …and the business community" as well as "building interactive communication between practitioners and researchers". The editors and reviewers of this special issue selected papers that contribute to the need for exacting and insightful research into blockchains and distributed ledger technologies which will both stimulate the necessary societal discourse around this exciting and disruptive technology and further the missions of the journal.

Overview of contributions

There are 10 papers in this special issue reflecting contributions from academic researchers as well as from practitioners and expert commentators. The original call 'The Future of Money and Further Applications of the Blockchain' was ambitious as the editors want to highlight the possibilities for Distributed Ledger Technologies (DLT) not only within the financial services industry but beyond as well. Further, the aim is to provide a forum for critical conversation about the risks, complexities, hopes and expectations of integrating this novel technology into existing systems and infrastructure. The 10 papers cover diverse terrain, from the blockchain's potentially transformative effects in the recorded music industry by O'Dair and Beaven, to Robert Herian's critical examination of the intersection between law and the blockchain. This editorial now provides a brief summary of each of the contributions.

Scott et al. locate the emergence of cryptocurrencies and the blockchain as the latest disruptor of corporations in the relatively short history of digital technologies. In particular, they focus on the potential for radical transformation in the way in which users might engage with financial services. The authors explore five factors that will be influential in determining future usage of blockchain technologies, in particular Distributed Collaborative Organizations, including: building a platform for trust; increasing political influence; supporting remittances; facilitating global commerce; and encouraging disintermediation. Their analysis highlights reasons why the technology might be only slowly adopted in regimes where existing infrastructure is stable, functioning and relatively well-trusted. In comparison, they point to alternate scenarios where, for example, transaction costs are high or where individuals are excluded (wittingly or unwittingly) from existing infrastructure (e.g. international remittances). The central question, they argue, is about either transitioning from existing systems of institutionalized trust or building novel systems where previously none existed.

Nakamoto's (2008) original conception was for a peer-to-peer electronic cash system. Subsequently, and unsurprisingly, the non-technical research literature has tended to focus on implications in financial services. Kewell et al. move beyond this narrow perspective to consider how blockchain technologies might be operationalised in support of the UN's Sustainable Development Goals (SDG) or, as they put it, 'Blockchain for Good'. The potential of DLTs for the SDGs, they argue, relies on being able to recognise the existence of meaningful *affordances*. The idea behind affordances is that artefacts such as technologies have no power in and of themselves: rather, they have 'action possibilities' (Withagen and Chemero, 2012), bound to users' perceptions of what the artefacts can be or can do. In spite of criticisms of Bitcoin as 'evil' (Krugman, 2013) as well as the dominant focus of research effort on financial services, Kewell et al. present evidence of a growing number of DLT initiatives that include a remit for doing good.

In his paper "Future Applications of Blockchain in Business and Management: a Delphi study" White examines blockchain as a digital innovation. The work provides an overview from the

limited literature available in selected leading academic databases on blockchain in early 2016. The search revealed only 28 papers across computer science and business. In order to explore the potential of blockchain as an innovation, the author employs a Delphi study with academic and practitioner experts to capture their perspective on the potential future application of this technology by asking the question "*how blockchain may be expected to change the future of business?*" The study identifies seven possible applications, some of which have been or are being developed but others that may still provide opportunity for innovation and development. This study, though reporting on a very limited number of respondents, is interesting in providing an estimate of the potential of blockchain applications. As a longitudinal piece it will provide a test of blockchain development and how good the Delphi technique is at predicting future applications.

Robert Herian presents a paper titled "Trusts Law in a Post-Trust World: Blockchain and the (Re)imagining of Trusts Jurisprudence". The paper frames the development and application of blockchain in light of the traditional role of trusts law. The work examines how proof of work might achieve the accepted legitimacy and integrity of smart trusts, informing trustees of fund activity and capital growth. The paper questions whether trusteeship, as enacted by those working to support the blockchain, challenges the established fiduciary and trusts jurisprudence that trustees do not act primarily for personal reward. With regards privacy, the blockchain departs from trust privacy models which reveal no information, in that it provides transparency of transaction but shields the identity of the individuals. Whilst blockchain as a technology provides many of the elements that create trust-like conditions to achieve trust-like outcomes, complex decisions currently still require human intervention. As such, blockchain may play a role in trusts, but it is not yet an autonomous system.

McConaghy et al.in their paper "Visibility and digital art: blockchain as an ownership layer on the internet" present a use case of blockchain as a trusted record of asset ownership. The paper recognises a problem to be solved: artwork is owned by an individual and is shared online, but necessary acknowledgements and if required payments are not made to the owner/creator. A solution to this problem is developed, named 'ascribe', which uses a distributed ledger as a register of ownership as part of a broader offering that includes a tool that finds and identifies an artist's work where it is used on the internet. Here the blockchain is part of a system to provide visibility and traceability. The use of blockchain is appropriate as it forms only part of a business offering that helps artists and owners of art establish ownership and enables them to try to re-assert some degree of control. The work demonstrates how blockchain may help establish an ownership layer on the internet, facilitating transactions and acting as a trust-less asset management system. Whilst the paper is applied to the niche market of digital art, it provides a case example that may have much wider application in numerous contexts.

O'Dair and Beaven reflect on the impact of blockchain technologies in the recorded music industry. The recorded music industry has been something of a bellwether for the impact of digital technologies having experienced, perhaps disproportionately, significant shocks to the industry's dominant design (Abernathy and Utterback, 1978; Anderson and Tushman, 1990) in terms of economic and business models (Myrthianos et al., 2014; Parry et al., 2012), especially in respect of file-sharing networks such as Napster that appeared to threaten the sustainability of the industry and the artists within it. According to the authors, blockchain technologies threaten the industry's business models again, but seemingly in positive ways, at least for artists. They identify transformative potential in three areas: accuracy and accessibility of copyright data;

speed of royalty payments; and transparency of the value chain. Providing further evidence of the recorded music industry's propensity to be a bellwether of technological impact, O'Dair and Beaven usefully illustrate their article with DLT use cases such as singer, songwriter and producer Imogen Heap's Mycelia project. As is typical in the case of emergent technologies, real life applications are relatively slow to emerge and the dominant discourse continues to revolve around white papers and proofs of concept. In such an abstract sea, concrete use cases such as those provided by O'Dair and Beaven are a valuable resource.

Described as a disruptive innovation, one of the primary areas of DLT impact is speculated to be on business models. Business models perform a variety of functions, as Scale Models, Role Models, Scientific Models and Academic Schema (Baden-Fuller and Morgan, 2010) and, as such, they are useful to: describe and classify businesses; operate as sites for scientific investigation; and act as recipes for creative managers to be used as communication or planning tools. Drawing on data collected from a workshop of senior industrialists, a series of interviews, and a review of the existing technical literature and proof of concept projects, Maull et al.'s paper *"Distributed Ledger Technology: Applications and Implications"* focuses on the latter of these purposes. In terms of their impact on business models, and so application possibilities, Maull et al. identify a disruptive pathway consisting of five overarching themes: DLTs as a *new and unique technology*; leading to *transparency and trust*; leading to *new ways of thinking* which combine with *different solutions* to produce a *disrupted future* of business and economic models. Importantly, and consistent with the theme of this special issue, the authors note that DLTs are no panacea to all the world's problems, let alone questions relating to business models. Consequently they also propose a conceptual model for identifying the limitations of DLTs, which could be used to promote future problem-solving in this area. The specification of such a framework, identifying the circumstances under which DLT solutions might or might not be used and what types are appropriate for what conditions, should prove useful for managers and a stimulus for future research.

The role of Bitcoin in the blockchain saga is, of course, integral but its future, according to some commentators, is precarious as upstart and niche cryptocurrencies threaten to out-compete it and incumbent organisations subsume it. Taking a *promissory* or *expectations* perspective, Kewell and Ward propose an alternate future, one in which Bitcoin remains a dominant force. Their analysis is based on interview data with an expert informant and long-time bitcoin trader. Although single-informant designs suffer from a number of problems (Bou-Llusar *et al.*, 2016), where phenomena are complex and/or emergent or under-researched and informants are knowledgeable and expert about the issues being researched they can offer valuable insights (Kumar *et al.*, 1993), as is the case in Kewell and Ward's paper. This is an important article for it prompts and reminds us of our ability to (re-)imagine alternative futures for novel technologies. New technologies are not deterministic; on their own they have no power and so they can be shaped. Whether or not Bitcoin becomes culturally anachronistic (and if yes, when) or carves out a central role in facilitating the continued evolution of DLTs has yet to be played out. Kewell and Ward offer us glimpses of alternative futures which are in the hands of (non-)users to shape.

Decentralisation, disintermediation and the removal of trusted third parties is a key feature of distributed ledger technology and blockchain. Voshmgir challenges us to imagine how such a world might look and operate and, using insights from theory and her own practical experience, challenges the more simplistic and utopian beliefs that lie behind these aspirations, so demonstrating that reality is at once more complex ("unknown unknowns") and more resilient.

The paper asks what sort of governance structures might emerge given the apparent solutions provided by blockchain and algorithmic smart contracts to principal-agent conflict, and reduced transaction costs redefining organisational and national boundaries. Moving from the example of Bitcoin, decentralised autonomous organisations are put forward as an example of DLT application beyond currency, employing smart contracts running on a blockchain to "govern" according to preset rules among a consenting community. Voshmgir demonstrates that potential solutions to Bitcoin's continued growth, limited by scalability and increasing transaction fees (on a supposedly free-to-use network), are being hampered by a lack of consensus between developers and operators with no apparent approaching end to the ongoing discourse and friction. The attack on *TheDAO*, an Ethereum-based community, demonstrated the meaningfulness of the debate between pure code as written, or repair and rewrite through a hardfork, after heated discussion that did not include all the stakeholders. Voshmgir reaches the tentative conclusion that it is likely that there will be the ongoing need for "experts", who could (mis)use their position. Rightly she concludes by saying that now is the time for debate around these issues of potential mis-governance in supposedly decentralised disintermediated worlds.

Manski continues the theme of emerging dichotomies and "contradictory futures" as blockchains develop. In particular, whether the potential for supporting a global co-operative commonwealth (as described by Rifkin 2014) will be met by an alternate of increased concentration in social and economic power and wealth, potentially exacerbated by the "experts" described by Voshmgir, leading instead to increased inequalities. There is a clear need for research into the contingencies of each potential future. Blockchain development is being spurred by two different groups. Manski proposes on the one hand there are financial institutions, governments and venture capitalists, keen to gain economic and institutional advantage. On the other are a more disparate socially motivated group of social entrepreneurs and co-operatives who see opportunity including the financial, but beyond into more equitable organisational structures. Manksi argues that it is a "critical task" of researchers at this stage of development and growth to describe, understand and communicate the factors that will determine, lead, or at least influence the discourse as to which development path is taken. Manski provides examples of the latter through a number of snapshots, before demonstrating that the growth of permissioned or private blockchains could lead in effect to a new series of enclosures limiting the effective use and ownership of the technology to a few, alongside the growth of a "blockchain technological elite". The code might be open source, but is accessible only to "experts". As Manski points out, an increasing use of smart contracts and DAO's has the potential to significantly reduce job opportunities in many industries; remaining jobs may in effect become inaccessible to the majority. Echoing Voshmgir, Manski argues that the debate over, and research into, the "countervailing tendencies" of blockchain should be joined now, and should be as open as possible.

Future research agenda

A blockchain, in its essence, is little more than a secure list or register; a way of recording data on things that have happened that are believed by the blockchain user community to be true. The value of the blockchain lies in the belief that it reflects a true representation of 'reality' at a point in time and in doing so creates trust in performance between parties. Conceptually it acts as a state-machine, storing the status of something and updating that status whilst retaining a permanent record of past states that are immensely difficult to alter. In contrast, the internet presents many different views of the world that have no integrating mechanism. The two systems

together present new possibilities, blockchain helping maintain a record of past states, the internet providing the platform for innovation and exploration. It is at the point of integration of these two exciting and powerful systems that future research will lie.

The disintermediating functionality also is worthy of exploration. By providing a trusted and auditable account of ownership and transactions, blockchains may replace many firms across a wide number of sectors who currently profit from providing such services. Disintermediation may be painful for many and have its own risks; these layers of redundancy may act to save us from ourselves, and be an essential part of separation and balance of power.

The blockchain offers possibilities to "do good": whilst it offers many commercial benefits we must consider its potential in addressing triple helix problems; social, environmental and economic. One challenge in achieving this is that the current process of blockchain mining is akin to the manufacturer's sweatshop. The technology is currently predicated in a need for constant work, undertaken by machines that churn over millions of solutions employing enormous computing power with little regard for the broader environmental consequences. Currently this inefficiency contributes to the security and immutability of a blockchain. Is an immutable truth, securely held and stored more or less valuable in the world of 2017?

It is likely that there will be many blockchains; both public (unpermissioned) and private (permissioned) blockchains will rise and fall. Little has been said about what happens to the legacy of a dead blockchain. How should we seek to cap the well of immutable truth? If a secure solution is not found, old blockchains may be rewritten, forgotten and their veracity lost. This area may require legislation, but how will the forum for such legislation be constituted? What will be the international consequence of disparate legal frameworks as blockchain is an international construct, whilst laws are nationally and regionally determined?

We began this editorial by noting both the relative infancy of blockchain technology and also the proliferation of interest in its potential. According to Whetten (1989) a complete theory consists of four essential elements: What, How, Why and Context (Who, Where, When). What and How describe; context provides an understanding of what is going on through an appreciation of where and when it is happening; only Why explains. The 10 papers that constitute this special issue principally relate to the What and How questions as well as providing some limited context. Broadly speaking, they are focused on empirical discovery and description. These are characteristics of a field at an early stage of its theoretical development (Burgess et al 2006) in which awareness is created of a phenomenon in need of examination or explanation and initial explanations of it developed (Handfield and Melnyk, 1998). One consequence of this phase of theory-building is that, in identifying the features of the conceptual landscape, too many factors might be introduced (Whetten, 1989): the phenomenon is 'over-described' leading to conceptual competition, overlap or redundancy (Morrow, 1983). Communication and acquisition of knowledge can be hindered by differences and disagreements over nomenclature. For theory to be built we need, as a minimum, to define and agree upon our terminology and scope. This is even more necessary when the subject is necessarily multidisciplinary and accessible through a variety of methodologies. For example when is a 'blockchain not a blockchain?', as evidenced by Sovrin[3] which utilizes a "public permissioned" distributed ledger—not a blockchain—that provides public access for identity owners while permitting only known, trusted, vetted entities to serve as nodes. The editors are aware of work that is being undertaken by ISO and national

[3] https://www.sovrin.org/technology.html

standards organisations in this area, but standardization or even agreement of description is unlikely to happen over the short term. In the meantime we need to take care not to mislead each other, and in particular to learn from practitioners who may well develop standards independently.

Distributed Ledger Technology has been argued to have the potential to catalyse exceptional levels of innovation and take the internet to the next level (Walport, 2016). The direction of this travel is still being determined and it is hoped that the contributions to this special issue of *Strategic Change: Briefings in Entrepreneurial Finance* will provide the reader with knowledge and ideas about how this technology might be used as well as to excite interest amongst researchers to contemplate its potential impacts, good or bad, intended or unintended, on the ways in which we live our lives.

Our final task as editors is to gratefully acknowledge the contribution of the anonymous reviewers of submissions to this special issue, without whose work and constructive input this publication would not have been possible.

The editors

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Phil was a member of the expert panel advising Sir Mark Walport, the UK Government Chief Scientific advisor, during his preparation of Distributed ledger Technology: beyond block chain. Within this leading and highly influential report, Phil wrote chapter 5 - 'Disruptive Potential' – which explored the way blockchain technology might spark the next "industrial revolution", and the implications for the economy and society.

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