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Bitcoin, Blockchain and Fintech: a systematic review and case studies in the supply chain

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ABSTRACT

This paper aims to bridge the knowledge gap in the existing literature on Bitcoin, Blockchain and Fintech. It begins by clarifying the definition of these concepts. Through a systematic review and case studies in the supply chain industry, this paper brings out the applications, the benefits/value, and the challenges/issues of Bitcoin, Blockchain and Fintech in several industries. It also presents the research methodologies/approaches used during such research. The classification framework developed and used to perform an analysis of 141 articles from five top academic databases serves as a baseline study. It offers the opportunity to evaluate the level of knowledge on Bitcoin, Blockchain and Fintech, and their evolution over time. The findings show that these technologies are evolving, and organizations are embracing them for competitive advantage. Thus, organizations need to leverage research on these technologies to better understand them, optimize their business strategies, and develop critical insights for decision-making.

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KEYWORDS
Bitcoin; Blockchain; Fintech; supply chain

Introduction

Why are Bitcoin, Blockchain and Financial Technology (Fintech) quickly emerging and attracting so much attention from scholars and practitioners? The simple answer to this critical question is their potential for transforming supply-chain networks in almost all business sectors. This study aims to conceptualize such transformation, driven by these technologies, by reviewing various discoveries on the subject. Due to their growing popularity and their potential for generating business value, these technologies have become the focus of academic and corporate investigation. Existing literature refers to any of the three technologies as a 'profound new technology' (Wright and De Filippi 2015), a 'disruptive and foundational technology' (Pilkington 2016), a 'disruptive innovation' (Atzori 2015), a digital revolution (Crosby et al. 2016), or a 'disruptive technological revolution' (Trautman 2016). The rationale behind such statements is that these technologies, like no others, can tackle key business challenges related to digital payments, contracts, and database and records management (Ammous 2016). They have a unique and innovative way of ensuring transaction integrity in today's data-driven world (Aniello et al. 2017), which is what academia and industry professionals hope to explore and exploit.

Some companies have already started testing their ability to trade using bitcoin and blockchain technology (Basden and Cottrell 2017; DeCovny 2015). Most recently, IBM and the Danish transport conglomerate Maersk announced the launching of a not-for-profit joint venture to redefine the global shipping industry for the blockchain age (Marshall 2018). Current research shows the potential of blockchain technology in almost every domain. For instance, it can efficiently address the interoperability challenges in IT systems, including in the health sector (Linn and Koo 2016); circumvent digital identity-authentication issues (Shrier, Wu, and Pentland 2016); and revolutionize the underlying technology of the payment-clearing and credit-information systems in banks (Guo and Liang 2016). Some even suggest that the technology is so disruptive that it will cause banks as we know them to disappear by 2026 (Trautman 2016).

Despite the excitement and growing interest in these technologies, much ambiguity still surrounds their underlying concepts. Indeed, potential adopters still struggle to understand the related concepts required to capture business value from them. However, very few empirical studies have been conducted to assess the real meaning and potential of these disruptive technologies. Therefore, this paper aims to bridge the knowledge gap in the existing literature on Bitcoin, Blockchain and Fintech, and achieve the following research objectives:

- Clarify the definitions and concepts related to Bitcoin, Blockchain and Fintech;
- Develop a classification framework for these technologies based on the relevant literature;

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- Use the classification framework to classify, analyze, and summarize all relevant articles;
- Examine the potential benefits and challenges of these technologies by exploring use cases; and
- Develop future research directions to establish new research domains and examine business cases based on associated benefits and challenges.

After the introduction to this article, The next section – Towards a comprehensive definition of Bitcoin, Blockchain and Fintech – provides definitions for Bitcoin, Blockchain and FinTech respectively, and discusses the potential of these technologies in data-driven organizations. The next section – Materials and methods – introduces the research methodology, followed by – Results. The next section – Discussion – discusses the results, followed by – Implications for research and practice – which provides limitations of the study, and suggestions for future research. Finally, the work concludes in the section – Further research and conclusions.

Towards a comprehensive definition of Bitcoin, Blockchain and Fintech

Bitcoin, Blockchain and Fintech are generating tremendous attention worldwide. On January 10, 2017, a Google search returned 324 million results for Bitcoin, 21.6 million for Blockchain, and 12.1 million for Fintech. The three technologies are attracting a rising level of interest, reflected by Google trends that identify Nigeria, South Africa, Ghana, Singapore and Slovenia as the countries most interested in Bitcoin. The most searched Bitcoin-related topics include bitcoin as a payment system, price, USD, Bitcoin network (software) and bitcoin value. The countries most interested in Blockchain are Ghana, St. Helena, Nigeria, Luxembourg and South Africa. The most searched Blockchain-related topics include the actual nature of blockchain, its relationship to bitcoin as a payment system, bitcoin wallet and cryptocurrency. Finally, Singapore, Hong Kong, Luxembourg, St. Helena and Taiwan are the countries showing the most interest in Fintech. Search-related topics include banks, start-ups, business types, Singapore, and blockchain. Considering the emerging nature of these concepts, discovering their various definitions is critical. Thus, several definitions of Bitcoin, Blockchain and Fintech appear in Tables 1–3, respectively. The definitions of bitcoin and blockchain have been categorized into holistic and specific definitions as shown in Tables 4 and 5.

In terms of value, scholars and practitioners have considered bitcoin to be a currency, using several terms to specify the type of currency. The literature identifies the currency as cryptographic (Morisse and Ingram 2016), virtual (Ram, Maroun, and Garnett 2016), digital (Plassaras 2013), private (Plassaras 2013), online (Lambert 2015), or electronic (Park and Park 2017). Other researchers have associated it with money or a form of money (Lambert 2015), including digital money (Lambert 2015), a money-like informational commodity (Sinha 2014), a unit of value (Piotrowska 2016), a unit of account (Plassaras 2013), or a medium of exchange (Tu and Meredith 2015). Its price or market value is highly volatile since it has no physical counterpart with legal-tender status (Plassaras 2013).

Scholars and practitioners have also determined Bitcoin to be a software application or technology. For some of them, Bitcoin is a system associated with financial operations (Rose 2015), online monetary transactions (Lambert 2015), e-transaction (Vassiliadis et al. 2017), financial control (Richter, Kraus, and Bouncken 2015), e-payment (Ryan 2017), and electronic cash (Jacobs 2011). Others always link Bitcoin to computer networks, and in that context, it appears as a peer-to-peer (Simser 2015) and consensus (Lambert 2015) payment network (Abramowicz 2016). It is also identified as an open-source software platform (Jacobs 2011) and an online communication protocol (Böhme et al. 2015) that uses blockchain technology (Park and Park 2017). Based on the definitions of bitcoin reviewed, one might notice that certain fundamental aspects characterize this currency or technology. The following qualifiers epitomize the six main characteristics of bitcoin: decentralized (Piotrowska 2016); irreversible (Simser 2015); pseudonymous (Bryans 2014); unregulated (Plassaras 2013); cheap (Morisse and Ingram 2016); and trusted (Morisse and Ingram 2016). To easily memorize these terms, the authors came up with the acronym DIPUCT, representing the first letter of each of these six characteristics of bitcoin. It can be a very handy communication tool during scientific writing and teaching if the characteristics of bitcoin need to be presented.

Considering bitcoin as both a unit of value and a technology, the authors propose a more holistic definition of bitcoin: *a computer-based currency with no physical legal counterpart, used as a medium of exchange through an open system of computer networks and online communication protocols*.

'Ledger' is the word most scholars and practitioners use when defining blockchain. This ledger is said to hold bitcoin transactions. However, its applications extend into other domains. According to the literature, such a ledger can be distributed (Sklaroff 2017), public (Medeiros and Chau 2016), virtual (Abboushi 2017), online (Extance 2015), encrypted (Mik 2017), data-based (Alcazar 2017), or in the form of a platform (Tapscott and Tapscott 2017b), but also it can be an account (Smit, Buekens, and Du Plessis 2016) or a record of transactions (Mansfield-Devine 2017). Some articles also present blockchain as a distributed (Klaus 2017), transactional (Simser 2015), and electronic (Sikorski, Haughton, and Kraft 2017) database, while others present it as a series of blocks of recorded data (Klaus 2017) or a chain of transactions (Harwick 2016).

Technologically, the relevant literature tends to describe Blockchain as a distributed ledger technology (DLT) (Swan 2017), because it is data-management technology made up of both a chain of decentralized computer terminals (Letourneau and Whelan 2017) and a network software protocol (Swan 2016) on a peer-to-peer network of nodes (Medeiros and Chau 2016). The various definitions of Blockchain, as they occur in the literature, reveal 13 intrinsic characteristics of this technology. The qualifiers describing

Table 1. Definitions of Bitcoin.

Definitions of 'bitcoin'	Authors, Date
Bitcoin is a crypto-currency. It is 'a way to make electronic transactions cheaper and less cumbersome by replacing a trusted intermediary with an infallible cryptographic system'	(Nakamoto 2008)
'Bitcoin is a virtual "currency" which, initially, appears similar to traditional currencies'	(Ram, Maroun, and Garnett 2016)
'Bitcoin is a crypto-currency based on open-source software and protocols that operate in peer-to-peer networks as a private irreversible payment mechanism'. 'Bitcoin is an Internet-based payment protocol which operates like a virtual currency'. 'Bitcoin lacks a physical form and does not require the intermediation of government or of a private third-party to settle transactions'.	(Simser 2015)
Bitcoin is 'a system for electronic transactions without relying on trust'.	(Vassiliadis et al. 2017)
'Bitcoin is an online communication protocol that facilitates the use of virtual currency, including electronic payments'.	(Böhme et al. 2015)
Bitcoin is a 'free open source peer-to-peer electronic cash system that is completely decentralized, without the need for a central server or trusted parties'.	(Jacobs 2011)
'Bitcoin is a money-like informational commodity (MLIC) or crypto-currency that came into existence in 2008'.	(Sinha 2014)
'Bitcoin is an exemplary and extremely closed-loop payment system even compared to other private currencies'.	(Dostov and Shust 2014a)
Bitcoin is 'a decentralized network and a digital currency that uses a peer-to-peer system to verify and process transactions'.	(Piotrowska 2016)
Bitcoin is the 'most prominent virtual currency that uses digital currency units and operates directly from user to user without involvement by the bank or other institution'.	(Abboushi 2017)
Bitcoin is 'a private currency issued and governed by a global network of computers'.	(Raskin 2015)
Bitcoin is 'a decentralized, partially anonymous, and largely unregulated digital currency that has become particularly popular in the last few years'.	(Plassaras 2013)
Bitcoin is 'an open platform used for the exchange of values, a protocol-based system on which one can develop various applications'.	(Pîrjan et al. 2015)
Bitcoin is 'a medium of exchange that is electronically created and stored, and lacks the backing of government authority, central bank, or a commodity like gold'.	(Tu and Meredith 2015)
Bitcoin is 'an electronic payment system employing cryptographic proof, instead of trust, in order to ensure that reversal of a transaction, once entered into, is impossible'.	(Ryan 2017)
Bitcoin is 'a combination of a digital address and a number that is known as a private key, a cryptographic tool that is the only way to unlock the bitcoins belonging to that address'.	(Angel and McCabe 2015)
Bitcoin is 'a cryptocurrency that operates as a peer-to-peer network'. It is 'a new financial system, designed by the people, for the people, and theoretically, everyone has equal power'.	(Rose 2015)
Bitcoin is 'a new, widely accepted, virtual currency that is currently being used by businesses as a method of payment to minimize costs' or 'a consensus network that enables payments through digital money, or "cash for the internet"' or 'an online, digital currency managed by bitcoin users in a decentralized peer-to-peer network instead of a centralized authority'.	(Lambert 2015)
Bitcoin is a cryptocurrency, or it is 'a private monetary system that manages itself and does not depend on central banks or governments'.	(Kurihara and Fukushima 2017)
Bitcoin is 'a virtual and crypto-currency based on a peer-to-peer network, digital signatures and zero-knowledge proof that allows the users to do irreversible money transfer without any intermediate'.	(Pakrou and Amir 2016)
Bitcoin is "a decentralized currency with a peer-to-peer network and control system".	(Richter, Kraus, and Bouncken 2015)
Bitcoin is 'a new electronic cash system that is fully peer-to-peer with no trusted third party'.	(Dandapani 2017)
Bitcoin is 'an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party'.	(Low and Teo 2017)
Bitcoin is 'a digital currency alternative to the legal currencies, like any other cryptocurrency'.	(Cocco and Marchesi 2016)
Bitcoin is 'a decentralized digital currency used to purchase goods and services online'.	(Isaacson 2017)
Bitcoin is 'a virtual currency with the equivalent value in real currency but no legal tender status, at least in most places'.	(Piazza 2017)
Bitcoin is 'a cryptocurrency built using distributed ledger technology (DLT) protocols to enable participants to create, store, and exchange money itself'.	(Sklaroff 2017)
Bitcoin is 'an online currency that is used worldwide to make online payments'.	(Kim et al. 2017)
Bitcoin is 'a popular virtual currency based on a decentralized peer-to-peer (P2P) network, much like BitTorrent, the popular protocol for sharing files over the Internet such as music, games, and video'.	(Trautman and Harrell 2017)
Bitcoin is 'a decentralized digital currency system allowing peer-to-peer, anonymous transactions without a central authority control'.	(Masoni, Guelfi, and Gensini 2016)
Bitcoin is 'a purely online virtual currency, unbacked by either physical commodities or sovereign obligation; instead, it relies on a combination of cryptographic protection and a peer-to-peer protocol for witnessing settlements'.	(Meiklejohn et al. 2016)
Bitcoin is 'a protocol promoted as the first peer-to-peer institution—an alternative to a central bank'.	(Abramowicz 2016)
Bitcoin is 'a type of virtual currency'.	(Huang 2015)
Bitcoin is 'a decentralized peer-to-peer payment network that is powered by its users with no central authority or middlemen'.	(Nieman 2015)
Bitcoin is 'a peer-to-peer electronic cash system that provides for a method of making electronic payments between individuals or entities without a financial intermediary'.	(Barre 2015)
Bitcoin is an 'electronic payment system based on cryptographic proof'.	(Chu, Nadarajah, and Chan 2015)
Bitcoin is 'a peer-to-peer payment system'.	(Small 2015)
Bitcoin is 'a decentralized, virtually anonymous (commonly called pseudonymous), peer-to-peer (transactions occur directly between users) network'.	(Bryans 2014)

Table 2. Definitions of Blockchain.

Definitions of blockchain	Authors, Date
Blockchain is 'an electronic log of all Bitcoin transactions'.	(Ram, Maroun, and Garnett 2016)
Blockchain is 'a network software protocol that enables the secure transfer of money, assets, and information via the Internet, without the need for a third-party intermediary such as a bank'.	(Swan 2017)
Blockchain is 'a transaction database shared by all nodes participating in a system based on the bitcoin protocol'.	(Davidson and Block 2015)
Blockchain is 'a series of recorded data blocks or records maintained on a distributed ledger'.	(Klaus 2017)
Blockchain is 'a chain of decentralized-computer-terminal participants that are linked together through a key-access system that enables direct contracting between buyers and sellers without employing intermediaries, while nevertheless creating an immutable transactional record'.	(Letourneau and Whelan 2017)
Blockchain is 'a decentralized account ledger that keeps track of each transaction that has ever taken place in the system'.	(Smit, Buekens, and Du Plessis 2016)
Blockchain is a ledger that can be freely distributed (i.e. decentralized) and that relies on cryptographic tools to allow all users of the network to verify its consistency and preclude them from making unilateral changes.	(Halaburda 2016)
Blockchain is 'a decentralized peer-to-peer network of nodes recording authenticated, encrypted transactions as a distributed public ledger, thereby providing a trust and verification system by using programmed rules to govern the replication of the ledger across the computing nodes of the networks'.	(Medeiros and Chau 2016)
Blockchain is 'a virtual ledger in which cryptocurrency transactions are recorded'.	(Abboushi 2017)
Blockchain is 'a secure platform, ledger, or database where buyers and sellers could store and exchange value without the need for traditional intermediaries'.	(Tapscott and Tapscott 2017b)
Blockchain is 'a distributed database comprising records of transactions that are shared among participating parties'.	(Nowiński and Kozma 2017)
Blockchain is 'an electronic payment system based on cryptographic proof that hashes and timestamps transactions into an ongoing chain of hash-based proof of work, allowing any two willing parties to transact directly with each other without the need for a trusted third party'.	(Ryan 2017)
Blockchain is 'a public ledger of all Bitcoin transactions that have ever been executed'.	(Irwin and Milad 2016)
Blockchain is 'a distributed transaction database in which different computers—called nodes—cooperate as a system to store sequences of bits that are encrypted as a single unit or block and then chained together'.	(Lemieux 2016)
Blockchain is 'a distributed ledger with Byzantine fault-tolerant consensus, i.e. a highly resilient peer-to-peer database architecture maintaining blocks of transactions that contain each a timestamp and a reference to a previous block'.	(Davy, Wouter, and Elisabeth 2017)
Blockchain is 'a time-stamped distributed database of every transaction by the peer-to-peer method that does not need central authority and third-party intermediaries across the programming network'.	(Chen 2018)
Blockchain is 'a text file acting as a public ledger recording events such as transactions'.	(Mansfield-Devine 2017)
Blockchain is 'a type of distributed, electronic database (ledger) which can hold any information (e.g. records, events, transactions) and can set rules on how this information is updated'.	(Sikorski, Haughton, and Kraft 2017)
Blockchain is 'a decentralized, distributed, shared, and immutable database ledger that stores registry of assets and transactions across a peer-to-peer (P2P) network'.	(Khan and Salah 2017)
Blockchain is 'a technology that stores data in a way that makes it incorruptible, doing so via its integrated data ledgers'.	(Alcazar 2017)
Blockchain is 'an online record keeping system that tracks the ownership of specific bitcoins from their creation (in a process called mining) through every subsequent transaction'.	(Tsukerman 2015)
Blockchain is 'a public ledger for transactions that can prevent hacking during transactions involving virtual cash'.	(Park and Park 2017)
Blockchain is 'a register containing information tracking the creation and transfer of bitcoins much like a bank ledger tracks payment between bank accounts'.	(Low and Teo 2017)
Blockchain is 'an online ledger that records every Bitcoin transaction ever made'.	(Extance 2015)
Blockchain is 'a way of recording and reconciling every transaction that has ever occurred, between every single participant, going back to the beginning of bitcoin'.	(Sklaroff 2017)
Blockchain is 'a replicated graph data structure that encodes all Bitcoin activity, past and present, in terms of the public digital signing by key parties to each transaction'.	(Meiklejohn et al. 2016)
Blockchain is 'a decentralized, peer-validated crypto-ledger that provides a publicly visible, chronological and permanent record of all prior transactions'.	(Mik 2017)

such characteristics are secure (Swan 2017), shared (Davidson and Block 2015), immutable (Letourneau and Whelan 2017), decentralized (Letourneau and Whelan 2017), distributed (Medeiros and Chau 2016), authenticated (Medeiros and Chau 2016), encrypted (Ryan 2017), open-source (Swan 2017), incorruptible (Alcazar 2017), integrated (Alcazar 2017), publicly visible (Mik 2017), chronological (Mik 2017) and permanent (Mik 2017).

Materials and methods

This study uses a mixed-method approach that encompasses two phases. The first phase is based on a comprehensive literature review of journal articles dealing with different aspects of Bitcoin, Blockchain and Fintech. This is somewhat similar to the approach used for a literature review on CRM and data mining by (Ngai, Xiu, and Chau 2009), and for reviews of RFID-related topics by (Ngai et al. 2008), (Wamba, Anand, and Carter 2013), and (Lim, Bahr, and Leung 2013). The approach of this study is based on three main steps: (i) developing a classification framework; (ii) conducting a literature review; and (iii) classifying the relevant journal articles. The study also follows the recommendations of (Wamba et al. 2015) by focusing specifically on peer-reviewed journal articles because they represent the highest level of research rigour, and because both academia and practitioners rely on them to acquire and disseminate information and new findings. The second phase uses a case-study approach, considered relevant when analyzing emerging complex phenomena such as the adoption and use of Bitcoin, Blockchain and Fintech within supply-chain management (Eisenhardt 1989, Yin 1994) for theory building (Benbasat, Goldstein, and Mead 1987).

Table 3. Definitions of Fintech (Source: Authors 2018).

Definitions of financial technology (Fintech)	Authors, Date
Fintech is 'financial services delivered by technology'.	(Swan 2017)
Fintech is 'the use of technology to deliver financial solutions'.	(Arner, Barberis, and Buckley 2017)
Fintech is 'new financial industry that applies technology to improve financial activities'.	(Schueffel 2016)
Fintech is 'technology-based businesses that compete against, enable and/or collaborate with financial institutions'.	(Pollari 2016)

Table 4. Categorization of Bitcoin definitions.

Key categories			
Holistic	'Bitcoin is a crypto-currency based on open-source software and protocols that operate in peer-to-peer networks as a private irreversible payment mechanism' (Simser 2015). Bitcoin is 'a virtual and crypto-currency based on a peer-to-peer network, digital signatures and zero-knowledge proof that allows the users to do irreversible money transfer without any intermediate' (Pakrou and Amir 2016). Bitcoin is 'a new, widely accepted, virtual currency that is currently being used by businesses as a method of payment to minimize costs' (Lambert 2015). Bitcoin is 'a popular virtual currency based on a decentralized peer-to-peer (P2P) network, much like *bitTorrent*, the popular protocol for sharing files over the Internet such as music, games, and video' (Trautman and Harrell 2017). Bitcoin is 'a cryptocurrency that operates as a peer-to-peer network [*as*] a new financial system, designed by the people, for the people, and theoretically everyone has equal power' (Rose 2015). Bitcoin is 'a decentralized, virtually anonymous (commonly called pseudonymous), peer-to-peer (transactions occur directly between users) network' (Bryans 2014). Bitcoin is 'a purely online virtual currency, unbacked by either physical commodities or sovereign obligation; instead, it relies on a combination of cryptographic protection and a peer-to-peer protocol for witnessing settlements' (Meiklejohn et al. 2016). Bitcoin is 'a decentralized peer-to-peer payment network that is powered by its users with no central authority or middlemen' (Nieman 2015). Bitcoin is 'a peer-to-peer electronic cash system that provides for a method of making electronic payments between individuals or entities without a financial intermediary' (Barre 2015).		
	Crypto-currency	Virtual currency/electronic currency/ electronic transaction	Decentralized network/ Peer-to-peer network/open source/ Closed-loop payment systems
Specific		Bitcoin is 'an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party' (Low and Teo 2017).	
	Bitcoin is 'a cryptocurrency built using distributed ledger technology (DLT) protocols to enable participants to create, store, and exchange money itself' (Sklaroff 2017).	Bitcoin is 'an online communication protocol that facilitates the use of a virtual currency, including electronic payments' (Böhme et al. 2015).	Bitcoin is 'a private currency issued and governed by a global network of computers' (Raskin 2015).
	Bitcoin is 'a cryptocurrency or it is a private monetary system that manages itself and does not depend on central banks or governments' (Kurihara and Fukushima 2017).	Bitcoin is a 'virtual 'currency' which, initially, appears similar to traditional currencies' (Ram, Maroun, and Garnett 2016).	Bitcoin is 'an exemplary and extremely closed-loop payment system even compared to other private currencies' Dostov and Shust 2014a).
	Bitcoin is 'a crypto-currency [that allows] a way to make electronic transactions cheaper and less cumbersome by replacing a trusted intermediary with an infallible cryptographic system' (Nakamoto 2008).	Bitcoin is 'a system for electronic transactions without relying on trust' (Vassiliadis et al. 2017).	Bitcoin is 'a free open source peer-to-peer electronic cash system that is completely decentralized, without the need for a central server or trusted parties' (Jacobs 2011).

Classification framework

The classification framework for this study considers five related dimensions: (i) the applications; (ii) the benefits/value; (iii) the challenges/issues; (iv) the industry; and (v) the research methodology/approach.

Literature review search strategies

Leading databases of scholarly articles were used to obtain the academic literature from which the subject was reviewed as comprehensively as possible, including ABI/INFORM Complete, Academic Search Complete, Emerald Journals, JSTOR and ScienceDirect.

A search within 2007–2017 timeframe was considered representative, as the actual emergence of the bitcoin and blockchain technologies only dates back to 2008 (Nakamoto 2008). Despite disparities recorded when searching between databases, the following generic query was used to search the titles, abstracts, and keywords of every article in the selected databases: 'Blockchain OR Bitcoin OR Fintech'. Table 6 presents a summary of the search results:

The references and abstracts of all articles were downloaded into the EndNote 7.2.1 reference-management software for further analysis. Subsequently, the abstract of each article was screened to assess its relevance to the research objectives of this study, and to identify duplicates (Wamba,

Table 5. Categorization of Blockchain definitions.

Key categories		
Holistic	Blockchain is 'an electronic log of all Bitcoin transactions' (Ram, Maroun, and Garnett 2016). Blockchain is 'a network software protocol that enables the secure transfer of money, assets, and information via the Internet, without the need for a third-party intermediary such as a bank' (Swan 2017). Blockchain is 'a chain of decentralized-computer-terminal participants that are linked together through a key-access system that enables direct contracting between buyers and sellers without employing intermediaries, while nevertheless creating an immutable transactional record' (Letourneau and Whelan 2017). Blockchain is 'a virtual ledger in which cryptocurrency transactions are recorded' (Abboushi 2017). Blockchain is 'a secure platform, ledger, or database where buyers and sellers could store and exchange value without the need for traditional intermediaries' (Tapscott and Tapscott 2017b). Blockchain is 'an electronic payment system based on cryptographic proof that hashes and timestamps transactions into an ongoing chain of hash-based proof of work, allowing any two willing parties to transact directly with each other without the need for a trusted third party' (Ryan 2017). Blockchain is 'a decentralized, distributed, shared, and immutable database ledger that stores registry of assets and transactions across a peer-to-peer (P2P) network' (Khan and Salah 2017). Blockchain is 'a technology that stores data in a way that makes it incorruptible, doing so via its integrated data ledgers' (Alcazar 2017). Blockchain is 'a register containing information tracking the creation and transfer of bitcoins much like a bank ledger tracks payment between bank accounts' (Low and Teo 2017). Blockchain is 'a way of recording and reconciling every transaction that has ever occurred, between every single participant, going back to the beginning of bitcoin' (Sklaroff 2017). Blockchain is 'a replicated graph data structure that encodes all Bitcoin activity, past and present, in terms of the public digital signing by key parties to each transaction' (Meiklejohn et al. 2016). Blockchain is 'a decentralized, peer-validated crypto-ledger that provides a publicly visible, chronological and permanent record of all prior transactions' (Mik 2017). Blockchain is 'a decentralized account ledger that keeps track of each transaction that has ever taken place in the system' (Smit, Buekens, and Du Plessis 2016). Blockchain is 'an online record keeping system that tracks the ownership of specific bitcoins from their creation (in a process called mining) through every subsequent transaction' (Tsukerman 2015).	
	Ledger	Database
Specific	Blockchain is 'a series of recorded data blocks or records maintained on a distributed ledger' (Klaus 2017).	Blockchain is 'a transaction database shared by all nodes participating in a system based on the bitcoin protocol' (Davidson and Block 2015).
	Blockchain is a 'ledger that can be freely distributed (i.e. decentralized) and that relies on cryptographic tools to allow all users of the network to verify its consistency and preclude them from making unilateral changes' (Halaburda 2016).	Blockchain is 'a distributed database comprising records of transactions that are shared among participating parties' (Nowiński and Kozma 2017).
	Blockchain is 'a decentralized peer-to-peer network of nodes recording authenticated, encrypted transactions as a distributed public ledger, thereby providing a trust and verification system by using programmed rules to govern the replication of the ledger across the computing nodes of the networks' (Medeiros and Chau 2016).	Blockchain is 'a distributed transaction database in which different computers—called nodes—cooperate as a system to store sequences of bits that are encrypted as a single unit or block and then chained together' (Lemieux 2016).
	Blockchain is 'a public ledger of all Bitcoin transactions that have ever been executed' (Irwin and Milad 2016)	Blockchain is 'a type of distributed, electronic database (ledger) which can hold any information (e.g. records, events, transactions) and can set rules on how this information is updated' (Sikorski, Haughton, and Kraft 2017)
	Blockchain is 'a distributed ledger with Byzantine fault-tolerant consensus, i.e. a highly resilient peer-to-peer database architecture maintaining blocks of transactions that contain each a timestamp and a reference to a previous block' (Davy, Wouter, and Elisabeth 2017). Blockchain is 'a text file acting as a public ledger recording events such as transactions' (Mansfield-Devine 2017). Blockchain is 'a public ledger for transactions that can prevent hacking during transactions involving virtual cash' (Park and Park 2017). Blockchain is 'an online ledger that records every Bitcoin transaction ever made' (Extance 2015).	Blockchain is 'a time-stamped distributed database of every transaction by the peer-to-peer method that does not need central authority and third-party intermediaries across the programming network' (Chen 2018).

Anand, and Carter 2013, Ngai et al. 2008). Finally, each of the remaining 149 relevant articles was analyzed by two co-authors independently. The authors organized several working sessions to compare, verify and validate the results that each reviewer obtained. At the end of this process, 141 articles were retained because they were deemed relevant and acceptable for classification.

Case studies settings

For the second phase, three cases were selected. For each case, data were collected using multiple sources of evidence including semi-structured interviews, industrial reports and nontechnical and technical reports related to the technologies under study.

Table 6. Results of search strings: 'Blockchain OR Bitcoin OR Fintech'.

Search Date	Database	Search conditions	Search results	Relevant papers	Irrelevant papers
01–04 December 2017	ABI/INFORM Complete	Scholarly journals; Article;	168	66	102
	Academic Search Complete	English; Full text; Peer reviewed; 2007–2017	73	69	4
	Emerald Journals	Anywhere; All content; Accepted articles and Backfiles; Articles and chapters; 2007–2017	20	3	17
	JSTOR	All content; Articles; English; 2007–2017	4	0	4
	ScienceDirect	Search All journals; Articles; 2007–Present	49	11	38
Total			314	149	165

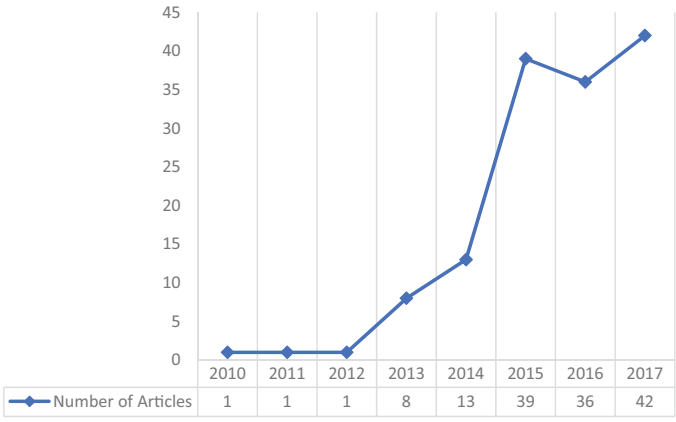

Figure 1. Classification of articles by the year of publication.

The first organization included in this study is called Manukora, a New Zealand-based producer and supplier of high-quality Manuka honey. Due to its high value, Manuka honey is a target for fraudulent claims made by sellers of sub-standard honey and counterfeits. Manukora set out to improve its overall supply-chain integrity by using technology to strengthen consumer engagement, product traceability and authentication of its products. Moreover, the company wanted to connect its extended supply chain of honey producers to its network. In order to protect its brand and ensure that consumers in the international and the domestic markets could authenticate its products, Manukora engaged New Zealand-based Trust Codes to utilize the Trust Codes® consumer-focused platform. The goal of the platform is to facilitate consumer engagement through scanning of a serialized QR code on a Manukora product. The scan enables the consumer to access product information related to the product, process, provenance, authentication and company information. Furthermore, the platform is blockchain-enabled for end-to-end traceability to individual beehives and provenance by batch number, which facilitates rapid recall capabilities.

The second organization case study is a Shanghai-based online farmers' market firm called Yimishiji. It opened for business in September 2015, in response to the country's recurring food-safety crisis and consumer concern about the lack of transparency and trust in food. Yimishiji aims to educate the public about environmentally friendly, safe, and sustainable food choices. Before listing a product on its platform, it schedules supplier visits to conduct comprehensive audits. The audits provide verification of food safety and scientific evidence to prove credence claims such as organic, pesticide-free, non-GMO and grass fed. Moreover, forensic and chemical testing verifies the authenticity of products and the food provenance (source or origin). Yimishiji engaged Slovenia-based Origin Trail to develop a blockchain-based solution for ensuring a high degree of data integrity, enabling supply-chain visibility, and addressing food-chain traceability and transparency. Yimishiji aimed to deliver on its promise of clean, sustainable and trustworthy food. The Origin Trail pilot implemented a decentralized blockchain network to connect suppliers to the Yimishiji platform. The choice of a decentralized network addressed scalability for business growth. Moreover, to enable seamless interoperability between the trading partners, Origin Trail created a protocol that acts as technology-agnostic middleware, providing blockchain-to-blockchain and blockchain-to-legacy interoperability that facilitates the supplier onboarding process and data integrity.

The third and last organization used for a case study is Ireland Craft Beers. The firm was set up in 2014 to showcase Irish products on the world stage. At the time, some craft beers on the market were not craft brewed and authenticity in the sector was in doubt. As a result of the emergence of blockchain technologies and their ability to deliver transparency and trust, downstream craft beer was born. It was the first in its sector designed specifically to use blockchain technology to reveal 'everything you want to know about your beer, its ingredients and brewing methods' (http://www.down-stream.io).

The company engaged with arc-net, a Belfast-based technology provider involved in DLT since 2011, and cryptography and information assurance since 2006. The objective was to utilize DLT to introduce the downstream beer brand and to tell the story of the craft beer from raw-material sourcing, through processing and distribution. The brand owners wanted a way to showcase the passion and pride involved in the craft-brewing process.

Table 7. Classification of bitcoin articles by application domain or context.

Bitcoin application domain	References	Number of referencess	%
Accounting and financial regulation	(Ram, Maroun, and Garnett 2016; Gross, Hoelscher, and Reed 2015; Antonikova 2015; Harrison and Mano 2015; Jacobs 2011, Kurihara and Fukushima 2017; Pakrou and Amir 2016; Irwin and Milad 2016; Mikolajewicz-Wozniak and Scheibe 2015; Tu and Meredith 2015; Swartz 2014; Ly 2014)	12	11.01
Law, taxation and legal regulation	(Lee et al. 2015; Raskin 2015; Kowalski 2015; Irwin and Milad 2016; Trautman and Harrell 2017; Sirer 2016; Luther 2016b; Huang 2015; Tu and Meredith 2015; Tsukerman 2015; Nieman 2015; Barre 2015; Small 2015; Swartz 2014; Ly 2014; Ajello 2015; Antonikova 2015; Wiseman 2016)	20	18.35
Cryptocurrency market	(Gandal and Halaburda 2016; Halaburda 2016; White 2015; Cunliffe et al. 2017; Kim 2015)	5	4.59
Financial market	(Vassiliadis et al. 2017; McCallum 2015; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Kurihara and Fukushima 2017; Kauffman, Liu, and Ma 2015; Donier and Bouchaud 2015; Chu, Nadarajah, and Chan 2015)	8	7.34
Financial and digital payment services and systems	(Jacobs 2011; Piotrowska 2016; Tu and Meredith 2015; Ober, Katzenbeisser, and Hamacher 2013; Angel and McCabe 2015; Wonglimpiyarat 2016; Pakrou and Amir 2016; Grant, Stiehler, and Boon 2013; Mikolajewicz-Wozniak and Scheibe 2015; Allen 2017; Trautman and Harrell 2017; Meiklejohn et al. 2016; Böhme et al. 2015; McCallum 2015; Rose 2015; Lambert 2015; Kurihara and Fukushima 2017; Jordan 2015; Kim et al. 2017; Swartz 2014; Luther 2016a; Pîrjan et al. 2015; Luther 2016b)	23	21.10
Technology and innovation	(Dotsika and Watkins 2017; Kauffman, Liu, and Ma 2015; Delgado-Segura, Tanas, and Herrera-Joancomartí 2016; Folkinshteyn and Lennon 2016; Pakrou and Amir 2016)	5	4.59
Business and economic, concepts, theories and models	(Davidson and Block 2015; Sinha 2014; Bouri, Azzi, and Dyhrberg 2017; Kowalski 2015; Cocco and Marchesi 2016; Tu and Meredith 2015; McCallum 2015; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Wonglimpiyarat 2016; Hendrickson, Hogan, and Luther 2016)	11	10.09
Ecommerce, online market places, supply chains, transport and logistics	(Gad 2014; Raskin 2015; Kowalski 2015; Pakrou and Amir 2016; Basu 2014)	5	4.59
Gambling and lottery	(Andrychowicz et al. 2016, Connell 2014)	2	1.83
Crime and illicit activities (drugs, money laundering, terrorism …)	(Simser 2015; Dostov and Shust 2014b; Basu 2014; Irwin and Milad 2016; Cunliffe et al. 2017; Huang 2015; Ajello 2015; Isaacson 2017; Gad 2014; Broséus et al. 2016; Andrychowicz et al. 2016; Piazza 2017; Masoni, Guelfi, and Gensini 2016)	13	11.93
Mining	(Cocco and Marchesi 2016; Kim et al. 2017)	2	1.83
Teaching pedagogy	(Barre 2015)	1	0.92
Social phenomena	(Morisse and Ingram 2016; Kim et al. 2017)	2	1.83
Total		109	100.00

Table 8. Classification of blockchain articles by application domain or context.

Blockchain application domain	References	Number of references	%
Digital identification and authentication	(Wolfond 2017; Swan 2017)	2	4.65
Registry and records management	(Swan 2017; Lemieux 2016; Sikorski, Haughton, and Kraft 2017)	3	6.98
Contractual agreements	(Swan 2017; Letourneau and Whelan 2017; Sikorski, Haughton, and Kraft 2017; Sklaroff 2017; Mik 2017)	5	11.63
Environmental sustainability	(Cocco, Pinna, and Marchesi 2017)	1	2.33
Governance and regulation	(Babkin Alexander et al. 2017; Tapscott and Tapscott 2017b; Kiviat 2015)	3	6.98
Industry processes	(Tapscott and Tapscott 2017b; Davy, Wouter, and Elisabeth 2017; Wesley and Ray 2017; Kshetri 2017; Sikorski, Haughton, and Kraft 2017; Shiyong et al. 2017)	6	13.95
Business, economics and finance	(Nowiński and Kozma 2017; Rooney, Aiken, and Rooney 2017; Huckle and White 2016; Richter, Kraus, and Bouncken 2015; Dandapani 2017; Prybila et al. 2017; Underwood 2016; Collomb and Sok 2016; Low and Teo 2017; Wolfond 2017; Swan 2017)	11	25.58
Computing and technology	(Ryan 2017; Evans 2017; Dandapani 2017; Kshetri 2017; Sikorski, Haughton, and Kraft 2017; Khan and Salah 2017; Underwood 2016; Folkinshteyn and Lennon 2016; Alcazar 2017; Bailis et al. 2017; Park and Park 2017; Shiyong et al. 2017)	12	27.91
Total		43	100.00

Table 9. Classification of Fintech articles by application domain or context.

Fintech application domain	References	Number of references	%
Banking and finance services	(Milne 2016; Medeiros and Chau 2016; Schueffel 2016; Pollari 2016)	4	40.00
Business ecosystem	(Teja 2017; Dandapani 2017)	2	20.00
Technological development and computation	(Arner, Barberis, and Buckley 2017; Pollari 2016; Dandapani 2017; Kauffman et al. 2017)	4	40.00
Total		10	100.00

Table 10. Classification of bitcoin by potential benefits.

Potential benefits/business value of bitcoin	Authors, Date
More efficient transactions; cheaper transactions, independent of geographic boundaries, fast, secure and inclusive system.	(Morisse and Ingram 2016)
Store of wealth; speculative investment.	(Ram, Maroun, and Garnett 2016)
Easier cross-border transactions; little transactional cost; trusted community, robust code; support from currency garners in the computing community.	(Simser 2015)
A convenient mechanism for monetizing contributions that are currently zero priced.	(Luther 2016a)
Lower processing fees; protection against fraud; potential penetration of new markets not included in current global payment networks.	(Lee et al. 2015)
Worldwide use; the increasing number of users; no brokers; low transaction costs; high transactions speed; ultimately a constant number of bitcoins in the system (an anti-inflation mechanism); protection of personal data of all participants.	(Vassiliadis et al. 2017)
Creates an account without charge; no central vetting procedure; no real name required; decentralized core technologies; cheaper consumer payments; diversification (investments).	(Böhme et al. 2015)
Faster transactions and payments; less expensive transactions and payments.	(Wolfson 2015)
Low transaction cost.	(Sinha 2014)
Effective means of making international transfers; effective means of paying remittances; lower transaction costs than standard banking fees; much speedier settlement.	(Collomb and Sok 2016)
Transparent; immutable; cryptographically verifiable by all participants in the bitcoin network; independent currency; International scope; reliable; quick bug fixes; robust infrastructure; control own money; disintermediation; high speed of transfer; low cost of transfer; ease of innovation; open-source application programming interface (API); common language; high transaction security.	(Folkinshteyn and Lennon 2016)
Open source protocol; no central authority; no central recordkeeping; robustness.	(Gandal and Halaburda 2016)
Secure; no central issuing authority.	(Milne 2016)
No central issuing or settlement authority; anonymity as privacy.	(Dostov and Shust 2014a)
No central management bodies; portability; durability; divisibility; security; accessible online.	(Harwick 2016)
Rapid transactions; low cost of transactions; no central oversight and management.	(Halaburda 2016)
Smooth operations; online transactions; security; anonymity; low transaction costs.	(Piotrowska 2016)
The medium of exchange; fast transactions; accurate, secure, and monitored record system; free of a central authority; lower cost of international financial transactions; low-cost alternative to credit card system; easy to use the system; global accessibility via the Internet; cybersecurity; stable base layer protocol.	(Abboushi 2017)
No central issuing authority; Integrity of transactions; Secure transactions; Low transaction cost.	(Plassaras 2013)
Open source software; reduced associated costs of settling and maintaining contracts; efficient and reliable; transitioning from the bitcoin to an Alt-Coin.	(Pirjan et al. 2015)
Payment alternative; commodity, asset class, or security ripe for speculative investment; solution to the 'double spending' problem; lower costs and fees; increased anonymity in transactions; insulation from inflation; insulation from government manipulation; fewer risks for merchants; increased anonymity for users; increased speed and ease of transfer/payment.	(Tu and Meredith 2015)
Alternative payment method.	(Kowalski 2015)
Anonymity; reduction in certain transaction costs; infinite divisibility; Anti-spam.	(McCallum 2015)
Saves costs related to the production, transportation, and handling of physical currency; allows for money transfers at low costs and relatively fast; low transaction fees; short execution time; reduce opportunities for theft; global currency (no transaction costs related to currency exchange); open source software algorithm; medium of exchange; anonymity; transparency.	(Ciaian, Rajcaniova, and Kancs 2016)
Transparency; anonymity; privacy; irreversible transactions; reduction in transaction costs.	(Angel and McCabe 2015)
Global currency; alternate means of payment.	(Rose 2015)
Minimal transactions costs and efficiency; cheap cost compared to other financial instruments; diversification of financial instruments for investors; a hedging instrument for other financial transactions.	(Lambert 2015)
Free entry; anonymity.	(White 2015)
Low-cost payments.	(Pakrou and Amir 2016)
High levels of security.	(Irwin and Milad 2016)
Alternative online currencies.	(Grant, Stiehler, and Boon 2013)
Criminal activity.	(Lemieux 2016)
Reduction of transaction costs is the result; World-Wide Toll-Free Transfers; no possibility of censorship or blocking; no inflation; speedy transactions; transparency/tamper resistant; sustainable.	(Richter, Kraus, and Bouncken 2015)
Cost reduction; increasing the security of online transactions; innovation in financial services; facilitating payment transactions.	(Mikolajewicz-Wozniak and Scheibe 2015)

(*continued*)

Table 10. Continued.

Potential benefits/business value of bitcoin	Authors, Date
Tax-free transactions; anonymity.	(Dandapani 2017)
Fewer threats and less violence in drug deals; reduced risks of arrest and rip-off.	(Cunliffe et al. 2017)
Reduced regulatory issues; no monetary policy; anonymity.	(Dotsika and Watkins 2017)
Alternative innovative means of payment.	(Kauffman, Liu, and Ma 2015)
Lower transaction costs; beneficial for developing economies; an efficient medium of exchange.	(Kiviat 2015)
Secure; decentralized; user anonymity; rewarding mechanism; reputation mechanism; high security.	(Delgado-Segura, Tanas, and Herrera-Joancomartí 2016)
Low transaction cost; stable currency in weak markets.	(Tsukerman 2015)
Robust.	(Low and Teo 2017)
Open source system.	(Cocco and Marchesi 2016)
Low international transaction cost.	(Extance 2015)
Easy and accessible to everyone; anonymity.	(Isaacson 2017)
The instantaneous and direct transfer of value.	(Sklaroff 2017)
Effect payments quickly; reduce transaction costs; secure transactions over great distances; low transaction costs; fast and efficient transactions.	(Allen 2017)
Low transaction cost; no central authority; faster transactions.	(Trautman and Harrell 2017)
Secure and pseudonymous payments.	(Hendrickson, Hogan, and Luther 2016)
Alternative payments; scalable, irrevocable; anonymous payments.	(Meiklejohn et al. 2016)
Decentralized protocols that are secure; distributed system; no central authority; no double-spending; flexibility in defining the condition on how the transaction can be redeemed.	(Andrychowicz et al. 2016)
The high degree of security and; cuts down on transaction fees.	(Wiseman 2016)
Alternative currency; the digital medium of exchange; store of value; no central authority; decision-making.	(Abramowicz 2016)
Transfer value online; decentralized medium; free from government interference Lower transaction cost; decentralized.	(Prentis 2015)
Confidentiality; security; decentralized; no government authority; payment freedom; instantaneous and borderless transactions; low transaction fees; irreversible transactions.	(Huang 2015)
Global currency.	(Nieman 2015)
Low transaction costs; anonymity; irreversible transactions; no government control; open source; transparency; stability; no double-spending; no intermediaries; privacy; auditability.	(Zohar 2015)
High liquidity; reduced costs; high-speed transactions.	(Chu, Nadarajah, and Chan 2015)
Low-cost alternative to real currencies.	(Kim 2015)
Low transaction cost; privacy; financial independence.	(Swartz 2014)
Not reliant on the financial industry; provides anonymity to transaction participants.	(Harrison and Mano 2015)
Low transaction costs.	(Ajello 2015)
Total number of publications	62

Table 11. Classification of Blockchain by potential benefits.

Potential benefits/business value of blockchain	Authors, Date
More efficient government operations; improve service delivery in the public and private sectors; reduces cost and fraud; simplify customer experience; facilitates the immutable, secure, and privacy-respecting sharing and validation of digital attributes for consumers and businesses; improved password management; transform remittances—the largest flow of funds—into the developing world; provides immutable land title registration.	(Wolfond 2017)
Cybersecurity; real-time money transfer; very low costs; transparency; secure transactions; open source; efficient land titling and birth registration; leapfrog technology for global financial inclusion; personalized economic services; long-tail personalized economic services; payment channels and peer banking services; less friction and human involvement needed to transfer goods and services; less physical infrastructure needed to transfer goods and services.	(Swan 2017)
Optimizes the global financial infrastructure; enhance the efficiency of current financial systems; achieving sustainable development; promote economic growth; accelerate the development of green technologies; reduce foreign exchange (FX) transfer costs and times; augment existing business networks; provide increased discoverability; reliable instant transactions; increased security; significant energy and cost efficiency improvements; provide increased trust.	(Cocco, Pinna, and Marchesi 2017)
Less costly; exchanging funds and managing staff payments.	(Luther 2016a)
Facilitates creativity; catalyzes digital innovation; transactional generality; corporate governance benefits; quasi-exhaustive recording; precise recordings with quasi-real-time Updates; facilitates enforcing capital or liquidity regulations; makes it possible to have on the same digital data infrastructure both cash and securities accounts; tool to track systemic risk; hard-to-corrupt authentication mechanism.	(Collomb and Sok 2016)
Key-access restrictions; reduces intermediary/transaction costs; enhances finance transactions; protecting against cyber attacks.	(Letourneau and Whelan 2017)
Increases trust; reliable; quick bug fixes; open source; record integrity; API availability; auditable; free participation; distributed availability; lower cost record tracking; improves securities offerings and recordkeeping; reduces costs; eliminates intermediaries; simplifies processes.	(Folkinshteyn and Lennon 2016)
More efficient business information systems; transparency.	(Evans 2017)
Increased security of transactions; integrity of transactions; verifiability of transactions; Transparency; interoperability; trusted solutions.	(Medeiros and Chau 2016)
Transparency.	(Abboushi 2017)

(*continued*)

Table 11. Continued.

Potential benefits/business value of blockchain	Authors, Date
Eliminates transaction costs; uses outside resources as easily as internal resources; stores and exchanges value without the need for traditional intermediaries (Internet of value); distributed system; it is public; it is encrypted.	(Tapscott and Tapscott 2017b)
Authenticating traded goods; disintermediation; lowering transaction costs; secure transactions; data security; transparency and integrity; anti-tampering and anti-forgery; high efficiency; low cost.	(Nowiński and Kozma 2017)
Transparency.	(Raskin 2015)
E-payment system; reduced need for trusted third parties in mediating bilateral communications; streamlines online exchanges; reduces corruption; reduces mistakes; reduces fraud; reduces tax evasion; provides and builds trust and reputation; saves time and costs; immediacy and immutability; reliable reputation ratings.	(Ryan 2017)
Decentralized transparency and auditability; immutable ledger; direct transactions; no government control; promotes greater institutional participation.	(Huckle and White 2016)
Reliability; authenticity; identity; integrity; provenance; long-term digital preservation; trustworthy public ledger.	(Lemieux 2016)
Securing IoT-enabled dataflow-oriented networked production processes; secure and trustworthy data management; decentralized identity and relationship management for users, sensors, actuators, gateways and cloud services; data transparency, integrity, authenticity and authorization; auditing support for data exchange between nodes in the production network; trustworthy digital identities and profiles; greater transparency and auditing of all processes for the customer; flexibility in expressing authorization policies; better auditing capabilities and availability.	(Davy, Wouter, and Elisabeth 2017)
User privacy; almost incorruptible digital ledger.	(Dandapani 2017)
The authenticity of the transaction; transparency; ledger accounts shared by all and is accessible to all; provides an easy and efficient chronology and context to data.	(Mansfield-Devine 2017)
Low susceptibility to manipulation and forgery by malicious participants; identity and access management; removes the need for third parties in transactions; permissionless and permissioned chains to meet security, privacy, and other requirements; possible to target specific members in the chain such as regulators and auditors; data is fully encrypted; cryptographic hash functions are used; data is received only by the intended recipient.	(Kshetri 2017)
Anonymity; a financial incentive to publish blocks; optional transaction fees; facilitates M2M interactions; establish an M2M electricity market.	(Sikorski, Haughton, and Kraft 2017)
Address space management; identity and access management; data authentication and integrity; authorization, and privacy; secure communications.	(Khan and Salah 2017)
Establishes decentralized trust; allow verification; flexibility.	(Prybila et al. 2017)
Trustless transactions; efficient digital-asset transfers; efficient document and; authorship verification; efficient title transfers; contract enforcement; transparent public ledger; secure electronic transfer; speed and cost; decentralized smart contracts; adaptable.	(Kiviat 2015)
Avoids information leakage; reduces transaction time; removes transaction intermediaries; reduces risk of fraud and cybercrime; observes transactions in real; time; security; immutability; transparency; and ability to cut out the middleman; trust.	(Underwood 2016)
Avoiding downside disruption risk; maximizing upside war-fighting opportunity; data corruption and compromise prevention; compatible with existing DOD networks; decentralized structure; reduces the possibility of data theft; reduce sender identity compromise.	(Alcazar 2017)
Anonymity; privacy; confidentiality; endpoint security; smart contracts.	(Bailis et al. 2017)
Decentralized; trustless; secure; efficient recording system.	(Tsukerman 2015)
Higher security.	(Park and Park 2017)
Recordkeeping cheaper and more accurate; decentralized consensus; instantaneous exchange; cheap and effective way to ensure the integrity of data Reduces costs; natural check against bad-faith manipulation of contract terms; anonymity.	(Sklaroff 2017)
Prevent double spending.	(Allen 2017)
Safety, security, and reliability of exchanges online; transparency and accountability; privacy; efficient transaction costs; more effective learning environments; trustable proof-of-truth mechanism.	(Tapscott and Tapscott 2017a)
Trustless; incorruptible; secure; decentralised.	(Mik 2017)
Total number of publications	33

Table 12. Classification of Fintech by potential benefits.

Potential benefits/business value of Fintech	Authors, Date
Achieves European Union policy objectives; promotes the goals of 'Capital Markets Union' and 'Banking Union'; provides risk finance to smaller innovative companies.	(Milne 2016)
Fairness and trustworthiness of financial transactions; financial inclusion; new market opportunities; competitive edge; broad-ranging applications; widely accepted.	(Medeiros and Chau 2016)
Developmental transformations: the emergence of digital financial services (DFS); creation of financial start-ups; increases financial market efficiency; reduces public distrust in the financial services industry; alternative sources of finance for small and medium enterprises; employment for financial professionals; commoditization of technology and the market penetration of the internet and mobile phones, particularly smartphones; reduces time-to-market at a potentially lower cost; provides better access to finance; fosters more innovative products reaching the market.	(Arner, Barberis, and Buckley 2017)
Facilitates transactions; features to better serve low to middle-level customers; higher convenience level; lower costs.	(Teja 2017)
Safe; transparent; rapid; affordable.	(Rooney, Aiken, and Rooney 2017)
Lowers entry barriers for new players; creates new business models; meets increasingly demanding customer needs; new start-ups and ventures; enhances the customer experience; streamlines operations; financial inclusion; affordability and literacy; trust.	(Pollari 2016)
New financial start-ups; faster and more cost-effective data transactions.	(Dandapani 2017)
Total number of publications	7

Table 13. High-value areas of bitcoin benefits.

High value/ benefits of Bitcoin	References	Number of references	%*
Anonymity and privacy	(Böhme et al. 2015; Halaburda 2016; Piotrowska 2016; Tu and Meredith 2015; McCallum 2015; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; White 2015; Dandapani 2017; Dotsika and Watkins 2017; Delgado-Segura, Tanas, and Herrera-Joancomartí 2016; Isaacson 2017; Hendrickson, Hogan, and Luther 2016; Meiklejohn et al. 2016; Dostov and Shust 2014a; Huang 2015; Zohar 2015; Swartz 2014; Harrison and Mano 2015)	20	32.26
Boundless (Global) and inclusiveness	(Morisse and Ingram 2016; Simser 2015; Vassiliadis et al. 2017; Folkinshteyn and Lennon 2016; Ciaian, Rajcaniova, and Kancs 2016; Rose 2015; Richter, Kraus, and Bouncken 2015; Huang 2015; Nieman 2015)	10	16.13
Cost	(Morisse and Ingram 2016; Simser 2015; Chu, Nadarajah, and Chan 2015; Böhme et al. 2015; Wolfson 2015; Sinha 2014; Collomb and Sok 2016; Folkinshteyn and Lennon 2016; Halaburda 2016; Piotrowska 2016; Abboushi 2017; Plassaras 2013; Pîrjan et al. 2015; Tu and Meredith 2015; McCallum 2015; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Lambert 2015; White 2015; Pakrou and Amir 2016; Richter, Kraus, and Bouncken 2015; Mikolajewicz-Wozniak and Scheibe 2015; Dandapani 2017; Kiviat 2015; Tsukerman 2015; Extance 2015; Allen 2017; Trautman and Harrell 2017; Wiseman 2016; Prentis 2015; Huang 2015; Zohar 2015; Kim 2015; Swartz 2014; Ajello 2015)	36	58.06
Decentralization (transactions)	(Böhme et al. 2015; Gandal and Halaburda 2016; Delgado-Segura, Tanas, and Herrera-Joancomartí 2016; Andrychowicz et al. 2016; Prentis 2015; Huang 2015)	6	9.68
Disintermediation	(Vassiliadis et al. 2017; Folkinshteyn and Lennon 2016; Gandal and Halaburda 2016; Milne 2016; Dostov and Shust 2014a; Harwick 2016; Halaburda 2016; Abboushi 2017; Plassaras 2013; Tu and Meredith 2015; Dotsika and Watkins 2017; Sklaroff 2017; Trautman and Harrell 2017; Andrychowicz et al. 2016; Abramowicz 2016; Prentis 2015; Huang 2015; Zohar 2015)	18	29.03
Efficiency	(Morisse and Ingram 2016; Pîrjan et al. 2015; Lambert 2015; Kiviat 2015; Allen 2017)	5	8.06
Immutability and fraud	(Chu, Nadarajah, and Chan 2015; Folkinshteyn and Lennon 2016; Plassaras 2013; McCallum 2015; Meiklejohn et al. 2016; Huang 2015; Zohar 2015)	7	11.29
Open source	(Folkinshteyn and Lennon 2016; Gandal and Halaburda 2016; Pîrjan et al. 2015; Cocco and Marchesi 2016; Zohar 2015)	5	8.06
Security	(Morisse and Ingram 2016; Folkinshteyn and Lennon 2016; Milne 2016; Harwick 2016; Piotrowska 2016; Abboushi 2017; Plassaras 2013; Ciaian, Rajcaniova, and Kancs 2016; Irwin and Milad 2016; Mikolajewicz-Wozniak and Scheibe 2015; Delgado-Segura, Tanas, and Herrera-Joancomartí 2016; Wolfson 2015; Hendrickson, Hogan, and Luther 2016; Wiseman 2016; Huang 2015)	15	24.19
Speed	(Morisse and Ingram 2016; Vassiliadis et al. 2017; Wolfson 2015; Collomb and Sok 2016; Folkinshteyn and Lennon 2016; Halaburda 2016; Abboushi 2017; Tu and Meredith 2015; Ciaian, Rajcaniova, and Kancs 2016; Richter, Kraus, and Bouncken 2015; Allen 2017; Chu, Nadarajah, and Chan 2015)	12	19.35
Transparency	(Folkinshteyn and Lennon 2016; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Richter, Kraus, and Bouncken 2015; Zohar 2015)	5	8.06

*These percentages show the proportion of articles with high-value benefits of bitcoin in the total number of articles on bitcoin benefits identified (62).

Table 14. High-value areas of Blockchain benefits.

High value/ benefits of Blockchain	References	Number of references	%*
Efficiency	(Wolfond 2017; Swan 2017; Cocco, Pinna, and Marchesi 2017; Evans 2017; Nowiński and Kozma 2017; Mansfield-Devine 2017; Kiviat 2015; Tsukerman 2015; Tapscott and Tapscott 2017a)	9	27.27
Immutability and fraud	(Wolfond 2017; Collomb and Sok 2016; Medeiros and Chau 2016; Nowiński and Kozma 2017; Ryan 2017; Huckle and White 2016; Lemieux 2016; Davy, Wouter, and Elisabeth 2017; Dandapani 2017; Kshetri 2017 ; Khan and Salah 2017; Underwood 2016; Alcazar 2017; Sklaroff 2017; Mik 2017)	15	45.45
Privacy	(Wolfond 2017; Dandapani 2017; Kshetri 2017; Khan and Salah 2017; Alcazar 2017; Bailis et al. 2017; Tapscott and Tapscott 2017a)	7	21.21
Decentralization and disintermediation	(Collomb and Sok 2016; Tapscott and Tapscott 2017b; Nowiński and Kozma 2017; Huckle and White 2016; Davy, Wouter, and Elisabeth 2017; Kshetri 2017; Prybila et al. 2017; Kiviat 2015; Underwood 2016; Alcazar 2017; Tsukerman 2015; Sklaroff 2017; Mik 2017)	13	39.39
Reliability	(Cocco, Pinna, and Marchesi 2017; Folkinshteyn and Lennon 2016; Ryan 2017; Lemieux 2016; Alcazar 2017; Sklaroff 2017; Tapscott and Tapscott 2017a)	7	21.21
Security	(Wolfond 2017; Swan 2017; Cocco, Pinna, and Marchesi 2017; Letourneau and Whelan 2017; Medeiros and Chau 2016; Tapscott and Tapscott 2017b; Nowiński and Kozma 2017; Lemieux 2016; Davy, Wouter, and Elisabeth 2017; Mansfield-Devine 2017; Kshetri 2017; Khan and Salah 2017; Kiviat 2015; Underwood 2016; Alcazar 2017; Bailis et al. 2017; Tsukerman 2015; Park and Park 2017; Tapscott and Tapscott 2017a; Mik 2017)	20	60.61
Service delivery and innovation	(Wolfond 2017; Swan 2017; Collomb and Sok 2016; Letourneau and Whelan 2017; Ryan 2017; Huckle and White 2016; Sikorski, Haughton, and Kraft 2017)	7	21.21
Speed	(Swan 2017; Collomb and Sok 2016; Ryan 2017; Kiviat 2015; Underwood 2016; Sklaroff 2017)	6	18.18

(*continued*)

Table 14. Continued.

High value/ benefits of Blockchain	References	Number of references	%*
Transaction cost	(Wolfond 2017; Swan 2017; Luther 2016a; Letourneau and Whelan 2017; Folkinshteyn and Lennon 2016; Tapscott and Tapscott 2017b; Nowiński and Kozma 2017; Ryan 2017; Kiviat 2015; Sklaroff 2017)	10	30.30
Transparency and accountability	(Swan 2017; Folkinshteyn and Lennon 2016; Evans 2017; Medeiros and Chau 2016; Abboushi 2017; Nowiński and Kozma 2017; Raskin 2015; Davy, Wouter, and Elisabeth 2017; Mansfield-Devine 2017; Prybila et al. 2017; Kiviat 2015; Underwood 2016; Tapscott and Tapscott 2017a)	13	39.39
Trust	(Cocco, Pinna, and Marchesi 2017; Folkinshteyn and Lennon 2016; Medeiros and Chau 2016; Ryan 2017; Lemieux 2016; Davy, Wouter, and Elisabeth 2017; Prybila et al. 2017; Kiviat 2015; Underwood 2016; Tsukerman 2015; Mik 2017)	11	33.33

*These percentages show the proportion of articles with high-value benefits of blockchain in the total number of articles on blockchain benefits identified (33).

Table 15. High-value areas of Fintech benefits.

High-value benefits of Fintech	References	Number of references	%*
Service delivery and innovation	(Milne 2016; Arner, Barberis, and Buckley 2017; Teja 2017; Medeiros and Chau 2016; Pollari 2016; Dandapani 2017)	6	85.71
Transaction costs	(Arner, Barberis, and Buckley 2017; Teja 2017; Rooney, Aiken, and Rooney 2017; Pollari 2016; Dandapani 2017)	5	71.43

*These percentages show the proportion of articles with high-value benefits of Fintech in the total number of articles on Fintech benefits identified (7).

Table 16. Benefits of Bitcoin from a business perspective.

Operational	• Reduced transaction costs • Increased transaction speed • No central vetting procedure/authority (disintermediation) • Anonymous(pseudonymous) transactions • Transparent transactions • Secure transactions • Immutable transactions • Instantaneous transfer of value • Irreversible transactions • Easily accessible to everyone with an internet connection • Trusted community • Convenient mechanism for monetizing contributions that are currently zero priced • Infinite divisibility • World-Wide Toll-Free Transfers (Tax free) • Independent currency
Strategic	• Support business growth due to absence of geographic boundaries • Build customer base due to increasing number of users • Supports speculative investment
Infrastructure	• Robust infrastructure • Decentralized core technologies • No central record keeping • Low cost of production and maintenance • Robust code • Open source

Table 17. Benefits of Blockchain from a business perspective.

Operational	• Reduced cost of recordkeeping • Improved accuracy of recordkeeping • Reduced fraud • More secure transactions • More transparent • Increased transaction speed • Quasi-real-time updates • Disintermediation • Improved data integrity • Improved privacy • Quasi-exhaustive recording • Customer service improvements • Improved password management
Managerial	• Improved identity management • Improved space management • Improved service delivery • Personalized financial services • Enhanced efficiency of financial services • Reduced foreign exchange (FX) transfer costs and times
Strategic	• Support sustainable development gaols • Promote economic growth • Reduce corruption • Accelerate the development of green technologies • Augment existing business networks • Catalyse digital innovation • Provide increased discoverability • Build customer trust
Infrastructure	• Open source • Less physical infrastructure needed for the transfer of goods and services

Results

Classification of articles by year of publication

As seen in Figure 1, the first scholarly publications on topics related to Bitcoin, Blockchain and Fintech date from 2010, and account for only 0.71% of publications resulting from the search methodology described above. The number of publications stood at a constant rate of 0.71% each year until 2013, when it increased to 5.67%. Since then, a steady increase is observed, from 9.22% in 2014 to 27.66% by the end of 2015. There was a slight decrease in the number of publications in 2016 (25.53%), but it then rose to 29.79% by the end of 2017, thus highlighting an increased interest in Bitcoin, Blockchain and Fintech.

Classification of articles by application domain or context

The classification of articles on Bitcoin, Blockchain and Fintech by application domain or context is presented in Tables 7–9. The search of databases found 109 publications that address the concept of Bitcoin. Most publications on the subject focused on financial digital-payment services and systems (21.10% of publications), and others dealt with law, taxation and legal regulation (18.35% of publications); accounting and financial regulation (11.01%); and business and economic concepts, models and theories (10.09%). The remaining articles on Bitcoin relate to financial markets

Table 18. Benefits of Fintech from a business perspective.

Operational	• Reduced time-to-market at a potentially lower cost • Easier access to finance • Streamlined operations • More affordable financial services • More inclusive financial services • More trusted financial system • Improved customer experience • Reduced entry barriers for new players
Managerial	• Alternative sources of finance for small and medium enterprises; • New employment opportunities for finance professionals • commoditization of technology and the market penetration of the internet and mobile phones • Gain a competitive advantage • Foster more innovative products reaching the market
Strategic	• Opportunity to develop new digital services • Increase financial market efficiency • Facilitate the achievement of digital currency policy objectives • Provide risk finance to smaller companies • Develop new market opportunities • Opportunity for new business models

Table 19. Classification of articles by challenges/issues related to bitcoin.

Challenges/issues related to Bitcoin	Authors, Date
Technologies and standards; internal oversight; transparency; scalability of business infrastructure; robustness; price; collective identity; interdependency between the technical system and the social systems; security concerns; instabilities in the protocol; transaction malleability; considerable use for illicit purposes; very few firms; nascent stage; stability and adaptability of firms.	(Morisse and Ingram 2016)
Cost and fair value models of accounting; limited research on governance, accountability and financial reporting paradigms; considerable use for illicit purposes; lack of regulation; unrecognised at cost; no reliably measurable for future cash flow; knowledge about how it should be accounted for by reporting entities and communicated to the users of their financial statements.	(Ram, Maroun, and Garnett 2016)
Proper classification of bitcoins on the balance sheet; recognizing changes in the value of bitcoins after they are received.	(Gross, Hoelscher, and Reed 2015)
Ecologically unfriendly; the number of transactions per block; high computational power needed.	(Cocco, Pinna, and Marchesi 2017)
Nascent stage and the evolution of the virtual currency is difficult to predict; Untraceable; highly illiquid and unstable; Use in illegal activity; Private key theft; Misadventures - loss of bitcoins; Hacking and denial of service; bitcoin-denominated fraud; Unregulated gaming enterprises; Taxation; decentralized operation; lack of a central settling authority.	(Simser 2015)
Incumbent-monies problem (cost required to transition from the incumbent money to bitcoin); competition from Alt-Coins (competition from other cryptocurrencies, otherwise known as alt-coins); illicit transactions; regulatory risk.	(Luther 2016a)
Volatility in exchange rates; susceptibility to attacks from cybercriminals – hacking, fraud, scams; susceptible to illicit use by cybercriminals; unregulated marketplace; potential fatal technical issues; lack of jurisdiction for the Federal Reserve; experimental nature.	(Lee et al. 2015)
Economic value; highly dependent on participants' trust in system; susceptible to speculative bubbles; no material form; high-value fluctuations; susceptible to user errors; decreases reward for users; provides computing power to the system ("miners"); mining using CPU and GPU unprofitable.	(Vassiliadis et al. 2017)
Sustainability; double-spending; risk of loss; the cost of production; trust.	(Dowd and Hutchinson 2015)
Validation time; computational costs; governance structure; payments are irreversible; hacking and denial-of-service attacks; digital wallet service issues (hard to install software, need to download Blockchain, risk of loss of bitcoins …); silk road and other illicit activities; regulation issues; taxation issues.	(Böhme et al. 2015)
Volatile prices; hacked digital wallets regulatory issues; illicit activities; legislative issues.	(Wolfson 2015)
No stable value; illicit activities; unregulated; unrecognized by central banks	(Sinha 2014)
Illicit activities; fraud; user/developer error; risk of business failure; security risk; code/crypto error risk; regulatory risk; viability; user interfaces.	(Folkinshteyn and Lennon 2016)
Purely digital; nascent market; many players entering and competing; slow transaction times; the pre-determined number of coins in the bitcoin system; very powerful specialized equipment to participate in the network; risk of theft from the wallet.	(Gandal and Halaburda 2016)
Volatility clustering of the price returns; hashing capability; power consumption; the hardware and electricity expenses.	(Cocco and Marchesi 2016)
Anonymity; illegal activities; cybersecurity.	(Extance 2015)
Cybercrime; Illegal transactions; Anonymity.	(Gad 2014)
Money laundering; financing of terrorism; cannot be used in the real economy Value of bitcoin is only based on the shared perception of value; no universal acceptance; inequality in the currency distribution; exchange rates highly volatile; tax crimes; anonymity as hidden identity.	(Dostov and Shust 2014a)
Legal regulations; financial intermediation; stability of value; high cost of mining (mainly electricity); moneyness; borrowing and lending risks.	(Harwick 2016)
Illegal trade; mining requires substantial energy; price volatility; validity as a currency; the cost of production.	(Halaburda 2016)

(*continued*)

Table 19. Continued.

Challenges/issues related to Bitcoin	Authors, Date
The volatility of its value; no legal tender status; illegal money laundering; illicit use to support global crime; tax evasion; unsupervised capital traffic; anonymity; unreported questionable activities; transactions are unidirectional and irrevocable; the slow pace of operation; infrastructural issues.	(Abboushi 2017)
Volatility; lack of liquidity.	(Bouri, Azzi, and Dyhrberg 2017)
Jurisprudence; classification; illegal activity; multi-signature technology; complications to bitcoin as tangible property.	(Raskin 2015)
Risks of misuse, confusion, and obfuscation; cybersecurity.	(Isaacson 2017)
Legitimacy; lack of regulation; acceptance; arduous and time-consuming ''mining'' process; high cost of electricity; the uncertainty of operations and growth; network externalities; speculative attacks.	(Plassaras 2013)
Volatility; categorization (money or property); regulatory concerns and considerations; no legal tender status; risk of theft; no centralized entity; anonymity concerns; susceptibility for misuse; illegal use; electronic storage; irreversible transfers; puffery; nondisclosure of material information; affirmative misrepresentation; online attacks.	(Tu and Meredith 2015)
Taxation; computing power; legal tender nor electronic money status; illicit activities; limited regulation.	(Kowalski 2015)
Lack of an oversight institution; information asymmetry; cost of getting acquainted with bitcoin system; cost of adoption of the payment technology; negligible market presence globally; network externalities; no legal tender; difficulty to procure bitcoins; dispute resolution not available; absence of bitcoin-denominated credit; unit of account; divisibility; relative price; comparability problem; price volatility; store of value; non-inationary supply; deationary pressure; cyber security; illegal activities.	(Ciaian, Rajcaniova, and Kancs 2016)
Business ethics; unrecoverable losses; hacked bitwallets; store of value.	(Angel and McCabe 2015)
Price volatility; illegitimate; store of value.	(Rose 2015)
Unregulated; illegal activities; market value; intrinsic value; destructibility; taxability.	(Lambert 2015)
Speculative; price volatility; no regulation; risky.	(Kurihara and Fukushima 2017)
Not recognized as legal tender; no intrinsic value; price volatility; legality; vulnerable to theft and loss; interoperability; insecurity.	(Wonglimpiyarat 2016)
Taxability; regulations.	(Jordan 2015)
Illicit transactions; lack of laws and regulations.	(Irwin and Milad 2016)
Security threat; danger of virtual money system collapse; impacts of the real world; monetary systems; money laundering, tax evasion and online criminal; value fluctuation of virtual money; lack of acceptance by governments, banks or the economy; limited group of users; value fluctuation of virtual money; impacts of real-world monetary systems; danger of virtual money system collapse; acceptance and faith.	(Richter, Kraus, and Bouncken 2015)
Tax evasion; unregulated environment; lack of the system operator; lack of precise legal regulations; difficulties with understanding how the system and its infrastructure operate; impedes the users' rights and make them subject to abuse.	(Mikolajewicz-Wozniak and Scheibe 2015)
Volatility and valuation; universal acceptability; lack of regulatory control; fraudulent and criminal behaviour; exchangeability; security; theft; lack of safety to depositors; irreversibility of transactions; anonymity; illegal activity; legal status; no refunds.	(Dandapani 2017)
Illegal activities; traceability.	(Broséus et al. 2016)
Wild price volatility; fraudulent investment schemes; multimillion-dollar hacks; acceptance as a monetary standard; a poor store of value; price volatility; federal regulations.	(Kiviat 2015)
State regulation; destroyed, lost, or stolen; lack intrinsic value; price volatility; energy consumption during mining; silk road; medium of exchange; token of value.	(Tsukerman 2015)
Loss of value; cybersecurity; legal recognition	(Low and Teo 2017)
International standard of regulation; illegal activity; final and irreversible; anonymity; cybercrime.	(Piazza 2017)
Lacking governmental and central bank support; volatility of the price; store of value; little or no regulatory system; risk of system failure.	(Allen 2017)
Illegal activity; Usability acceptability.	(Kim et al. 2017)
Limited payment laws and regulation; illegal activities; price volatility; currency stability.	(Trautman and Harrell 2017)
Illegal activities; anonymity; cybercrime.	(Masoni, Guelfi, and Gensini 2016)
Illicit transactions; government regulation; anonymity; disrupts government activities.	(Hendrickson, Hogan, and Luther 2016)
Criminal activities.	(Meiklejohn et al. 2016)
Illegal activities; price volatility; fluctuating value; classification; tax collection.	(Wiseman 2016)
Currency; financial security; price volatility.	(Prentis 2015)
Anonymity; Illicit transactions.	(Huang 2015)
Mining limitations; illegal activities; exchange rate fluctuations.	(Barre 2015)
Trafficking of illegal goods; online gambling; money laundering; tax evasion; funding terrorism.	(Small 2015)
Volatility; theft; international crime; bitcoin regulation; risk to investors	(Swartz 2014)
No central control or regulation; illegal activity.	(Connell 2014)
Criminal activities; tax evasion; investment scams; limited regulation.	(Ly 2014)
Illegal activities; limited regulation.	(Ajello 2015)
Money laundering; lack of foresight by the regulation writers.	(Bryans 2014)
Complexity of the technology; inflation; lack of institutionalization.	(NeguriĂA 2014)
Excessive regulation; volatility; security breaches; criminal uses.	(Brito and Castillo 2013)
Legal risks; criminal activities; value fluctuation; theft and fraud; lack of trust.	(Turpin 2013)
Vulnerable to speculation and hoarding; labouring, electricity, and the infrastructures of mining; anonymity; illegal activities; value fluctuations; Bitcoin protocols do not provide an incentive for nodes to broadcast transactions; not incentive-compatible.	(Maurer, Nelms, and Swartz 2013)
Money laundering; regulatory framework.	(Stokes 2012)
Volatility; general decline in value; anonymity; tax evasion.	(Pittman 2015)
Total number of publications	65

Table 20. Classification of articles by challenges/issues related to Blockchain.

Challenges/issues related to Blockchain	Authors, Date
Identity verification and authentication; trust between citizens and the services they access.	(Wolfond 2017)
Scalability; complicated technology; unresolved technical issues; effective government regulation; illegal practice detection and tracking.	(Swan 2017)
Performance; significant energy consumption; high cost of hardware; no standardized implementation; scalability; costs; security; computational speed and processing power; block size limit; the number of transactions.	(Cocco, Pinna, and Marchesi 2017)
Storage burden issues over time; undesirable delays due to update.	(Böhme et al. 2015)
Disintermediation; governance, standards and interoperability.	(Collomb and Sok 2016)
Regulatory compliance; illicit commerce; scalability; interoperability with existing legacy systems; storage capacity; cybersecurity; industrial standardization; computing power.	(Letourneau and Whelan 2017)
Risk of business failure.	(Folkinshteyn and Lennon 2016)
Offline readiness; lack of decentralization; depends upon the trustworthiness of those providing the feedback.	(Ryan 2017)
Cost and managerial overhead; setting-up is too time demanding.	(Davy, Wouter, and Elisabeth 2017)
Newness; limited adoption.	(Kshetri 2017)
Scalability; efficiency; arbitration/regulations; key collision; vulnerability.	(Khan and Salah 2017)
Cybersecurity; transaction confirmation time.	(Prybila et al. 2017)
Selfish miner problem; a Sybil attack.	(Alcazar 2017)
Security of transaction; security of wallet; security of software.	(Park and Park 2017)
Drug dealing; money laundering; legal identity.	(Wenker 2014)
Privacy; security; scalability; throughput; latency; size and bandwidth; wasted resources; usability; versioning, hard forks, multiple chains.	(Yli-Huumo et al. 2016)
Total number of publications	16

Table 21. Classification of articles by challenges/issues related to Fintech.

Challenges/issues related to Fintech	Authors, Date
Co-ordination amongst competing institutions; no individual gains in competitive advantage; reluctance to agree on standards; weak/lack of incentives; network structure of banking; regulation of access to banking platforms.	(Milne 2016)
Jurisprudence; regulatory activities; compliance; intellectual property; branding.	(Medeiros and Chau 2016)
Monitoring and enforcing increasingly demanding regulatory requirements on fast-changing, rapidly growing and cross-border markets; rapidly transforming financial systems; Infrastructure to support Fintech; cooperation with industry participants; compliance; cybersecurity.	(Arner, Barberis, and Buckley 2017)
Collaboration; innovation.	(Teja 2017)
The efficiency of technology infrastructure; improving systems stability; resilience and security.	(Pollari 2016)
Total number of publications	5

Table 22. High value areas of challenges related to bitcoin.

High value challenges/ issues related to Bitcoin	References	Number of references	%*
Accounting and finance	(Ram, Maroun, and Garnett 2016; Chu, Nadarajah, and Chan 2015; Vassiliadis et al. 2017; Wolfson 2015; Dostov and Shust 2014a; Harwick 2016; Bouri, Azzi, and Dyhrberg 2017; Tu and Meredith 2015; Kowalski 2015; Ciaian, Rajcaniova, and Kancs 2016; Lambert 2015; Kurihara and Fukushima 2017; Wonglimpiyarat 2016; Dandapani 2017; Kiviat 2015; Tsukerman 2015; Allen 2017; Trautman and Harrell 2017; Wiseman 2016; Prentis 2015; Barre 2015; Swartz 2014; NeguriÅA 2014; Brito and Castillo 2013; Turpin 2013; Maurer, Nelms, and Swartz 2013; Pittman 2015)	27	41.54
Anonymity	(Extance 2015; Gad 2014; Dostov and Shust 2014a; Abboushi 2017; Tu and Meredith 2015; Dandapani 2017; Piazza 2017; Masoni, Guelfi, and Gensini 2016; Hendrickson, Hogan, and Luther 2016; Meiklejohn et al. 2016; Huang 2015; Maurer, Nelms, and Swartz 2013; Pittman 2015)	13	20.00
Pricing and economic value	(Morisse and Ingram 2016; Ram, Maroun, and Garnett 2016; Simser 2015; Luther 2016a; Chu, Nadarajah, and Chan 2015; Vassiliadis et al. 2017; Böhme et al. 2015; Sinha 2014; Cocco and Marchesi 2016; Dostov and Shust 2014a; Harwick 2016; Halaburda 2016; Abboushi 2017; Bouri, Azzi, and Dyhrberg 2017; Tu and Meredith 2015; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Rose 2015; Kurihara and Fukushima 2017; Wonglimpiyarat 2016; Richter, Kraus, and Bouncken 2015; Dandapani 2017; Kiviat 2015; Tsukerman 2015; Low and Teo 2017; Allen 2017; Prentis 2015; Pittman 2015)	28	43.08
Security and crime	(Morisse and Ingram 2016; Simser 2015; Lee et al. 2015; Vassiliadis et al. 2017; Wolfson 2015; Folkinshteyn and Lennon 2016; Gandal and Halaburda 2016; Extance 2015; Gad 2014; Isaacson 2017; Tu and Meredith 2015; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Lambert 2015; Wonglimpiyarat 2016; Richter, Kraus, and Bouncken 2015; Dandapani 2017; Kiviat 2015; Tsukerman 2015; Low and Teo 2017; Piazza 2017; Masoni, Guelfi, and Gensini 2016; Swartz 2014; Ly 2014; Brito and Castillo 2013; Turpin 2013)	26	40.00
Energy consumption and environmental friendliness	(Cocco, Pinna, and Marchesi 2017; Vassiliadis et al. 2017; Cocco and Marchesi 2016; Harwick 2016; Plassaras 2013; Kowalski 2015; Tsukerman 2015; Barre 2015; Maurer, Nelms, and Swartz 2013)	9	13.85
Illicit activities	(Morisse and Ingram 2016; Ram, Maroun, and Garnett 2016; Simser 2015; Luther 2016a; Lee et al. 2015; Vassiliadis et al. 2017; Böhme et al. 2015; Wolfson 2015; Sinha 2014;	41	63.08

(*continued*)

Table 22. Continued.

High value challenges/ issues related to Bitcoin	References	Number of references	%*
	Folkinshteyn and Lennon 2016; Extance 2015; Gad 2014; Dostov and Shust 2014a; Halaburda 2016; Abboushi 2017; Raskin 2015; Tu and Meredith 2015; Kowalski 2015; Ciaian, Rajcaniova, and Kancs 2016; Lambert 2015; Irwin and Milad 2016; Richter, Kraus, and Bouncken 2015; Dandapani 2017; Broséus et al. 2016; Tsukerman 2015; Piazza 2017; Kim et al. 2017; Trautman and Harrell 2017; Masoni, Guelfi, and Gensini 2016; Hendrickson, Hogan, and Luther 2016; Meiklejohn et al. 2016; Wiseman 2016; Huang 2015; Barre 2015; Small 2015; Connell 2014; Ly 2014; Ajello 2015; Bryans 2014; Maurer, Nelms, and Swartz 2013; Stokes 2012)		
Regulation and legislation	(Morisse and Ingram 2016; Ram, Maroun, and Garnett 2016; Simser 2015; Luther 2016a; Lee et al. 2015; Böhme et al. 2015; Wolfson 2015; Sinha 2014; Folkinshteyn and Lennon 2016; Harwick 2016; Abboushi 2017; Raskin 2015; Plassaras 2013; Kowalski 2015; Lambert 2015; Kurihara and Fukushima 2017; Jordan 2015; Irwin and Milad 2016; Mikolajewicz-Wozniak and Scheibe 2015; Dandapani 2017; Kiviat 2015; Tsukerman 2015; Low and Teo 2017; Piazza 2017; Trautman and Harrell 2017; Hendrickson, Hogan, and Luther 2016; Swartz 2014; Connell 2014; Ly 2014; Ajello 2015; Bryans 2014; NeguriĂA 2014; Brito and Castillo 2013; Turpin 2013; Stokes 2012; Pittman 2015)	36	55.38
Technologies and standards	(Morisse and Ingram 2016; Cocco, Pinna, and Marchesi 2017; Simser 2015; Böhme et al. 2015; Folkinshteyn and Lennon 2016; Gandal and Halaburda 2016; Abboushi 2017; Raskin 2015; Tu and Meredith 2015; Wonglimpiyarat 2016; Mikolajewicz-Wozniak and Scheibe 2015; Dandapani 2017; Piazza 2017; Allen 2017; NeguriĂA 2014; Maurer, Nelms, and Swartz 2013)	16	24.62

*These percentages show the proportion of articles with high-value challenges related to bitcoin in the total number of articles on bitcoin challenges identified (65).

Table 23. High-value areas of challenges related to Blockchain.

High value challenges/issues related to Blockchain	References	Number of references	%*
Security	(Cocco, Pinna, and Marchesi 2017; Letourneau and Whelan 2017; Folkinshteyn and Lennon 2016; Khan and Salah 2017; Prybila et al. 2017; Park and Park 2017; Yli-Huumo et al. 2016)	7	43.75
Regulation and legislation	(Swan 2017; Collomb and Sok 2016; Letourneau and Whelan 2017; Folkinshteyn and Lennon 2016; Khan and Salah 2017)	5	31.25
Technology and standards	(Swan 2017; Cocco, Pinna, and Marchesi 2017; Böhme et al. 2015; Collomb and Sok 2016; Letourneau and Whelan 2017; Ryan 2017; Kshetri 2017; Khan and Salah 2017; Yli-Huumo et al. 2016)	9	56.25

*These percentages show the proportion of articles with high-value challenges related to Blockchain in the total number of articles on bitcoin challenges identified (16).

(7.34%); cryptocurrency markets (4.59%); technology and innovation (4.59%); e-commerce, online market places, supply chains, transport and logistics (4.59%); gambling and lottery (1.83%); mining (1.83%); social phenomena (1.83%); and teaching pedagogy (0.92%). Blockchain was the main topic of 43 articles. The applications of Blockchain in computing and technology were the focus of most publications (27.91%), followed by its applications in business, economics, and finance (25.58%). While a significant portion of articles covered blockchain applications in industry processes (13.95%) and contractual agreements (11.63%), other blockchain application areas were governance and regulation (6.98%), registry and records management (6.98%), digital identification and authentication (4.65%), and environmental sustainability (2.33%).

Finally, only 10 articles dealt with Fintech, 40% of them concerned with the applications of Fintech in banking and financial services, 40% covering technological development and computing, and the remaining 20% addressing the applications of Fintech in the business ecosystem.

Classification of articles by potential benefits/ business value

Tables 10–12 present the classification of articles reviewed according to the potential benefits or business value of Bitcoin, Blockchain and Fintech. Sixty-two articles on Bitcoin, thity-three articles on Blockchain, and seven on Fintech contained this information. Most articles acknowledged more than one benefit of Bitcoin, Blockchain and Fintech. Areas of high-value benefits for each concept were identified based on their popularity in the articles reviewed, as presented in Tables 13–15. Eleven areas of high-value benefit were identified for Bitcoin articles, eleven for Blockchain articles, and two for Fintech articles. The top five areas of benefit for Bitcoin included cost (58.06%), anonymity and privacy (32.26%), disintermediation (29.03%), security (24.19%), and speed (19.35%). For Blockchain, the top five areas of benefit included security (60.61% of articles on bitcoin benefits), immutability and fraud (45.45%), decentralization and

Table 24. Practical classification of Bitcoin challenges.

Awareness and understanding	• Experimental nature • Nascent market • Difficulties with understanding how the system and its infrastructure operate
Human and organization	• Limited internal oversight • Inadequate business infrastructure • Difficult stability and availability of firms • Susceptible to user/developer errors • Risk of business failure
Culture	• Interdependency between the technical system and the social systems
Value and cost	• High price volatility • Limited Cost and fair value models of accounting • Unrecognized value in some contexts • Not reliably measurable for future cash flow • No proper classification on balance sheets • Unregulated marketplace • Incumbent-monies problem (cost required to transition from the incumbent money to bitcoin) • Competition from Alt-Coins (competition from other cryptocurrencies, otherwise known as alt-coins); • The evolution of the currency is difficult to predict • Highly illiquid and unstable • Volatility in exchange rates • Highly dependent on participants' trust in the system • Susceptible to speculative bubbles • High-value fluctuations • No material forms • Expensive cost of mining (high cost of production) • Risk of theft from a digital wallet • No legal tender status • Danger of virtual money system collapse • Poor store of value
Regulation and governance	• Limited research on governance, accountability and financial reporting paradigms • Lack of regulation • Lack of central settling authority • Lack of jurisdiction for the Federal Reserve • No governing structure • Taxation concerns • Unrecognized by central banks • Unsupervised capital traffic • Lack of an oversight institution • Lack of precise legal regulation (making users subject to abuse) • Lacking governmental and central bank support
Security and privacy	• Security concerns • Transparency concerns • Considerable use for illicit purposes (financing terrorism, cyber crime, money laundering …) • Traceability concerns • Risk of private key theft • Loss of bitcoins • Susceptibility to attacks from cybercriminals • Bitcoin-denominated fraud • Irreversible payments • Anonymity and identity concerns
Technology and standards	• No technology standards • Instabilities in the protocol • Potential fatal technical issues • Digital wallet service issues (hard to install software, need to download blockchain, risk of loss of bitcoins …) • Very powerful specialized equipment to participate in the network • Lack of system operator • Highly complex technology • Protocols do not provide an incentive for nodes to broadcast transactions
Environment and energy	• Ecologically unfriendly • High computational power needed • High power consumption • High hardware and electricity expenses

disintermediation (39.39%), transparency and accountability (39.39%) and trust (33.33%). Only two areas of high-value benefit were identified for Fintech: service delivery and innovation (85.71%), and cost (71.43%). These benefits were further classified using dimensions from the framework proposed by (Shang and Seddon 2000) to classify ERP benefits. This brings out their operational, managerial, strategic and infrastructural benefits from a business perspective, as shown in Tables 16–18.

Classification of articles by challenges/issues

Tables 19–21 present the classification of the articles reviewed according to challenges or issues related to Bitcoin, Blockchain and Fintech. 65 articles highlighted some challenges/issues related to Bitcoin, 16 articles did the same for Blockchain and 5 for Fintech. Most of the articles reviewed acknowledge more than one issue related to Bitcoin, Blockchain and Fintech. High-value challenges for each

Table 25. Practical classification of Blockchain challenges.

Awareness and understanding	• Newness • Limited adoption
Organization	• Offline readiness concerns • Setting-up is too time demanding
Cost efficiency	• Cost and managerial overhead
Regulation and governance	• No government regulation • Disintermediation concerns • Regulatory compliance issues • Lack of decentralization
Security and privacy	• Identity verification and authentication concerns • Highly trust-dependent • Difficult illegal practice detection and tracking • Susceptible to cyberattacks • Key collision issues • Security of transaction, of wallet, and of software • Privacy concerns
Technology and standards	• Complicated technology • Unresolved technical issues • Scalability concerns • High cost of hardware • No standardized implementation • High computational speed and processing poser required • Block size limit concerns • Storage burden issues over time • Undesirable delays due to update • No interoperability standards • Slow transaction confirmation time • Throughput concerns • Network size and bandwidth concerns
Environment and energy	• High energy consumption

Table 26. Practical classification of Fintech challenges.

Organization	• Lack of coordination amongst competing institutions • No individual gains in competitive advantage • Reluctance to agree on standards • Weak/lack of incentives • Network structure of banking • Intellectual property concerns • Limited cooperation between industry participants
Culture	• Rapid transformation of financial systems
Regulation and governance	• Regulation concerns about access to banking platforms • Compliance issues • Monitoring and enforcing increasingly demanding regulatory requirements on fast-changing, rapidly growing and cross-border markets
Security and privacy	• Susceptible to cyber attacks
Technology and standards	• Robust infrastructure needed to support Fintech • Limited system stability • Resilience and security concerns

concept were identified based on their popularity among the articles reviewed, as presented in Tables 22 and 23. Eight areas of the high-value challenge were identified for Bitcoin, three for Blockchain, and none for Fintech. The top five areas of challenges related to Bitcoin included illicit activities (63.08% of articles on Bitcoin challenges), regulation and legislation (55.38%), pricing and economic value (43.08%), accounting and finance (41.54%) and security and crime (40.00%). The three major areas identified for Blockchain included technology and standards (56.25%), security (43.75%) and regulation and legislation (31.25%). These challenges were further categorized into dimensions identified as relevant for practical implications, as shown in Tables 24–26.

Classification of articles by industry

The distribution of articles by industry is shown in Table 27. The review of all publications showed the following percentages according to their focus areas: 53 articles (40.15%) focused on financial services; 41 of them (31.06%) focused on public administration and defence, compulsory social security and law and taxation; 8 (6.06%) focused on e-commerce; 6 each (4.55% each) focused on wholesale and retail, and on information and communication technology; while the arts, entertainment and recreation, manufacturing, education, healthcare, transportation and storage, environmental protection and sustainability and other private sectors each

Table 27. Classification based on industry.

Industry	Number of articles (%)	Authors, Date
Administrative and support services	1 (0.76%)	(Lemieux 2016)
Arts, entertainment and recreation	2 (1.52%)	(Nowiński and Kozma 2017; Kauffman et al. 2017)
Chemical, electricity, gas, steam and air conditioning	1 (0.76%)	(Sikorski, Haughton, and Kraft 2017)
Education	2 (1.52%)	(Tapscott and Tapscott 2017a; Barre 2015)
Financial services	53 (40.15%)	(Morisse and Ingram 2016; Ram, Maroun, and Garnett 2016; Cocco, Pinna, and Marchesi 2017; Vassiliadis et al. 2017; Jacobs 2011; Collomb and Sok 2016; Letourneau and Whelan 2017; Milne 2016; Harwick 2016; Piotrowska 2016; Medeiros and Chau 2016; Arner, Barberis, and Buckley 2017; Nowiński and Kozma 2017; Teja 2017; Bouri, Azzi, and Dyhrberg 2017; Antonikova 2015; Raskin 2015; Plassaras 2013; Pîrjan et al. 2015; Tu and Meredith 2015; Ober, Katzenbeisser, and Hamacher 2013; Schueffel 2016; Kowalski 2015; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Rose 2015; Kurihara and Fukushima 2017; White 2015; Wonglimpiyarat 2016; Pakrou and Amir 2016; Pollari 2016; Grant, Stiehler, and Boon 2013; Richter, Kraus, and Bouncken 2015; Mikolajewicz-Wozniak and Scheibe 2015; Dandapani 2017; Mansfield-Devine 2017; Kauffman, Liu, and Ma 2015; Underwood 2016; Piazza 2017; Allen 2017; Kim et al. 2017; Sirer 2016; Andrychowicz et al. 2016; Mik 2017; Nieman 2015; Donier and Bouchaud 2015; Chu, Nadarajah, and Chan 2015; Kristoufek 2015; Kondor et al. 2014; Maurer, Nelms, and Swartz 2013; Wang and Vergne 2017)
Information and communication technology	6 (4.55%)	(Khan and Salah 2017; Delgado-Segura, Tanas, and Herrera-Joancomartí 2016; Bailis et al. 2017; Park and Park 2017; Cocco and Marchesi 2016; Swan 2016)
Manufacturing and production	2 (1.52%)	(Davy, Wouter, and Elisabeth 2017; Shiyong et al. 2017)
Public administration and defence; compulsory social security; law, taxation	41 (31.06%)	(Wolfond 2017; Simser 2015; Chu, Nadarajah, and Chan 2015; Jacobs 2011; Babkin Alexander et al. 2017; Nowiński and Kozma 2017; Rooney, Aiken, and Rooney 2017; Antonikova 2015; Tu and Meredith 2015; Ryan 2017; Huckle and White 2016; Kowalski 2015; McCallum 2015; Lambert 2015; Jordan 2015; Irwin and Milad 2016; Lemieux 2016; Cunliffe et al. 2017; Kshetri 2017; Broséus et al. 2016; Kiviat 2015; Alcazar 2017; Tsukerman 2015; Low and Teo 2017; Piazza 2017; Trautman and Harrell 2017; Hendrickson, Hogan, and Luther 2016; Wiseman 2016; Mik 2017; Abramowicz 2016; Prentis 2015; Huang 2015; Nieman 2015; Wenker 2014; Swartz 2014; Connell 2014; Ajello 2015; NeguriĂA 2014; Turpin 2013; Chiu 2017; Stokes 2012)
Healthcare	2 (1.52%)	(Kshetri 2017; Masoni, Guelfi, and Gensini 2016; Swan 2016)
Real estate activities	1 (0.76%)	(Lambert 2015)
Transportation and storage	2 (1.52%)	(Basu 2014; Wesley and Ray 2017)
Wholesale and retail trade	6 (4.55%)	(Nowiński and Kozma 2017; Ciaian, Rajcaniova, and Kancs 2016; Lambert 2015; White 2015; Mansfield-Devine 2017; Kshetri 2017)
Other (private sector)	3 (2.27%)	(Wolfond 2017; Babkin Alexander et al. 2017; Kshetri 2017)
Other (e-commerce)	8 (6.06%)	(Gross, Hoelscher, and Reed 2015; Collomb and Sok 2016; Rose 2015; Pakrou and Amir 2016; Mansfield-Devine 2017; Kauffman et al. 2017; Sklaroff 2017; Meiklejohn et al. 2016)
Other (environmental protection and sustainability)	2 (1.52%)	(Cocco, Pinna, and Marchesi 2017; Al Kawasmi, Arnautovic, and Svetinovic 2015)
Total	132	

Note: Some articles are counted more than once because they cover more than one industry. Also, some articles did not concern any specific industry.

Table 28. Classification of articles by research approach.

Research approach	Number of articles (%)	Authors, Date
Conceptual	26 (16.88%)	(Wolfond 2017; Ram, Maroun, and Garnett 2016; Swan 2017; Davidson and Block 2015; Sinha 2014; Collomb and Sok 2016; Letourneau and Whelan 2017; Folkinshteyn and Lennon 2016; Smit, Buekens, and Du Plessis 2016; Milne 2016; Nowiński and Kozma 2017; Ryan 2017; Huckle and White 2016; Ober, Katzenbeisser, and Hamacher 2013; Wonglimpiyarat 2016; Chen 2018; Sikorski, Haughton, and Kraft 2017; Prybila et al. 2017; Park and Park 2017; Tapscott and Tapscott 2017a; Hendrickson, Hogan, and Luther 2016; Andrychowicz et al. 2016; Swan 2016; Al Kawasmi, Arnautovic, and Svetinovic 2015; Wagner 2016; Micheler 2015)
Review	53 (34.42%)	(Chu, Nadarajah, and Chan 2015; Lee et al. 2015; Vassiliadis et al. 2017; Böhme et al. 2015; Gad 2014; Harwick 2016; Halaburda 2016; Evans 2017; Medeiros and Chau 2016; Abboushi 2017; Nowiński and Kozma 2017; Teja 2017; Rooney, Aiken, and Rooney 2017; Antonikova 2015; Plassaras 2013; Pîrjan et al. 2015; Tu and Meredith 2015; Huckle and White 2016; Schueffel 2016; Kowalski 2015; McCallum 2015; White 2015; Basu 2014; Irwin and Milad 2016; Grant, Stiehler, and Boon 2013; Mikolajewicz-Wozniak and Scheibe 2015; Davy, Wouter, and Elisabeth 2017; Dandapani 2017; Mansfield-Devine 2017; Kshetri 2017; Sikorski, Haughton, and Kraft 2017; Dotsika and Watkins 2017; Khan and Salah 2017; Prybila et al. 2017; Underwood 2016 Bailis et al. 2017; Low and Teo 2017; Piazza 2017; Allen 2017; Trautman and Harrell 2017; Wiseman 2016; Abramowicz 2016; Prentis 2015; Huang 2015; Nieman 2015; Wenker 2014; Swartz 2014; Connell 2014; Ly 2014; Ajello 2015; NeguriĂA 2014; Chiu 2017; Yli-Huumo et al. 2016)
Data analysis	24 (15.58%)	(Cocco, Pinna, and Marchesi 2017; Folkinshteyn and Lennon 2016; Gandal and Halaburda 2016; Bouri, Azzi, and Dyhrberg 2017; Ober, Katzenbeisser, and Hamacher 2013; Ciaian, Rajcaniova, and Kancs 2016; Angel and McCabe 2015; Kurihara and Fukushima 2017; Davy, Wouter, and Elisabeth 2017; Cunliffe et al. 2017; Sikorski, Haughton, and Kraft 2017; Kauffman et al. 2017; Dotsika and Watkins 2017; Delgado-Segura, Tanas, and Herrera-Joancomartí 2016; Cocco and Marchesi 2016; Kim et al. 2017; Meiklejohn et al. 2016; Donier and Bouchaud 2015; Chu, Nadarajah, and Chan 2015; Kristoufek 2015; Kondor et al. 2014; Maurer, Nelms, and Swartz 2013; Stokes 2012; Wang and Vergne 2017)
Survey	8 (5.19%)	(Morisse and Ingram 2016; Halaburda 2016; Piotrowska 2016; Pakrou and Amir 2016; Wesley and Ray 2017; Mansfield-Devine 2017; Tsukerman 2015; Piazza 2017)
Experimental	10 (6.49%)	(Vassiliadis et al. 2017; Raskin 2015; Ober, Katzenbeisser, and Hamacher 2013; Angel and McCabe 2015; Rose 2015; Wonglimpiyarat 2016; Richter, Kraus, and Bouncken 2015; Davy, Wouter, and Elisabeth 2017; Cocco and Marchesi 2016; Kim 2015)
Case study (and laws)	25 (16.23%)	(Morisse and Ingram 2016; Gross, Hoelscher, and Reed 2015; Simser 2015; Lee et al. 2015; Folkinshteyn and Lennon 2016; Tu and Meredith 2015; Lemieux 2016; Broséus et al. 2016; Alcazar 2017; Park and Park 2017; Isaacson 2017; Allen 2017; Trautman and Harrell 2017; Wiseman 2016; Abramowicz 2016; Prentis 2015; Huang 2015; Nieman 2015; Shiyong et al. 2017; Swartz 2014; Connell 2014; Ly 2014; Ajello 2015; Turpin 2013; NeguriĂA 2014)
Developmental	8 (5.19%)	(Luther 2016a; Dowd and Hutchinson 2015; Wolfson 2015; Arner, Barberis, and Buckley 2017; Lambert 2015; Grant, Stiehler, and Boon 2013; Kauffman, Liu, and Ma 2015; Masoni, Guelfi, and Gensini 2016)
Total	154	

Note: Some articles are counted more than once because they use more than one type of research approach.

had less than 3% of the articles focusing on them. The following industries were the focus of only one article each (0.76% each): administrative and support services; chemical, electricity, gas, steam and air conditioning; and real estate.

Distribution of articles by research approach

Table 28 presents the classification of the reviewed articles by research approach. Most of the publications were reviews (53 articles, 34.42%), followed by conceptual articles (26 articles, 16.88%), case studies (25 articles, 16.23%), data analyses (24 articles, 15.58%), experimental studies (10 articles, 6.49%), developmental studies (8 articles, 5.19%), and surveys (8 articles, 5.19%).

Distribution of articles by journal

As shown in Table 29, nine journals were found to have published at least three articles on Bitcoin, Blockchain or Fintech, accounting for 29% of all reviewed publications (that is, 41 articles out of the 141 reviewed in this study). *PLOS One* alone published nine articles (6.38% of all reviewed publications), while *Communications of the ACM* published seven (4.96%), with five in *Technology Innovation and Management Review (3.55%)*. *Cato Journal* and the *Journal of Internet Banking and Commerce* published four articles each (2.84% each), while only three relevant articles were found in each of the following journals: *Communications and Strategies; Future Generation Computer Systems; Future Internet;* and *Law, Innovation &Technology* (contributing 2.13% each to the total number of publications reviewed).

Table 29. Classification of articles per journal (with minimum of 3 publications).

Journal	Number	%*
Cato Journal	4	2.84
Communications and Strategies	3	2.13
Communications of the ACM	7	4.96
Future Generation Computer Systems	3	2.13
Future Internet	3	2.13
Journal of Internet Banking and Commerce	4	2.84
Law, Innovation and Technology	3	2.13
PLOS ONE	9	6.38
Technology Innovation Management Review	5	3.55
Total	41	29.09

*Number of articles in journal/total number of articles reviewed (141).

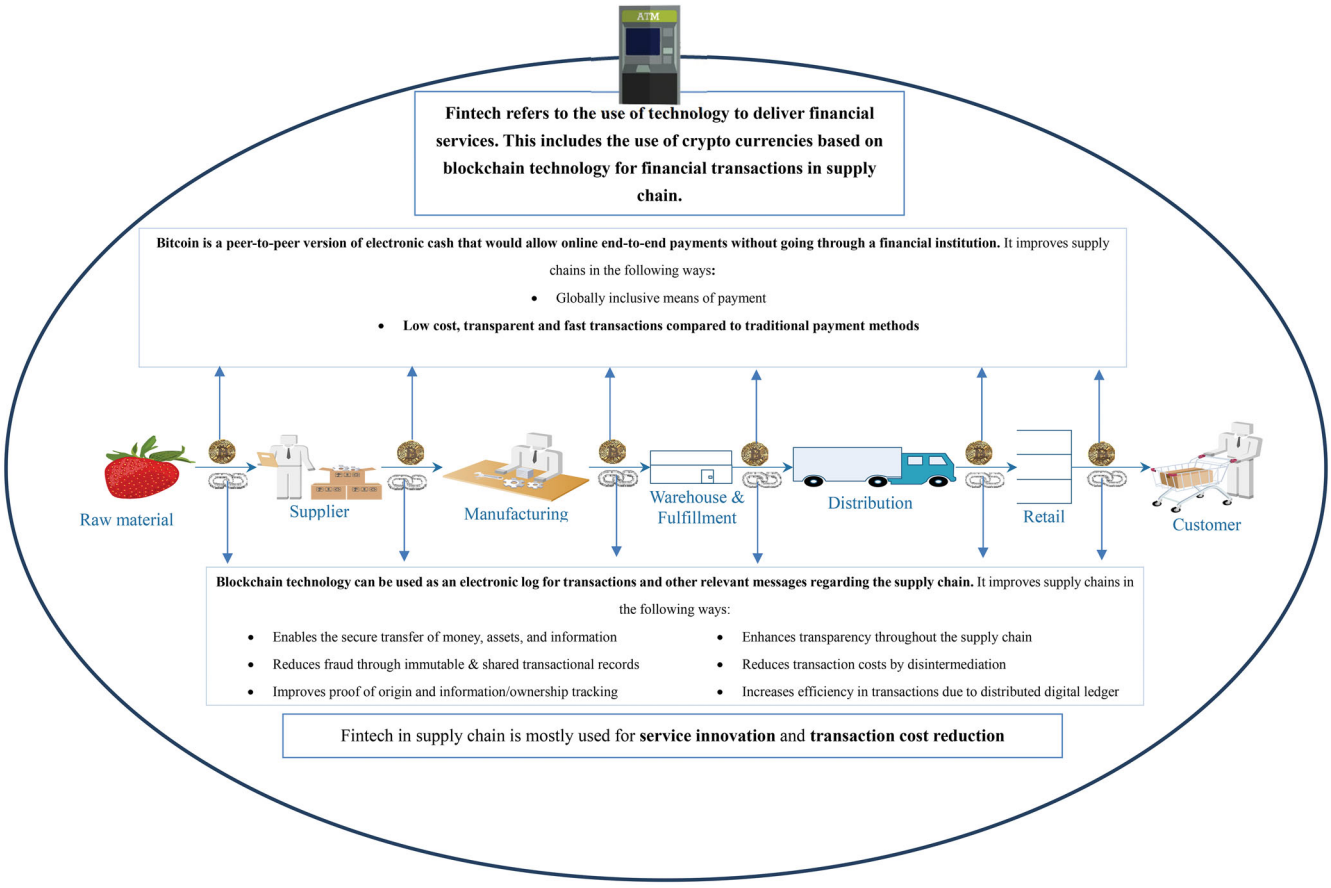

Figure 2. Positioning Bitcoin, Blockchain and Fintech in the supply chain context.

Figure 2 summarizes the role of bitcoin, blockchain and Fintech in the supply chain context.

Insights from case studies

Important benefits identified from the case studies

The analysis of three case studies provides some important insights. Currently, Manukora can use its overall Blockchain platform to achieve a competitive advantage. On the consumer side, scan rates are more than 10% in Asia (China has the highest scan rates) and less than 10% in North America. The usage of Blockchain builds trust and integrity into the Manuka Honey supply chain. The platform further allows Manukora to add provenance data, certification data, and quality reports, and to associate them with each batch.

Yimishiji was awarded the Social Impact Fellowship from the Gerson Lehrman Group (GLG) in October 2017, as part of their 'Tech for Social Good' program. The award gives Yimishiji free access to 500,000 GLG experts to help develop their business. In November 2017, the Origin Trail project at Yimishiji was awarded the Walmart China award for food-safety innovation, which includes business mentoring. As the Origin Trail protocol is open source, barriers for usage are low while scalability is high. The protocol can be utilized for rapid deployment to solve real-world problems in data integrity, enabling supply-chain transparency and improving consumer trust. Moreover, should something go wrong in the supply chain, such as the need to issue a food-safety recall, the problem can be easily and rapidly traced to the source within seconds.

Key challenges identified from the case studies

Many challenges also are related to these cases. One encountered by Manukora was engaging with and onboarding honey suppliers and getting buy-in to share data using a blockchain. The key to this challenge is helping the parties understand the value and usage of a blockchain, how it works, and how they can participate and share data. Another important challenge facing the firm is extending the platform to third parties such as logistics providers, who need to access data and provide data back to the platform. Overall it takes time to educate and get the extended supply chain on board. During blockchain feasibility testing, system performance was impacted and slowed significantly. This is a critical area of focus and trade-off as transactions ground to a halt. To counteract this problem, Trust Codes moved to a smart contract approach, and new members joining the blockchain could do so through identity management using an agreed-upon unique identity hash. Data is then held in the Trust Codes cloud (or other blockchain solutions), to be called up by a party with verified identity and role. Trust Codes

developed this platform approach to overcome the performance issues inherent in a pure Blockchain approach. Overall, the solution will benefit further from an agreed-upon Blockchain protocol to facilitate interoperability, which is something on which Trust Codes is focusing.

Yimishiji also faces several challenges. From the initiation of the project, a decision was made to ensure alignment with GS1 supply-chain standards for data and information. As such, a technical challenge at the outset included the mapping of the core GS1 standards in the solution, such as global trade item number (GTIN) and global location number (GLN). Once this was done, the team could focus on using the GS1 standards to set up the data-governance model and ensure the integrity of inbound data. With the connection of the first supplier, bad data was identified and corrected. Mapping the GS1 standards and setting up data governance and data mapping are keys to success. Furthermore, determining which data attributes to share, as well as when and why to share them, is important for all parties, to ensure the protection of data as well as data integrity. After this is set up, onboarding of a new supplier is a standardized and structured process. An important challenge is ensuring the platform is ready for future applications of the Internet of Things, AI, and big-data analysis. As such, future usage of sensor devices used on-farm, on-product, and in-transit – such as temperature control monitors – must be easily connectable to the blockchain platform to provide business intelligence.

For Ireland Craft Beers, the Blockchain solution is used to support a connected community and enhance the emotional bond between the consumer and the brand. For example, once the beer launched in November 2017 as the 'first craft beer on a blockchain', it sold out in a short period of time. The mobile application facilitated direct consumer feedback that suggests that those consumers value transparency of the craft or artisan beer-making process. Moreover, they see value in brands sharing product and process data to validate the beer's authenticity and provenance.

Discussion

Results of this comprehensive review of articles on Bitcoin, Blockchain and Fintech disclose several interesting revelations. Having presented clear definitions and concepts related to Bitcoin, Blockchain and Fintech, a classification framework was developed and used to perform an analysis of 141 articles from five top academic databases.

Research publications on Bitcoin, Blockchain and Fintech began appearing in 2010, and this nascent research is attributable to the introduction of Bitcoin in 2008. The first peer-reviewed papers on these topics started appearing a few years later, both following and helping to extend the popularity of those technologies. High-value areas of interest in the potential benefits and challenges of Bitcoin, Blockchain and Fintech were also identified. The degree of credibility for a benefit or challenge was based on the number of published articles on the subject, and the minimum level of acceptability was at least five articles. Thus, any other benefit or challenge not classified as high value needs further investigation.

Financial services and public administration are understandably the industries with the greatest interest in Bitcoin, Blockchain and Fintech. Despite their nascent status, as electronic media of exchange, these technologies are already threatening the traditional financial systems, all the more serious in that they are easily associated with other technologies. Financial-service organizations and systems are investigating how to explore the advantages of Bitcoin, Blockchain and Fintech while striving to overcome related challenges. The situation is different in public administration, where these new systems are still difficult to regulate and control. In the absence of clear regulations applicable to these technologies in most countries worldwide, they cannot be easily contained and controlled.

Researchers primarily used a review approach, to summarize previously published studies in various industries and contexts rather than to report new facts or analyses. Many authors also used conceptual studies and case studies to contribute to better understanding and to develop theories, practice, and professional issues in ways that are unique to this specific context. Despite their youth, Bitcoin, Blockchain and Fintech have given rise to approaches that are undeniably useful in the analysis of specific human problems, no matter the circumstances.

Implications for research and practice

Overall, this research serves as a baseline study, as it offers the opportunity to evaluate the level of knowledge on Bitcoin, Blockchain and Fintech, and their evolution over time. The classification framework as presented initiates and directs future empirical research on these topics. The definitions and main characteristics of Bitcoin, Blockchain and Fintech are expected to help shed more light on the definitional aspects of each concept.

Practically speaking, the fast-growing interest that many scholars and practitioners in almost every industry are currently showing in Bitcoin, Blockchain and Fintech clearly confirms the timeliness of this research. From a managerial perspective, this study highlights the main contexts or domains in which applications of Bitcoin, Blockchain and Fintech could occur, while emphasizing their potential benefits and business value. It also presents high-value challenges and issues related to Bitcoin, Blockchain and Fintech, as well as articles in which managers can find information concerning these technologies in their respective industries. From a research perspective, this study sets out a general classification of publications on Bitcoin, Blockchain and Fintech, and identifies key elements within each category. It significantly extends and complements other findings from systematic reviews in this research stream. From a professional practitioner's perspective, this study offers critical insights into the formulation and implementation of Bitcoin, Blockchain and Fintech strategies. It places Bitcoin, Blockchain and Fintech benefits and challenges in context, facilitating the

identification of new opportunities for innovation and the prioritization of business strategies.

Managers need to align existing organizational cultures and capabilities across the organization if they want to make the most of Bitcoin, Blockchain and Fintech. The fact that users consider lower transaction costs as the most frequently searched high-value potential benefit of Bitcoin should convince managers to rethink business models in which transaction cost is integrated, as is the case in many banks and financial institutions today. Moreover, Bitcoin offers anonymous transactions and guarantees user privacy more successfully than most financial systems do. These transactions are also relatively fast and secure, making Bitcoin very attractive. Therefore, it is in the interest of managers and institutions looking to make the most of cryptocurrencies (e.g. bitcoin) to consider these priority factors, while always keeping abreast of activity in this domain, as the trends vary extremely quickly over time. As one of the best tools for secure and immutable transactions, Bitcoin minimizes fraud and guarantees the reliability of transactional data in this data-driven world. The nonintervention of a central authority or of any intermediate partially explains why bitcoin transactions are much cheaper and faster, compared to any other means of transaction. Furthermore, this system is known to be trustworthy, given the degree of transparency and accountability attached to it. Business managers seeking high levels of transparency, accountability and increased trust could benefit from the blockchain technology. Major contributions of Fintech include lowering transaction costs in financial operations, improving the quality of services rendered, and creating more innovative ways of offering financial services. Managers from any industry need to better understand the full benefits of Fintech if they intend to take advantage of them. In addition to these key potential benefits that can be used to create business value, cryptocurrencies such as bitcoin, as well as related technologies (including blockchain and Fintech), have yet to unveil all their benefits.

At the same, it is necessary for managers interested in Bitcoin, Blockchain or Fintech to think about the challenges and issues that come with these concepts. For example, Bitcoin has a very flawed connotation arising from its alleged extensive use in illicit activities and cybercrimes. With the absence or the extremely low level of regulation and legislation to date, many people are still not sure about where and how to carry out transactions using their bitcoin. Besides, the fact that bitcoin has no legal status, is not a store of value, is highly volatile, and has no accounting standard or classification makes it very challenging to use for transactions. As for the blockchain technology, prospective users or adopters should bear in mind that it is still new and at its primary stage of development, with very few standards. In addition, blockchain requires very high computational power and an expensive IT infrastructure, as well as a certain degree of security in transactions, in combination with wallet operations, and alongside regulatory issues remaining to be addressed. The review also identifies challenges or issues related to Fintech. This implies that managers exploring Fintech and interested in investing in the technology should take those into consideration within the context of their particular business problem.

One limitation of this research work relates to the articles explored and reviewed, as those retrieved from the five academic databases were all written in English. It could be of great interest to explore other databases with articles written in other languages to complement the findings of this study. Additionally, the systematic approach used to carry out this study and the selection of articles and classifications were subjective. Other authors may find it interesting to replicate this study with their own selection criteria and classification schemes.

Further research and conclusions

This paper presents a systematic review of the peer-reviewed academic literature published from 2007 to 2017, pertaining to Bitcoin, Blockchain and Fintech, based on their perceived application domains, potential benefits, challenges, and applicable industries. It represents a baseline study for the 2007–2017 period that reveals the actual evolution of Bitcoin, Blockchain and Fintech as indicated in peer-reviewed research. It also provides significant insights for academia to establish new research domains, and for practitioners to assess their needs and ability to adopt any of these technologies. The findings show that these technologies are evolving, and organizations are embracing them for competitive advantage. Thus, organizations need to leverage research on these technologies to better understand them, optimize their business strategies, and develop critical insights for decision-making. To the best of the authors' knowledge, this study is the first review combining Bitcoin, Blockchain and Fintech, and spanning the 2007–2017 timeframe.

The review and classification proposed in this study offer useful insights into Bitcoin, Blockchain and Fintech research. They place all three concepts in one paper, making a comparative analysis easier for readers. In addition, the proposed definitions and findings can be used as a research agenda in Bitcoin, Blockchain and Fintech orientations and related discussions, amid the perception that further research in this area should be aligned to its rapid development. Building a strong business case for Bitcoin, Blockchain or Fintech will require expanding businesses from their current state to more sophisticated applications in the emerging market. Further research could focus on developing explanatory and predictive theories and models for better understanding of these technologies. Specifically, emphasis may be put on strategies and techniques of creating business value from the well-known benefits of the technologies, as well as on the ways and means of overcoming the explored challenges of Bitcoin, Blockchain and Fintech. Another angle of research may consist of investigating these technologies in other domains, such as the healthcare sector, where the research is very limited.

Disclosure statement

No potential conflict of interest was reported by the authors.

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References

Abboushi, S. 2017. "Global Virtual Currency. Brief Overview." *The Journal of Applied Business and Economics* 19(6): 10–18.

Abramowicz, M. 2016. "Cryptocurrency-Based Law." *Arizona Law Review* 58(2): 359–420.

Ajello, N. J. 2015. "Fitting a Square Peg in a round Hole." *Brooklyn Law Review* 80(2): 435–461.

Al Kawasmi, E., E. Arnautovic, and D. Svetinovic. 2015. "Bitcoin-Based Decentralized Carbon Emissions Trading Infrastructure Model." *Systems Engineering* 18(2): 115–130. doi:10.1002/sys.21291.

Alcazar, V. 2017. "Data You Can Trust: Blockchain Technology." *Air & Space Power Journal* 31(2): 91–101.

Allen, H. J. 2017. "$=€=Bitcoin?" *Maryland Law Review* 76(4): 877–939.

Ammous, S. H. 2016. "Blockchain technology: What is it good for?" *SSRN*, August 8. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2832751.

Andrychowicz, M., S. Dziembowski, D. Malinowski, and Ł. Mazurek. 2016. "Secure Multiparty Computations on Bitcoin." *Communications of the ACM* 59(4): 76–84. doi:10.1145/2896386.

Angel, J. J., and D. McCabe. 2015. "The Ethics of Payments: Paper, Plastic, or Bitcoin?" *Journal of Business Ethics* 132(3): 603–611. doi:10.1007/s10551-014-2354-x.

Aniello, L., R. Baldoni, E. Gaetani, F. Lombardi, A. Margheri, and V. Sassone. 2017. "A prototype evaluation of a tamper-resistant high performance blockchain-based transaction log for a distributed database." Paper presented at 13th European Dependable Computing Conference (EDCC), Geneva, Switzerland, September 4–8.

Antonikova, N. 2015. "Real Taxes on Virtual Currencies: What Does the IRS Say?" *Virginia Tax Review* 34(3): 433–466.

Arner, D. W., J. Barberis, and R. P. Buckley. 2017. "FinTech, RegTech, and the Reconceptualization of Financial Regulation." *Northwestern Journal of International Law & Business* 37(3): 371–413.

Atzori, M. 2015. "Blockchain technology and decentralized governance: Is the State still necessary?" *SSRN*, December 1. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2709713.

Babkin Alexander, V., D. D. Burkaltseva, W. W. Pshenichnikov, and A. S. Tyulin. 2017. "Cryptocurrency and Blockchain-Technology in Digital Economy: Development Genesis." *St. Petersburg State Polytechnical University Journal. Economics* 621: 319–334. doi:10.18721/JE.10501.

Bailis, P., A. Narayanan, A. Miller, and S. Han. 2017. "Research for Practice: Cryptocurrencies, Blockchains, and Smart Contracts; Hardware for Deep Learning." *Communications of the ACM* 60(5): 48–51. doi:10.1145/3024928.

Barre, T. J. 2015. "Bitcoin: A Pedagogical Guide for the College Classroom." *Journal of Education for Business* 90(6): 335–339. doi:10.1080/08832323.2015.1046358.

Basden, J., and M. Cottrell. 2017. "How utilities are using blockchain to modernize the grid." *Harvard Business Review*, March 27. https://hbr.org/2017/03/how-utilities-are-using-blockchain-to-modernize-the-grid.

Basu, G. 2014. "The Strategic Attributes of Transnational Smuggling: Logistics Flexibility and Operational Stealth in the Facilitation of Illicit Trade." *Journal of Transportation Security* 7(2): 99–113. doi:10.1007/s12198-013-0132-0.

Benbasat, I., D. K. Goldstein, and M. Mead. 1987. "The Case Research Strategy in Studies of Information Systems." *MIS Quarterly* 11(3): 369–386. doi:10.2307/248684.

Böhme, R., N. Christin, B. Edelman, and T. Moore. 2015. "Bitcoin: Economics, Technology, and Governance." *The Journal of Economic Perspectives* 29(2): 213–238. doi:10.1257/jep.29.2.213.

Bouri, E., G. Azzi, and A. H. Dyhrberg. 2017. "On the Return-Volatility Relationship in the Bitcoin Market around the Price Crash of 2013." *Economics* 11(2): 1–17. doi:http://dx.doi.org/10.5018/economics-ejournal.ja.2017-2.

Brito, J., and A. Castillo. 2013. "Bitcoin: A Primer for Policymakers." *Policy* 29(4): 3–12.

Broséus, J., D. Rhumorbarbe, C. Mireault, V. Ouellette, F. Crispino, and D. Décary-Hétu. 2016. "Studying Illicit Drug Trafficking on Darknet Markets: Structure and Organization from a Canadian Perspective." *Forensic Science International* 264: 7–14. doi:10.1016/j.forsciint.2016.02.045.

Bryans, D. 2014. "Bitcoin and Money Laundering: Mining for an Effective Solution." *Indiana Law Journal* 89(1): 441–472.

Chen, R.-Y. 2018. "A Traceability Chain Algorithm for Artificial Neural Networks Using T–S Fuzzy Cognitive Maps in Blockchain." *Future Generation Computer Systems* 80: 198–210. doi:10.1016/j.future.2017.09.077.

Chiu, I. H. Y. 2017. "A New Era in Fintech Payment Innovations? A Perspective from the Institutions and Regulation of Payment Systems." *Law, Innovation & Technology* 9(2): 190–234. doi:10.1080/17579961.2017.1377912.

Chu, J., S. Nadarajah, and S. Chan. 2015. "Statistical Analysis of the Exchange Rate of Bitcoin." *PLOS One* 10(7): 1–27. doi:10.1371/journal.pone.0133678.

Ciaian, P., M. Rajcaniova, and D. Kancs. 2016. "The Digital Agenda of Virtual Currencies: Can BitCoin Become a Global Currency?" *Information Systems and e-Business Management* 14(4): 883–919. doi:10.1007/s10257-016-0304-0.

Cocco, L., and M. Marchesi. 2016. "Modeling and Simulation of the Economics of Mining in the Bitcoin Market." *PLOS One* 11(10): 1–31. doi:10.1371/journal.pone.0164603.

Cocco, L., A. Pinna, and M. Marchesi. 2017. "Banking on Blockchain: Costs Savings Thanks to the Blockchain Technology." *Future Internet* 9(3): 25. doi:10.3390/fi9030025.

Collomb, A., and K. Sok. 2016. "Blockchain/Distributed Ledger Technology (DLT): What Impact on the Financial Sector?" *Communications & Strategies* 103: 93–111.

Connell, J. 2014. "Alderney: Gambling, Bitcoin and the Art of Unorthodoxy." *Island Studies Journal* 9(1): 69–78.

Crosby, M., P. Pattanayak, S. Verma, and V. Kalyanaraman. 2016. "Blockchain Technology: Beyond Bitcoin." *Applied Innovation* 2: 6–10.

Cunliffe, J., J. Martin, D. Décary-Hétu, and J. Aldridge. 2017. "An Island apart? Risks and Prices in the Australian Cryptomarket Drug Trade." *International Journal of Drug Policy* 50: 64–73. doi:10.1016/j.drugpo.2017.09.005.

Dandapani, K. 2017. "Electronic Finance – Recent Developments." *Managerial Finance* 43(5):614–626. doi:10.1108/MF-02-2017-0028.

Davidson, L., and W. E. Block. 2015. "Bitcoin, the Regression Theorem, and the Emergence of a New Medium of Exchange." *Quarterly Journal of Austrian Economics* 18(3): 311–338.

Davy, P., J. Wouter, and I.-Z. Elisabeth. 2017. "Trustworthy Data-Driven Networked Production for Customer-Centric Plants." *Industrial Management & Data Systems* 117(10): 2305–2324. doi:10.1108/IMDS-10-2016-0419.

DeCovny, S. 2015. "Chips off the Old Blockchain." *CFA Institute Magazine* 26(6): 24–25. doi:10.2469/cfm.v26.n6.8.

Delgado-Segura, S., C. Tanas, and J. Herrera-Joancomartí. 2016. "Reputation and Reward: Two Sides of the Same Bitcoin." *Sensors (14248220)* 16(6): 1–23. doi:10.3390/s16060776.

Donier, J., and J.-P. Bouchaud. 2015. "Why Do Markets Crash? Bitcoin Data Offers Unprecedented Insights." *PLOS One* 10(10): 1–11. doi:10.1371/journal.pone.0139356.

Dostov, V., and P. Shust. 2014a. "Cryptocurrencies: An Unconventional Challenge to the AML/CFT Regulators?" *Journal of Financial Crime* 21(3): 249–263. doi:10.1108/JFC-06-2013-0043.

Dostov, V., and P. Shust. 2014b. "Customer Loyalty Programs: Money Laundering and Terrorism Financing Risks." *Journal of Money Laundering Control* 17(4): 385–394. doi:10.1108/JMLC-06-2013-0021.

Dotsika, F., and A. Watkins. 2017. "Identifying Potentially disruptive trends by Means of Keyword Network Analysis." *Technological Forecasting and Social Change* 119: 114–127. doi:10.1016/j.techfore.2017.03.020.

Dowd, K., and M. Hutchinson. 2015. "Bitcoin Will Bite the Dust." *Cato Journal* 35(2): 357–382.

Eisenhardt, K. M. 1989. "Building Theories from Case Study Research." *Academy of Management Review* 14(4): 532–550. doi:10.5465/amr.1989.4308385.

Evans, G. L. 2017. "Disruptive Technology and the Board: The Tip of the Iceberg 1." *Economics and Business Review* 3(17): 205–223. doi:10.18559/ebr.2017.1.11.

Extance, A. 2015. "The Future of Cryptocurrencies: Bitcoin and beyond." *Nature* 526(7571): 21–23. doi:10.1038/526021a.

Folkinshteyn, D., and M. Lennon. 2016. "Braving Bitcoin: A Technology Acceptance Model (TAM) Analysis." *Journal of Information Technology Case and Application Research* 18(4): 220–249. doi:10.1080/15228053.2016.1275242.

Gad, M. 2014. "Crimeware Marketplaces and Their Facilitating Technologies." *Technology Innovation Management Review* 4(11): 28–33. doi:10.22215/timreview/847.

Gandal, N., and H. Halaburda. 2016. "Can We Predict the Winner in a Market with Network Effects? Competition in Cryptocurrency Market." *Games* 7(3): 16. doi:10.3390/g7030016.

Grant, P. S., B. Stiehler, and E. Boon. 2013. "Through Bubbles and Crises: An Analysis of the Journal of Financial Services Marketing from 2000 to 2012." *Journal of Financial Services Marketing* 18(4): 260–270. doi:10.1057/fsm.2013.21.

Gross, A., J. Hoelscher, and B. Reed. 2015. "Accounting Issues Related to Accepting Bitcoins." *Journal of the International Academy for Case Studies* 21(4): 71–74.

Guo, Y., and C. Liang. 2016. "Blockchain Application and Outlook in the Banking Industry." *Financial Innovation* 2(1): 24.

Halaburda, H. 2016. "Digital Currencies: Beyond Bitcoin." *Communications & Strategies* 213(103): 77–92.

Harrison, J., and R. Mano. 2015. "Accounting for Virtual Currency Transactions." *Journal of the Utah Academy of Sciences, Arts & Letters* 92: 109–118.

Harwick, C. 2016. "Cryptocurrency and the Problem of Intermediation." *The Independent Review* 20(4):569–588.

Hendrickson, J. R., T. L. Hogan, and W. J. Luther. 2016. "The Political Economy of Bitcoin." *Economic Inquiry* 54(2): 925–939. doi:10.1111/ecin.12291.

Huang, A. 2015. "Reaching within Silk Road: The Need for a New Supoena Power That Targets Illegal Bitcoin Transactions." *Boston College Law Review* 56(5): 2093–2125.

Huckle, S., and M. White. 2016. "Socialism and the Blockchain." *Future Internet* 8(4): 49. doi:10.3390/fi8040049.

Irwin, A. S. M., and G. Milad. 2016. "The Use of Crypto-Currencies in Funding Violent Jihad." *Journal of Money Laundering Control* 19(4): 407–425. doi:10.1108/JMLC-01-2016-0003.

Isaacson, S. 2017. "The Bamboozling Bite of Bitcoin: Bitcoin Doesn't Make White Collar Crime Possible, but It Does Make It Easier!." *Utah Bar Journal* 30(4): 32–36.

Jacobs, E. 2011. "Bitcoin: A Bit Too Far?." *Journal of Internet Banking and Commerce* 16(2): 1–4.

Jordan, J. L. 2015. "The Role of Gold in the Market-Based Monetary System." *Cato Journal* 35(2): 233–250.

Kauffman, R. J., K. Kim, S.-Y. T. Lee, A.-P. Hoang, and J. Ren. 2017. "Combining Machine-Based and Econometrics Methods for Policy Analytics Insights." *Electronic Commerce Research and Applications* 25: 115–140. doi:10.1016/j.elerap.2017.04.004.

Kauffman, R. J., J. Liu, and D. Ma. 2015. "Innovations in Financial IS and Technology Ecosystems: High-Frequency Trading in the Equity Market." *Technological Forecasting and Social Change* 99: 339–354. doi:10.1016/j.techfore.2014.12.001.

Khan, M. A., and K. Salah. 2017. "IoT Security: Review, Blockchain Solutions, and Open Challenges." *Future Generation Computer Systems* 82: 395–411. doi:10.1016/j.future.2017.11.022.

Kim, T. 2015. "The Predecessors of Bitcoin and Their Implications for the Prospect of Virtual Currencies." *PLOS One* 10(4):1–18. doi:10.1371/journal.pone.0123071.

Kim, Y. B., J. Lee, N. Park, J. Choo, J.-H. Kim, and C. H. Kim. 2017. "When Bitcoin Encounters Information in an Online Forum: Using Text Mining to Analyse User Opinions and Predict Value Fluctuation." *PLoS One* 12(5): 1–14. doi:10.1371/journal.pone.0177630.

Kiviat, T. I. 2015. "Beyond Bitcoin: Issues in Regulating Blockchain Transactions." *Duke Law Journal* 65(3):569–608.

Klaus, I. 2017. "Don Tapscott and Alex Tapscott: Blockchain Revolution." *New Global Studies* 11(1): 47–53. doi:10.1515/ngs-2017-0002.

Kondor, D., M. Pósfai, I. Csabai, and G. Vattay. 2014. "Do the Rich Get Richer? An Empirical Analysis of the Bitcoin Transaction Network." *PLOS One* 9(2): 1–10. doi:10.1371/journal.pone.0086197.

Kowalski, P. 2015. "Taxing Bitcoin Transactions under Polish Tax Law." *Comparative Economic Research* 18(3): 139–152. doi:10.1515/cer-2015-0025.

Kristoufek, L. 2015. "What Are the Main Drivers of the Bitcoin Price? Evidence from Wavelet Coherence Analysis." *PLOS One* 10(4): 1–15. doi:10.1371/journal.pone.0123923.

Kshetri, N. 2017. "Blockchain's Roles in Strengthening Cybersecurity and Protecting Privacy." *Telecommunications Policy* 27(10): 1027–1038. doi:https://doi.org/10.1016/j.telpol.2017.09.003.

Kurihara, Y., and A. Fukushima. 2017. "The Market Efficiency of Bitcoin: A Weekly Anomaly Perspective." *Journal of Applied Finance and Banking* 7(3): 57–64.

Lambert, E. E. 2015. "The Internal Revenue Service and Bitcoin: A Taxing Relationship." *Virginia Tax Review* 35(1): 88–115.

Lee, J., A. Long, M. McRae, J. Steiner, and S. G. Handler. 2015. "Bitcoin basics: A primer on virtual currencies." *Business Law International*. 16: 21.

Lemieux, V. L. 2016. "Trusting Records: Is Blockchain Technology the Answer?" *Records Management Journal* 26(2): 110–139. doi:10.1108/RMJ-12-2015-0042.

Letourneau, K. B., and S. T. Whelan. 2017. "Blockchain: Staying Ahead of Tomorrow." *The Journal of Equipment Lease Financing* 35(2): 1–6.

Lim, M. K., W. Bahr, and S. C. Leung. 2013. "RFID in the Warehouse: A Literature Analysis (1995–2010) of Its Applications, Benefits, Challenges and Future Trends." *International Journal of Production Economics* 145(1): 409–430. doi:10.1016/j.ijpe.2013.05.006.

Linn, L., and M. Koo. 2016. "Blockchain for health data and its potential use in health it and health care related research." *ONC/NIST Use of Blockchain for Healthcare and Research Workshop*. Gaithersburg, MD: ONC/NIST.

Low, K. F. K., and E. G. S. Teo. 2017. "Bitcoins and Other Cryptocurrencies as Property?" *Law, Innovation & Technology* 9(2): 235–268. doi:10.1080/17579961.2017.1377915.

Luther, W. J. 2016a. "Bitcoin and the Future of Digital Payments." *The Independent Review* 20(3): 397–404.

Luther, W. J. 2016b. "Mises and the Moderns on the Inessentiality of Money in Equilibrium." *The Review of Austrian Economics* 29(1): 1–13. doi:10.1007/s11138-015-0321-0.

Ly, M. K.-M. 2014. "Coining Bitcoin's 'Legal-Bits': Examining Regulatory Framework for Bitcoin and Virtual Currencies." *Harvard Journal of Law & Technology* 27(2): 587–608.

Mansfield-Devine, S. 2017. "Beyond Bitcoin: Using Blockchain Technology to Provide Assurance in the Commercial World." *Computer Fraud & Security* 2017(5): 14–18. doi:10.1016/S1361-3723(17)30042-8.

Marshall, M. 2018. "IBM and shipping giant Maersk launch blockchain company for global logisics." *VentureBeat*, January 16. Accessed 20/01/2018. https://venturebeat-com.cdn.ampproject.org/c/s/venturebeat.com/2018/01/16/ibm-and-shipping-giant-maersk-launch-blockchain-company-for-global-logisics/amp/.

Masoni, M., M. R. Guelfi, and G. F. Gensini. 2016. "Darknet and Bitcoin, the Obscure and Anonymous Side of the Internet in Healthcare." *Technology and Health Care* 24(6): 969–972. doi:10.3233/THC-161244.

Maurer, B., T. C. Nelms, and L. Swartz. 2013. "'When Perhaps the Real Problem Is Money Itself!': The Practical Materiality of Bitcoin." *Social Semiotics* 23(2): 261–277. doi:10.1080/10350330.2013.777594.

McCallum, B. T. 2015. "The Bitcoin Revolution." *Cato Journal* 35(2): 347–356.

Medeiros, M., and B. Chau. 2016. "Fintech - Stake a Patent Claim?" *Intellectual Property Journal* 28(3): 303–314.

Meiklejohn, S., M. Pomarole, G. Jordan, K. Levchenko, D. McCoy, G. M. Voelker, and S. Savage. 2016. "A Fistful of Bitcoins: Characterizing Payments among Men with No Names." *Communications of the ACM* 59(4): 86–93. doi:10.1145/2896384.

Micheler, E. 2015. "Custody Chains and Asset Values: Why Crypto-Securities Are Worth Contemplating." *The Cambridge Law Journal* 74(3): 505–533. doi:10.1017/S0008197315000598.

Mik, E. 2017. "Smart Contracts: Terminology, Technical Limitations and Real World Complexity." *Law, Innovation & Technology* 9(2): 269–300. doi:10.1080/17579961.2017.1378468.

Mikolajewicz-Wozniak, A., and A. Scheibe. 2015. "Virtual Currency Schemes - The Future of Financial Services." *Foresight: The Journal of Futures Studies, Strategic Thinking and Policy* 17(4): 365–377. doi:10.1108/FS-04-2014-0021.

Milne, A. 2016. "Competition Policy and the Financial Technology Revolution in Banking." *Communications & Strategies* 213(103): 145–161.

Morisse, M., and C. Ingram. 2016. "A Mixed Blessing: Resilience in the Entrepreneurial Socio-Technical System of Bitcoin." *Journal of Information Systems and Technology Management* 13(1): 3–26. doi:10.4301/S1807-17752016000100001.

Nakamoto, S. 2008. "Bitcoin: A peer-to-peer electronic cash system." *Bitcoin*. https://bitcoin.org/bitcoin.pdf.

NeguriÄA, O. 2014. "Bitcoin-between Legal and Financial Performance." *Contemporary Readings in Law & Social Justice* 6(1): 242–248.

Ngai, E. W., L. Xiu, and D. C. Chau. 2009. "Application of Data Mining Techniques in Customer Relationship Management: A Literature Review and Classification." *Expert Systems with Applications* 36(2): 2592–2602. doi:10.1016/j.eswa.2008.02.021.

Ngai, E. W. T., K. K. Moon, F. J. Riggins, and Y. Y. Candace. 2008. "RFID Research: An Academic Literature Review (1995–2005) and Future Research Directions." *International Journal of Production Economics* 112(2): 510–520. doi:10.1016/j.ijpe.2007.05.004.

Nieman, A. 2015. "A Few South African Cents' Worth on Bitcoin." *Potchefstroom Electronic Law Journal* 18(5): 1979–2010. doi:10.4314/pelj.v18i5.25.

Nowiński, W., and M. Kozma. 2017. "How Can Blockchain Technology Disrupt the Existing Business Models?" *Entrepreneurial Business and Economics Review* 5(3): 173–188. doi:10.15678/EBER.2017.050309.

Ober, M., S. Katzenbeisser, and K. Hamacher. 2013. "Structure and Anonymity of the Bitcoin Transaction Graph." *Future Internet* 5(2): 237–250. doi:10.3390/fi5020237.

Pakrou, M., and K. Amir. 2016. "The Relationship between Perceived Value and the Intention of Using Bitcoin." *Journal of Internet Banking and Commerce* 21(2): 1–18.

Park, J. H., and J. H. Park. 2017. "Blockchain Security in Cloud Computing: Use Cases, Challenges, and Solutions." *Symmetry (20738994)* 9(8): 1–13. doi:10.3390/sym9080164.

Piazza, F. 2017. "Bitcoin in the Dark Web: A Shadow over Banking Secrecy and a Call for Global Respoonse." *Southern California Interdisciplinary Law Journal* 26(3): 521–546.

Pilkington, M. 2016. "Blockchain Technology: Principles and Applications." *SSRN*, September 18. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2662660.

Piotrowska, A. I. 2016. "Fields of Potential Use of Cryptocurrencies in the Payment Services Market in Poland-Results of an Empirical Study." *Copernican Journal of Finance & Accounting* 5(2): 201–217. doi:10.12775/CJFA.2016.023.

Pîrjan, A., D.-M. Petrosanu, M. Huth, and M. Negoita. 2015. "Research Issues regarding the Bitcoin and Alternative Coins Digital Currencies." *Journal of Information Systems & Operations Management* 9 (1): 1–14.

Pittman, A. 2015. "The Evolution of Giving: Considerations for Regulation of Cryptocurrency Donation Deductions." *Duke Law & Technology Review* 14(1): 48–68.

Plassaras, N. A. 2013. "Regulating Digital Currencies: Bringing Bitcoin within the Reach of the IMF." *Chicago Journal of International Law* 14(1): 377–407.

Pollari, I. 2016. "The Rise of Fintech: Opportunities and Challenges." *JASSA* 3: 15–21.

Prentis, M. 2015. "Digital Metal: Regulating Bitcoin as a Commodity." *Case Western Reserve Law Review* 66(2): 609–638.

Prybila, C., S. Schulte, C. Hochreiner, and I. Weber. 2017. "Runtime Verification for Business Processes Utilizing the Bitcoin Blockchain." *Future Generation Computer Systems*. Advance online publication. doi:10.1016/j.future.2017.08.024.

Ram, A., W. Maroun, and R. Garnett. 2016. "Accounting for the Bitcoin: Accountability, Neoliberalism and a Correspondence Analysis." *Meditari Accountancy Research* 24(1): 2–35. doi:10.1108/MEDAR-07-2015-0035.

Raskin, M. I. 2015. "Realm of the Bitcoin: Bitcoin and Civil Procedure." *Fordham Journal of Corporate & Financial Law* 20(4): 969–1011.

Richter, C., S. Kraus, and R. B. Bouncken. 2015. "Virtual Currencies like Bitcoin as a Paradigm Shift in the Field of Transactions." *International*

Business & Economics Research Journal 14(4): 575–586. doi:10.19030/iber.v14i4.9350.

Rooney, H., B. Aiken, and M. Rooney. 2017. "Q&A. Is Internal Audit Ready for Blockchain?" *Technology Innovation Management Review* 7(10): 41–44. doi:10.22215/timreview/1113.

Rose, C. 2015. "The Evolution of Digital Currencies: Bitcoin, a Cryptocurrency Causing a Monetary Revolution." *International Business & Economics Research Journal* 14(4): 617–622. doi:10.19030/iber.v14i4.9353.

Ryan, P. 2017. "Smart Contract Relations in e-Commerce: Legal Implications of Exchanges Conducted on the Blockchain." *Technology Innovation Management Review* 7(10): 14–21. doi:10.22215/timreview/1110.

Schueffel, P. 2016. "Taming the Beast: A Scientific Definition of Fintech." *Journal of Innovation Management* 4(4): 32–54. doi:10.24840/2183-0606_004.004_0004.

Shang, S., and P. B. Seddon. 2000. "A comprehensive framework for classifying the benefits of ERP systems." *AMCIS 2000 proceedings*. https://aisel.aisnet.org/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1452&context=amcis2000.

Shiyong, Y., B. Jinsong, Z. Yiming, and H. Xiaodi. 2017. "M2M Security Technology of CPS Based on Blockchains." *Symmetry* 9(9): 1–16. doi:10.3390/sym9090193.

Shrier, D., W. Wu, and A. Pentland. 2016. "Blockchain & infrastructure (identity, data security)." *MIT Connection Science*, May 17. https://www.getsmarter.com/career-advice/wp-content/uploads/2017/07/mit_blockchain_and_infrastructure_report.pdf.

Sikorski, J. J., J. Haughton, and M. Kraft. 2017. "Blockchain Technology in the Chemical Industry: Machine-to-Machine Electricity Market." *Applied Energy* 195: 234–246. doi:10.1016/j.apenergy.2017.03.039.

Simser, J. 2015. "Bitcoin and Modern Alchemy: In Code we Trust." *Journal of Financial Crime* 22(2): 156–169. doi:10.1108/JFC-11-2013-0067.

Sinha, A. 2014. "Bitcoins: A Super Bubble Ready to Burst." *FIIB Business Review* 3(3): 3–6.

Sirer, E. G. 2016. "The State (and Security) of the Bitcoin Economy." *Communications of the ACM* 59(4): 85–85. doi:10.1145/2896382.

Sklaroff, J. M. 2017. "Smart Contracts and the Cost of Inflexibility." *University of Pennsylvania Law Review* 166(1): 263–303.

Small, S. 2015. "Bitcoin: The Napster of Currency." *Houston Journal of International Law* 37(2): 581–641.

Smit, J. P., F. Buekens, and S. Du Plessis. 2016. "Cigarettes, Dollars and bitcoins - An Essay on the Ontology of Money." *Journal of Institutional Economics* 12(2): 327–347. doi:10.1017/S1744137415000405.

Stokes, R. 2012. "Virtual Money Laundering: The Case of Bitcoin and the Linden Dollar." *Information & Communications Technology Law* 21(3): 221–236. doi:10.1080/13600834.2012.744225.

Swan, M. 2016. "The Future of Brain-Computer Interfaces: Blockchaining Your Way into a Cloudmind." *Journal of Evolution & Technology* 26(2): 60–81.

Swan, M. 2017. "Anticipating the Economic Benefits of Blockchain." *Technology Innovation Management Review* 7(10): 6–13. doi:10.22215/timreview/1109.

Swartz, N. D. 2014. "Bursting the Bitcoin Bubble: The Case to Regulate Digital Currency as a Security or Commodity." *Tulane Journal of Technology & Intellectual Property* 17: 319–335.

Tapscott, D., and A. Tapscott. 2017a. "The Blockchain Revloution & Higher Education." *Education Review* 52(2): 10–24.

Tapscott, D., and A. Tapscott. 2017b. "How Blockchain Will Change Organizations." *MIT Sloan Management Review* 58(2): 10–13.

Teja, A. 2017. "Indonesian Fintech Business: New Innovations or Foster and Collaborate in Business Ecosystems?" *The Asian Journal of Technology Management* 10(1): 10–18. doi:10.12695/ajtm.2017.10.1.2.

Trautman, L. J. 2016. "Is disruptive blockchain technology the future of financial services?" *SSRN*, May 28. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2786186.

Trautman, L. J., and A. C. Harrell. 2017. "Bitcoin versus Regulated Payment Systems: What Gives?" *Cardozo Law Review* 38(3): 1041–1097.

Tsukerman, M. 2015. "The Block Is Hot: A Survey of the State of Bitcoin Regulation and Suggestions for the Future." *Berkeley Technology Law Journal* 30: 1127–1169.

Tu, K. V., and M. W. Meredith. 2015. "Rethinking Virtual Currency Regulation in the Bitcoin Age." *Washington Law Review* 90(1): 271–347.

Turpin, J. B. 2013. "Bitcoin: The Economic Case for a Global, Virtual Currency Operating in an Unexplored Legal Framework." *Indiana Journal of Global Legal Studies* 21(1): 335–368.

Underwood, S. 2016. "Blockchain beyond Bitcoin." *Communications of the ACM* 59(11): 15–17. doi:10.1145/2994581.

Vassiliadis, S., P. Papadopoulos, M. Rangoussi, T. Konieczny, and J. Gralewski. 2017. "Bitcoin Value Analysis Based on Cross-Correlations." *Journal of Internet Banking and Commerce* 22(S7): 1–12.

Wagner, D. 2016. "Fairness and the Coin Flip." *Communications of the ACM* 59(4): 75–75. doi:10.1145/2898429.

Wamba, S. F., S. Akter, A. Edwards, G. Chopin, and D. Gnanzou. 2015. "How 'Big Data' can Make Big Impact: Findings from a Systematic Review and a Longitudinal Case Study." *International Journal of Production Economics* 165: 234–246. doi:10.1016/j.ijpe.2014.12.031.

Wamba, S. F., A. Anand, and L. Carter. 2013. "A Literature Review of RFID-Enabled Healthcare Applications and Issues." *International Journal of Information Management* 33(5): 875–891. doi:10.1016/j.ijinfomgt.2013.07.005.

Wang, S., and J.-P. Vergne. 2017. "Buzz Factor or Innovation Potential: What Explains Cryptocurrencies' Returns?" *PLOS One* 12(1): 1–17. doi:10.1371/journal.pone.0169556.

Wenker, N. 2014. "Online Currencies, Real-World Chaos: The Struggle to Regulate the Rise of Bitcoin." *Texas Review of Law & Politics* 19(1): 145–197.

Wesley, S. B., and A. M. Ray. 2017. "Practice or Lip Service: Exploring Collaboration Perspectives in Purchasing." *IMP Journal* 11(3): 452–467. doi:10.1108/IMP-05-2016-0009.

White, L. H. 2015. "The Market for Cryptocurrencies." *Cato Journal* 35(2): 383–402.

Wiseman, S. A. 2016. "Property or Currency? the Tax Dilemma behind Bitcoin." *Utah Law Review* 2016(2):417–440.

Wolfond, G. 2017. "A Blockchain Ecosystem for Digital Identity: Improving Service Delivery in Canada's Public and Private Sectors." *Technology Innovation Management Review* 7(10): 35–40. doi:10.22215/timreview/1112.

Wolfson, S. N. 2015. "Bitcoin: The Early Market." *Journal of Business & Economics Research* 13(4): 201. doi:10.19030/jber.v13i4.9452.

Wonglimpiyarat, J. 2016. "The New Darwinism of the Payment System: Will Bitcoin Replace Our Cash-Based Society?" *Journal of Internet Banking and Commerce* 21(S2): 1–15.

Wright, A., and P. D. De Filippi. 2015. "Decentralized blockchain technology and the rise of lex cryptographia." *SSRN*, March 10. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2580664.

Yin, R. K. 1994. *Case Study Research: Design and Methods*. Newbury Park, CA: Sage.

Yli-Huumo, J., D. Ko, S. Choi, S. Park, and K. Smolander. 2016. "Where Is Current Research on Blockchain Technology?—a Systematic Review." *PLOS One* 11(10): 1–27. doi:10.1371/journal.pone.0163477.

Zohar, A. 2015. "Bitcoin: Under." *Communications of the ACM* 58(9): 104–113. doi:10.1145/2701411.