Blockchain Technology Adoption: State of the Art

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Abstract. In the last few years our understanding of distributed ledger technology (DLT), blockchain and cryptocurrency has increased dramatically. One of the promising research streams has been the adoption of blockchain and DLT by consumers, firms and governments. The purpose of this paper is to synthesize the current state of the art on blockhain technology adoption. We analyze 64 papers on ABI Inform and SRRN databases and classify the literature into nine research streams, selectively reviewing the most significant papers in this paper. We conclude that most of the studies are a-theoretical, descriptive and conceptual, with only a small number of papers using primary empirical data. More theory-driven, multidisciplinary research using primary data is needed to advance our understanding of the complex phenomenon of blockchain technology adoption.

Keywords: Blockchain technology, cryptocurrency, systematic literature review, adoption

1 Introduction

In the past few years our knowledge of DLT (distributed ledger technology), blockchains and cryptocurrencies has increased dramatically. Researchers have examined the technical aspects of the technology (e.g., Yli-Huumo et al., 2016), mining strategies (e.g., proof-of-work and proof-of-stake) and consensus mechanisms (Cong and He, 2019), various applications of the technology (e.g., Harvey, 2016) as well as its impact on corporate governance and financial reporting (e.g., Yermack, 2017). The adoption of blockchain and DLTs by firms, consumers and governments has also been the subject of research in the literature.

Although the adoption of the blockchain technology in the real world is still in its infancy (Stratopoulos and Wang, 2018; Woodside, Augustine and Giberson, 2017), researchers have explored adoption through different theoretical lenses (e.g., UTAUT, diffusion of innovation, Gartner's hype cycle). The purpose of this paper is to synthesize the current state of knowledge on blockhain technology adoption under various research streams, identify common patterns, limitations and future research opportunities.

2 Method

We used a systematic approach to identifying salient research articles on the topic of blockchain adoption from two main sources of data: (1) ABI Inform database for peer reviewed articles and (2) SSRN (given the recency of the phenomenon under investigation, we included unpublished articles, and papers in progress from SSRN). We searched the databases using the following keywords in the paper titles and abstracts: blockchain, DLT, cryptocurrencies in conjunction with adoption, use and implementation. With the keywords adoption, DLT and/or Blockchain 34 papers were identified, with keywords of use + DLT and/or blockchain: 186 papers, with implementation + DLT and/or blockchain: 52; with adoption + cryptocurrencies, 106 papers for a total of 378 peer-reviewed papers from ABI Inform database. 45 articles were overlapping. From the SSRN database, we identified 39 papers on blockchain + adoption, 20 papers on DLT + adoption (all the same as with "blockchain"), 15 papers on cryptocurrencies + adoption (only 1 paper was new), and 59 papers on blockchain + implementation.

After reading abstracts and scanning the entire content of each paper, we have excluded technical papers, legal papers and those that are not related to the adoption, even though the keywords were mentioned in the title and/or the abstract. In addition, we excluded papers that overlapped between the SSRN and ABI Inform database. The end result of this selection process were 64 papers. These were summarized and categorized according to the research statement, methodology, theoretical foundation, unit of analysis, primary versus secondary data, country and industry of the study as well the key findings. These summaries enabled us to identify 9 streams of research related to blockchain adoption:

1. Challenges, barriers and benefits of adoption;
2. Data protection, sharing, security and privacy;
3. Socio-economic implications and macro consequences of blockchain adoption;
4. Impact of blockchain on business models and governance;
5. Environmental factors, government and ecosystem role in blockchain adoption;
6. Applications and use cases of blockchain adoption;
7. Factors affecting adoption;
8. State of blockchain adoption; and
9. Blockchain adoption and cryptocurrencies.

The following section provides an overview of the state-of-the-art and research developments under each of the nine research streams identified above.

3 State of the art

3.1 Research Stream I: Challenges, barriers, and benefits of adoption

The most frequently studied research stream related to blockchain technology adoption is the identification of the challenges, barriers and benefits of the adoption per sector or industry. The main benefits identified in the literature are efficiency and new opportunities for businesses (Allen et al., 2018), increase in transparency and accountability, reduction of inventory and lowering price in supply chain management (e.g., Chang et al., 2018), securing finance for SME (Chod, Trichakis and Tsoukalas, 2018), facilitating consumers' purchase decisions and increasing transparency (Sander, Semeijn, and Maher, 2018), reducing transaction and monitoring costs (e.g., Moyanno and Ross, 2017; Notheisen, Cholewa and Shanmugam, 2017), improving real-time data collection and analysis, and expanding participation opportunities for currently vulnerable, excluded, and underserved populations (e.g., Swan, 2017; Folkinshteyn and Lennon, 2016; Kshetri, 2017; Chod, Trichakis, Tsoukalas, 2018).

The main challenges are related to the risks associated with the technology, such as complexity, scalability, security, speed (e.g., Arora et al. 2017; Folkinshteyn and Lennon, 2016; Radanović and Likić, 2017), infrastructure requirements (e.g., Folkinshteyn and Lennon, 2016), lack of user-friendliness for DApp adoption (e.g., Witherspoon, 2017), regulatory uncertainty, skepticism of early decision-makers, organizational inertia and mindset barriers (e.g., Zamani and Giaglis, 2018), as well as a lack of required new skills and competencies (e.g., Radanović and Likić, 2017), among others.

Folkinshteyn and Lennon (2016) summarize the benefits and challenges of blockchain and cryptocurencies adoption from the perspective of (1) end users and (2) developers within the Technology Acceptance Model. The perceived risk of blockchain as a financial software platform for developers include risk of business failure, fewer regulatory issues and less stringent security concerns. The perceived ease of use and usefulness from the developers' perspective include open source, API availability, free participation, record integrity, auditable, distributed availability and lower cost record tracking. From the end-user perspective, beyond the currency aspects, many of the risks and the perception of ease of use are variable and cannot be adequately described, because they are application-specific. The perceived usefulness include reduced costs, elimination of intermediaries, simplification of processes as well as the value of each application.

Radanović and Likić (2017) find that the utilization of blockchain as it exists today is not without its weaknesses. The technology is immature and lacks public and expert knowledge, making it hard to have a clear strategic vision of its potential future uses. There is little proof of concept and few pilot projects and prototypes that demonstrate blockchain feasibility or practical applications. One could foresee performance and expenditure issues emerging in the developing parts of the world.

Blockchain technology adoption in healthcare has some specific additional problems concerning the management of large quantities of patient data. To operatereliably, such a system would require a significant amount of resources and computing power, though some solutions are now being developed, such as the possibility of storing the encrypted patient data 'off-chain', while the information about that data and its accessibility are both stored on the blockchain. Technical complexity of cryptography is also something to be mindful of because it may have negative effects on the adoption of this technology.

On the benefits side, for example in the financial sector, Pinna and Ruttenberg (2016) discuss that DLTs could stimulate a reorganization of financial markets, which could in turn: (i) reduce reconciliation costs, (ii) streamline the post-trade value chain, and (iii) allow more efficient use of collateral and regulatory capital. Blockchain technology adoption furnishes the ability to secure favorable financing terms to SMEs at lower signaling costs due to increased transparency (Chod, Trichakis, Tsoukalas, 2018).

3.2 Research Stream II: Data protection, sharing, security and privacy

Blockchain is a shared database that records transactions between parties, hence data privacy and data protection are among the main factors influencing blockchain adoption. Many papers address the privacy and security features of blockchain, with the majority focusing on the technical features. Some authors are optimistic about blockchain's ability to guarantee privacy and security of shared data and transactions; others are more skeptical. Of these studies, very few examine the impact of blockchain's security and privacy features on its adoption. Some of the papers focus more specifically on the public sector (Benjaafar, Chen, Taneri and Wan, 2018; Fabian et al., 2018; Elisa et al., 2018).

Zheng et al. (2018) confirm a direct relationship between blockchain adoption and data privacy protection. The authors propose a new scalable and privacy preserving data sharing scheme based on blockchain technologies. They introduce an innovative method to protect multi-party data privacy and test security proving that the scheme can ensure privacy. Fabian et al. (2018) examine the impact of security and privacy specifically in the context of the bitcoin blockchain. Using a survey with 125 bitcoin users and extensive analysis of blockchain transactions collected from a public transactions ledger, they measure security and privacy risks as well as related countermeasures by examining self-reported and actual adoption of salient security and privacy measures. The findings show that adopters are familiar with these measures; however, other measures are less known. To increase adoption, the authors recommend to improve the usability and awareness among users.

Benjaafar et al. (2018) demonstrate the ability of blockchain technology to provide higher data and information exchange security. The authors investigate whether the pairing of a new technology such as blockchain with an access-based blockchain

business model could alleviate three main types of information issues (moral hazard, adverse selection and hold-up). Notheisen and Weinhardt (2018) have a more negative perception of the impact of technology's feature on adoption. Using economic modeling under conditions of two-period lending game and the asymmetry of information assumption, they show that blockchain transactions related to data protection, privacy and security have a negative effect on the behaviors of the market participants and market outcomes.

Generally, research into the impact of blockchain's technological features on adoption remains in its infancy. Researchers are divided as to whether these features promote or impede blockchain technology adoption.

3.3 Research Stream III: Socio-economic implications of blockchain adoption

The implications of blockchain adoption and diffusion in the literature has typically been discussed under the broad rubrics of *financial* impact (e.g., reducing the possibility of data falsification and manipulation), *monetary system* impact (e.g., currency competition), *economic* impact (e.g., cost efficiencies, enhancing entrepreneurship), *social* impact (e.g., increasing access to financial services for the unbanked) and *institutional* impact (e.g., decentralised governance) (see Ben Dhaou, Zalan and Toufaily, 2017, for a synthesis).

Perhaps the most impactful papers in our review are those related to the social and institutional impact of blockchain adoption. In particular, implementations of DLT in development finance and financial inclusion have been the subject of the ADB report (based on survey data) (Ferranin, Maupin and Hinojales, 2017). The report emphasises the benefits of blockchain (increased transparency and accountability, reduced transaction and monitoring costs, improved real-time data collection and analysis possibilities), and, more importantly, expanded participation opportunities for currently vulnerable, excluded, and underserved populations.

Berg, Davidson and Potts (2018), in a conceptual piece, focus on the long-run economic and policy consequences of wide-spread blockchain technology adoption. The structural economic effects of blockchain as an institutional innovation (disintermediation in markets, de-hierarchicalization of organisations, and growing private provision of economic infrastructure for exchange, contracting and coordination) undercut the historical rationale for much modern economic policy, originally formulated to enable capitalism to cope with market power, to control hierarchy, and to furnish public infrastructure for trust. They hypothesise that blockchain will expand the role of markets (horizontal networks) and contract the role of hierarchy (vertical networks). Ultimately, blockchain adoption will have consequences for competition, innovation and industry policy.

In another provocative study involving economic modelling, Notheisen and Weinhardt (2019) pose the question of how core features of blockchain transactions affect behaviors of market participants and market outcomes. They argue that public disclosure of quality information can give rise to opportunistic behavior. Blockchain adop-

tion may lead to market collapses in markets with a high level of transparency and intense competition. In addition, using blockchain-based systems in environments prone to irrational behavior (retail markets) can harm welfare and impede a market's functioning.

3.4 Research Stream IV: Impact of blockchain on business models and governance

A number of papers have explored how blockchain will change organisations and ecosystems (Tapscott and Tapscott, 2016; Berg, Davidson and Potts, 2018; Berg, Novak, Potts and Thomas, 2018). Tapscott & Tapscott's report (2016), in particular, has been highly influential in arguing that blockchain will have a profound effect on some functional aspects in organisations (e.g., HR, finance and accounting, and sales and marketing). Nevertheless, it is worth bearing in mind that it is a descriptive report with few theoretical underpinnings.

Zamani and Giaglis (2018) examine how blockchains, which they consider disruptive innovations, lead to innovative business models (incl. automated money, autonomous economic agents and DAOs). Similarly, in a theory development paper, Nowiński and Kozma (2017) argue that blockchain can lead to innovative business models. Boots and Wilkins (2017) illustrate how equipment finance industry could benefit from the adoption of blockchain, smart contracts and AI. Felin and Lakhani (2018) explore what business problems can be solved with blockchain (e.g., reaching new customers, increasing efficiency and transparency) while differentiating themselves from competitors.

Governance issues and blockchain-associated risks are the focus of Dierksmeier and Seele (2018) and Arora and Arora (2018). In an economics paper, Benjaafar, Chen, Taneri and Wan (2018) present a strong case for a permissioned blockchain and discuss benefits of adoption (cost reduction).

3.5 Research Stream V: Environmental factors/ government and ecosystem role in blockchain adoption

Research on the adoption of the blockchain from an institutional perspective is scarce. Most of the papers are focused on the use-cases and potentiality of blockchain for the government. Very few papers highlight the role that the government and the institutions should play to improve the adoption of blockchain (Ølnes, Ubacht, and Janssen, 2017). However, several studies emphasizing the critical role of an ecosystem for the adoption of the blockchain technology identify a broader set of contextual and environmental factors.

Tapscott and Tapscott (2016) contend that the main factors influencing blockchain adoption are lower transaction costs and changes in how organizations are managed. Berg et al. (2018) apply an economic lens to the adoption of the blockchain technolo-

gy. They explain it through an evolutionary lens that considers 3 level of analysis: micro-, meso- and macro- levels. The researchers consider the integration of blockchain in the socio-economic system through a process of origination and diffusion. Adoption occurs through a process of variation, selection and retention between diverse institutional systems. This paper contributes to understanding the evolutionary path of blockchain technology to explain future adoption and development of socio-economic systems using the evolutionary-institutional approach. The authors argue that the technology is past the emerging phase, or what they present as the origination phase, and is possibly entering the maturation phase. This is facilitated by the narratives related to the improvements provided by blockchain as a ledger technology as well as the ability of the technology to endow people to secede from existing institutions and accede to new ones.

Several papers address the adoption of blockchain technology by governments and the existing and potential use cases. For example, Hyvarinen et al. (2017) assess the applicability of blockchain technology for public services. The authors propose and evaluate a prototype of blockchain in order to reduce tax fraud linked to the flow of dividends that constitutes an important backdrop to overcome the current double spending problem in the public taxation sector. The prototype is tested with Danish authorities whose tax losses were in the vicinity of US$1.8 billions in 2015. The researchers acknowledge that while their system offers major benefits of a blockchain-based solution (i.e., decentralization, transparency, immutability, automation), it cannot be considered an entirely trust-free system, as it requires compliance of banks and trust in the institutions that issue tokens (i.e., VP securities) and refund taxes (i.e., tax authorities). Other use cases of blockchain adoption by the public sector include decentralized peer-to-peer e-government systems that are able to alleviate a lack of trust and security of digital government services (Elisa et al., 2017; Ølnes, Ubach and Janssen, 2017).

Ølnes et al. (2017) investigate whether blockchain technology adoption will lead to innovation and transformation of governmental processes. They strongly recommend a shift from a technology-driven to a need-driven approach, where blockchain use cases are customized to ensure an adequate fit with administrative processes. Berg et al. (2018), informed by public choice and institutional theory, advocate ecosystem creation inclusive of other stakeholders so as to facilitate a blockchain-enabled economy and overcome barriers to innovation.

3.6 Research Stream VI: Applications and use cases

This topic, with 19 papers, is the second most frequently researched stream, which is not surprising. We classified the papers into use cases a) by a domain / industry and b) by country. These papers focus on describing various blockchain applications such as in finance, supply chain management, logistics and provenance and healthcare / insurance. For example, in a rare empirical paper, Sander, Semeijn and Mahr (2018) use a survey and interviews of various stakeholders to establish the acceptance of

blockchain in meat traceability and transparency. The results show that consumers are overwhelmed by the amount and complexity of certification labels. Blockchain implementation appears to have significant positive influences on consumers' purchasing decisions, mediated by consumers' quality perceptions. This study reveals the divergent perspectives of multiple stakeholders with regard to the importance of a blockchain in this particular use case. Francisco and Swanson (2018), in a theory-driven conceptual paper, introduce the Unified Theory of Acceptance and Use of Technology (UTAUT) to explain user acceptance of blockchain in traceability applications. The conceptual model is supported by researchable propositions and balanced with supply chain management implications and future research suggestions.

Using three case studies, Rutschman (2018) investigates how healthcare companies in the U.S., Sweden and Estonia are incorporating blockchain into their business models. In Sweden and U.S., the industry has adopted the consortium model, while the national model is popular in Estonia. Moyano and Ross (2017) propose a new approach to the KYC verification process for financial institutions, based on DLT adoption. The authors suggest that the adoption of blockchain/ DLT allows banks to observe the KYC cost structure at an aggregate level for all the financial institutions operating in a jurisdiction and to tackle the inefficiencies that emerge from a duplicationt of similar tasks by all participating institutions.

3.7 Stream VII: Factors affecting adoption

Several papers focus on identifying and/or analyzing factors and variables impacting blockchain adoption in different industry sectors. Some studies look at the use of blockchain technology in supply chain management (Benjaafar et al., 2018; Francisco and Swanson, 2018). Others link blockchain to smart city initiatives in the context of sustainable urban development (Marsal-Llacuna, 2018) and for cloud services (Prasad et al., 2018).

This research stream demonstrates that blockchain adoption is driven by different factors. In supply chain management, adoption is motivated by transparency and traceability (Francisco and Swanson, 2018) to deal with the information problems of moral hazard, adverse selection and hold-up (Benjaafar et al., 2018). The incentive to use the technology in urban development is the disruption of urban networks and the delivery of urban governance in a more decentralized, bottom-up and citizen-centric manner (Marsal-Llacuna, 2018). Prasad et al. (2018) focus on critical success factors that facilitate the use of blockchain-based cloud services.

In the supply chain area (for green certified sustainably sourced products), blockchain on its own cannot alleviate the information problems faced by a green supply chain. Large numbers of buyers need to pair the technology with an access-based permissioned blockchain business model to unleash its full potential (Benjaafar et al., 2018). Consumers are increasingly concerned about production practices (Francisco and Swanson, 2018). Blockchain technology enable firms to evaluate and mitigate

supply chain risks by providing means to security verification, secure transactions, rapid processing via smart contracts, track and trace product origins and processes.

Prasad et al. (2018) identify 19 key success factors that can facilitate the success of blockchain-based cloud services and its mutual interactions. These KSFs are related to user engagement, industry collaboration, rich ecosystem, standardization, regulatory clarity, cost and energy efficiency, handling bloat, miner incentives, business case alignment with capabilities, sidechains development, talent and leadership availability, technology investment and maturity, trust, integration with other cloud services, mature smart contract platform, security and privacy. The study is helpful for industry leaders to strategically focus on the main drivers ensuring that businesses get maximum benefits from blockchain.

In the context of urban development, the factors influencing blockchain adoption are related to (i) decentralization, that allows a bottom-up delivery of codes owned and implemented by the citizen and not by a central authority; (ii) disruptive approach, which may eradicate the subordination of physical networks to virtual ones thanks to its inherent coopetition networking environment; (iii) immutable accountability capabilities, that may empower and incentivise citizens to deliver codes as physical actions (Marsal-Llacuna, 2018).

The researchers emphasize that a concerted effort is needed to translate blockchain potential into reality (Prasad et al., 2018). Overall, there is a shortage of papers in this stream of research. More theoretical insights are required to better understand the underlying factors that will lead companies to, or discourage them from, adopting blockchain technologies (Francisco and Swanson, 2018).

3.8 Stream VIII: State of the adoption of Blockchain Technology

Three papers focus on the stage of the adoption of blockchain technology from B2C and B2B perspective (Woodside, Augustine and Giberson, 2017; Stratopoulos and Wang, 2018; Wang, Chen and Xu (2016). Stratopoulos and Wang (2018), in their study based on web searches, news articles, book titles and corporate disclosure, find that blockchain is still at the experimental stage and its diffusion is primarily limited to the early market (innovators and early adopters), hence it is yet to reach mass adoption. The majority of adopters have been largely experimenting with blockchain in an attempt to better understand rather than monetize the technology (Hileman and Rauchs, 2017). Wang, Chen and Xu (2016), based on the capability maturity model (CMM), establish that blockchain is still at Stage 1 (initial) of its adoption, which is described as the chaotic and ad hoc status of a new technology. Woodside et al. (2017), based on a triangulation analysis of the environmental variables (PEST), text analysis of the top 50 U.S. companies annual reports and a financial analysis based on currency circulation, find that blockchain technology is still at the innovators category of adopters (B2B), with a large degree of uncertainty around global governmental regulation and taxation requirements. The technology was classified by the top 50

U.S. companies as a " blue sky" type of technology, appealing in theory, but not proven in practice.

3.9 Stream IX: Blockchain and Cryptocurrencies

The research stream related to virtual currencies focuses mainly on the notion of volatility and the exchange rates of cryptocurrencies (e.g., Bolt and van Oordt, 2016, Cong, Li and Wang 2018; Folkinshteyn and Lennon, 2016), the mechanisms of valuing and investing in crypto-assets, in comparison with fiat currencies and commodities (Kim, Sarin and Virdi, 2018), popularity of cryptocurrencies and the reasons of their adoption in emerging markets (e.g., Carlson, 2016). Other studies investigate the cryptocurrency features that increase or impede adoption (e.g., Ciaian et al., 2016; Folkinshteyn and Lennon, 2016), the security and privacy measures in cryptocurrency adoption (Fabian et al., 2018); the reasons for adoption by retailers (Jonker, 2018), as well as on the Bitcoin Market Potential Index that ranks the potential use of cryptocurrencies and their rate of adoption across countries (Hileman and Rauchs, 2017; Hielman, 2013).

For example, using economic modeling Bolt and van Oordt (2016) show that three components are important for determining the exchange rate of cryptocurrencies: (1) the current use of cryptocurrencies to make payments; (2) the decision of forward-looking investors to buy virtual currencies and thereby effectively regulating supply; and (3) the elements that jointly drive future consumer adoption and merchant acceptance of virtual currency. On the consumer side of the market, private benefits may be large for those who frequently execute cross-border payment such as remittances. Additionally, consumers who value privacy and anonymity more, and those who are technologically more adept are likely to gain from using cryptocurrencies. On the other side of the market, large merchants may experience considerable private benefits from avoiding the high fees charged by traditional payment providers. Internet stores may gain as well, since they face relatively low implementation costs when accepting virtual currencies.

Cong, Li and Wang (2018), using an econometric model explain the valuation of tokens and the roles they play in the development and adoption of a digital economy. The expected price appreciation of cryptocurrencies makes token attractive to early users, allowing them to capitalize on future prospects of the platform, thereby accelerating adoption. The model predicts that, as virtual currency becomes more established, the exchange rate will become less sensitive to the impact of shocks to speculators' beliefs and their inflow into and outflow from the virtual currency market. In other words, more widespread use of virtual currencies by merchants and consumers lowers the impact of speculative behavior and therefore stabilizes the exchange rate. Cong, Li and Wang (2018) show that introducing tokens on a platform reduces user base volatility. Folkinshteyn and Lennon (2016) applied time series analysis to understand the reasons for bitcoin volatility and find that bitcoin attractiveness indicators (i.e., views on Wikipedia, new members and new posts), followed by market forces

(i.e., demand and supply), are the main drivers of bitcoin prices. Macro-economic and financial developments, by contrast, had no impact on bitcoin prices.

Jonker (2018), based on a large representative sample of online 768 retailers in the Netherlands, finds that acceptance of cryptocurrency payments is currently modest (2%), but there is substantial interest among retailers to adopt such payments in future. Consumer demand, net transaction benefits and perceived adoption effort (i.e., ease of use) influence adoption intention and actual acceptance by retailers. The most significant barrier for crypto acceptance by retailers is a lack of consumer demand, confirming the effect of network externalities in a two-sided market. Kim, Sarin and Virdi (2018) discuss the volume, size, and volatility of cryptocurrencies, which they compare to major fiat currencies and commodities. They provide a framework for valuing crypto-assets, while highlighting the still-evolving regulatory environment for this asset class and the mechanics of investing in cryptocurrencies. Carlson (2017), based on expert interviews in one country (Argentina), argues that the relationship between cryptocurrency adoption and capital controls has been overstated. Cryptocurrencies' popularity is more important than the country's history of capital controls or high rates of inflation. Other factors, including tax rate, levels of corruption, and history of multiple exchange rates have also contributed to the adoption of cryptocurrencies in Argentina.

Some studies (Ciaian et al., 2016; Folkinshteyn and Lennon, 2016) have identified and analyzed the features of cryptocurrencies which may facilitate or impede its adoption. Transactions costs, high anonymity and privacy, learning spillover effects, infinite divisibility and lack of inflationary pressures are bitcoin features that may facilitate its use as a currency. Absence of a legal tender attribute, difficulty to produce bitcoin, relatively high fixed costs of adoption, dependence on network externalities, absence of institutions enforcing dispute resolution, deflationary pressures, high price volatility and cybersecurity concerns may impede its use as a currency.

Research on crypto adoption also adresses security and privacy measures in cryptocurrencies. For example, Fabian et al. (2018), based on an online survey of 125 bitcoin users and an extensive analysis of all bitcoin transactions through the years, finds that knowledge of some privacy measures such as single-use of fresh addresses are well known and adopted among Bitcoin users, but other existing protection mechanism such multisigs and pay to script hash (P2SH) require further usability improvements and user awareness to strengthen their adoption. Ali et al. (2014) examine the economic incentives of adopting virtual currencies and assess potential risks to monetary and financial stability. A key attraction of virtual currencies at present is their low transactions fees and speculative motives. These fees may increase as usage grows and may eventually be higher than those charged by incumbent payment systems. Network effects play an important role in the adoption of a virtual currency.

4 Conclusion

Having systematically reviewed the literature on blockchain and cryptocurrency adoption, we reach the conclusion that this research is at an early stage of theory development. The vast majority of the articles are descriptive, rather than theory-driven. Further, most of theory-driven articles are based on UTAUT which offers a limited number of variables to explain such complex phenomenon as blockchain technology adoption. Econometric models have significantly enhanced our understanding of the phenomenon, and it is time to use complementary organizational, psychological and behavioral lenses to explore blockchain adoption. Lastly, a common limitation of extant research is that it is mono-disciplinary, an observations made previously by Glaser (2017).

Our second conclusion is that few studies are based on empirical research, particularly on primary data. For example, while many studies focus on barriers and benefits of blockchain adoption (Research Stream I, the most studied research stream), they tend to rely on secondary data. Surely, these issues need to be studied empirically to be of any use to practice.

These limitations of extant research offer new research directions. Specifically, more theory-driven, multi-disciplinary empirical research using primary data is the way forward. Blockchain technology adoption is a complex phenomenon which needs to take into consideration not only technical / technological dimensions, but also political and institutional dimensions, security/privacy and ethical issues, as well as socio-economic variables. Accordingly, the phenomenon of blockchain technology adoption requires a comprehensive, multi-level empirically tested framework which incorporates many interdependent actors in the blockchain ecosystem – consumers, developers, validators, investors, entrepreneurs, firms and governments.

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