Evolving Regulatory Frameworks: Blockchain as a Form of Trust—Comparative Evidence

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Abstract Firms and governments are interested in regulatory experiments in order to minimise compliance costs and improve business and regulatory efficiency. Blockchain presents many hopes for achieving the aforementioned objectives but presents many risks in the area of privacy and cyber risks. Considering its regulatory and business organisational features, it can be considered a regulatory tool that supplements, complements and substitutes law. In the area of AML, Blockchain can be employed to verify, validates and transfer information between two or more stakeholders. The aim of this chapter is to understand the organisational features of the four most prominent Blockchain networks and understand how and when firms and their associated Blockchain-based system operate. In order to do so, this chapter compares Blockchain features with national and international current regulatory frameworks for Blockchain. Results show that Blockchain does not undermine the role of the government, but it reinforces its role when the rule of law is weak or absent. Moreover, considering that technological actors can evolve into a digital sovereign, governments need to carefully assess the risks of this novel technological framework and set the right rules of the games that benefits all consumers and businesses.

1 Introduction

Blockchain technology has relaunched the debate how and when technology can be used for legal and administrative purposes thanks to its organisational features. If the internet provided a solid infrastructure for connecting individuals, Blockchain technology is creating a spectrum of novel economic and legal structures. They are incorporated in innovative organisational structures of firms in the form of smart contracts or self-executed legal code. In the Blockchain environment, legal

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objectives span from anti-money laundering (AML) measures to regulatory tools to strengthen the integrity of financial markets.

What is Blockchain? Broadly speaking, Blockchain is an open-source technological infrastructure which allows the exchange of information and wealth, allowing two or more individuals to interact into a virtual world of finance with or without a centralised authority, with or without formal and informal institutions. In the regulatory and legal circles, Blockchain is considered a form of "trust architecture" that supplements, substitutes and complements existing forms of law.[1] Advocates of Blockchain and its related applications would argue that Blockchain have useful applications when governments control or rule of law is absent,[2] allowing citizens, firms and governments to operate within a relatively safe environment to conduct business, administer territory, provide governments services and the list goes on.

Governments and firms have started regulatory experiments to understand how to use Blockchain. Blockchain can also serve for AML compliance as a verification and validation mechanism allowing consumers to upload their information, being stored on the Blockchain and shared across relevant institutions. In this regard, Blockchain can emerge as a self-regulatory tool for organisations to coordinate their activities[3] and can supplement, complement and substitute law. In becoming a regulatory tool for AML or other government services for regulation and supervision, Blockchain can exercise digital sovereignty, the exercise of power through various channels from the provision of technological products and services to the deployment of data and legal code at the expense of consumers. These self-regulatory objectives are not limited to associations, firms or industry groups and I argue that Blockchain itself represents a form of self-regulation. This has broader societal issues regarding market monopoly, lock-in of consumers, fairness of actors involved in the industry, with the latent detrimental effect on reducing consumer choices and their freedom.

The aim of this chapter is to explain when and how Blockchain technology supplements, complements and substitutes law. It cognizes the operational aspects and design of Blockchain technology, in particular the diverse architectural regulatory approaches taken in Blockchain technology for financial services in the area of crypto-assets, capital markets, token sales, digital identity and derivatives. This paper focuses on the technological infrastructure and the technological companies who operate in this space and exercise digital sovereignty. Digital sovereignty is the outcome of a coordination game played by a wide range of transnational communities with diverse purposes and missions. They exercise digital sovereignty in their regulatory and business functions rooted on substituting, complementing and adding law. This chapter examines why and when firms supplement, substitute or complement law by engaging with Blockchain technology either by joining industry groups or developing their own Blockchain infrastructure to address regulatory uncertainty. I employ a cross-country comparative approach by analysing global regulatory

[1] Werbach (2018b).

[2] Werbach (2018b).

[3] Werbach (2018b).

approaches employed by national governments and private Blockchain projects and the governance of eight Blockchain projects such as E-dinar, Barbados Central Bank digital currencies, Petro-backed digital currencies.[4] I compare the regulatory architecture of the four most prominent Blockchain infrastructures such as Bitcoin, Ethereum, Ripple and R3 in order to understand how traditional regulatory organisations are developing their mission and objectives in light of an emerging distributed ledger economy. This allows me to understand when and how Blockchain supplements, complements and substitute law in national and international settings. Surveying the regulatory technological perimeter, projects in Blockchain technology comprises of private, public, private-public partnerships, whereas the Blockchain industry comprises of technological companies, exchanges, wallet custodians, smart contracts company, payments companies, government companies. By assessing the governance of these projects and companies, technocratic and delegated governance materialise, in which self-executed law and technology are at the core of the organisation of these firms and aim to create a platform and digital economy by providing technological tools and law to governments, businesses and consumers.

This chapter adds to the relevant regulatory literature by advocating for a novel approach which differs from long standing traditions of regulatory scholars[5] who neglected the role of technology in examining political and regulatory order. This chapter ties regulatory and governance theories, by offering novel insights into the regulation of Blockchain. Blockchain allows governments and firms to set up transnational regulatory structures through policy coordination in which technology plays an important role in mediating individuals' and governments' sense of meaning, purpose and value according to code and law. In this fashion, I move from a conception of monist digital sovereignty like the idea of having a Leviathan Blockchain trust infrastructure which suffocates pluralism. Instead, I advocate for pluralism and a normative semi-distributed technological order embedded in technological and business infrastructures.

The structure of this chapter is as follows. The first section introduces the topic to the reader. The second section reviews new forms of business and regulation in Blockchain technology and how Blockchain can serve as a regulatory AML tool. Moreover, it surveys the relevant literature on trust and confidence two fundamental pillars of Blockchain technology, contract enforcement mechanisms and digital governance. The third section sets out the research design and the hypothesis of this chapter; it theorises how and when Blockchain supplements, complements and adds law. The fourth part summarises the main results and compares the four most prominent Blockchain networks with transnational and global Blockchain projects in the areas of payments, capital markets, digital identity and derivatives. In particular, it explains how current Blockchain projects can supplement, complement and add law. The fifth section concludes this chapter and addresses significant risks for governments, consumers and firms.

[4] For full list, please refer to Table 2.

[5] Stigler (1971) and Peltzman (1965).

2 Blockchain Technology: Digital Sovereignty and Exchange Without Government

Blockchain seems to facilitate AML compliance by introducing a series of technological and compliance mechanisms in which consumers can upload their information and shared it among a wide group of stakeholders. Blockchain as a regulatory tool can serve as a mechanism to verify information, accept documentation, and exchange value and information. Blockchain technology is a designed, developed, and distributed free software taking into consideration a different set of values, societal behaviours, and dynamics without a central authority. Blockchain as a self-regulatory organisation creates and designs a regulatory framework that supplies complements and substitutes law.

Companies in every industry have started to understand how to apply blockchain-based solutions to solve business problems,[6] especially in those areas where the financial infrastructure is underdeveloped. A market supported by Blockchain technology is not fundamentally different from more traditional forms of markets in which consumers are well identified from users or business physical interactions, but it poses certain challenges.[7] The internet allows firm to access bigger markets, but also expose customers to millions of potential fraudsters around the world. Prominent challenges[8] that governments have faced in the Blockchain environment include tracking transactions, digital identity of users, cyber-attacks to Blockchain companies and their associated liabilities. All of these challenges belong not only to AML protocols that firms need to follow but also for governments that need to supervise new business models, products and services.

On the topic of digital identity, cryptographic proof and pseudo anonymity around it, the supervision of these processes represents a challenge for government and impacted firms. Consumers and firms face a number of challenges when they need to take legal actions against actors in several countries.[9] With the rise of technology, new forms of trade have emerged which one could not think 20 years ago such as e-commerce, online banking etc. In this digital environment in which interactions and exchange occurs on the web, Blockchain technology allows users to transfer capital without a trusted central intermediary, which could be the government. The decentralised infrastructure of Blockchain technology represents both a barrier for government intervention as well as an opportunity for creating a global business ecosystem. No higher authority can command the infrastructure to do anything, verification nodes are distributed around the world going beyond national

[6] Please consult FT article: https://www.ft.com/content/caa52d44-6d53-11e8-852d-d8b934ff5ffa.

[7] Auer (2019).

[8] For a brief overview of the challenges of government in the area of decentralised financed and Blockchain please consult the latest article by FT https://www.ft.com/content/e6e7d9d6-7778-4286-ba6f-e5831fcbc538.

[9] Finextra (2021) online resource available here: https://www.finextra.com/blogposting/20516/defi-and-regulation-the-european-approach.

territories and creating a transnational world. Technology cannot often tell the difference between a thief and a legitimate user and its legal national territory due to the different layers of technological software in which consumers and businesses operate. In the same manner, Blockchain technology and smart contracts cannot tell between legal and illegal transactions, although strong design measures can help machines or distributed automated firms in addressing these problems. Notwithstanding the shortcomings of this technology, legal scholars, such as Wright and De Filippi argue that Blockchain "could make it easier for citizens to create custom legal systems, where people are free to choose and to implement their own rules within their own techno-legal frameworks".[10] Some activists take this argument even further "thanks to the Blockchain technology, we have the chance to not only re-invent governments, but fundamentally replace the nation state".[11] Theorists such as North (1990) and Stringham (2015) would have argued that exchange without government is limited to small and simple settings. In particular, North (1990) p. 12 states that: "realizing the economic potential of the gains from trade in a high technology world of enormous specialization and division of labour characterized by impersonal exchange is extremely rare, because one does not necessarily have repeated dealings, nor know the other party, nor deal with a small number of other people."[12] Moreover, he writes "the returns on opportunism, cheating, and shirking rise in complex societies. A coercive third party is essential",[13] which in the past would have been under the authority of the government or an established institution in the private sector. Going beyond these theoretical debates, Blockchain proves that exchange can occur without government in which resources and assets are owned, managed and distributed in self-executing economy or platform economy, formed of polycentric structure of actors with several interests and preferences for technological services and products. Blockchain allows to operate across several legal frameworks.[14] Scholars have studied and are studying design system to reduce market failures in these frameworks.[15] A key characteristic of Blockchain technology is rooted on trust and confidence. Standard market-based activities are grounded on trust.[16] Trust depends on many socio-economic factors and often is considered a market failure for countries in which there is a high level of corruption or rule of law.[17] Trusting a network can also present vulnerabilities, as people are required to

[10] Werbach (2018b) refers to Wright and De Filippi "Decentralised Blockchain Technology and the rise of Lex Cryptographia", 40 in p.158.

[11] Bitnation Panagea, para 2: "The world' first virtual nation – a Blockchain jurisdiction", Global Challenge Foundation https://globalchallenges.org/bitnation-pangea-the-worlds-first-virtual-nation-a-blockchain-jurisdiction/.

[12] North (1990), p. 12.

[13] North (1990), p. 35.

[14] https://publications.iadb.org/publications/english/document/Cross-Border-Payments-with-Blockchain.pdf.

[15] Please refer to Uzoki (2019), Chiu and Koeppl (2017) and Auer (2019).

[16] For an overview on the concept of trust please consult Fukuyama (1995).

[17] Lizhi and Weingast (2018).

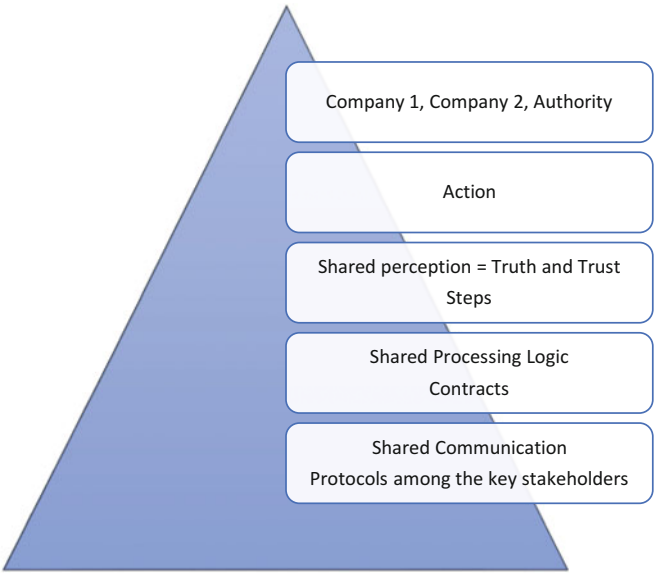

Fig. 1 Stylised Regulatory share model supported by a typical Blockchain model for AML. Notes: An Authority can be the government, or a regulatory agency. The triangle represents the space of action, it can be a model of platform economy. Each point in the space represents one user or stakeholder or a set of users or communities of stakeholders. A state is an immutable object representing a fact known by one or more nodes in the Blockchain. A contract is an agreement between two parties, in the blockchain can represent a self-executed smart contract or smart contract. A protocol is a set of rules of the operators in the Blockchain network. These mechanisms can be deployed to verify information during AML or KYC protocols

trust each other with the risk that someone can deviate from its optimal strategy and act deceitful with the risk that re-building trust in the system is difficult to be regained. Blockchain architecture aims to address these market failures such as asymmetric information between market participants as depicted in Fig. 1.

Figure 1 is a stylised regulatory model, built on the analysis of the four most prominent Blockchain networks. In particular, it shows two companies interacting with an authority.[18] This model assumes that firms have the same incentives and missions, cheaters must compete against the bulk of the network and the underlying assumption is the fact that being less honest is a disadvantage. Trusting the network is an important pillar for the functioning of the Blockchain network. However, in open-source project such as Bitcoin or Ethereum, developers can exercise excessive control over the rest of actors in the network due to their mining power. The interaction between the firms is filtrated through "the state" which represent a node in the network or a key decision that the network needs to undertake in order

[18]The Authority can be a government authority or a general authority exercising power or influence on the two companies. Collaboration across organisational boundaries allows the transfer of information or wealth.

to process a mechanism. The agreement between the parties occurs according to a contract or self-executed law between the parties or according to a protocol which represents a set of rules. This set of rules is followed by all members in the Blockchain network and can be extended to an ideal AML regulatory model. The Blockchain infrastructure runs on algorithm which are set by the software developers who validate the code on the nodes of the network. The nodes in the network represent checking points, anyone in the network can examine the code, verify the mechanism. The underlying principle of this infrastructure is trust. Trust can include vulnerability, undermine privacy, nudge people into decisions that were not intended or reinforce biases in the network. Similarly, within a self-regulatory framework based on rule of law, trust is shared among market participants and a central authority represented by a judge. Checks and balances ensure that the judge is "super-partes" and operates within his/her/their powers.

In order to address these challenges, firms are building governance schemes inside and outside their organisations and many firms have looked into applying Blockchain technology as a regulatory tool to orderly keep the duties and roles of agents. Thus, the ability to effectively design self-regulatory frameworks and their associated business and regulatory models depend on the prevailing coercion constraining institutions, which are those that influence decisions regarding the acquisition and use of coercive power and the preferences and values of all individuals in the system.[19] The design of regulatory organisations often resembles technocratic and delegated governance in which governments appoint strategic business leaders or delegate their regulatory functions to technological companies; blockchain companies operate across several horizontal, vertical and delegated layers of law.[20] With this in mind, I argue that technology allows them the acquisition and the use of coercive power. This is the case because many designed self-regulatory frameworks reveal information about wealth to those with coercive power.[21] Wealth-revealing, designed, contract-enforcement institutions will be utilized only if coercion-constraining institutions are such that this information does not undermine the security of a right, which can be a property right, control of wealth, or control over a piece of information. Those institutions[22] are not only self-regulatory but also

[19] Please refer to Fig. 1.

[20] Horizontal layers of law are regulatory framework across jurisdiction who shares similar constitutions and legal principles. Vertical layers of law refer to the intersection of national and international law. Delegate layers of law refers to when government functions are delegated to third parties (i.e. private management of tax collection).

[21] In this case coercive power is defined as the use of force to get an employee of an institution to follow an instruction. Moreover, in a Blockchains setting, the power to access a particular piece of information will be shared among several stakeholders and access to that information will be granted through the use of smart contracts. Little we know about those that have coercive power will be act according to "the rule of law" or not with the assumption that technology can limit their power and they can act as benevolent leaders.

[22] In this context, institutions are defined as Blockchain firms, firms providing Blockchain services and products to consumers and or public and private clients.

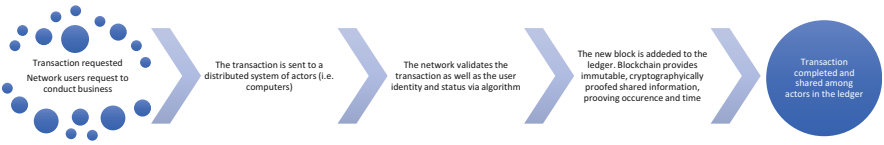

Fig. 2 Exemplified Blockchain regulatory model for AML in a distributed ledger economy

self-enforcing institutions meaning that following the guidelines of these institutions is the best response of the actors involved in the industry. What emerges is the concept of self-regulatory organisation which is also a digital sovereign. For the purpose of this paper, I define a digital sovereign institution an institution that exercises power by employing self-executed code either in the form of smart-contracts or within their platform business environment, which is often the case as a regulatory governance structure of tech firms. Considering the business and operational models of Blockchain companies and the overall Blockchain infrastructure as self-regulatory organisation or regulatory tools, companies are both becoming technology companies and self-regulated entities. Companies can use their technology as a regulatory tool or join associations of firms which will provide guidelines in using technology. As such, the difference between technology and code is becoming more blurred. Blockchain can also be used to address the market failures described above and detect fraud in market transactions.

This also allows to fulfil know-your-customer requirements easier. A blockchain-based AML platform[23] that utilizes smart contracts would be able to use inbuilt algorithms to automate the process of AML fraud detection. The inbuilt algorithms would follow processes as depicted in Fig. 2. The figure explains how transactions occurring within the Blockchain network would be validated across three layers of control between two access points one in which the transaction is requested and one in which transaction is requested. This stylised solution to address fraud in the market allow each market participants such as consumers, governments, firms and any third parties involved to act as a node and active participant in the Blockchain network. Moreover, with this implementation of Blockchain a consumer will be required to undergo this process only once and the information will be stored on the Blockchain and the consumers could share this information with other companies. This model also illustrates how in each step of the process, key regulatory formal and informal institutions will need to access piece of information to fulfil their functions.

[23] Hofman et al. (2021).

2.1 A Novel Approach to Reg-Tech

Widespread failures of ICO, fraud surrounding crypto-currencies and blockchain companies that do not go beyond the proof-of-concept stage contributed to the undermining of trust in the blockchain architecture. Stating that blockchain needs regulatory frameworks begs the question how Blockchain as a self-regulatory framework work in practice and which problems they aim to address. The aim of a regulatory framework whether public or private is to create trust between parties and encourage market integrity.[24] In this scenario, law enhances confidence between parties and reduce the probability of loss and or fraud in a transaction.[25] Law formalises relationships between market participants and can limit misunderstandings, develop first self-regulatory in a specified geographical area which eventually will enter the national legal code. Scholars have argued that law also shapes the behaviour of firms and consumers.[26] The legal system exists as a commitment mechanism for individuals to align private interest to private goals (Baldwin 2014). It is important to note that the legal system works if only the individuals trust the system and the actors involved. However, in countries where rule of law is poor, technology and a stylised platform economy seems to address these market failures. Institutions such as governments of business firms are indispensable for trust. What is trust? Trust comes from the interaction between two or more parties, from the predictability that the agent with whom one is conducting business, or it is interacting is reliable, from the design of an economic structure. As such, technology with its algorithms and self-defined rules embedded in software and code make it easier to coordinate actors' decisions and preferences and technology has been increasingly used in self-regulatory frameworks. Technology and law can promote trust, but also can undermine it.[27] Borrowing concepts from institutional economics and the theoretical framework developed by Werbach, I argue that self-regulation is grounded on two key elements: contract enforcement and contract coercion. Self-regulatory measures of contract enforcement and contract coercion are often forgotten in AML protocols, however within a Blockchain framework, they would be embedded in the business model of firms as well as in their regulatory perimeter. Scholars have mainly focus on coercion constraints "the range of transactions in which individuals can commit to keep their contractual obligations".[28] Moreover, these studies have mainly focused on self-regulation as the result of cooperative games. With the rise of technology, a platform either in the form of Blockchain or distributed system manage the preferences, objectives and decisions of actors and could support firms to fulfil their AML requirements.[29] Following Thomas Hobbes,

[24] Franks et al. (1997).

[25] Werbach (2018a).

[26] Please consult Werbach (2018a) and Black (2002).

[27] Werbach (2018b).

[28] Grief (2005), p. 1.

[29] Hofman et al. (2021).

credible enforcement institutions depend on the possibility of the governing authority of coercion. As Greif has detailed in his book check and balances on the authority of the state and separation of powers is important to ensure confidence among market participants. Blockchain allows to distribute the authority across different actors and this feature is very important to be considered for AML requirements.[30] Thus, trust requires institutions and institutions requires governance in order to operate cross-border and enforce rules.[31] Contract enforcement institutions (spontaneously) develop in the initial phases of market development as unintended and unforeseeable outcomes from the pursuit of individual interests[32] and rent-seeking behaviour.[33] Self-regulatory frameworks are also the result of incomplete-contracts, contracts can be the result of market failures in the forms of asymmetric information and or negative externalities. In particular, Oliver Haart, Bengt Holmstrom, Jean Tirole and other incomplete-contracts theorists explained that business practices around contracts (Hart 1988). They also argued that contracts may be dynamic arrangement that may necessarily require changes to address mutual arrangements and when a government is involved "immutability" may mean that socio-economic system is reluctant to legitimate political order. This is a vulnerable point, due to the fact that users can betray your trust (Werbach 2018b) or may lose confidence into technology or the system.

Confidence often emerges from trust but the distinction between the two concepts is often deceiving. Confidence is a different concept from trust;[34] confidence can be considered a feature of trust within a system or framework. Confidence often comes from our own impression and implies a lack of agency or authority between two or more parties.[35] In a utopian technological world, trust emerge into the institutions in which we decide to rely upon, and confidence lies in the technology.[36,37] Confidence is based on a consensus mechanism and technology may improve confidence by increasing transparency. Confidence and trust allow business, technological and regulatory models to be improved and developed. Technology is built into peer-to-peer network with several stakeholders who have conflicting interests and missions. Thus, Blockchain requires several models of governance. Two main models of governance emerge (1) delegated governance and (2) technocratic governance.

[30] AML compliance protocols involve many firms and institutions.

[31] Scholar Drezner has conducted extensive work on the governance and politics of Internet Regulation. Please consult Drezner (2007).

[32] Drezner (2007).

[33] The covid-19 crisis has increased the demand for digital services and products. Blockchain can facilitate these digital transactions. The covid-19 crisis has also highlighted rent-seeking behaviour of digital platforms. These arguments are beyond the scope of this chapter, but they are worthy to be mentioned.

[34] De Filippi et al. (2020).

[35] De Filippi et al. (2020).

[36] De Filippi et al. (2020).

[37] IBM (2020) available here https://www.ibm.com/blogs/blockchain/2020/01/measure-trust-with-blockchain-technology/.

The first model denotes the market together with the government to design a set of rules, norms and protocols over transnationally territory in which governance occurs through public-private partnerships and decisions are reached through consensus. The second model is the outcome of a top-down model of governance in which decisions are implemented through an institution that serves the interests of their users. In many Blockchain projects these differences are well visible however, based on the Blockchain structure of substituting, complementing and adding law, these models of governance are dynamic and aims to address market failures in the market. In these legal processes, governance operate across several layers of law. Blockchain seems to fit the gap in the regulatory frameworks as a self-regulatory organisation in horizontal, vertical and networked legal systems. In order to envision governance frameworks in Blockchain, I focus the analysis on policy coordination in which actors feel the need to cooperate in order to conduct business, exchange information and operate transnationally.

3 Research Design

3.1 Data

The global Blockchain industry represents a novel research field. Interest for a Blockchain infrastructure has grown both in the private and the public sector with governments and firms experimenting new models of governance and new models of trust. Moreover, the cumulative total investment in Blockchain amounts to US$ 1.6 billion as 2017 and is constantly growing.[38] Many new technological firms were established in the industry and several firms from allied industries (such as banks or payments providers) entered the industry and were confronted with the task of establishing a reputation after the 2008 financial crisis. Many financial firms are experimenting with Blockchain technology to reduce costs and improve compliance of their business models. I apply Werbach's Blockchain legal risk assessment, and I test his regulatory theory by looking at the operational infrastructure of four Blockchain such as Bitcoin, Ethereum, R3 and Ripple and ten Blockchain projects in the area of capital markets, digital identity, payments and digital assets. I chose the most eight prominent projects[39] and public and private Blockchain networks, with Bitcoin counting more than 5 million users, whereas Ripple counting more then 100 members.[40] I compare them with the functions and characteristics of current legal frameworks developed by national governments, firms and trade associations. I

[38] PWC (2018).

[39] These projects were developed by national governments, central banks, leading Blockchain companies and have been fully tested and few of them implemented. The scale and size of these project is significant, attracting the attention of policy makers and regulators.

[40] https://www.coindesk.com/100-counting-ripple-adds-new-members-distributed-ledger-network.

employed four criteria to assess the projects and the information of institutions under scrutiny: (1) analysis of their governance structure, (2) the business model, (3) the board structure, (4) involvement of regulatory bodies in the project. On the analysis of the governance structure, I looked at the procedural dimension of governance which looks at the activities of private transnational actors, the structural dimension of governance which distinguish norms, rules, network and actor constellation and the functional dimension of governance which highlights the relationship between material and ideational result of private governance in light of national and international public governance.[41]

I tested the hypotheses of my research in a single industry rather than multiple industries and at multiple time points from 2008 to 2019. This allowed me to account for any industry effects and to explain the institutional context in which legitimate organizations advanced the reputations of the Blockchain firms. In order to corroborate the analysis, 12 semi-structured interviews with experts in trade associations and with regulators were conducted and these inform the insights in the results section. Interviews were conducted over the phone and interviewees were recruited according to a snowball sampling principle, which is used when the sample size under investigation is relatively small.[42] In order to address this challenge, archival research was also conducted. Legal texts, codes of conduct of industry groups, white papers of Blockchain providers, policy texts developed by regulators were also examined in order to understand the differences between traditional and novel regulatory frameworks. In selecting code of conducts of institutions in Blockchain technology, a snowballing principle was applied. This sampling technique is used in hidden populations when researchers have difficulties in assessing data.[43] The methodology of this project differs from other studies of soft regulation and regulatory capitalisms[44] and analyse Blockchain as a regulatory tool.

A number of matters should be considered when assessing the results. First, Blockchain is a novel technology, the financial services industry per se was unfamiliar to products and services offered to prospective consumers and investors. Early adopters and consumers were confused due to misunderstanding in the area of technology, data privacy, cybersecurity, money laundry and terrorist financing which are also topics of considerable controversy. The only point of agreement about Blockchain technology was that it could enhance data transparency and reduce costs of transaction but not increase speed to transactions due to scalability issues.[45] As such, firms decided to experiment with Blockchain projects to address trust in the financial markets especially after the explosive growth and collapse of the securities-backed assets of the financial crisis in 2008 which spurred the debate on the

[41] Pattberg (2017) and Rudder (2016).

[42] Tansey (2007).

[43] Emmel (2013).

[44] Please refer to Pagliari and Young (2005) who offer an overview of traditional regulatory and governance frameworks and its underpinning mechanisms.

[45] Chiu and Koeppl (2017).

transparency of the banking industry and decided to join a new model of finance rooted on technology.

3.2 Hypothesis

Blockchain-based systems and associated self-regulatory frameworks can directly shape compliance, law enforcement and regulation in three possible scenarios. In what follows, I develop three hypotheses that will help to test how trust and law may enhance regulatory compliance[46] based on Werbach's theoretical framework.[47] I test these hypotheses by looking at both private and public Blockchain infrastructure and any regulatory frameworks in this industry. Blockchain technology allows self-regulatory frameworks in being efficient. Self- regulatory frameworks can support traditional government frameworks to achieve legal objectives. One legal objective in the Blockchain environment is AML as well as protecting consumers. Self-regulatory frameworks allow for firms the harmonisation of regulatory frameworks as well as establishing new regulatory frameworks without displacing current legal frameworks.[48]

(H1) The Supplement Hypothesis Self-regulatory frameworks supplement law, legal and technical code emerge and blockchain embroils law as the basic means of enforcement. Self-regulatory frameworks can address the challenge that governments face in the enforcement of legal rules. In this context, government often face the challenge in enforcing rules for actors in other countries, self-regulatory framework represents a mechanism for legal compliance across jurisdiction. Legal enforcement involves misalignments of the incentives of actors involved.[49]

(H2) The Complement Hypothesis Self-regulatory frameworks complement the law, when legal regime is flawed, blockchain intervenes in the dispute and address market failures due to lack of regulatory clarity. In the early days of the internet economy, governments were sceptical of self-defined rules outside legal frameworks, due to the fear that self-defined rules could undermine the power of national sovereignty and the private intermediation. Where government services such as judicial system are functional, a self-regulatory approach may improve efficiency and speed of the judicial process, but its benefits toward traditional legal system are limited. Actors trust the institutions and have confident in the technology in order to

[46] Regulatory compliance for AML in KYC and digital identity.
[47] Werbach (2018b).
[48] Werbach (2018b).
[49] Werbach (2018b).

use Blockchain as regulatory tool.[50] In this case, there no-state backed enforcement mechanisms behind self-regulatory regimes.[51]

(H3) The Substitute Hypothesis Self-regulatory frameworks substitute law, the legal technological code replaces law entirely and blockchain become an enforcement mechanism for disputes.

4 Results

Results of this analysis are summarised in Tables 1 and 2 highlighting two main models of governance (1) delegated governance and (2) technocratic governance in which Blockchain add, substitute and complements law. Table 1 assesses the business and regulatory model of the two most prominent Blockchain infrastructure Ripple and R3, who are developing the infrastructure for "digital cash". They resemble the structure of self-regulatory organisation with self-defined rules executed by automated code. Both entities apply an open-source protocol for their products and services, in which the source code is released under a licence in which the copyright holder allows users the rights to study, change and distribute the software to anyone and for any purposes. The open-source software is developed in a collaborative public manner and based on technocratic governance. For example, R3 continued to gain momentum with regulators through proactive outreach to regulators across the globe and providing advice, support and the knowledge to assist their policy processes and forward-looking initiatives on crypto and blockchain propositions.[52] Table 1 provides an overview of the business and regulatory model of Ripple, R3 and Bitcoin. Ripple launched the network system Stellar in 2014. Stellar is a decentralised payment network and protocol with native currency Stellar, serving approximately 3 million users and market capitalisation of $15 million. It can be considered as a self-regulatory framework for blockchain technology and follows a delegated governance framework. An example of private form of global standards in Blockchain infrastructure for financial services is the Stellar Partnership program. Stellar is a global rather national payment system, allowing users to transcend their local economies and interact globally. The payment system is ownerless, and it is defined as a network of peers. An important peer in the stellar partnership is IMB who has played an important role in the cryptography industry since the 1960, supporting the Data encryption standard together with the National Security agency (NSA) of the USA. IBM is constantly pursuing partnership and issuing patents with many business players aiming to become a world leader in Blockchain technology. An example of partnership is offered by the Hyperledger

[50] De Filippi et al. (2020).

[51] De Filippi et al. (2020).

[52] R3 is a leading consortium of industry players enabled by industry-leading distributed ledger technology R3 (2016).

Table 1 Results: Global and national initiatives in the area of Blockchain for financial service

	Type of entity	Initial release	Location of headquarter	Number of entities involved	Software	Main Services	Public/ Private Ledger	Regulatory tools	Restriction	Tech-regulatory tools	Interoperability
RIPPLE	Private company	2012	UK, global perspective	+100 firms	Open source	Supply blockchain tools to bank	Public/private distributed ledger	Payment protocol Stellar network	Cannot just connect to it and issue transactions to other clients	Smart contracts Applications	Work-in progress
R3	Private start-up company Backed by banks	2015	USA, global perspective	Consortium of 300 firms	Open source	Supply blockchain tools to bank	Public/private distributed ledger	Payment protocol *Additional requirements* Business policy Operator policy Technical policy	Admission policy based on KYC-AML as well as further checks HM Treasury Sactions etc.	Smart contracts Applications	Work-in progress
ETHEREUM	Foundation	2015	Global		Open source and public	Wide range of activities	Public	Payment protocol	Admission policy	Smart contracts, applications	Work-in progress
BITCOIN	Public software	2009	Global	Users-based, +5 million	Open source	Payment	Public	Payment protocol	Open	Various applications	Work-in-progress

Source: Author's dataset

Table 2 Results: Global and national initiatives in the area of Blockchain for financial service

Entity name	Type of entity (Corporate vs Government Initiative)	Country	Initiative scope	Initiative application	Distributed ledger system (supplement, complements, substitutes)	Blockchain	Sponsors
Calastone,	Corporate, London based global funds	UK	Global	Payments and international transactions	Supplements	Ethereum	
RMG the new digital gold standards	Government	UK	National	Process digitization	Supplements	Private	The Royal Mint
Vontobel digital assets vault	Corporate	Switzerland	Global	Process digitization	Complements	Ethereum and others Blockchain infrastructures	
Durable medium	Corporate	Poland	National	Disintermediation and decentralised network	Complements	Ethereum	
E-auction 3.0	Government	Ukraine	National	Platform network	Complement	Exonum blockchain	
E-dinar—digital currency	Government	Tunisia	National	Payments and international transactions	Supplements	Public blockchain bitcoin	La poste Tunisienne
Petro-backed digital currency	Government	Venezuela	National	Payments and international transactions	Supplement substitute	Ethereum	Government
Barbados central bank digital currency	Government	Barbados	National	Payments and international transactions	Supplement	Private Blockchain	Barbados central bank and bitt
Trade finance	Government	Argentina	National	Process digitization, auditing service	Complement	R3	Hong Kong monetary authority, Astri, R3 CEV

Source: Author's dataset

project created by the Linux Foundation. Hyperledger is a private delegated framework for Blockchain technology for business. Unlike Bitcoin, which only allow users to transfer Bitcoin, Hyperledger allows users to transfer any asset to which a value has been assigned. Hyperledger does not own a cryptocurrency.[53] Among other partners of the Hyperledger projects, JP Morgan and Swifts also appear and beyond financial services Ford features.[54] Another example of private-public partnership is offered by R3, an enterprise blockchain software firm working with a broad ecosystem of more than 300 members and partners across multiple industries from both the private and public sectors to develop on Corda, our open-source blockchain platform, and Corda Enterprise. Generally speaking, R3, Ripple, Ethereum employs a technocratic blockchain network based on four core values propositions: decentralised control, a shared view of the truth, collaboration across organisational boundaries, the direct exchange of value with tokens. On the matter of decentralisation, a blockchain network has different value proposition that one can build around traditional intermediaries.[55] It also allows business and regulatory operations across several legal jurisdictions. The governance of the network is very important because CEOs of Blockchain companies are in the position of controlling the value proposition of the network and can exercise digital sovereignty by complementing, adding or substituting law based on their business and regulatory preferences. The intermediation process resides in the ledger not in the ledger creator, however some nodes which represents companies may exercise more power than others. This model of technocratic governance shares truth in which the parties involved in the network cannot exercise exclusive authority. Everyone in the network has a copy of the ledgers and the decision-making process of the authority is based in the consensus.[56] On the matter of value, exchange occurs via digital token complementing the current payment infrastructure. Token can represent value or a piece of information operating in a separate or congruous and complementary government infrastructure.[57]

Table 2 shows how Blockchain-based systems can strengthen traditional government-led legal frameworks in many circumstances. For example, post-trade systems in the EU have developed nationally with different forms and different business practices.[58] The four blockchain infrastructures also show several degrees

[53] Hyperledger Foundation 2019, 2020, 2021 information available at: https://www.hyperledger.org/about.

[54] Please refer to the document issued by the World Bank titled "BLOCKCHAIN Opportunities for Private Enterprises in Emerging Markets Second and Expanded Edition, January 2019. World Trade Organisation (2018) and World Bank (2019).

[55] Zutshi et al. (2021).

[56] Consensus consists of a polycentric order of actors who represent different views, objectives and are based in different jurisdictions.

[57] In this case the governance structure is both delegated and/or technocratic.

[58] European Commission (2020) available here: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/financial-markets/post-trade-services/financial-markets-infrastructure-policy_en.

of intervention regarding compliance with AML/KYC requirements. This fragmentation increases the complexity of cross-border clearing and settlements of transactions. This also creates costs, risks and inefficiencies for investors, institutions and issuers. Distributed ledgers offer a different model of business and regulatory: a single real time record that tracks directly ownership in which many actors can check and verify information and enforce regulation. This mechanism can be integrated into the established securities regulatory regimes without replacing existing legal frameworks. If companies could issue their stocks on a distributed ledger, the number of traders who follow an arbitrage strategy would be reduced and or prevented, complementing trust in the system from a public-private framework. This stylised framework would require companies to not replace law but to evolve towards an inclusive distributed legal framework. The implementation of this framework is not easy and the intermediaries that resist from the current legal framework may resist. In scenarios where trust based legal system is not functioning efficiently due to incomplete markets, blockchain-based systems support the enforcement of legal rules via smart-contracts. It is true that Blockchain enhance trust, however the problem of trust will be present and cannot be addressed if the Blockchain infrastructure is managed by a potential "unreliable" government.

Moreover, the blockchain ledger can be implemented as a workable legal compliance system helping firms to reduce cost and meet their compliance requirements towards national and international regulation. A prominent example is R3 regulatory reporting tool developed with the Financial Conduct Authority (UK) and two global banks.[59] This blockchain-based solution allowed multiple parties to access a shared authoritative record offered an elegant simplification of many regulatory functions through the creation of a regulatory platform. This platform removed the need to send copies of information and removed futile double-checking mechanisms. The built-in features of distributed ledgers—like requiring transaction validation at each step and recording a full audit trail complete with cryptographic signatures—improved data integrity throughout the entire process and increased the speed of transferring information.

This system is a good illustration of new model for financial infrastructure offered by DLT which provide new tools to promote safer and more efficient markets. Where rule of law is unstable or absent, the Blockchain infrastructure can substitute, complement or supplement regulatory frameworks. In these contexts, mechanisms that introduces workable legal rules are likely to emerge according to a bottom-up framework developed by business leaders and governments who seek to solve market failures present in the market. A practical example is the Barbados central Bank Digital currency project,[60] aimed at addressing financial inclusion. This project develops a payment infrastructure for small-medium enterprises and consumers

[59] R3 press release available here: https://www.r3.com/press-media/r3-unlocks-regulatory-reporting-on-corda-with-financial-conduct-authority-and-two-global-banks/.

[60] Mondaq (2020), online article available here https://www.mondaq.com/fin-tech/892778/bitt-launches-world39s-first-central-bank-digital-currency-hub.

conducting business in the Caribbean islands.[61] One take-way from these examples is important to remember is that institutions are not disappearing, but they need to keep up with the innovation process and the societal pressures to digitisation, however where governmental institutions can fail, technological infrastructure can also fail. These extra-legal regimes can go beyond national boundaries, allowing firms and government to operate in transnational area which comprises of many legal jurisdictions with wider markets and bigger risks. One key advantage of employing technology as a regulatory tool is allowing institutions to regulate areas of the economy which it was difficult to supervise or monitor before. Traditional-self regulatory frameworks and payment network such as Bitcoin have emerged in unexpected places (i.e. virtual games) and could potentially scale up. Moreover, technology-based solutions have been implemented in areas where the financial infrastructure was underdeveloped and Blockchain aims to address financial inclusion, with Barbados being an important example of this claim.

The distinct nature of Blockchain technology and their associated decentralised technology infrastructure allow firms to develop a set of collectively supplied, specific industry relevant skills and capabilities designed for firms and user organisations based on the principle of trust and confidence. In order to operate, Blockchain projects have a range of formal solutions and sanctions supported by Blockchain technology such as the block of "bad" users through a smart contract and informal sanctions typically including denial of media access, bad advertisements on Blockchain public forums and membership expulsions from associations and consortium. These rules are applied in the case a member misconduct, similarly in the Blockchain infrastructure decision-making algorithms can automatically punish members when they misconduct enhancing trust and transparency.

Having examined the main characteristics of these Blockchain projects, I can affirm that they operate as a form of self-regulatory frameworks. These self-regulatory frameworks seem to suggest that they do not compete over regulatory authority, but they complement it.[62] Blockchain cannot rid of institutions and cooperation between incumbent players and Blockchain technology is important. Depending on the context in which Blockchain is applied, this notion of relationship of complementarity emerges, connotating that one mechanism of Blockchain strengthens the functionality of the other or compensates for its weaknesses.[63] For example, the chamber of digital commerce in the USA, an example of private-public sector partnership, aims to strengthen relationship between private and public actors in order to advance regulatory experiments in Blockchain and protecting consumers.[64] To conclude, these regulatory frameworks seem to be an extension of

[61] https://www.euronews.com/next/2021/04/06/eastern-caribbean-becomes-the-first-currency-union-to-issue-blockchain-based-digital-curre.

[62] Black (2008).

[63] Höpner (2005).

[64] Chamber of Digital Commerce (2020), description of the organisation available here https://digitalchamber.org/about/.

innovation, exercising a form of digital and regulatory sovereignty over firms and consumers.

5 Conclusion

The proposed analyses of the current national and international regulatory frameworks and of the Blockchain infrastructure as a self-regulatory organisation enabled a systematic treatment of the main regulatory and business factors and an innovative approach to the analysis of private governance in Blockchain. I pragmatically identified three models according to which Blockchain operates by adding, complementing and substituting law. I have also analysed governance frameworks in Blockchain and have categorised their mechanisms into two models (1) delegated governance and (2) technocratic governance. By comparing and contrasting global government projects and the different regulatory architecture employed by firms in the Blockchain industry, I showed how technology allowed and will continue to allow firms that operate on the Blockchain to go beyond national sovereignty and exercise digital sovereignty in an open global business and political scenario with a bigger role played by traditional and technological institutions. The mechanisms by which firms exercise digital sovereignty are numerous ranging from supplementing, complementing to adding new rules to legal regulatory frameworks to building platforms which aim to control and monitor consumers via a public and private Blockchain ledgers. These mechanisms are examples of how emerging technologies can "induce firms to cooperate"[65] as well as governments to interact with a series of technological infrastructures. These technological infrastructures such as Blockchain networks allow the incumbent players and start-ups to reinforce powers in global governance relations while maintaining or reinforcing their institutional role in governments and society. As financial services activities are migrating from physical infrastructure such as banks to the internet of finance, the space of traditional governance is not decreasing. The internet of regulation and Blockchain are challenging how governments regulate reporting activities, especially in auditing business functions and products and the reports associated with them.[66] In this light, governments should take a responsible, proactive way to create a regulatory framework which allows fair competition and address any anti-trust issues arising from a close number of players involved in this industry. Governments are increasingly required to understand how technology can facilitate their regulatory and supervisory functions and create a digital economy that can operate on a public or private Blockchain. Going forward, we need more private and public regulatory

[65] Cutler et al. (1999), p. 8.

[66] This is very relevant for AML regulation and business compliance. Table 2 shows how governments and firms are conducting regulatory experiments in many business areas that involve auditing products and services.

experiments with much better results. Blockchain supplements, complements and adds to law whilst the government being the administrator of a novel technological justice establishes the principles of law and digital order.

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