

DISSERTATION
GIOVANNI PERANI



School of Law

DUAL LL.M. IN COMMERCIAL LAW

BLOCKCHAIN: IS SELF-REGULATION SUFFICIENT?

SUPERVISOR: Miriam Goldby
ALUMNUS: Giovanni Perani
Student ID: 160714418
Dissertation Code: QLS001
Number of Words: 14.500

Academic Year 2016-17

BLOCKCHAIN: IS SELF-REGULATION SUFFICIENT?

Giovanni Perani

TABLE OF CONTENTS

<u>INTRODUCTION</u>	3
<u>I CHAPTER - BLOCKCHAIN TECHNOLOGY AND ITS APPLICATIONS</u>	4
1.1. BLOCKCHAIN: A DISTRIBUTED LEDGER TECHNOLOGY	4
1.2. BLOCKCHAIN FROM 1.0 TO 3.0.	5
1.3. A GLANCE AT THE IMMEDIATE AND DISTANT FUTURE	7
<u>II CHAPTER - THE OBJECTIVES OF REGULATION</u>	8
2.1. UNDERSTANDING REGULATIONS	8
2.2. THE BIRTH OF NEW REGULATIONS	9
2.3. THE PURPOSE OF REGULATIONS	10
<u>III CHAPTER - CURRENT SITUATION</u>	12
3.1. EARLY REGULATIONS AND ACTIONS BY STATES	12
3.2. CASES AND EARLY FRAMEWORKS	13
3.3. SHOULD THE TECHNOLOGY ITSELF BE REGULATED AS DISTINCT FROM THE APPLICATIONS?	14
<u>IV CHAPTER - ANALYSIS</u>	15
4.1. WHAT: IS IT THE DLT TECHNOLOGY OR THE APPLICATION WHICH MUST BE REGULATED? AND WHEN: BEFORE OR AFTER CREATION?	15
4.2. WHO AND HOW: DO WE NEED A SPECIFIC NATIONAL OR INTERNATIONAL ORGANISATION OR WHO SHOULD HAVE THE POWER TO DO SO?	17
<u>CONCLUSION</u>	20
<u>BIBLIOGRAPHY</u>	21

INTRODUCTION

It is happening in silence. Even as its arrival is being whispered about, it is laying the foundation for an inevitable future. It is the new digital revolution¹ and it is based on the new technology called Blockchain.²

Technological innovation has always meant structural changes with deep implications for the social, political and economic fabric of the world. In a broad sense the chapters of our history have all been written by these changes- from coal to the steam engine, from the invention of electricity to the use of petroleum. Today we are setting off into a world of virtual transfers and this revolution will perhaps be the most compelling because it will involve every sector and will dismantle the world as we know it.

Since the very first blockchain application – Bitcoin³- was created, many further uses of the technology have been invented and developed. Unsurprisingly, there has also been a large movement of regulators looking to find any pretext to regulate the use of this emerging technology. The result, however, has not led to a real solution to the problem posed by this technology, which is capable of changing the rules of the game.

Now that the future situation has come into view, the focus has been placed on the practical applications of the blockchain and on their inevitable social, political and economic consequences. This has opened a debate, therefore, on the need, or not, to shape ‘legal’ rules to accompany these changes. In fact, the impact will involve various sectors such as finance and politics, where the need for a central authority will be diminished. This concept was already widely accepted after the ‘phenomenon of Bitcoin’ and ‘Ethereum,’ but the establishment of regulations may have repercussions not only for the ECB⁴ and the Fed but also for all those who pose as intermediaries: financial markets, banks, payment managers/handlers. All this was foreseen beforehand by Microsoft⁵. According to a report by InnoVentures⁶ it is estimated that by 2022 between 15 and 20 billion dollars could be saved on average on charges on payments and money transfers in the world if the blockchain system is used instead of the traditional one. To this we must add the possible implications of the weakening of political control of the central state and its central bank. The application of the new technology could lead to a different relationship between the public administration and citizens, where the latter could assume a less passive role towards the administration and could force a wider reevaluation of the principle of *res publica*.

The impact may stretch even beyond these borders. One of the goals of this research is connected to the conceptual and ethical issues surrounding the necessity, or not, of trying to regulate this upcoming wave of innovation. Although it is true that we will be moving towards more decentralization and transparency as guaranteed by the blockchain system, the problem of understanding, as Juvenal wrote around 50 AD, *quis custodiet ipsos custodies?*⁷ remains.

The aim of this research is twofold: on one hand, performing an analysis of the blockchain technology and of its innovative implications so as to understand why it will lead to an unstoppable alteration of society and the economy, and on the other hand, imagining how and in what way regulating the technology and the dynamics surrounding it is necessary. Should there be freedom to self-regulate or should it be directly regulated in some way?

Chapter I will concentrate on the technology called blockchain, which is simply a ‘type of database that is shared, replicated, and synchronised among the members of a network. The distributed ledger records the transactions, such as the exchange of assets or data, among the participants in the network.’⁸ Blockchain innovation may decrease the role of a figure placed between the principal parties in most financial and administrative transactions – the intermediary. By enabling individuals to exchange a one-of-a-kind bit of computerized property or information directly with others, in a protected, secure, and pre-set, fixed way, the innovation can make: advanced monetary standards that are not upheld by any administrative body; self-authorizing computerized contracts (called *keens* gets), whose execution does not require any human mediation; decentralized commercial centers that expect to work free from the range of direction;

¹ Yochai Benkler, *The Wealth Of Networks* (Yale UP 2006) 62.

² Blockchain, also known as distributed ledger technology <https://en.wikipedia.org/wiki/Blockchain>.

³ Lawrence Trautman, ‘Virtual Currencies; Bitcoin & What Now After Liberty Reserve, Silk Road, And Mt. Gox?’ (2014) 20 *Rich JL & Tech* 13.

⁴ Paolo Fiore, ‘Così Draghi per liberare la BCE pensa alla blockchain’ (Smart Money, 25 February 2016) www.smartmoney.startupitalia.eu/banche/52084-20160225-draghi-bce-blockchain accessed 8 May 2017.

⁵ Jemima Kelly, ‘Microsoft launches cloud-based blockchain platform with Brooklyn start-up’ (Reuters, 10 November 2015) www.reuters.com/article/us-microsoft-tech-blockchain-idUSKCN0SZ2ER20151110.

⁶ Oliver Wyman Survey, ‘The Fintech 2.0 Paper: rebooting financial services’ www.oliverwyman.com/content/dam/oliver-wyman/global/en/2015/jun/The_Fintech_2_0_Paper_Final_PV.pdf accessed 2 July 2017.

⁷ Juvenal, translation from Latin, “Who will watch the watchmen?”

⁸ Solane Brakeville and Bhargav Perepa, *Blockchain Basics: Introduction to Distributed Ledgers* (IBM Developer Works, 9 May 2016) www.ibm.com/developerworks/cloud/library/cl-blockchain-basics-intro-bluemix-trs/index.html accessed 4 July 2017.

decentralized correspondence platforms that will be progressively difficult to wiretap; and web-empowered resources that can be controlled, like computerized property.⁹

Chapter II will enter into the *ratio* behind regulations in general, exploring where and why the needs of a community caused the rise of institutions with the power to issue rules and how these can influence the natural flow of markets and socio-economic developments. In Chapter III some of the initial frameworks and plans regarding the applications of blockchain, as well as the purpose behind them, will be illustrated. Finally, Chapter IV will present an analysis which seeks to answer if, how and by whom the DLT technology will have to be regulated, and especially with what process and in what way.

I CHAPTER - BLOCKCHAIN TECHNOLOGY AND ITS APPLICATIONS

SUMMARY: 1.1. BLOCKCHAIN: A DISTRIBUTED LEDGER TECHNOLOGY; 1.2. BLOCKCHAIN FROM 1.0 TO 3.0.; 1.3. A GLANCE AT THE IMMEDIATE AND DISTANT FUTURE.

‘The first generation of the digital revolution brought us the Internet of information. The second generation - powered by blockchain technology - is bringing us the Internet of value: a new platform to reshape the world of business and transform the old order of human affairs for the better’¹⁰

1.1. BLOCKCHAIN: A DISTRIBUTED LEDGER TECHNOLOGY

The new era of technology has begun, and underlying it there are several technologies which have in many ways revolutionised the world as we once knew it. Many people, however, are overly sensitive to these new technologies and especially to how these new technologies will transform their routines. The new technologies seem to be growing more and more complex and this increased complexity presents a socio-cultural problem. Most new technologies initially meet resistance before they are fully understood, adopted and brought into widespread use.

In spite of the resistance which greets a seemingly complex new invention, most technologies are not as complex they appear. In fact, one of their main purposes nowadays is to make repetitive and mechanical processes easier. In addition, they may simplify complicated problems or aid in shortening the times involved in performing certain tasks.

One example of this would be the creation and introduction of digital currencies and the impact they have had on the financial and banking industries. Ever since the global financial crisis in 2008, in fact, states have been putting more and more effort into controlling financial and banking operations by introducing stricter regulations and policies. In many cases, these new changes have been met with controversy ‘as many people believe that policy makers should promote freedom and transparency by empowering the public to directly interfere and change the system for public interest.’¹¹ The complexity of regulations, however, has not made the financial system an easier and safer place, and it remains controversial whether states should continue to implement and encourage policy makers or allow the free expansion of freedom and transparency with effective financial tools.¹²

Here is where technology may alter the complexity of regulations and open up new opportunities to fix these problems. The use of digital currencies represents a perfect example. In fact, in a world where digital technology is increasingly making everything paperless, the creation and use of digital currencies can only be seen as an intuitive development. Bitcoin, as the first digital currency introduced into our market, was created by Satoshi Nakamoto¹³ in 2009. It was the first conceptualisation of ‘blockchain’ technology and its impact has begun to be felt more widely. Today the blockchain is used to simplify money transactions. Furthermore, financial institutes have also started to use this technology in order to enhance efficiency – for example, smart contracts, smart assets, Clearing and Settlement, Payments and Digital Identity.¹⁴

⁹ Aaron Wright and Primavera De Filippi, ‘Decentralized Blockchain Technology and the Rise of Lex Cryptographia’ (10 March 2015) <https://ssrn.com/abstract=2580664> accessed 6 August 2017.

¹⁰ Don Tapscott, Canadian business executive.

¹¹ Quoc Khanh Nguyen, ‘Blockchain - A Financial Technology for Future Sustainable Development’ (3rd International Conference on Green Technology and Sustainable Development (GTSD), Kaohsiung, November 2016) 1.

¹² *ibid.*

¹³ Bitcoin were invented by an unknown programmer, or a group of programmers, under the name Satoshi Nakamoto. Satoshi Nakamoto was also involved, during the Bitcoin implementation, in the first blockchain database. L.S., ‘Virtual Friend Fires Employee’ (Naked Law, 1 May 2009) www.economist.com/blogs/economist-explains/2015/11/economist-explains-1 accessed 30 June 2017.

¹⁴ Chris Skinner, ‘The five major use cases for financial blockchains’ (Brave NewCoin, 11 March 2016) www.bravenewcoin.com/news/the-five-major-use-cases-for-financial-blockchains accessed 1 August 2017.

On one hand Bitcoin has become the most well-known application of blockchain technology, and a growing number of people have started to understand it. On the other hand, blockchain technology itself is still new to most people. All this is despite the fact that it has been involved in modernising several other fields, such as property certification, intellectual property, social inequality and contracts.¹⁵

So, what is blockchain and when was it born?

The first work on a cryptographically secured chain of blocks was done between 1991 and 1997, but it was only in 1998 that Nick Szabo introduced Bit Gold as a mechanism for a decentralised digital currency and smart contracts. Subsequently, in the first year of the new millennium, Stefan Konst introduced a general cryptographic theory of secured chains, but the first real conceptualisation of the blockchain technology had to wait till the arrival of Bitcoin. This, however, was only the first generation of blockchain technology. In 2014 blockchain took another step forward with its evolution, called Blockchain 2.0, and new applications of this technology were seen.

The reason for this faster¹⁶ evolution and the wider use of blockchain is due to its characteristics and simplicity; the mechanisms underpinning it are simpler than may be expected. Blockchain, in fact, is a distributed database (Distributed Ledger Technology) and it is defined by the authors of *Blockchain Revolution* as ‘an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value.’¹⁷ This meant that for the first time technology allowed consumers and suppliers to connect directly and perform digital transactions without need of a third party.

Sarah Underwood in the Journal Communications of the ACM¹⁸ defines blockchain technology and its impact as an ‘open, global infrastructure that allows companies and individuals making transactions to cut out the middle-man, reducing the cost of transactions and the time lapse of working through third parties.’ Furthermore, the technology is grounded on a distributed ledger structure and consensus process which permit the creation of a reliable connection between computers on the network without central control of any authority, and since it is public, it is viewable by all the network users.¹⁹

Thus, a blockchain is nothing more than a database (or ledger) of virtually any type of recordable information, made-up of ‘blocks,’ or stored data, and ‘chained’ together to form a cohesive, unbroken record of that information.²⁰

The arrival of blockchain formed the foundation for the revolution which involves any value transaction, whether those transactions are based on money, goods or property. But the importance is not only limited to this. Since every transaction is recorded and distributed on a public ledger, its potential uses may be almost limitless. In fact, once we believed the revolution was simply the cryptocurrencies based on the blockchain technology. This, however, was only the first step of the journey.

1.2. BLOCKCHAIN FROM 1.0 TO 3.0.

When a discovery is made in the technological world, often it will have multiple applications, and this is certainly true of blockchain. Although blockchain was used for the first time to create a particular digital currency, namely Bitcoin, and others such as Litecoin²¹ and Dogecoin²², the technology has started to be used for other purposes.

It is important to note, however, that the terminology surrounding this phenomenon is not helpful and can be confusing. For example, the word ‘bitcoin’ is generally used to refer to three different concepts: the first one, is the underlying technology, the blockchain itself. The second one is the protocol, which is the software that transfers the money using the blockchain ledger. Finally, the last layer is Bitcoin, or rather the currency itself.²³

Blockchain is already the cash of internet, a digital payment system, but this is just its first application.²⁴ For that reason, it is frequently referred to as Blockchain 1.0. Furthermore, since a cryptocurrency can be a programmable open network for decentralised trading of all resources, the concept of Blockchain 1.0 has already been extended to

¹⁵ Don Tapscott and Alex Tapscott, *Blockchain Revolution* (1st edn, Portfolio Penguin 2016).

¹⁶ Mark Buitenhok, ‘Understanding and applying Blockchain technology in banking: Evolution or revolution?’ (2016) 1 J of Digital Banking 111-119.

¹⁷ Tapscott and Tapscott (n 15).

¹⁸ Communication of the Association for Computing Machinery (ACM) was established in 1957. It is a monthly journal where articles focus on practical implications of advances in information technology.

¹⁹ Sarah Underwood, ‘Blockchain Beyond Bitcoin’ (2016) 59 Communications of the ACM 15.

²⁰ Definition of Blockchain in the Clyde & Co LLP survey, June 2016.

²¹ Litecoin <https://litecoin.org/it>.

²² Dogecoin <http://dogecoin.com>.

²³ Melanie Swan, *Blockchain, Blueprint for a New Economy* (1st edn, O’Reilly 2015).

²⁴ Annah Levine and Andreas Antonopoulos, ‘Let’s talk Bitcoin! #149 Price and popularity’ (podcast, Let’s Talk Bitcoin, 30 September 2014) <http://letstalkbitcoin.com/blog/post/lets-talk-bit-coin-149-price-and-popularity>.

Blockchain 2.0.²⁵ This is seen ‘as a programmable distributed trust infrastructure.’²⁶ As opposed to it being viewed as a process which permits only the decentralisation of money and payments, the new concept of Blockchain 2.0 increases the scope of the technology and enables the decentralisation of markets across different fields. More broadly, by providing registers for certificates, rights and obligations, Blockchain 2.0 transactions can involve other types of assets such as real estate, IPR, cars, works of art and so on.²⁷

Thus, the idea behind Blockchain 2.0 is to use the decentralised transaction ledger to register, confirm and transfer all the processes by which contracts are made and assets transferred, creating so-called smart contracts.

Smart contracts are another application of decentralised public ledger technology. They can also be viewed as self-executing transactions, or as ‘automated programs that transfer digital assets within the blockchain upon certain triggering conditions.’²⁸ However, smart contracts are not a completely new concept²⁹ and they are defined as ‘computer protocols that embed the terms and conditions of a contract.’³⁰ The blockchain technology, in fact, enables parties to enter into contracts and mitigates the risk of entering into a contract without the need for a third party. Trust is created and maintained by the simple fact that the blockchain technology is a database which cannot be tampered with and all transactions, once established, should be carried out with a minimum or no risk to either party, and therein lies its power. In *Harvard Business Review*, Patrick Murck said, ‘The power of blockchain technology is that it can algorithmically enforce private agreements and community principles at a global scale by shifting the cost of trust and coordination to the network. This is what allows blockchains to create new markets where they couldn’t exist before, whether for political or for economic reasons. To do this, we have to be able to trust the blockchain, and to trust that no one controls it.’³¹

Thus, for the first-time technology allows parties to connect directly to each other, eliminating the need for a third party, such as a subject, a state or ‘trust.’ Patrick Murck also said, ‘Blockchain networks tend to support principles, like open access and permissionless use, that should be familiar to proponents of the early internet. To protect this vision from political pressure and regulatory interference, blockchain networks rely on a decentralised infrastructure that can’t be controlled by any one person or group. Unlike political regulation, blockchain governance is not emergent from the community. Rather, it is *ex ante*, encoded in the protocols and processes as an integral part of the original network architecture. To be a part of a community supporting a blockchain is to accept the rules of the network as they were originally established.’³² Furthermore, in any blockchain transaction the parties don’t have to trust the counter-party to achieve their duties, since the web guarantees this through automated, standardised processes.

So, we can finally define the blockchain-based smart contracts by using the definition provided by Richard Genda Brown in ‘A simple model for smart contracts.’ He states that the smart contract is ‘a piece of code, deployed to the shared, replicated ledger, which can maintain its own state, control its own assets and which responds to the arrival of external information or the receipt of assets.’³³

Financial services and public records, as well as crowdfunding and smart property, can be migrated to the Blockchain 2.0 technology. Thus, the idea of Blockchain 2.0 is not applicable only for smart contracts, but it is really to be seen as a platform for many other applications.

Not only is blockchain technology revolutionising and reinventing every category of economic and financial services, but it is having a great impact on the idea of central authority. It creates a decentralised model for organising activities and effectively removes the need for a central authority to supervise or monitor these transactions. Indeed, Blockchain 1.0 and 2.0 focus on providing benefits such as economic efficiency and cost savings, both of which spring directly from interaction in decentralised network models without the need for intermediaries. The revolution does not stop there, however. The next step is Blockchain 3.0. With the interconnections created by the web, all humans are part of the same network, creating a global process that was previously unimaginable.

²⁵ Swan (n 23) 5.

²⁶ Tim Swanson, ‘Blockchain 2.0. Let a Thousand Chains Blossom’ (Let’s talk Bitcoin, 8 April 2014) www.letstalkbitcoin.com/blockchain-2-0-let-a-thousand-chains-blossom.

²⁷ Martin von Haller Gronbaek, ‘Blockchain 2.0, smart contracts and challenges’ (Bird&Bird Article, 16 June 2016) www.twobirds.com/en/news/articles/2016/uk/blockchain-2-0--smart-contracts-and-challenges accessed 20 June 2017.

²⁸ Joshua Fairfield, ‘Smart Contracts, Bitcoin Bots, and Consumer Protection’ 71 (Wash & Lee L Rev Online 36 2014) <http://scholarlycommons.law.wlu.edu/wlulr-online/vol71/iss2/3/> accessed 7 May 2017.

²⁹ Nick Szabo, ‘Formalizing and Securing Relationships on Public Networks’ (First Monday, 1 September 1997) www.firstmonday.org/ojs/index.php/fm/article/view/548 accessed 6 August 2017.

³⁰ Von Haller Gronbaek (n 27).

³¹ Patrick Murck, ‘Who Controls the Blockchain?’ (Harvard Business Review, 19 April 2017) www.hbr.org/2017/04/who-controls-the-blockchain accessed 5 July 2017.

³² *ibid.*

³³ Richard Gendal Brown, ‘A simple model for smart contracts’ (Richard Gendal Brown, 10 February 2015) www.gendal.me/2015/02/10/a-simple-model-for-smart-contracts accessed 24 June 2017.

Blockchain 3.0 is the unleashed potential of the technology application in every form imaginable, ‘in particular to allow for increasingly automated resource allocation of physical-world assets and also human assets.’³⁴ We are speaking about blockchain beyond currency, markets, and economics.

Furthermore, in her book, Melanie Swan says that every system in life comes down to economics to some degree, thus blockchain could be applicable too. For that reason, the wider view of Blockchain 3.0 could be used in any field such as in facilitating big data’s predictive task automation. The idea is to use Blockchain 1.0 and 2.0 technology to change the *ratio* behind other tasks. Blockchain 3.0 aids in revolutionising the organisational model we used to know, ‘perhaps, all models of human activity could be coordinated with blockchain technology to some degree, or at a minimum reinvented with blockchain concepts.’³⁵

1.3. A GLANCE AT THE IMMEDIATE AND DISTANT FUTURE

The new millennium has seen new applications of technology change the traditional concept of financial firms: the so-called Fin-tech (financial technology) firms provide a wide and varied array of services which rely on technology and which have brought about change. Bill Gates, 20 years ago, opined that ‘Banking is essential, banks are not.’³⁶ In our near future, technology may take the place of banking, for example. It is already doing so in ways that were unimagined only a few decades ago. Peer-to-peer lending and crowdfunding, for example, have become possible due to the technology of the internet and the interconnections which come directly from it.

Blockchain is and will be a fundamental part of this process of decentralisation. This is already occurring with e-money or cryptocurrencies. The transition into widespread use of virtual currencies is still at its dawn and blockchain is now moving out of the cyber universe and interacting more often with the real world. In fact, this is creating difficulty for the institutions and governing bodies which have until recently been the regulators of all financial transactions.

Fundamental issues such as an exact definition of virtual currencies have proven to be elusive and difficult to pin down. The Central Bank of Canada defines the decentralised e-money based on blockchain technology as e-money which is ‘stored and flows through a peer-to-peer computer network that directly links users, much like a chat room. No single user controls the network.’³⁷ The ECB report on virtual currencies,³⁸ on the other hand, defined e-money based on its interaction with fiat money and the real economy, and so its value is calculated based only on the interaction with real money – that produced and controlled by states and banks. According to the ECB report, cryptocurrencies are commodities, and not real currencies. However, it is the market that dictates their prices and values.

Finding a precise definition of e-currencies is only part of the problem, especially since it only touches on the first layer of Blockchain technology, that is to say Blockchain 1.0. The other matter is finding a common approach toward this new technology. Although it is becoming more and more accepted by states and banks, there are some countries in which Bitcoin is considered illegal, such as in Bolivia, Ecuador, Kyrgyzstan and Bangladesh.³⁹

Therefore, there is another problem which should be evaluated: whether states will be open to the growing array of the applications of the blockchain technology. Furthermore, the Blockchain 2.0 revolution is approaching. In fact at the inaugural Smart Contracts Symposium held at Microsoft’s New York City headquarters, many blockchain experts ‘discussed the myriad of ways that smart contracts are poised to disrupt the *status quo* in 2017 and beyond.’⁴⁰

Therefore, it is clear that interactions between technology companies stand to benefit from the application of blockchain or distributed ledger technology and this opens up a new era of opportunities. The market and regulatory agencies will contribute even more in the next year to increasing the benefits which consumers will have.⁴¹ Moreover, ‘leading the trend by transforming business model and taking steps to apply Blockchain technology in financial activities would be a tactical preparation for a sustainable development of corporations in general.’⁴²

³⁴ Swan (n 23) 29.

³⁵ *ibid.*

³⁶ For further information and reports by SVB about the investment trends in Fintech, please go to <http://www.svb.com/News/Company-News/2015-Fintech-Report--Investment-Trends-in-Fintech/?site=uk>.

³⁷ Bank of Canada, ‘Decentralized E-Money (Bitcoin)’ (Backgrounders, April 2014) www.bankofcanada.ca/wp-content/uploads/2014/04/Decentralize-E-Money.pdf.

³⁸ European Central Bank, ‘Virtual currency schemes – a further analysis, Eurosystem Report’ (February 2015) www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf.

³⁹ Wikipedia, Blockchain <https://en.wikipedia.org/wiki/Blockchain>.

⁴⁰ Rob Marvin, ‘Blockchain in 2017: The Year of Smart Contracts’ (PCmag, 12 December 2016) www.pcmag.com/article/350088/blockchain-in-2017-the-year-of-smart-contracts accessed 4 July 2017.

⁴¹ Nguyen (n 11) 53.

⁴² *ibid.*

The market and people are ready for this revolution. Technology will be part of our ‘new world,’ but every process, every step along this path must be taken into a web that controls part of our freedom, the states.

How is blockchain viewed by regulators and states? Have regulations or laws which circumscribe blockchain technology already been put in place? Before analysing these issues, we must understand what is a regulation and why we need to regulate.

II CHAPTER - THE OBJECTIVES OF REGULATION

SUMMARY: 2.1. UNDERSTANDING REGULATIONS; 2.2. THE BIRTH OF NEW REGULATIONS; 2.3. THE PURPOSE OF REGULATIONS.

‘Being caught up in a game without having a clue about the rules, may be extremely maddening and frustrating. Liberty may be so frightening and grueling, that many don’t conceal their passion for rules and regulations, since these can give a relieving feeling of security and protection’⁴³

2.1. UNDERSTANDING REGULATIONS

What is a regulation? Why regulate? These questions might seem easy to answer; everyone can imagine what a regulation is and why we need it. Nevertheless, the origin of regulation is more complicated than expected and before answering the main question of this research, whether self-regulation is sufficient for blockchain technology, we need to analyse the fundamental reasons why we need regulations, and from where they come.

In Steve Tombs article, ‘Understanding Regulation,’ he defines the need for regulation by stating that in its absence chaos will be sovereign. The historical record demonstrates, in fact, that the result would be the wide-scale production of death, destruction and despoliation.⁴⁴ As the author himself admits, this straightforward exclamation may be a bit overstated. However, regulating, suppressing and avoiding certain actions or behaviours in a particular community is typical of any society and often this stems from its own members’ decisions. The need for rules is an endogenous requirement of a community.

Indeed, the backbone of early regulations came from years of fighting, wars, and political clashes, all of which have been present since the birth of the first human community. In fact, as established by the famous Latin maxim ‘*Ubi homo, ibi societas. Ubi societas, ibi jus. Ergo ubi homo, ibi jus*,’⁴⁵ rules have been established to promote peaceful coexistence. Additionally, as Edward W. Younkins said, ‘Whereas society is a spontaneous order, the state is a protective agent with the monopoly role of enforcing the rules of the game. Since the monopoly on coercion belongs to the government, it is imperative that this power not be misused. Under the rule of law, everyone is bound by rules, including the government.’⁴⁶

Thus, it is hard to find a specific definition of what a regulation is, and there are many researchers who have tried to do so.⁴⁷ Robert Baldwin, in his book, *Understanding Regulation*, has divided the types of regulation into:

- *a specific set of commands* - where regulation is seen as a ‘set of rules to be applied by a body devoted to this purpose;’
- *deliberate state influence* - where regulation is not a strict list of commands, but is rather the exercise of specific influence on business and social comportment;
- *all forms of social or economic influence* – where regulations influence every behaviour in a community.⁴⁸

Therefore, regulations are not only a set of commands, but they can be viewed as a wider spectrum of influence exercised by an era, a leader, or an idea. However, beyond the regulations in and of themselves there is another important principle, regulatory enforcement, that is to say the power with which regulations bind people or behaviour.

Nowadays, regulatory enforcement is carried out under the authority of regulatory enforcement agencies around the world. This supervision can manifest itself in many forms: ‘non-enforcement [that] is the most frequently found

⁴³ Erik Pevernagie

⁴⁴ Steve Tombs, ‘Understanding Regulation’ (2002) 11 Soc & Legal Stud 113.

⁴⁵ *Ubi Societas Ibi Jus* is a legal maxim which means ‘Where there is society, there is law’.

⁴⁶ E.W. Younkins, *Capitalism and Commerce, Conceptual Foundations of Free Enterprise* (Lexington Books 2002) 145.

⁴⁷ Anthony Ogus, *Regulation: Legal Form and Economic Theory*, *The Modern Law Review*, Vol. 59, No. 1 (Jan. 1996).

⁴⁸ Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, OUP 2014) 3.

characteristic; and enforcement activity [which] tends to focus upon the smallest and weakest individuals and organisations; and sanctions following regulatory activity are light.⁴⁹

Another form of regulation, which is often considered the strongest,⁵⁰ is self-regulation. In fact, as the author Braithwaite maintains, ‘State regulators won’t have the power to enforce a regulatory law as if it is something felt from inside, and not imposed from the outside.’⁵¹ Self-regulation is based on the carrot-and-stick concept. In fact, when self-regulation is unsuccessful, the next regulatory tactic is to introduce ‘enforced self-regulation’, and this presupposes that an ‘entity’ should custom-build a set of rules which will enable it to comply with law. That law will be ‘enforced’ from ‘inside’ the community, but only after ‘external’ regulators will provide for it.⁵²

There is a theory that associate regulation was born in the post-privatisation control of the utilities.⁵³ However, the origin of regulation as a *specific set of commands* created and enforced by an authority had already been developed by the Egyptian, Indian, Greek, and Roman civilisations.⁵⁴ In fact, in the ancient world regulation existed in the form of norms, customs, and privileges, such as standardised weights and measures for gold as an international currency, but later the enforcement of regulation was aided by the unifying Christian identity and a sense of honour regarding contracts.⁵⁵

Beginning in the late nineteenth century,⁵⁶ however, the first specialist regulatory institutions were born in the UK,⁵⁷ introducing control over several activities, such as health and employment conditions,⁵⁸ the supply of water and gas, and the control over safety and price.⁵⁹

Globalisation has surely given impetus to global regulation. An example would be that in 2017 in the EU there are more than 60,000 legal acts, 44,000 court verdicts and 62,000 international standards.⁶⁰

Therefore, after having understood what regulation is and how it developed, now we shall turn our attention to why we regulate and thus, how governments draft new regulations.

2.2. THE BIRTH OF NEW REGULATIONS

There are several reasons why governments may regulate a particular activity or behaviour. In general, the main purpose comes down to matters regarding public safety or economic interests. The technical justification, however, remains the pursuit of public interest.

Another objective often given for regulating is avoiding ‘market failure.’ John Francis, in fact, believes that, the uncontrolled marketplace may, in some circumstances, fail to produce comportment or consequences in accordance with the public interest and only an ‘external action’ can control it.⁶¹ Thus the government has no choice but to act.

In the world of economics, there are other well-recognised reasons beyond that of market failure. Although several ‘regulatory activities undertaken are not correctly rationalised by market failure,’⁶² situations where monopolies (including natural monopolies), windfall profits, information inadequacies, or anti-competitive behaviour arise, government intervention is needed. According to Prosser, the idea of setting up regulation in order to correct ‘market failure’ is not the correct approach. Regulation should be seen as ‘seeking to further social objectives, rather than as simply acting to correct market failures.’⁶³

Thus, the aim of regulation should not be limited to regulatory laws designed to correct the market, but should rather be part of betterment and should “provide the frameworks of rights and processes that allow markets to work and

⁴⁹ Laureen Snider, *Corporate Crime: Contemporary Debates* (U Toronto Press 1993).

⁵⁰ Philip Booth, ‘Lessons from history show self-regulation to be the best kind of control,’ *Telegraph* (London, 8 August 2010) www.telegraph.co.uk/finance/comment/7933318/Lessons-from-history-show-self-regulation-to-be-the-best-kind-of-control.html accessed 15 May 2017.

⁵¹ Brent Fisse and John Braithwaite, *Corporations, Crime and Accountability* (CUP 1993).

⁵² Ian Ayres and John Braithwaite, *Responsive Regulation: Transcending the Deregulation Debate* (OUP 1992).

⁵³ Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, OUP 2014) 4.

⁵⁴ John Braithwaite and Péter Drahos, *Global Business Regulation* (CUP 2000).

⁵⁵ *ibid.*

⁵⁶ Anthony I Ogus, ‘Regulation: Regulatory Law: Some Lessons from the Past’ (1992) 12 *Legal Studies* 1.

⁵⁷ Oliver MacDonagh, ‘The Nineteenth-Century Revolution in Government: A Reappraisal’ (1958) *Historical Journal* 52.

⁵⁸ Paul Craig, *Administrative Law* (5th edn, Sweet & Maxwell 2003).

⁵⁹ James Foreman-Peck and Robert Millward, *Public and Private Ownership of British Industry 1820–1990* (OUP 1994).

⁶⁰ Eur-lex search results as of July 19, 2017 (advanced search: Domain: EU law and related documents, Subdomain: Legislation, Limit to legislation in force, Exclude corrigenda) <http://eur-lex.europa.eu/advanced-search-form.html>.

⁶¹ John G. Francis, *The Politics of Regulation: A Comparative Perspective* (Blackwell 1993).

⁶² T. Prosser, ‘Regulation and Social Solidarity’ (2006) 33 *Journal of Law and Society* 364.

⁶³ Baldwin (n 53) 22.

to protect markets from fragmentation.’⁶⁴ In some circumstances, regulation can be set early as a means to avoid market failure, and as a method of organising social relations.⁶⁵

Public interest is surely the main objective behind most regulation, and to further this end there are several approaches which can be adopted.⁶⁶ All share a common core which explains the origin of every regulation. Indeed, there are two different stimuli which give rise to the birth of new regulation. These are exogenous and endogenous factors: the former comes from the demand of political-social nature, and thus these are considered ‘external’ factors; the latter, instead, adapts to ‘internal’ demands such as cultural or geographical needs.⁶⁷

The authors Robert Baldwin, Martin Cave and Martin Lodge in their book, *Understanding Regulation*, consider the four main explanations for which regulation arises:

- *public interest theories*: as a driver in creating new regulations these are surely among the foremost and must be analysed. The concept of ‘public interest’ differs from the bureaucratic world and it is less economically and politically oriented,⁶⁸
- *interest group theories*: this is the second most important approach to regulations. In this case, there is no longer a turning point towards a broad sphere that includes public interest, but to a specific interest group. A perfect example would be in the economic field; in fact, the economic theory of regulation is based on the principle that enterprise can self-regulate, but only in order to improve and maximise the benefits that the group will be able to have. Obviously, these benefits will to some extent reflect wider social interests;
- *‘power of ideas’ explanations*: ideas, ideologies, and beliefs can have a radical influence on public policy and regulation. Customs and traditions have a strong influence inside a community. Indeed, these habits and customs form the basis for the creation of many laws and regulations. The ideologies, therefore, can significantly influence the way regulation is born;
- *institutional theories*: the last piece, nowadays the most important, concerns institutionalism. Different institutional approaches, in fact, can create different formal rules in a specific field. However, the social context, as well as the policies between different actors with different goals, must always be examined. Institutionalists, therefore, agree that institutional arrangements can have a significant impact on how regulation is developed.⁶⁹

The further we go into the analysis of the roots of regulation, the clearer it becomes that it is not possible to summarise briefly the process and development behind regulation.⁷⁰ Given the multiplicity of laws arising from the most diverse causes, with different processes and timing, we cannot settle on a single theory. As we move toward an increasingly globalised world, where standardisation will become the origin of law, in the future the ‘primary’ cause of the birth of legislation might be attributed to this. However, nowadays, the different theories, habits and customs around the world are the ingredients to study and seek at the heart of any regulation.

2.3. THE PURPOSE OF REGULATIONS

Now that the causes and processes that have led to the birth of regulation and to the creation of regulations in the modern era have been explored, let us move on to the purpose of regulation and analyse the objective of technological regulation as it may be applied to blockchain.

When being drawn up, every regulation has a principal aim which must be considered. For example, the main purpose of financial regulations is to prevent financial instability, and thus, one of its targets is to minimise or eliminate direct losses to innocent bystanders and minimise the economic impact of a systemic financial crisis.⁷¹ However, there should always be a loophole, or how can we prove that there is no ‘theoretical reason or empirical evidence that regulators are any better at anticipating bubbles or business downturns than anyone else.’⁷²

⁶⁴ *ibid* 23.

⁶⁵ Clifford Shearing, ‘A Constitutive Conception of Regulation’ in P. Grabosky and J. Braithwaite (eds) *Business Regulation and Australia’s Future* (Australian Institute of Criminology 1993).

⁶⁶ Robert Horwitz, *The Irony of Regulatory Reform: The Deregulation of the American Telecommunications Industry* (OUP 1989).

⁶⁷ Baldwin (n 53) 41.

⁶⁸ J.W. Roxbee Cox, ‘The Appeal to the Public Interest’ (1973) 3 *British Journal of Political Science* 229.

⁶⁹ Bronwen Morgan and Karen Yeung, *An Introduction to Law and Regulation: Text and Materials* (CUP 2007).

⁷⁰ Michael E Levine and Jennifer L Forrence, ‘Regulatory Capture, Public Interest and the Public Agenda: Towards Synthesis’ (1990) 6 *Journal of Law, Economics, and Organization* 167.

⁷¹ Bill Watkins, ‘What is the Purpose of Financial Regulation?’ (California Lutheran University, CERF Blog, 27 April 2010).

⁷² *ibid*.

In recent years, with the uncontrolled evolution of the internet and all its applications, the main objective of governments around the world has been to protect consumers and businesses against the poor management of sensitive information. However, this just scratches the surface of something even more complicated. In the early years of the internet, we did not need any particular regulations to create an online market, to sell or buy products or play online. Every ‘online’ activity reflected another one already performed in the real world and, thus, already subject to regulation.

Nevertheless, the internet has evolved, and a growing number of activities done via the web and technology do not have an exact reflection in the real world. Technology is growing more independent, and the goal of these new inventions, as Ivan Illich explored in his book, *Tools for Conviviality*, in 1973, was to make men more self-sufficient, more liberated, more suited to satisfying their own particular goals. At first, it was important to configure apparatuses (advances, establishments, connections) for the administration of man, instruments fit for freeing human potential and inventiveness. They partitioned men into masters and slaves, experts and slaves.⁷³

If the technologies around us are designed to channel our actions toward certain limited behaviours which can be measured and then analysed, managed and transformed into future consumption forecasts, then our contractual power over these technologies is very low, and our efforts, our ‘individual response,’ the attempt to resist the manifold possibilities provided by technologies is weak or irrelevant.

Some of us will also be able to find the right personal balance between the benefits of digital technologies and the time they take from other more social activities, but these attempts will only be exceptions.⁷⁴

For these reasons, should we allow the evolution of technology to remain totally independent? Or should the states take an active role in that evolution and regulate its processes? Technology is not supplementary to our lives anymore. We are becoming an essential part in its development. This independence, and growing dependence, will become the main problem facing regulators in the near future.

There is no difference between technology, artificial intelligence or robotics anymore. The three laws of robotics (also known as Asimov’s Laws), which were defined in science fiction by the author Isaac Asimov, are no longer fantasy.⁷⁵ The makers of regulatory frameworks should start evaluating how to regulate all the applications of new technologies invented by science every day. Nonetheless, here, the problem is not in identifying whether the reason for drafting new regulation is due to public interest theories, interest group theories, ‘power of ideas’ explanations or institutional theories,⁷⁶ but rather how far the power of technology will reach, and try to understand whether only its applications must be regulated or whether the freedom of people to ‘create’ through technology itself should be subject to regulation.

Even Stephen Hawking has warned us about how far technology can go if it is not controlled and regulated. In fact, he said, ‘Technology has advanced at such a pace that its aggression may destroy us all by nuclear or biological war. We need to control this inherited instinct by our logic and reason.’⁷⁷ Artificial Intelligence will change our approach to technology, and since the world-wide networking of the web and the power of technology without borders has continued to grow, we need to establish a method of identifying threats quickly, before they have a chance to intensify.⁷⁸

Furthermore, Professor Hawking back in 2015 in a Reddit AMA said that ‘AI is likely to be either the best or worst thing ever to happen to humanity’⁷⁹ and in his interview with *The Times*, he suggested that ‘some form of world government’ might be part of a plan which could prevent problems. However, he also said that a “world government” would itself create more problems.

⁷³ Ivan Illich, *Tools for Conviviality* (Harper and Row 1973)

⁷⁴ Tiziano Bonini, ‘Possono esistere delle (nuove) tecnologie conviviali?’ (Doppiozero, 22 luglio 2017) www.doppiozero.com/materiali/possono-esistere-delle-nuove-tecnologie-conviviali accessed 23 June 2017.

⁷⁵ Isaac Asimov, *I, Robot*, (Fawcett Publications 1950). The Three Laws, quoted as being from the ‘Handbook of Robotics, 56th Edition, 2058 A.D.’, are:

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm;
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law;
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

⁷⁶ See Section 2.2. The Birth of New Regulations, according to Morgan and Yeung.

⁷⁷ Tom Whipple and Oliver Moody, Interview to Stephen Hawking on humanity (and Jeremy Corbyn) *Times* (London, 7 March 2017) www.thetimes.co.uk/edition/news/hawking-on-humanity-and-corbyn-jk88zx0w2 accessed 3 May 2017.

⁷⁸ Aatif Sulleyman, ‘Without a “World Government” Technology Will Destroy Us, Says Stephen Hawking’ *Independent* (London, 8 March 2017) www.independent.co.uk/life-style/gadgets-and-tech/news/stephen-hawking-world-government-stop-technology-destroy-humankind-th-a7618021.html accessed 23 June 2017.

⁷⁹ Andrew Griffin, ‘Stephen Hawking: Artificial Intelligence Could Wipe Out Humanity When It Gets Too Clever As Humans Will Be Like Ants’ *Independent* (London, 8 October 2015) www.independent.co.uk/life-style/gadgets-and-tech/news/stephen-hawking-artificial-intelligence-could-wipe-out-humanity-when-it-gets-too-clever-as-humans-a6686496.html accessed 14 June 2017.

A similar viewpoint was expressed by the Tesla CEO Elon Musk, who has already warned that humans are in danger of becoming extraneous. ‘Over time I think we will probably see a closer merger of biological intelligence and digital intelligence,’ he said, suggesting that people could merge with machines in the future, in order to keep up.⁸⁰

To sum up, it seems necessary to report that in July 2017 an AI chat-bot designed by Facebook started to invent its own language, and researchers immediately had to shut it down.⁸¹ Thus, due to the risk that we may indeed lose control over future technology, as demonstrated by the Facebook research, it would seem that time is growing short, and states should start thinking of ways to regulate, or to manage, this evolution.

III CHAPTER - CURRENT SITUATION

SUMMARY: 3.1. EARLY REGULATIONS AND ACTIONS BY STATES; MOST SIGNIFICANT CASES; SHOULD TECHNOLOGY ITSELF BE REGULATED AS DISTINCT FROM APPLICATION?

‘In that sense, technological innovations are similar to legislative acts of political foundings that establish a framework for public order that will endure over many generations... The issues that divide or unite people in society are settled not only in the institutions and practices of politics proper, but also, and less obviously, in tangible arrangements of steel and concrete, wires and semiconductors, nuts and bolts’⁸²

3.1. EARLY REGULATIONS AND ACTIONS BY STATES

Given the importance of the growing role of blockchain technology in the new millennium, and its acceptance in the economic system, we shall now examine another core element. Its first application, cryptocurrencies, are increasingly utilised in the monetary economy, but what role do regulations play for them? Even though we are still not in a position to give firm answers about the future of blockchain technology itself, in recent years several regulators have started to turn their attention to virtual and cryptocurrencies. With the different interpretations of cryptocurrencies (which are, for example, recognised as private money⁸³ or as commodities), different issues may arise, including that of taxation.⁸⁴

In Europe, shortly after centralised virtual currencies and decentralised cryptocurrencies were introduced in 2012, the ECB began considering the implications they would have for monetary policy. Due to the independent structure which underpinned it, not a lot of importance was initially attached to it.⁸⁵ Virtual currencies, in fact, did not pose a risk to financial stability according to the ECB. However, in the following year, virtual cryptocurrencies had a different regulatory response, but they were still not recognised as a currency, ‘Euro-system central banks do not recognise that these concepts would belong to the world of money or currency as used in economic literature, nor is virtual currency money, currency or a currency from a legal perspective.’⁸⁶ Subsequently, in 2015 the ECB changed its approach and stated its intention to monitor possible threats to monetary policy and financial stability due to the growing ‘mainstream acceptance’ of virtual currencies.⁸⁷ Even more important, now that the market capitalisation of cryptocurrencies stands at around 116 billion USD.⁸⁸

⁸⁰ Aatif Sulleyman, ‘Elon Musk: Humans Must Become Cyborgs To Avoid AI Domination’ *Independent* (London, 15 February 2017) www.independent.co.uk/life-style/gadgets-and-tech/news/elon-musk-humans-cyborgs-ai-domination-robots-artificial-intelligence-ex-machina-a7581036.html accessed 29 May 2017.

⁸¹ James Walker, ‘Researchers shut down AI that invented its own language’ (Digital Journal, 21 July 2017) www.digitaljournal.com/tech-and-science/technology/a-step-closer-to-skynet-ai-invents-a-language-humans-can-t-read/article/498142 accessed 24 July 2017.

⁸² Langdon Winner, ‘Do Artifacts Have Politics?’ in *The Whale And The Reactor: A Search For Limits In An Age Of High Technology* (U Chicago Press 1986) 19.

⁸³ The German Finance ministry has recognised the Bitcoin as a unit of account, and so as a type of private money. <http://www.spiegel.de/international/business/germany-declares-bitcoins-to-be-a-unit-of-account-a-917525.html>.

⁸⁴ Gareth Peters, Efstathios Panayi and Ariane Chapelle, ‘Trends in crypto-currencies and blockchain technologies: A monetary theory and regulation perspective’ (2015) 3 *Journal of Financial Perspectives* (EY Global Financial Services Institute Winter) 37.

⁸⁵ European Central Bank, ‘Virtual currency schemes – a further analysis, Eurosystem Report’ (October 2012) www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemes201210en.pdf.

⁸⁶ European Central Bank, ‘Virtual currency schemes – a further analysis, Eurosystem Report’ (February 2015) 23 www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf.

⁸⁷ Peters (n 84) 37.

⁸⁸ Value as of 7 August 2017 at <https://coinmarketcap.com>.

Thus, in Europe there is not a joint, shared approach to the regulation of these virtual cryptocurrencies. For example, in Sweden virtual currency must be registered with the financial authorities, whereas in France and in Germany certain bitcoin activities must be subject to authorisation. Clearly a unified approach from the beginning would also help in the development of a future regulatory framework

Most of the early actions governments have taken thus far regarding decentralised cryptocurrencies concern the problem of AML (Anti-Money Laundering). The UK government, for example, has introduced various steps to deal with the AML problem and the aim of these measures is to ensure that law enforcement bodies have the means to fight criminal activity in the digital currency space.⁸⁹ Another example would be the action taken by the New York Department of Financial Services (NYDFS), which has released a Bit-License regulatory framework⁹⁰ with the goal of controlling, administering, or issuing a virtual currency. It states that any individual or corporation engaged in the aforementioned activities is required to obtain a license to do so.

Outside of the EU and US, there are few regulatory or policy interventions which regulate activities regarding blockchain and more specifically cryptocurrencies. Certainly, some actions have been taken to limit and warn against price volatility due to its nature as a non-state-backed currency. China, for example, is very strict on this, forbidding the use of cryptocurrencies by financial institutions. Japan, instead, states that 'due to their intangible nature and reliance on third parties, bitcoins are effectively not subject to ownership, and therefore are not covered by existing regulation.'⁹¹ Unlike China and Japan, the Australian approach is more open-minded. In fact, the Australian Senate 'put forward recommendations to treat Bitcoin as money, as treating Bitcoin as a tradeable commodity would have created a double taxation effect.'⁹²

3.2. CASES AND EARLY FRAMEWORKS

As for blockchain technology and all its applications, it is too early to analyse the approaches the courts around the world have taken so far. However, under EU law, the European Court of Justice has already had the opportunity to give its opinion regarding AML/CFT in October 2015 in *Skatteverket v. David Hedqvist*.⁹³

In the *Hedqvist* case, the issue regarded whether a professional must pay value added tax (VAT) while doing business that exchanges Bitcoin for traditional fiat currency (and *vice versa*).⁹⁴ This was just one of the most important cases where Bitcoin was the subject of the case and it affirmed that a trade of Bitcoin for conventional money is a supply of services. Thus, the court held that a trade of Bitcoin fell inside the exception in Article 135(1)(e) of the VAT Mandate. This exempts exchanges 'concerning cash, monetary certificates and coins utilised as lawful delicate' from VAT. However, the issue refers to VAT, and thus, to taxes and not the technology itself.

As we can see, the action taken by the Swedish government is focused on tax issues, and even if nowadays there are no existing regulations for virtual currencies, there are instead some guidance and frameworks issued by US governmental bodies, such as FinCEN, the Internal Revenue Service (IRS), SEC, CFTC, and the Consumer Financial Protection Bureau (CFPB).

Let's examine some of these frameworks and proposals, even though they address the issues surrounding virtual currencies:

1. *FinCEN Guidance, Rulings, and Enforcement*. Under the Bank Secrecy Act (BSA)⁹⁵ banks and other financial institutions must be subject to some registration and record keeping requirements for controlling and developing AML

⁸⁹ Tom Rees, 'Regulating Bitcoin: how new frameworks could be a catalyst for cryptocurrencies' *Telegraph* (London, 16 April 2017) www.telegraph.co.uk/business/2017/04/16/regulating-bitcoin-new-frameworks-could-catalyst-cryptocurrencies accessed 6 May 2017.

⁹⁰ New York State Department Of Financial Services, Title 23, Department Of Financial Services - Chapter I. Regulations Of The Superintendent Of Financial Services Part 200. Virtual Currencies. (2015) www.dfs.ny.gov/legal/regulations/adoptions/dfsp200t.pdf.

⁹¹ Kyodo, 'Bitcoins lost in Mt. Gox debacle "not subject to ownership" claims: Tokyo court' *The Japan Times* (Tokyo, 6 August 2015) www.japantimes.co.jp/news/2015/08/06/national/crime-legal/bitcoins-lost-in-mt-gox-debacle-not-subject-to-ownership-claims-tokyo-court-rules accessed 23 May 2017.

⁹² Byron Kaye, 'Australian inquiry says digital currencies are real money' (Reuters, 5 August 2015) www.reuters.com/article/us-australia-bitcoin-idUSKCN0QA0TS20150805 accessed 23 May 2017.

⁹³ Case C-264/14 *Skatteverket v. David Hedqvist* [2015] EU:C:2015:718.

⁹⁴ Jesse H. Rigsby, 'Virtual Currency, Blockchain Technology, and EU Law: The "Next Internet" in AML/CFT Regulation's Shadow' (Master's thesis, Lund University Spring 2016) 39.

⁹⁵ Bank Secrecy Act, Pub L 91-508, 84 Stat 1114 (USA).

and customer identification programs. In March 2013, all these rules were extended to cover participants who transact in ‘convertible virtual currencies’.^{96, 97}

2. *CFTC Jurisdiction over Bitcoin Derivatives and Market Manipulation Oversight.* The CFTC has jurisdiction over derivatives contracts related to interests not traditionally thought of as commodities.⁹⁸ Regarding blockchain, the CFTC established that virtual cryptocurrencies are ‘properly defined as commodities,’⁹⁹ and in September 2014, the CFTC oversaw the launch of the bitcoin swap execution facility (SEF).

Potential applications of blockchain technology, as we have seen in the first chapter, are diverse and multiple; they are not restricted to money transfers and payments. The conceptual basis behind Bitcoin, and in a more marked way behind the concept of blockchain, involves the transfer of ‘value’ however it is defined. Like a digital envelope, these containers can carry ‘coins’ across the network; but they can also transmit richer forms of information, holding promise for many compelling applications beyond Bitcoin.¹⁰⁰

Setting Bitcoin aside, in fact, we find that blockchain developers can create their own coin by setting different rules with different purposes, according to a desired set of economic properties.¹⁰¹ A few examples would be, Viacoin, a new ‘notary’ platform where it is possible to time-stamp, transfer and verify ownership of documents;¹⁰² Storjcoin, which unlike Bitcoin, is a decentralised cloud storage system;¹⁰³ and, finally, Litecoin, a platform similar to Bitcoin with quicker transaction confirmations for high-volume merchants.¹⁰⁴ These platforms, among others, will also need some sort of guidance in the future.

Everything is set for the future, the senior operations officer, Mariana Dahan, at the World Bank in charge of the 2030 development agenda and United Nations relations, says, ‘We believe blockchain is a major breakthrough and has great potential. It will make an impact on, and bring value to, any transaction that requires trust, a social resource that is all too often in short supply,’¹⁰⁵ but we are already at the time of this revolution, and this technology and its effects are not controllable with the older regulations which have been thus far applied to other situations. We need to create a policy platform which can provide a solid foundation for further work. First and foremost, we must understand whether the technology itself should be regulated or not.

3.3. SHOULD THE TECHNOLOGY ITSELF BE REGULATED AS DISTINCT FROM THE APPLICATIONS?

‘The buzz surrounding Bitcoin has reached a fever pitch. Yet in academic legal discussions, disproportionate emphasis is placed on bitcoins (that is, virtual currency), and little mention is made of blockchain technology—the true innovation behind the Bitcoin protocol. Simply put, blockchain technology solves an elusive networking problem by enabling “trustless” transactions: value exchanges over computer networks that can be verified, monitored, and enforced without central institutions (for example, banks). This has broad implications for how we transact over electronic networks.’¹⁰⁶

Finally, in a recent regulatory response, a new trend of thought has developed, where the UK government has ‘identified that more promising perspectives of virtual currencies may actually lie in the technology they use, i.e. the

⁹⁶ US Department of the Treasury, Financial Crimes Enforcement Network, Guidance on Application Of Fincen’s Regulations To Persons Administering, Exchanging or Using Virtual Currencies Fin-2013-G001 (2013) <http://Perma.Cc/5xaf-Pafc> [Hereinafter Fincen Guidance].

⁹⁷ Trevor I. Kiviat, ‘Beyond Bitcoin: Issues In Regulating Blockchain Transactions’ (2015) 65 Duke LJ 569.

⁹⁸ Robert L. McDonald, *Derivatives Markets* (2nd edn, Northwestern UP 2006).

⁹⁹ Coinflip Inc, ‘Order Instituting Proceedings Pursuant to Sections 6(c) and 6(d) of the Commodity Exchange Act, Making Findings and Imposing Remedial Sanctions at 3’ (CFTC Docket No. 15-29, 17 September 2015) www.cftc.gov/idc/groups/public/@lrenforcementactions/documents/legalpleading/enfcoinfliprorder09172015.pdf accessed 2 June 2017.

¹⁰⁰ Tim Swanson, *Great Chain of Numbers: A Guide To Smart Contracts, Smart Property And Trustless Asset Management* (self-published 2014) <https://s3-us-west2.amazonaws.com/chainbook/Great+Chain+of+Numbers+A+Guide+to+Smart+Contracts,+Smart+Property+and+Trustless+Asset+Management+-+Tim+Swanson.pdf> accessed 26 May 2017.

¹⁰¹ *ibid.*

¹⁰² Viacoin <http://Viacoin.Org> [[Http://Perma.Cc/Agt6-6ehp](http://Perma.Cc/Agt6-6ehp)].

¹⁰³ Storj <http://Www.Storj.Io> [[Http://Perma.Cc/Wd67-Fv5l](http://Perma.Cc/Wd67-Fv5l)].

¹⁰⁴ Litecoin <http://Www.Litecoin.Org> [[Http://Perma.Cc/Svys-9den](http://Perma.Cc/Svys-9den)].

¹⁰⁵ Underwood (n 19).

¹⁰⁶ Kiviat (n 97) 569.

distributed ledger technologies.¹⁰⁷ The UK government, following the recommendations in the HM Treasury survey,¹⁰⁸ has set out a range of proposals to unlock the potential of companies exploring the innovative uses of blockchain technology for advanced cash transactions. These companies will have leeway to act and will not be subject to strict regulation.

Even if it is floating in the air, it is still early to say that 2017 is the year of Blockchain, interpreted as the broader concept of technology, not as its principal applications of ‘coin’ and of all the cryptocurrencies that we have already seen. The data from a survey performed by IBM say that globally only 15% of transactions in the enterprise market have started to use the technology and this fifteen percent are principally banks and financial institutions. Many others, however, are ready to adopt the blockchain technology but the majority (51%) are waiting for 2018. The remainder are in fact delaying until 2020.¹⁰⁹

But why is it that blockchain technology is not yet mature? According to Aldo Peter Lo Castro, Head of Research & Development of the company ICT Aliaslab UK, the reason lies in several factors: a coherent, unambiguous definition of blockchain is still lacking; a standard for this technology has not been defined yet; the blockchain, in addition, is perceived as a risk factor because it is disruptive to past business and operating models. To these reasons one must add the fact that there is an absence of concrete use cases that would clarify what the effective advantages to business blockchain technology represents. Furthermore, there is the theme of governance, in particular, in the public use of blockchain: it is fundamental to know to whom the shared data belongs and whose responsibility it is when the technology is used incorrectly.

Therefore, a technical standard for blockchain would permit the clarity that is lacking. There has been a call to find an unambiguous definition of the nature of blockchain as well as to set measures which guarantee proper governance and safety. The first to respond to this call was Standards Australia, which at the beginning of 2016 requested the creation of a technical commission to define a standard. In Beijing on 10 September 2016 the standard ISO TC 307 was created.¹¹⁰ There was also a meeting that saw the participation of 17 countries and 2 external organisations: the European Community and SWIFT. In April of this year the first full meeting was held in Sydney and the first teams were created to work on establishing such standards.

What we are trying to understand is who should decide what goes into the protocols, as a regulatory device, of this technology. Can we link a regulation to the technology itself? Who has the power to do so? Should it be put in the hands of a public agency or should the creator’s freedom of choice drive it? Furthermore, should you apply a prior regulation which will limit that freedom?

IV CHAPTER - ANALYSIS

SUMMARY: 4.1. WHAT: IS IT THE DLT TECHNOLOGY OR THE APPLICATION WHICH MUST BE REGULATED?
4.2. WHO AND HOW: DO WE NEED A SPECIFIC NATIONAL OR INTERNATIONAL ORGANISATION OR WHO SHOULD HAVE THE POWER TO DO SO?

‘Governments that wish to repress the voices of citizens everywhere and have captured technologies like the Internet to silence dissidents and block outside media will find blockchain technology significantly more challenging’¹¹¹

4.1. WHAT: IS IT THE DLT TECHNOLOGY OR THE APPLICATION WHICH MUST BE REGULATED? AND WHEN: BEFORE OR AFTER CREATION?

In the idea of Blockchain 1.0, where the only application imaginable was virtual currencies, regulations affected only the currencies themselves. States, banks and regulation makers focused their work on how a decentralised ‘money’ would affect the economy. However, there are differences between money and value, and the evolution of blockchain did not centre only on virtual currencies. As we saw previously, the eras of Blockchain 2.0 and Blockchain 3.0 are near.

¹⁰⁷ Peters (n 84) 37.

¹⁰⁸ See www.gov.uk/government/consultations/digital-currencies-call-for-information/digital-currencies-call-for-information.

¹⁰⁹ IBM Survey, ‘Blockchain Adoption Moving Rapidly in Banking and Financial Markets: Some 65 Percent of Surveyed Banks Expect to be in Production in Three Years’ (28 Sep 2016) www-03.ibm.com/press/us/en/pressrelease/50617.wss accessed 12 May 2017.

¹¹⁰ ISO/TC 307, ‘Blockchain and distributed ledger technologies’ www.iso.org/committee/6266604.html.

¹¹¹ Tapscott and Tapscott (n 15) 245.

Indeed, the revolution has already started. We are talking about money in all its forms: savings, pensions, companies, rights, people's livelihoods, stock portfolios and the economy, and this will touch everyone.¹¹²

Since we are on the verge of a revolution, it seems strange there is not a broad set of regulations or guidelines under development to manage the effects. As Don Tapscott and Alex Tapscott say in their book, *Blockchain Revolution*, 'Can and should governments show restraint in the face of the seismic shifts to come?'¹¹³ Furthermore, should the DLT technology or the applications be subject to regulation?

Governments will be key in this process. In fact, unlike its role in the past, governments will lose their historical role in monetary policy, financial regulation and in being the 'third party' in almost all the important value transactions.¹¹⁴

Therefore, if we need a way to regulate the blockchain technology, where should we begin? Governments, start-ups and incumbents believe we need regulation, but the path seems more unclear than what some people claim.¹¹⁵ For example, Russia's government is moving ahead and they want to introduce rules for blockchain. According to the news service TASS, 'the adoption of legal acts' related to blockchain is near, positing 2019 as the timeframe for the update.¹¹⁶ Furthermore, Dmitrij Medvedev,¹¹⁷ during an investor event in Sochi in late February, said, 'I'm not against the use of [blockchain] technologies that have become widely circulated and which may thus decisively change our lives.'¹¹⁸

In certain circles, the concept of blockchain technology is well accepted. However, regulating the technology will put a brake on people's freedom to create and write their own code, therefore limiting what it may offer.

The European Parliament was the first to analyse whether it is the DLT technology or the application which must be regulated. During an event which took place on 11 May 2017 the MEPs focused on the future of blockchain regulation in the 28-nation economic block. When asked 'When and how should governments intervene?' MEP Jakob von Weizsäcker said, 'It's probably too early to intervene at this stage, because we as legislators don't yet see sufficiently clearly to know what the main issues are going to be – so in order not to stifle innovation, we don't want it to be now.'¹¹⁹

Nevertheless, the idea was to adapt existing regulation to new technology rather than creating a specifically new one. In a famous widespread keynote speech the technologist, Vinay Gupta, chosen by the EU to 'outline a framework to understand the difficulties in regulating software,' said that this wasn't possible. 'Software is regulated for what it does,'¹²⁰ he said in an interview with CoinDesk, and MEP Eva Kaili echoed this thought, 'We can't legislate the technology, but we can legislate the uses.'¹²¹

Thus, there are two important issues which must be analysed. The first of these is deciding what exactly needs regulating. The underlying code or the uses? The problem lies in the fact that we don't know, a priori, what the potential uses of this technology may be. The hundreds of pilots and proofs-of-concept currently in motion are just a little piece of what the endless possibilities of this technology are.¹²² Second, 'the unusual schism (for a technology) of private vs public networks requires two different approaches. While it's possible to draft laws regarding the development of private blockchains, regulating public networks according to their uses is obviously a non-starter given the international, free-access nature of the distribution.'¹²³

Finally, it seems the EU is following a new strategy and is giving lawmakers greater freedom in deciding the future of new technology, and especially blockchain technology. Emerging technologies will soon benefit from endorsement.¹²⁴

¹¹² *ibid* 296.

¹¹³ *ibid*.

¹¹⁴ Please see chapter 1.1: Blockchain: A Distributed Ledger Technology.

¹¹⁵ Noelle Acheson, 'Blockchain Regulation: Is Europe Getting It Right?' (CoinDesk Weekly Journal, 15 May 2017) www.coindesk.com/blockchain-regulation-europe-getting-right accessed 18 June 2017.

¹¹⁶ TASS is available here: <http://tass.ru/ekonomika/4234819>.

¹¹⁷ Dmitrij Medvedev is a Russian politician, currently the Prime Minister of Russia.

¹¹⁸ Stan Higgins, 'Blockchain regulation likely by 2019, Russian Ministry says' (CoinDesk Weekly Journal, 8 May 2017) www.coindesk.com/blockchain-regulations-likely-2019-russian-ministry-says accessed 19 July 2017.

¹¹⁹ Noelle Acheson, 'Regulating Ethereum? EU Parliament Weighs Blockchain's Big Issues' (CoinDesk Weekly Journal, 15 May 2017) www.coindesk.com/regulating-ethereum-eu-parliament-weighs-blockchains-big-issues accessed 12 June 2017.

¹²⁰ Jeremy Nation, 'Vinay Gupta Speaks To European Parliament About Blockchain Technology' (ETH News, 11 May 2017) www.ethnews.com/vinay-gupta-speaks-to-european-parliament-about-blockchain-technology accessed 12 July 2017.

¹²¹ Acheson, *Regulating Ethereum?* (n 120).

¹²² Nolan Bauerle, 'How Could Blockchain Technology Change Finance?' (CoinDesk Weekly Journal) www.coindesk.com/information/how-blockchain-technology-change-finance accessed 28 May 2017.

¹²³ Acheson, *Regulating Ethereum?* (n 120).

¹²⁴ Joseph Young, 'UK Government grants permission to issue blockchain-based currency' (Cointelegraph, 12 February 2017) <https://cointelegraph.com/news/uk-government-grants-permission-to-issue-blockchain-based-currency> accessed 16 May 2017.

The plan is composed of two important steps: the first one will explore use cases to test impact and laws, and the second one will give more self-confidence to new businesses to ensure that their work will be accepted by the market and governments.¹²⁵ ‘This approach could not only encourage an ecosystem of thinkers and doers. It could also end up making Europe a prime destination for blockchain development, as businesses choose the continent for their domicile and as talent flocks to the area.’¹²⁶ The process of acceptance and recognition of this technology is slow, but it is already beginning to move towards a process of openness and security. As MEP Eva Kaili said during the event in the European Parliament, ‘Maybe this way we can regain some trust.’¹²⁷

Therefore, it seems clear that regulating the application of blockchain technology is the easiest way. However, the implications and the immediate results that this might have, may be dangerous for the web, the market and state security. It would be possible to create guidelines or supervision over this process, but these regulations or standards can only be indicative. If the control over these technologies were to be too strict, the risk would be to remove the freedom of the author to create their own code, and thus limit the future potential of the technology.

Another problem would be creating regulations or standards on future applications without knowing if those applications would be legal or illegal. This begs the question: who would have the power to decide whether an application is legal or illegal? The implications are greater than we thought. Blockchain has the potential to destabilize the state monopoly over the citizens and increase our freedom through the web. Using this technology is like taking a step towards independence. The web, with its global character, would enable us to become master of ‘neutral’ data commands through our own input (coding).

However, the risk to lose control remains, and so, is it just sensible to have some governance before the ‘bad’ blockchain is created?

Furthermore, another issue which must be evaluated is if the regulations must focus on the technology first, thus before the creation of any application, or only on the applications themselves. Let us start by saying, ‘In the context of the decentralised ledger technology ecosystem, determining which incentives to present and when to present them is further complicated by “law lag”, a term often used in law and technology literature to refer to the circumstances’¹²⁸ in which ‘existing legal provisions are inadequate to deal with a social, cultural or commercial context created by rapid advances in information and communication technology.’¹²⁹

Furthermore, history has taught us that regulating prematurely, which means before grasping the implications, can have deep consequences. The Locomotive Acts (or Red Flag Acts), which were introduced during the latter part of the 19th century, are a prime example of this. The most draconic restrictions were that all road locomotives, which included automobiles, had to travel at a maximum of 4 mph in the country and 2 mph (3.2 km/h) in the city. They also required a man waving a red flag to alert bystanders and horses of the coming arrival of these strange road vehicles pulling multiple wagons. The idea of regulation was prevention, but the result was obviously counterproductive and worse than expected.¹³⁰

The same conclusion was reached by Steve Beaugard, CEO of GoCoin¹³¹ who said, ‘When Web pages were first going up, regulators were trying to determine what regulatory regime they should fall under. One idea surfaced requiring people who built and hosted Web sites to get a citizen’s band radio license because it was seen as broadcasting. Can you imagine having to have a CB radio license so you could put a Web site up?’¹³² Fortunately, as Don Tapscott and Alex Tapscott pointed out, that’s never come to pass.

The opportunity here lies in not trying to regulate too much too soon, but rather in involving both governments and the users and developers of the technology in dialogue, as stated by the authors of *Blockchain Revolution*.¹³³ In fact, they

¹²⁵ Laura Shin, ‘Blockchain Summit Examines The Role Of Privilege In Spreading A Democratizing Technology’ (Forbes, 4 August 2017) www.forbes.com/sites/laurashin/2017/08/04/blockchain-summit-examines-the-role-of-privilege-in-spreading-a-democratizing-technology accessed 9 August 2017.

¹²⁶ *ibid.*

¹²⁷ Amelia Tomasicchio, ‘Bitcoin regulation in Europe: “it’s too early”’ (Holy Transaction’s Blog, 12 May 2017) www.holytransaction.com/blog/2017/05/bitcoin-regulation-europe-early.html accessed 3 August 2017.

¹²⁸ Carla L. Reyes, ‘Moving Beyond Bitcoin to an Endogenous Theory of Decentralized Ledger Technology Regulation: An Initial Proposal’ (2016) 61 Villanova Law Review 191.

¹²⁹ Jeremy Pitt and Ada Diaconescu, ‘The Algorithmic Governance of Common-Pool Resources’ in John H. Clippinger and David Bollier (eds) *From Bitcoin to Burning Man and Beyond: The Quest for Identity and Autonomy in a Digital Society* (Off the Commons Books 2014).

¹³⁰ Locomotives Act 1865 (UK)

¹³¹ ‘GoCoin is a boutique Bitcoin payment processor. We provide all the tools, [integrations](#), and customer support for merchants to accept Bitcoin and other digital currencies online. We let customers pay with the currencies they want to use, and pay out our merchants in the currencies they use to pay their bills.’ <https://www.gocoin.com/about>.

¹³² Don Tapscott and Alex Tapscott, Interview with Steve Beaugard (April 30, 2015).

¹³³ Tapscott and Tapscott (n 15) 298.

declared, ‘We believe effective regulation and, by extension, effective governance come from a multistakeholder approach where transparency and public participation are valued more highly and weigh more heavily in decision making. For the first time in human history, nonstate, multistakeholder networks are forming to solve global problems.’¹³⁴

4.2. WHO AND HOW: DO WE NEED A SPECIFIC NATIONAL OR INTERNATIONAL ORGANISATION OR WHO SHOULD HAVE THE POWER TO DO SO?

The evolution of the web as it is today can be divided into three phases: Web 1.0, composed of the classic HTML technologies, in which the users acted essentially as consumers with a very restricted group serving as creators; successively Web 2.0 where the approach to the world of the network became more participatory. Through mass social networks, blogs and forums the lines of cooperation and interaction became wider, and the participants assumed a less passive and more active role. The vulnerability of this new system consisted in, and consists in, the credibility of the sources. In principle so-called ‘fake news’ is difficult to control because it is relatively easy to manipulate information and links, and therefore establish the credibility of the information based on the name or site publishing it. Web 3.0 cannot be defined precisely at the moment because it is still in evolution and we do not know how far it will go. In general it is rooted in the idea of ‘connective intelligence,’ or rather in the new ability of web software to connect data, ideas and people.¹³⁵

It is in this new idea of Web 3.0 that we find the application of blockchain technology. Here the internet is nowadays considered the ‘internet of value’¹³⁶ and the risk is higher than in Web 1.0 and 2.0. However, the internet and the web have become a global resource in such a short time, and this evolution occurred under strong leadership and governance in spite of the powerful forces against it. Thus, who governed the first-generation of internet and how? And who and what will the next one be like?

According to Marc Pilkington the first-generation internet was governed by ‘a vast ecosystem of companies, civil society organisations, software developers, academics, and governments, namely the U.S. government, in an open, distributed, and collaborative manner that we cannot measure by traditional command-and-control hierarchies and frameworks. No governments or group of governments control the Internet or its standards, though several U.S. government agencies once funded it.’¹³⁷

Nonetheless, nowadays with the arrival of Web 3.0 and blockchain, governments have thus far shown both restraint and foresight as well as interest. They have demonstrated restraint by limiting regulation and control thereby allowing the internet to evolve independently and foresight by allowing the ecosystem to flourish before trying to impose rules and regulations. However, ‘this multistakeholder network worked for the Internet, but we need to recognise that there will be a greater role for regulation of blockchain technologies. Whereas the Internet democratised information, the blockchain democratises value and cuts to the core of traditional industries like banking. Clearly there will be a regulatory role to ensure that consumers and citizens are protected. Yet, our research suggests that the Internet governance model is a good template.’¹³⁸

Moreover, another problem is understanding which jurisdictional laws to apply since the domiciles of the blockchain creators, generally, are not known. However, ‘the main public blockchains have been rigorously tested by the market, and have – to date, at least – proven to be resilient. So, focus can shift to the applications built on top of public blockchains. Even here reach will be limited, as apps can be launched from anywhere, by anyone, in some cases with indeterminate jurisdiction. In this case, regulators have no choice but to let the market decide.’¹³⁹

Thus, what will the national or international organisation working on this new regulation be? Will it be a ‘new’ regulation or a reapplication of another current regulatory framework? And how can it be built?

In essence, at this point we have a wall in front of us: how to face the problem of the inadequacy of applying any regulatory approach to the decentralized technology industry. In the article ‘The Algorithmic Governance of Common-

¹³⁴ *ibid.*

¹³⁵ Glenn Remoreras, ‘Forecast 2020: Web 3.0+ and Collective Intelligence’ (Glenn Remoreras Blog, 28 July 2010) www.glennremoreras.com/2010/07/28/forecast2020 accessed 8 June 2017.

¹³⁶ Marc Pilkington, ‘Blockchain Technology: Principles and Applications’ in F. Xavier Olleros and Majlinda Zhegu (eds) *Research Handbook on Digital Transformations* (Edward Elgar 2016) <https://ssrn.com/abstract=2662660>.

¹³⁷ Don Tapscott and Lynne St. Amour, ‘The Remarkable Internet Governance Network – Part I’ (Global Solution Networks, U of Toronto 2014).

¹³⁸ Tapscott and Tapscott (n 15) 299.

¹³⁹ Acheson, *Regulating Ethereum?* (n 120).

Pool Resources,' written by Jeremy Pitt and Ada Diaconescu, the authors analysed the problem and offered three different proposals:

1. Apply existing law to Alt-coin¹⁴⁰ and other decentralised virtual currencies by considering them as a normal asset or property category.
2. Use federal financial services law to all decentralised virtual currencies in order to address the money laundering risk, but leave the remaining policy issues to the states.
3. Leave the DLT to a self-regulation organisation.¹⁴¹

Furthermore, the authors also said that 'notably, most of the proposals in each category focus on building a regulatory approach to Bitcoin and other decentralised virtual currencies, and do not address regulation of the underlying decentralised ledger technology. When the literature does turn its attention to the legal implications of decentralised ledger technology, it tends to skip the question of how to regulate the blockchain and moves straight to jurisprudential questions of how the blockchain might disrupt or alter known legal structures such as contract law,¹⁴² property law,¹⁴³ and judicial decision making^{144, 145}.

Let's now try to analyse these three ideas in order to find out which might be the most appropriate approach to further regulation. So, the first group recognises all applications springing from blockchain as assets or real property, the only difference being that they are used 'virtually.' As absurd as this may seem, this theory has a stable and valid principle underlying it. All the applications of blockchain technology are attributable to real goods, such as intangible property,¹⁴⁶ money,¹⁴⁷ securities,¹⁴⁸ uncertificated securities,¹⁴⁹ or some other presently recognised form of legal asset.¹⁵⁰ If we were to take this out of the virtual world and view these applications as the means to legal recognition, the path would seem all downhill, and the application of current financial and real property law, now mature, would seem perfectly attractive. This, however, is only in theory. These legal frameworks follow different patterns from those based on DLT technology. Various problems of compliance between alt-coin and normal currencies can arise, but one figure is still missing, the third party. As we have said, this figure plays an important role and characterizes our political and economic systems. By forcing this technology into opposing legislative environments which do not exactly mirror each other, even if they share the same common denominator, the principal risk is that only the application is regulated and the blockchain technology is not. Since the technology is multiform and lends itself to many applications, this would only create strain and difficulty in compliance, thus leading to effects in conflict with those desired.

The second proposal is 'that decentralised ledger technology service providers, and especially those offering a service related to decentralised virtual currency, should remain subject to existing "customer-identification program and AML compliance program requirements of Sections 326 and 352 of the USA PATRIOT Act, and with the economic sanctions regulations enforced by OFAC" and FinCEN regulations as appropriate, and that the remaining regulatory functions should be left to state governments.'¹⁵¹ We can therefore say that these transactions must be inserted as assets into categories of real goods, but we have to understand more broadly that they must enter into specific categories of 'consumer protection.' For this the most suitable regulations should be applied. To provide an example, Bitcoin is the cryptocurrency par excellence which most resembles every other currency on the market. Therefore, to be able to buy and use that currency, it must be subject to the various financial regulations present today in different states. The purpose of forcing such conformity stems from the need to limit the risk of consumers to the volatility of cryptocurrencies,¹⁵² on one hand, and the desire to limit the risk of money laundering and facilitating other illicit activities, on the other.¹⁵³ The situation here is similar to the one above, 'These proposals, like both the first group of proposals and current regulation, minimise compliance risk and illicit use at the expense of innovation and adaptability. Further, these proposals lack

¹⁴⁰ Altcoin are Alternate cryptocurrencies or Bitcoin alternatives.

¹⁴¹ Pitt (n 130).

¹⁴² Joshua Fairfield, 'Smart Contracts, Bitcoin Bots, and Consumer Protection' 71 (Wash & Lee L Rev Online 36 2014) <http://scholarlycommons.law.wlu.edu/wlulr-online/vol71/iss2/3/> accessed 9 July 2017.

¹⁴³ Joshua Fairfield, 'BitProperty' (2015) 88 S Cal L Rev 805.

¹⁴⁴ Michael Abramowicz, 'Cryptocurrency-Based Law' (2015) George Wash U, Research Paper 2015-9.

¹⁴⁵ Pitt (n 130).

¹⁴⁶ Rhys Bollen, 'The Legal Status of Online Currencies: Are Bitcoins the Future?' (2013) 24 J Bank & Fin L & Prac 272.

¹⁴⁷ Nicholas A. Plassaras, 'Regulating Digital Currencies: Bringing Bitcoin Within the Reach of the IMF' (2013) 14 CHI J INT L 377, 403.

¹⁴⁸ Ruoke Yang, 'When Is Bitcoin a Security Under U.S. Securities Law?' (2013) 18 J TECH L & Policy 99, 108.

¹⁴⁹ Jeanne L. Schroeder, 'Bitcoin and the Uniform Commercial Code' (2015) Benjamin N. Cardozo Sch. Law, Research Paper 458.

¹⁵⁰ George K. Fogg, 'Perkins Coie: The UCC and Bitcoins - Solution to Existing Fatal Flaw' (CoinDesk Weekly Journal, 29 Jan 2015) www.coindesk.com/perkins-coie-bitcoin-can-learn-real-estate-law accessed 9 July 2017.

¹⁵¹ Trautman (n 3).

¹⁵² David Groshoff, 'Kickstarter My Heart: Extraordinary Popular Delusions And The Madness Of Crowdfunding Constraints And Bitcoin Bubbles' (2014) 5 WM & MARY BUS L REV 489.

structured consideration of issues related to minimising malfunctions, data security, or systemic risks. Finally these approaches will likely not garner broad stakeholder support, especially among industry stakeholders. As a result this group of proposals generally only upholds two of the criteria to a high degree.¹⁵⁴

The third option, in the end, is the most interesting, but above all, is the most complex. The process of self-regulation, in fact, is based on the technology of blockchain itself. Since this technology is capable of being independent from ‘third parties,’ it can support itself independently. Obviously, to do so, there must be a “code itself acting as law to restrain activity; contractual obligations self-imposed through a service provider’s terms of service, privacy policy, and other consumer-directed documents; and private lawsuits to hold service providers ‘liable for all losses due to their negligence, recklessness, or disregard for users’ rights.’¹⁵⁵ As the process was similar to the birth of the *Lex Mercatoria*, it came to be called the *Lex Cryptographia*.¹⁵⁶ The authors of that theory, in fact, defined it as ‘a set of rules administered through self-executing smart contracts and decentralised (and potentially autonomous) organisations’¹⁵⁷ and they argue that ‘one of the key consequences of the blockchain could be a rapid expansion of what Lawrence Lessig referred to as “architecture” – the code, hardware, and structures that constrain how we behave – or at a minimum a redefinition of how laws and regulations are designed, implemented, and enforced.’¹⁵⁸

Like the *Lex Mercatoria* and the *Lex Informatica* which adapted itself to the social era in which it arose, the *Lex Cryptographia* will also be a child of its times. If its function will be characterised by the self-regulation of blockchain, it will be based on the needs required by the technology itself.

Furthermore, the *Lex Mercatoria* and the *Lex Informatica* are focused on rules and principles for the private sector whereas many of the fundamental dynamics surrounding the technology of decentralised ledgers imply public rights issues. As a result, can a system of self-regulation, including that of the *Lex Cryptographia*, be sufficient for the great reach of such a revolution?

CONCLUSION

It may seem a rash comparison but the book, *Empire of Cotton*,¹⁵⁹ by Sven Beckert, springs to mind. It is a seductive and disarming narrative about the global world from Marco Polo to Walmart. By following the imaginary thread of cotton production through time and examining the economic motives connected with it, it unravels the social political and economic history of the world. It includes vast developments, geographical transformations, economic upsets, the politics of colonial interest, the slave trade, and wars. By following the thread of the new digitalization, we can see that the precursors are in place for a revolution as transformative as that created by cotton. It is possible to glimpse a future where this new technology will be the base for mankind’s freedom from institutions, or at least, the passage from dependence on these institutions, bureaucratically slow and always present, to a binary system of automation.

The accent, however, remains the same: can the blockchain be private or must it be public, centralized, decentralized or distributed? And then if it is self-regulated and the software becomes intelligent, who is the user and who is the regulator in charge? And thus, we return to the question posed in the introduction, *quis custodiet ipsos custodiet?*

There is a remarkable and influential current of thought which retains that the monopoly of the blockchain structure must remain public and that only in this way will it express its characteristics in the best way. Siddharth Kalla CTO of Acipay finds convincing arguments to sustain that ‘Innovative technologies are often constructed out of open protocols’ and not only warns of a partial failure of the banks, but also of those organizations that gathered around blockchain and have sought to make it an exclusive private technology.¹⁶⁰

The possible attempts to regulate the uses of the decentralised ledger technology can only compromise potential results because they will not be suited to the ever-evolving technology itself. The alternative regulatory methods proposed, instead, are designed only to protect consumers from the shortcomings. They thus focus only on the payment applications of blockchain technology, such as Bitcoin. However, this work seeks to go beyond that and analyse in a

¹⁵³ Stephen T. Middlebrook and Sarah Jane Hughes, ‘Regulating Cryptocurrencies in the United States: Current Issues and Future Directions’ (2014) 40 Wm Mitchell L Rev 813.

¹⁵⁴ Pitt (n 130).

¹⁵⁵ Rhys Bollen, ‘The Legal Status of Online Currencies: Are Bitcoins the Future?’ (2013) 24 J Bank & Fin L & Prac 272.

¹⁵⁶ Wright (n 9).

¹⁵⁷ *ibid.*

¹⁵⁸ *ibid.*

¹⁵⁹ Sven Beckert, *Empire of Cotton* (Random House 2014).

¹⁶⁰ Siddharth Kalla, ‘The Case for Banks to Use Open Public Blockchains’ (American Banker, 9 March 2016) www.americanbanker.com/opinion/the-case-for-banks-to-use-open-public-blockchains accessed 5 August 2017.

more holistic way what the problem of limiting at the outset the effects and the results of the technology might be. Therefore, 'What regulatory approach to the decentralised ledger technology itself can keep pace with innovation while still addressing common market and governance failures?'¹⁶¹

Vitalik Buterin, the creator of Ethereum, a platform which strives to go beyond Bitcoin and create a flexible blockchain for the market, has a differing view. He retains that privately managed technology could be faster, less costly and better designed so that it would allow faster interventions in the case of needed repairs. It must be added, however, that he agrees that such a centralized management of the technology would restrict the freedom of access.¹⁶²

Aaron Wright and Primavera De Filippi believe that 'The rise of *Lex Cryptographia* presents a world where ideals of individual freedom and emancipation might come true. The blockchain could offer people access to alternative currencies, global markets, automated and trustless transactions systems, self-enforcing smart contracts, smart property and cryptographically activated assets, and innovative models of governance based on transparency and corruption-free voting. Combined, these elements could be used to promote individual freedoms and user autonomy.'¹⁶³

But the world is built on compromise and pure black and white don't exist. It would be opportune to start a debate about how to begin a legislative process which follows the themes that this technological innovation implies for the present and the future.

It is already late but it is imperative that states and judicial authorities understand the effects of this new digital revolution on our society and, in the name of human ethics, juridically forestall, wherever possible, the eventual crises of democracy and ethical freedom which will accompany progress toward a better world.

Therefore, if we really want to fight for the principles contained in the constitutions of our states, we have to face this revolution with open minds. Distributed ledger technology is the prime ingredient in harnessing the power of technology and the power of emerging independent systems in such a way as to promote economic growth, protect democratic institutions and ensure individual freedoms.

To conclude, it seems fundamental that an endogenous approach to regulation be followed. This will only have a clear and definite result if all the relevant stakeholders actively participate in the debate. As suggested by Reyes in her article,¹⁶⁴ 'Such endogenous regulation offers unique compliance incentives and stakeholder buy-in that should enable more efficient ex ante regulation while simultaneously reducing the need for expensive coercive enforcement action.' Thus, a fundamental reform in the approach of every regulation, but especially a reform of financial regulation, seems necessary and only if it is a 'technology-assisted regulation, or regulation-through-code, that bypasses the ex ante/ex post dichotomy and influences actions in real time.'¹⁶⁵ This is the only real way to catch and ride the wave of this revolution, or as Andreessen once stated, '*Software is eating the world.*'¹⁶⁶

BIBLIOGRAPHY

Abramowicz M, 'Cryptocurrency-Based Law' (2015) George Wash U, Research Paper 2015-9

Acheson N, 'Blockchain Regulation: Is Europe Getting It Right?' (CoinDesk Weekly Journal, 15 May 2017) www.coindesk.com/blockchain-regulation-europe-getting-right accessed 18 June 2017

Acheson N, 'Regulating Ethereum? EU Parliament Weighs Blockchain's Big Issues' (CoinDesk Weekly Journal, 15 May 2017) www.coindesk.com/regulating-ethereum-eu-parliament-weighs-blockchains-big-issues accessed 12 June 2017

Andreessen M, 'Why Software is Eating the World' *Wall Street Journal* (New York, 20 August 2011) <https://www.wsj.com/articles/SB10001424053111903480904576512250915629460>

Asimov I, *I, Robot* (Fawcett Publications 1950)

Ayres I and Braithwaite J, *Responsive Regulation: Transcending the Deregulation Debate* (OUP 1992)

Baldwin R, Cave M and Lodge M, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, OUP 2014)

Bank of Canada, 'Decentralized E-Money (Bitcoin)' (Backgrounders, April 2014) www.bankofcanada.ca/wp-content/uploads/2014/04/Decentralize-E-Money.pdf

¹⁶¹ Reyes (n 129).

¹⁶² Joseph Young, 'Interview: Vitalik Buterin on Scaling Ethereum, Its Popularity in Asia and ICOs' (Bitcoin Magazine, 8 June 2017) bitcoinmagazine.com/articles/interview-vitalik-buterin-ethereum-scaling-issues-popularity-asia-and-icos accessed 2 August 2017.

¹⁶³ Wright (n 9).

¹⁶⁴ Reyes (n 129)

¹⁶⁵ *ibid.*

¹⁶⁶ Marc Andreessen, 'Why Software is Eating the World' *Wall Street Journal* (New York, 20 August 2011) <https://www.wsj.com/articles/SB10001424053111903480904576512250915629460>.

Bank Secrecy Act, Pub L 91-508, 84 Stat 1114 (USA)

Bauerle N, 'How Could Blockchain Technology Change Finance?' (CoinDesk Weekly Journal) www.coindesk.com/information/how-blockchain-technology-change-finance accessed 28 May 2017

Beckert S, *Empire of Cotton* (Random House 2014)

Benkler Y, *The Wealth Of Networks* (Yale UP 2006)

Bollen R, 'The Legal Status of Online Currencies: Are Bitcoins the Future?' (2013) 24 J Bank & Fin L & Prac 272

Bonini T, 'Possono esistere delle (nuove) tecnologie conviviali?' (Doppiozero, 22 luglio 2017) www.doppiozero.com/materiali/possono-esistere-delle-nuove-tecnologie-conviviali accessed 23 June 2017

Booth P, 'Lessons from history show self-regulation to be the best kind of control,' *Telegraph* (London, 8 August 2010) www.telegraph.co.uk/finance/comment/7933318/Lessons-from-history-show-self-regulation-to-be-the-best-kind-of-control.html accessed 15 May 2017

Braithwaite AJ and Drahos P, *Global Business Regulation* (CUP 2000)

Brakeville S and Perepa B, *Blockchain Basics: Introduction to Distributed Ledgers* (IBM Developer Works, 9 May 2016) www.ibm.com/developerworks/cloud/library/cl-blockchain-basics-intro-bluemix-trs/index.html accessed 4 July 2017

Brown RG, 'A simple model for smart contracts' (Richard Gendal Brown, 10 February 2015) www.gendal.me/2015/02/10/a-simple-model-for-smart-contracts accessed 24 June 2017

Buitenhek M, 'Understanding and applying Blockchain technology in banking: Evolution or revolution?' (2016) 1 J of Digital Banking 111

Case C-264/14 Skatteverket v. David Hedqvist [2015] EU:C:2015:718

Coinflip Inc, 'Order Instituting Proceedings Pursuant to Sections 6(c) and 6(d) of the Commodity Exchange Act, Making Findings and Imposing Remedial Sanctions at 3' (CFTC Docket No. 15-29, 17 September 2015) www.cftc.gov/idc/groups/public/@lrenforcementactions/documents/legalpleading/enfcoinfliporder09172015.pdf accessed 2 June 2017

Craig P, *Administrative Law* (5th edn, Sweet &Maxwell 2003)

ECB, 'Virtual currency schemes – a further analysis, Eurosystem Report' (October 2012) www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemes201210en.pdf

ECB, 'Virtual currency schemes – a further analysis, Eurosystem Report' (February 2015) www.ecb.europa.eu/pub/pdf/other/virtualcurrencyschemesen.pdf

Fairfield J, 'BitProperty' (2015) 88 S Cal L Rev 805

Fairfield J, 'Smart Contracts, Bitcoin Bots, and Consumer Protection' 71 (Wash & Lee L Rev Online 36 2014) <http://scholarlycommons.law.wlu.edu/wlulr-online/vol71/iss2/3/> accessed 9 July 2017.

Fiore P, 'Così Draghi per liberare la BCE pensa alla blockchain' (Smart Money, 25 February 2016) www.smartmoney.startupitalia.eu/banche/52084-20160225-draghi-bce-blockchain accessed 8 May 2017

Fisse B and Braithwaite J, *Corporations, Crime and Accountability* (CUP 1993)

Fogg GK, 'Perkins Coie: The UCC and Bitcoins - Solution to Existing Fatal Flaw' (CoinDesk Weekly Journal, 29 Jan 2015) www.coindesk.com/perkins-coie-bitcoin-can-learn-real-estate-law accessed 9 July 2017.

Foreman-Peck J and Millaward R, *Public and Private Ownership of British Industry 1820–1990* (OUP 1994)

Francis JG, *The Politics of Regulation: A Comparative Perspective* (Blackwell 1993)

Griffin A, 'Stephen Hawking: Artificial Intelligence Could Wipe Out Humanity When It Gets Too Clear As Humans Will Be Like Ants' *Independent* (London, 8 October 2015) www.independent.co.uk/life-style/gadgets-and-tech/news/stephen-hawking-artificial-intelligence-could-wipe-out-humanity-when-it-gets-too-clever-as-humans-a6686496.html accessed 14 June 2017

Groshoff D, 'Kickstarter My Heart: Extraordinary Popular Delusions And The Madness Of Crowdfunding Constraints And Bitcoin Bubbles' (2014) 5 WM & MARY BUS L REV 489

Higgins S, 'Blockchain regulation likely by 2019, Russian Ministry says' (CoinDesk Weekly Journal, 8 May 2017) www.coindesk.com/blockchain-regulations-likely-2019-russian-ministry-says accessed 19 July 2017

Horwitz R, *The Irony of Regulatory Reform: The Deregulation of the American Telecommunications Industry* (OUP 1989)

IBM Survey, 'Blockchain Adoption Moving Rapidly in Banking and Financial Markets: Some 65 Percent of Surveyed Banks Expect to be in Production in Three Years' (28 Sep 2016) www-03.ibm.com/press/us/en/pressrelease/50617.wss accessed 12 may 2017

Illich I, *Tools for Conviviality* (Harper and Row 1973)

ISO/TC 307, 'Blockchain and distributed ledger technologies' www.iso.org/committee/6266604.html

Kalla S, 'The Case for Banks to Use Open Public Blockchains' (American Banker, 9 March 2016) www.americanbanker.com/opinion/the-case-for-banks-to-use-open-public-blockchains accessed 5 August 2017

Kaye B, 'Australian inquiry says digital currencies are real money' (Reuters, 5 August 2015) www.reuters.com/article/us-australia-bitcoin-idUSKCN0QA0TS20150805 accessed 23 May 2017

Kelly J, 'Microsoft launches cloud-based blockchain platform with Brooklyn start-up' (Reuters, 10 November 2015) www.reuters.com/article/us-microsoft-tech-blockchain-idUSKCN0SZ2ER20151110

Kiviat TI, 'Beyond Bitcoin: Issues In Regulating Blockchain Transactions' (2015) 65 Duke LJ 569

Kyodo, 'Bitcoins lost in Mt. Gox debacle "not subject to ownership" claims: Tokyo court' *The Japan Times* (Tokyo, 6 August 2015) www.japantimes.co.jp/news/2015/08/06/national/crime-legal/bitcoins-lost-in-mt-gox-debacle-not-subject-to-ownership-claims-tokyo-court-rules accessed 23 May 2017

Levine AB and Antonopoulos AM, 'Let's talk Bitcoin! #149 Price and popularity' (podcast, Let's Talk Bitcoin, 30 September 2014) <http://letstalkbitcoin.com/blog/post/lets-talk-bit-coin-149-price-and-popularity>

Levine D and Forrence R, 'Regulatory Capture, Public Interest and the Public Agenda: Towards Synthesis' (1990) 6 *Journal of Law, Economics, and Organization* 167

MacDonagh O, 'The Nineteenth-Century Revolution in Government: A Reappraisal' (1958) *Historical Journal* 52

Marvin R, 'Blockchain in 2017: The Year of Smart Contracts' (PCmag, 12 December 2016) www.pcmag.com/article/350088/blockchain-in-2017-the-year-of-smart-contracts accessed 4 July 2017

McDonald RL, *Derivatives Markets* (2nd edn, Northwestern UP 2006)

Middlebrook ST and Hughes SJ, 'Regulating Cryptocurrencies in the United States: Current Issues and Future Directions' (2014) 40 *Wm Mitchell L Rev* 813

Morgan B and Yeung MK, *An Introduction to Law and Regulation: Text and Materials* (CUP 2007)

Murck P, 'Who Controls the Blockchain?' (Harvard Business Review, 19 April 2017) www.hbr.org/2017/04/who-controls-the-blockchain accessed 5 July 2017

Nation J, 'Vinay Gupta Speaks To European Parliament About Blockchain Technology' (ETH News, 11 May 2017) www.ethnews.com/vinay-gupta-speaks-to-european-parliament-about-blockchain-technology accessed 12 July 2017

New York State Department Of Financial Services (NYDFS), Title 23, Department Of Financial Services - Chapter I. Regulations Of The Superintendent Of Financial Services Part 200. Virtual Currencies. (2015) www.dfs.ny.gov/legal/regulations/adoptions/dfsp200t.pdf

Nguyen QK, 'Blockchain - A Financial Technology for Future Sustainable Development' (3rd International Conference on Green Technology and Sustainable Development (GTSD), Kaohsiung, November 2016)

Ogus AI, 'Regulation: Legal Form and Economic Theory' (1996) 59 *The Modern Law Review*

Ogus AI, 'Regulation: Regulatory Law: Some Lessons from the Past' (1992) 12 *Legal Studies* 1

Oliver Wyman Survey, 'The Fintech 2.0 Paper: rebooting financial services' www.oliverwyman.com/content/dam/oliver-wyman/global/en/2015/jun/The_Fintech_2_0_Paper_Final_PV.pdf accessed 2 July 2017

Peters G, Panayi E, and Chapelle A, 'Trends in crypto-currencies and blockchain technologies: A monetary theory and regulation perspective' (2015) 3 *Journal of Financial Perspectives* (EY Global Financial Services Institute Winter)

Pilkington M, 'Blockchain Technology: Principles and Applications' in F. Xavier Olleros and Majlinda Zhegu (eds) *Research Handbook on Digital Transformations* (Edward Elgar 2016) <https://ssrn.com/abstract=2662660>

Pitt J and Diaconescu A, 'The Algorithmic Governance of Common-Pool Resources' in John H. Clippinger and David Bollier (eds) *From Bitcoin to Burning Man and Beyond: The Quest for Identity and Autonomy in a Digital Society* (Off the Commons Books 2014)

Plassaras NA, 'Regulating Digital Currencies: Bringing Bitcoin Within the Reach of the IMF' (2013) 14 *CHI J INT L* 377

Prosser T, 'Regulation and Social Solidarity' (2006) 33 *Journal of Law and Society* 364

Rees T, 'Regulating Bitcoin: how new frameworks could be a catalyst for cryptocurrencies' *Telegraph* (London, 16 April 2017) www.telegraph.co.uk/business/2017/04/16/regulating-bitcoin-new-frameworks-could-catalyst-cryptocurrencies accessed 6 May 2017

Remoreras G, 'Forecast 2020: Web 3.0+ and Collective Intelligence' (Glenn Remoreras Blog, 28 July 2010) www.glennremoreras.com/2010/07/28/forecast2020 accessed 8 June 2017

Reyes CL, 'Moving Beyond Bitcoin to an Endogenous Theory of Decentralized Ledger Technology Regulation: An Initial Proposal' (2016) 61 *Villanova Law Review* 191

Rigsby J, 'Virtual Currency, Blockchain Technology, and EU Law: The "Next Internet" in AML/CFT Regulation's Shadow (Master's thesis, Lund University Spring 2016)

Roxbee Cox JW, 'The Appeal to the Public Interest' (1973) 3 *British Journal of Political Science* 229

Schroeder JL, 'Bitcoin and the Uniform Commercial Code' (2015) *Benjamin N. Cardozo Sch. Law, Research Paper* 458

Shearing C, 'A Constitutive Conception of Regulation' in P. Grabosky and J. Braithwaite (eds) *Business Regulation and Australia's Future* (Australian Institute of Criminology 1993)

Shin L, 'Blockchain Summit Examines The Role Of Privilege In Spreading A Democratizing Technology' (Forbes, 4 August 2017) www.forbes.com/sites/laurashin/2017/08/04/blockchain-summit-examines-the-role-of-privilege-in-spreading-a-democratizing-technology accessed 9 August 2017

Skinner C, 'The five major use cases for financial blockchains' (Brave NewCoin, 11 March 2016) www.bravenewcoin.com/news/the-five-major-use-cases-for-financial-blockchains accessed 1 August 2017

Snider L, *Corporate Crime: Contemporary Debates* (U Toronto Press 1993)

Sulleyman A, 'Elon Musk: Humans Must Become Cyborgs To Avoid AI Domination' *Independent* (London, 15 February 2017) www.independent.co.uk/life-style/gadgets-and-tech/news/elon-musk-humans-cyborgs-ai-domination-robots-artificial-intelligence-ex-machina-a7581036.html accessed 29 May 2017

Sulleyman A, 'Without a "World Government" Technology Will Destroy Us, Says Stephen Hawking' *Independent* (London, 8 March 2017) www.independent.co.uk/life-style/gadgets-and-tech/news/stephen-hawking-world-government-stop-technology-destroy-humankind-th-a7618021.html accessed 23 June 2017

Swan M, *Blockchain, Blueprint for a New Economy* (1st edn, O'Reilly 2015)

Swanson T, 'Blockchain 2.0. Let a Thousand Chains Blossom' (Let's talk Bitcoin, 8 April 2014) www.letstalkbitcoin.com/blockchain-2-0-let-a-thousand-chains-blossom

Swanson T, *Great Chain of Numbers: A Guide To Smart Contracts, Smart Property And Trustless Asset Management* (self-published 2014) <https://s3-us-west-2.amazonaws.com/chainbook/Great+Chain+of+Numbers+A+Guide+to+Smart+Contracts,+Smart+Property+and+Trustless+Asset+Management+-+Tim+Swanson.pdf> accessed 26 May 2017

Szabo N, 'Formalizing and Securing Relationships on Public Networks' (First Monday, 1 September 1997) www.firstmonday.org/ojs/index.php/fm/article/view/548 accessed 6 August 2017

Tapscott D and St Amour L, 'The Remarkable Internet Governance Network – Part I' (Global Solution Networks, U of Toronto 2014)

Tapscott D and Tapscott A, *Blockchain Revolution* (1st edn, Portfolio Penguin 2016)

Tomasicchio A, 'Bitcoin regulation in Europe: "it's too early"' (Holy Transaction's Blog, 12 May 2017) www.holytransaction.com/blog/2017/05/bitcoin-regulation-europe-early.html accessed 3 August 2017

Tombs S, 'Understanding Regulation' (2002) 11 Soc & Legal Stud 113

Trautman L, 'Virtual Currencies; Bitcoin & What Now After Liberty Reserve, Silk Road, And Mt. Gox?' (2014) 20 Rich JL & Tech 13

Underwood S, 'Blockchain Beyond Bitcoin' (2016) 59 Communications of the ACM 15

US Department of the Treasury, Financial Crimes Enforcement Network, Guidance on Application Of Fincen's Regulations To Persons Administering, Exchanging or Using Virtual Currencies Fin-2013-G001 (2013) <http://Perma.Cc/5xaf-Pafc>

Von Haller Gronbaek M, 'Blockchain 2.0, smart contracts and challenges' (Bird&Bird Article, 16 June 2016) www.twobirds.com/en/news/articles/2016/uk/blockchain-2-0--smart-contracts-and-challenges accessed 20 June 2017

Walker J, 'Researchers shut down AI that invented its own language' (Digital Journal, 21 July 2017) www.digitaljournal.com/tech-and-science/technology/a-step-closer-to-skynet-ai-invents-a-language-humans-can-t-read/article/498142 accessed 24 July 2017

Watkins B, 'What is the Purpose of Financial Regulation?' (California Lutheran University, CERF Blog, 27 April 2010)

Whipple T and Moody O, Interview to Stephen Hawking on humanity (and Jeremy Corbyn) *Times* (London, 7 March 2017) www.thetimes.co.uk/edition/news/hawking-on-humanity-and-corbyn-jk88zx0w2 accessed 3 May 2017

Wikipedia, Blockchain: <https://en.wikipedia.org/wiki/Blockchain>

Winner L, *The Whale And The Reactor: A Search For Limits In An Age Of High Technology* (U Chicago Press 1986)

Wright A and De Filippi P, 'Decentralized Blockchain Technology and the Rise of Lex Cryptographia' (10 March 2015) <https://ssrn.com/abstract=2580664> accessed 6 August 2017

Yang R, 'When Is Bitcoin a Security Under U.S. Securities Law?' (2013) 18 J TECH L & Policy 99

Young J, 'Interview: Vitalik Buterin on Scaling Ethereum, Its Popularity in Asia and ICOs' (Bitcoin Magazine, 8 June 2017) bitcoinmagazine.com/articles/interview-vitalik-buterin-ethereum-scaling-issues-popularity-asia-and-icos accessed 2 August 2017

Young J, 'UK Government grants permission to issue blockchain-based currency' (Cointelegraph, 12 February 2017) <https://cointelegraph.com/news/uk-government-grants-permission-to-issue-blockchain-based-currency> accessed 16 May 2017

Younkins EW, *Capitalism and Commerce, Conceptual Foundations of Free Enterprise* (Lexington Books 2002)