DOCTRINAL CHALLENGES FOR THE LEGALITY OF SMART CONTRACTS: LEX CRYPTOGRAPHIA OR A NEW, 'SMART' WAY TO CONTRACT?

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Abstract

Theorized two decades ago, smart contracts had little hope for organizing our private relationships. With the evolution of blockchain, smart contracts emerged as a new way to form digital agreements in the private and possibly in the public law sphere. These 'coded' agreements, automate contractual terms disrupting traditional contract law; thus posing new legal challenges.

Some postulate that this technology will displace law by replacing court enforcement with enforcement by code and this displacement would be marked by the emergence of a new, independent from law, set of rules – *Lex Cryptographia*. Others argue that given current technological capabilities, smart contract legality would only be possible by extension of existing legal doctrines.

This paper addresses the divergent view on this topic and argues that private law can, and is better positioned to be updated for encompassing the new factual patterns offered by this technology. Thus, the first purpose of this paper is to provide a preliminary diligence for evaluating the major doctrinal concerns related to smart contract legality. The second purpose: reconciling these concerns by proposing ways to integrate smart contracts into existing private law concepts.

I. Introduction

Compared to the internet, blockchain is at its early stages but the contemporary relevance of blockchain technology[1] is gaining more and more space in the public discourse. Some argue that blockchain is a "paradigm shifter"[2], a next internet age – an "internet of value"[3] – that will change society. Without doubt, while in 2009, blockchain's acclaim emerged mysteriously when the anonymous, Nakamoto, published his seminal paper outlining bitcoin – a virtual currency, [4] nowadays, fast forward ten years, and this currency's $200 billion[5] valuation justifies the broad public resonance it now receives. For all its worth, bitcoin proves the capacity of blockchain but many other – arguably more significant – applications are constrained by the uncertainty created due to a lack of regulatory guidance. Smart contracts are one of such disruptive but hindered applications.

Szabo, the 'theorist' of smart contracts, defined this technology as: "a set of promises, specified in digital form, including protocols within which the parties perform on the other

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[1] *See* Aaron Wright & Primavera De Filippi, *Decentralized Blockchain Technology and the Rise of Lex Cryptographia*, SSRN 1, 2 (Mar. 12, 2015) (introducing the main themes of Blockchain and how they are a growing technology in the field of encrypted databases and repository of information). Blockchain can be described as: "[a] distributed, shared, encrypted database that serves as an irreversible and incorruptible public repository of information. It enables, for the first time, unrelated people to reach consensus on the occurrence of a particular transaction without the need for a controlling authority." *Id.*

[2] *See* Alexander Savelyev, Contract Law 2.0: Smart Contracts as the Beginning of the End of Classic Contract Law 9 (2016) (unpublished manuscript) (on file with National Research University Higher School of Economics) (commenting on how Blockchain is an innovative technology which will change the way contracts are drafted).

[3] *See* YOCHAI BENKLER, THE WEALTH OF NETWORKS: HOW SOCIAL PRODUCTION TRANSFORMS MARKETS AND FREEDOM (2006); Toward an Internet of Value: An Interview with Chris Larsen, CEO of Ripple Labs, 8 MCKINSEY ON PAYMENTS 22, 22 (2015) (describing how Blockchain technologies akin to Ripple are paving the way to becoming a recognized leader in distributed payments technology).

[4] *See* Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System*, BITCOIN 1, 1 (2008) (introducing a new electronic payment system which would replace the uncertainties of unencrypted transactions).

[5] *See* THE STATISTICS PORTAL, MARKET CAPITALIZATION OF BITCOIN FROM 1ST QUARTER 2012 TO 4TH QUARTER 2018 (IN BILLION U.S. DOLLARS) (Jan. 24, 2019), *archived at* https://perma.cc/X4T7-DN6V (highlighting the valuation of bitcoin at approximately $237.62 billion).

promises". [6] To date, scholars have no consensus on the 'right' definition of smart contracts.[7] What remains uncontested throughout the scholarly discourse reviewed by this work: this new way of organizing private relationships, closely resembles and conflicts with traditional contracts.[8] Recent blockchain innovations bring this technology within the reach of possibility.[9]

Smart contracts already have the potential for binding digital agreements in code and automating performance by leveraging blockchain technology[10]. Today, companies like Monax[11] are creating smart contract templates to democratize this technology for the greater public. Slock.it[12] and Etherparty[13] are automating micro payments for the sharing economy. Overall, there are more than 15 types of transactions which smart contracts can improve – across industries.[14]

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[6] *See* Nick Szabo, *Formalizing and Securing Relationships on Public Networks*, THE J. OF TRANSHUMANIST THOUGHT (Sept. 1, 1997), *archived at* https://perma.cc/2Z82-939E [hereinafter *Relationships on Public Networks*] (discussing how protocols are a combination of messages and algorithms that are used to create new contracts); *see also* Nick Szabo, *Smart Contracts: Building Blocks for Digital Markets*, EXTROPY 3 (1996) [hereinafter *Smart Contracts*] (describing how smart contracts do not use artificial intelligence but they are a set of promises in digital form that include protocols).

[7] *See* Susan George, *Smart Contracts: Tools for Transactional Lawyers*, 81 TEX. B. J. 403, 403 (2018) (recognizing that there are "varying definitions" of smart contracts, but the concept is similar in the traditional sense).

[8] *See id.* (defining a traditional contract as one that "defines expected performance and also memorializes intent and how the parties conduct themselves").

[9] *See id.* (explaining that blockchain technology is compatible with smart contracts because of its immutability and how it's posted in a successive ledger format).

[10] *See* Philipp Paech, *The Governance of Blockchain Financial Networks*, 80 MOD. L. R. 1, 3 (2017) (defining a "smart contract" as having the ability to "autonomously run self-executable programmes").

[11] *See Legal Engineering*, MONAX (Jan. 25, 2019), *archived at* https://perma.cc/T453-YMA6 (highlighting that Monax is using legal contract because they are more easily digested than paper contracts).

[12] *See Developing the USN - Universal Sharing Network*, SLOCK.IT (Jan. 25, 2019), *archived at* https://perma.cc/DM97-AF72 (providing that the Universal Sharing Network is an open source sharing economy using the Blockchain).

[13] *See* Kevin Hobbs et al., *User-Friendly Smart Contract Compiler*, ETHERPARTY 1, 4 (2017) (stating the goal of Etherparty, "[w]e believe the demand for smart contracts will continue to grow as applications that automate peer interactions or facilitate coordinated group actions4 become more prevalent in everyday society").

[14] *See* JOHN REAM, YANG CHU & DAVID SCHATSKY, UPGRADING BLOCKCHAINS SMART CONTRACT USE CASES IN INDUSTRY 4 (Deloitte 2016) (showing the transactions that can be used from various industries such as financial services, life sciences and health care, and the public sector); *see also* Satya Asharaf &

These applications are not just the aspirations of startups. Within the public law sphere, consider for example how the Estonian government aims to create a digital government; facilitated and secured by smart contracts. [15] Even the most established and regulated industries leverage smart contracts: the International Swaps and Derivatives Association (ISDA) is developing a smart contract standard which will ensure fluidity and safety of financial transactions. [16] These, and many other applications, could only be possible if the law recognizes their legality.

While commercial adoption is rising, and industry players wait for regulatory actions, the ecosystem is struggling to answer: are smart contracts legal?[17] Do we need a new body of law, the so called Lex Cryptographia to justify their legality?[18] Or smart contracts are simply a new, 'smart' way to contract that will progressively be regulated by the traditional framework of private law?

Blockchain's potential and legality is perceived with great trepidation and uncertainty. In the public sphere, many conclude that the lack of a comprehensive regulatory approach is a major issue for further propagation of this technology. In disarray, the

Srikar Adarsh, DECENTRALIZED COMPUTING USING BLOCKCHAIN TECHNOLOGIES AND SMART CONTRACTS: EMERGING RESEARCH AND OPPORTUNITIES 48-9 (IGI Global eds., 2017) (illustrating that smart contracts will be able to lease vehicles, homes, rooms, among many other operations without the need for manual service); *see also* SMART CONTRACTS ALLIANCE, SMART CONTRACTS: 12 USE CASES FOR BUSINESS & BEYOND, CHAMBER OF DIGITAL COMMERCE 14-38 (Deloitte 2016) (providing 12 cases where the use of smart contracts can be applicable).

[15] *See KSI Blockchain*, E-ESTONIA (Jan. 25, 2019), *archived at* https://perma.cc/SJ6D-LQKZ (outlining how Estonia is a completely digital society, implemented after they experienced cyber-attacks in 2007).

[16] *See* Scott O'Malia, *The Legal Aspects of Smart Contracts*, ISDA (Aug. 9, 2017), *archived at* https://perma.cc/9H7E-TDWK (discussing that in the derivatives market, the ISDA is putting an emphasis on using smart contracts to their advantage).

[17] *See* Stéphane Blemus, *Law and Blockchain: A Legal Perspective on Current Regulatory Trends Worldwide*, 4 REVUE TRIMESTRIELLE DE DROIT FINANCIER 10, 10 (2018) (showing that the Federal Reserve's December 2016 report discussed three main legal concerns regarding blockchain and smart contract technology).

[18] *See* Wright & De Filippi, *supra* note 1, at 4 (defining lex cryptographia as a new body of law regulating blockchain, or "rules administered through self-executing smart contracts and decentralized (autonomous) organizations").

likes of Cermeño[19] and Dong He[20] call for an open discussions and collaborative stakeholder agreements. While the European Banking Institute[21], the European Parliamentary Service[22] and United Kingdom's Chief Scientist[23], expound unassailable risks, the Securities and Exchange Commission[24] in accord with the Commodity Futures Trading Commission[25] take firm but conflicting stances. In summary, institutions and regulators, as pointed out by Perugini and Checco, are focusing on deterring risks while taking a "wait-and-see" approach when considering policy stances. [26] While possibly good for innovation, 'waiting and seeing', leaves a legal gap and increases uncertainty for market actors. The private space, however, applauds blockchain smart contracts with great excitement. Norton Rose Fulbright in collaboration with one of the most prolific banking consortiums,

[19] *See* Javier Sebastian Cermeño, Blockchain in Financial Services: Regulatory Landscape and Future Challenges for Its Commercial Application 12 (Dec. 2016) (unpublished manuscript) (on file with BBVA Research) (noting that in order for distributed ledger technology to be most effective it will require collaboration on the part of developers to create "a new world of decentralized autonomous businesses governed by automated relationships").

[20] *See* DONG HE ET AL., VIRTUAL CURRENCIES AND BEYOND: INITIAL CONSIDERATIONS 21 (2016) (providing an overview of the new technologies that are catalyzing transformational changes in the global economy, including how goods, services, and assets are exchanged).

[21] *See* DIRK ZETZCHE ET AL., THE DISTRIBUTED LIABILITY OF DISTRIBUTED LEDGERS: LEGAL RISKS OF BLOCKCHAIN 1 (2017) (stressing that the risk associated with distributed ledger technology must be given significant consideration).

[22] *See* PHILIP BOUCHER, HOW BLOCKCHAIN TECHNOLOGY COULD CHANGE OUR LIVES 6 (2017) (highlighting the potential impacts and developments, and the risks and advantages of blockchain-based currencies).

[23] *See* U.K. GOV'T CHIEF SCI. ADVISER, DISTRIBUTED LEDGER TECH.: BEYOND BLOCK CHAIN 6 (2016) (articulating that developing ledger technologies are not without risk, and must be given serious consideration in order to best protect modern infrastructures).

[24] *See* Public Statement from Jay Clayton, Chairman, *Statement on Cryptocurrencies and Initial Coin Offerings*, SEC. & EXCH. COMM'N (Dec. 11, 2017), *archived at* https://perma.cc/RM52-QSYV (highlighting the SEC's is concern that everyday investors may be unequipped for the emerging technologies unless they have the wherewithal "to ask good questions, demand clear answers and apply good common sense when doing so.").

[25] *See A CFTC Primer on Virtual Currencies*, COMM. FUT. TRADING COMM'N (Oct. 17, 2017), *archived at* https://perma.cc/BKF2-VQPX (proclaiming the goal of the CFTC to avoid systemic risk to consumers and market users by promoting open and transparent financial markets).

[26] *See* MARIA LETIZIA PERUGINI & PAOLO DAL CHECCO, SMART CONTRACTS: A PRELIMINARY EVALUATION 23 (2015) (concluding that institutions are open to possible implementation under existing regulations, but prefer to wait to see where further development goes).

R3, spear-heads the hypothesis that legality is conceivable.[27] Baker McKenzie[28] and Clyde & Co[29] take a partial validity stance; explaining specific forms of legality. Similarly, Hogan Lovells[30] and Linklaters[31] find creative workarounds for using existing doctrine for new use cases. Yet, it is not clear how these approaches are advanced. Positioning oneself as a legal expert can attract clients but proposed solutions may not stand in a court of law if there are no legal sources to rely on. Above all, these works intuit that solutions are available but may require doctrinal reconciliation.

That said, some theorize that a corresponding law will emerge organically – a self-regulation. De Filippi[32], Raskin[33], and Werbach[34] – to name a few – believe that the emergence of a new set of rules – *Lex Cryptographia* – will displace private law.[35] 'Lex Cryptographia' alludes to the *Lex Mercatoria:* "a set of general

[27] *See Can Smart Contracts Be Legally Binding Contracts?*, R3 & NORTON ROSE FULBRIGHT, LLP (2018), *archived at* https://perma.cc/XMC9-7MRH (explaining that smart contracts are legally binding as long as they are under the law in contracting jurisdictions).

[28] *See* ADRIAN LAWRENCE ET AL., BLOCKCHAINS AND LAWS: ARE THEY COMPATIBLE?, BAKER MCKENZIE 1 (2017) (discussing the various legal and regulatory hurdles for regulated financial institutions seeking to leverage the benefits of DLT); *see also* Donna Brewer, *Baker McKenzie Named World's Strongest Law Firm Brand for 9th Consecutive Year*, BAKER MCKENZIE (Oct. 2, 2018), *archived at* https://perma.cc/7GS6-NYHB (highlighting Baker McKenzie as a leading global law firm).

[29] *See* BLOCKCHAIN AND THE LAW: AN UNCHARTED LANDSCAPE, CLYDE & CO. 1 (2016) (discussing the various legal issues with the use of blockchain, DAOs, and smart contracts); *see also About Us*, CLYDE & CO. (Jan. 28, 2019), *archived at* https://perma.cc/K6GZ-UBSV (declaring that Clyde & Co is a multi-focused, rapidly growing international law firm).

[30] *See* WINSTON MAXWELL & JOHN SALMON, A GUIDE TO BLOCKCHAIN AND DATA PROTECTION 11 (Hogan Lovells 2017) (suggesting that in the blockchain environment applicable law needs to be analyzed on a case by case basis).

[31] *See* WHITEPAPER: SMART CONTRACTS AND DISTRIBUTED LEDGER – A LEGAL PERSPECTIVE, ISDA LINKLATERS 19 (2017) (conceptualizing storing data between parties in transactions as well as smart contract logic).

[32] *See* Wright & De Filippi, *surpa* note 1, at 1 (defining *Lex Cryptographia* as "rules administered through self-executing smart contracts and decentralized [autonomous] organizations.").

[33] *See* Max Raskin, *The Law and Legality of Smart Contracts*, 1 GEO. L. TECH. REV. 305, 321 n.59 (furthering Wright and De Filippi's definition of *Lex Cryptographia* as "rules administered through self-executing smart contracts and decentralized (autonomous) organizations.").

[34] *See* Kevin Werbach & Nicolas Cornell, *Contracts Ex Machina*, 67 DUKE L. J. 313, 319 (2017) (citing Wright and De Filippi regarding expansion of public law into private sector).

[35] *But see id.* at 318 (arguing that smart contracts will not replace traditional contract law).

principles and customary rules spontaneously referred to or elaborated […] without reference to a particular national system of law". [36] In this way, blockchain enthusiasts compare themselves, as Hatzimhail comments, to a "community of international merchants, who were cosmopolitan – probably in spirit and certainly in their needs".[37]

This comparison begs to consider: could market actions of smart contract enthusiasts pave the path to smart contract legality? This proposition is, on the one hand, contestable, and on the other, a feasible reality. Thus, this paper aims to address: do we really need a *Lex Cryptographia* to ensure the legality of smart contracts?

A. Defining Smart Contracts

1. A Primer on Blockchain Technology

To explain practical and legal applications of this technology we need to rely on some technical discourse. Like Werbach, let us consider 3 functional – architectural elements of blockchain.[38] Blockchain is a *network*[39] which as Nakamoto notes, is "robust in its unstructured simplicity".[40] This network is 'robust' because it allows users to manage online interactions without a central authority – it is decentralized – ensuring the integrity of data exchange. A number of distributed computers are connected to this network via software. Data flows from computer to computer simultaneously; each computer maintains a record of all transactions.

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[36] *See* BERTHOLD GOLDMAN, THE APPLICABLE LAW: GENERAL PRINCIPLES OF LAW — THE LEX MERCATORIA (1987), *reprinted in* CONTEMPORARY PROBLEMS IN ARBITRATION 10, 116 (Julian Lew ed., 1987) (defining Lex Mercatoria and organic self-regulation).

[37] *See* Karen Knop et al., *The Many Lives and Faces of Lex Mercatoria: History as Genealogy in International Business Law*, 71 L. AND CONTEMP. PROBS., 169, 177 (2008) (referencing Schmitthoff's account of the development of international commercial law).

[38] *See* Werbach & Cornell, *supra* note 34, at 326 (explaining the three primary elements in the Blockchain architecture, namely, the ledger, the network, and the consensus).

[39] *See* ANTONY LEWIS, A GENTLE INTRODUCTION TO BLOCKCHAIN TECHNOLOGY 5 (Brave Newcoin 2017) ("[T]he Bitcoin Blockchain ecosystems acts like a network of replicated databases, each containing the same list of past bitcoin transactions.").

[40] *See* SATOSHI NAKAMOTO, BITCOIN: A PEER-TO-PEER ELECTRONIC CASH SYSTEM 8 (2018) (discussing the issue of double-spending and how there needs to be a peer-to-peer network using proof-of-work to record public history of transactions).

Blockchain is also the *architecture* of an information system with a set of rules – also known as a protocol – for data exchange. As Halpern and Pass explain:

> At the heart of the distributed ledger technology is a blockchain protocol, a protocol for achieving consensus on a public ledger that records bitcoin transactions. To the extent that a blockchain protocol is used for applications such as contract signing and making certain transactions[.][41]

Each computer connected to this information system, algorithmically solves a computer programing problem known as the Byzantine Generals. [42] By solving this problem the computer "[…] establishes the truth of an event without recourse to a trusted third party […]". [43] This type of validation allows parties to agree on a single version of truth – about the data – that is stored, secured and is verifiable by other users. In a simplified sense, the blockchain is a database of transactions organized in smaller data sets – "blocks". [44]

Continuing the database analogy, the blockchain is an *immutable public ledger*. Each block containing information about transactions is created in a chronological manner: "linked to each-other (like a chain) in a linear, chronological order [...]" keeping and updating this 'chain' every 10 minutes. [45] This sequential organization explains the name 'block'-'chain'. The effect: an identical record that is shared amongst all users; much like an open, public ledger where data cannot be changed or altered once it is

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[41] *See* JOESEPH Y. HALPERN & RAFAEL PASS, A KNOWLEDGE-BASED ANALYSIS OF THE BLOCKCHAIN PROTOCOL 324 (Jérôme Lang ed., 2017) (describing the concept of blockchain protocol when applied to bitcoin transactions).

[42] *See* Leslie Lamport et al., *The Byzantine Generals Problem*, 4 ACM TRANS. ON PROGRAMMING LANGS. & SYS. 382, 382 (1982) (defining abstractly the Byzantine Generals Problem as the failure of a computer system to cope with the failure of one or more of its components that exhibits a type of behavior that is often overlooked).

[43] *See* Eliza Mik, *Smart Contracts: Terminology, Technical Limitations and Real World Complexity*, 9.2 L., INNOVATION AND TECH. 7 (2017) (establishing the reasoning behind the industry's fascination with bitcoin).

[44] *See* Don Tapscott & Alex Tapscott, *How Blockchain Will Change Organizations*, MIT SLOAN MR REVIEW (Dec. 7, 2016), *archived at* https://perma.cc/AVR2-AP2N (explaining how data is organized into smaller databases that are connected to the preceding database, thus creating a chain of "blocks" – blockchain).

[45] *See* Michael Crosby et al., *Blockchain Technology: Beyond Bitcoin*, APPLIED INNOVATION REV. 9 (2015) (explaining that blockchain technology solved the problem of maintaining the order of transactions).

recorded on the blockchain – it is *immutable*.[46]

2. A Primer on Smart Contracts

i. A Formal Definition of Smart Contracts – Lexicological Priorities

There is "[…] no agreed upon definition for smart contract[s…] [compared to other blockchain concepts] this creates the greatest confusion and an incomparable level of disagreement for regulators […]".[47] Competing technical and legal interpretations create diverging effects. Walch recognizes this issue as a "challeng[ing] unstable verbal terrain […] for regulators […] in how they understand, discuss and ultimately regulate (or not) the technology and its uses".[48] Thus, this work supplements the lack of a formal definition with common characteristics.[49]

Recognizing the 'definition problem', Amuial considers three functional elements that concretize this concept.[50] Element one, relates to a transaction that is evidenced and stored on the blockchain; while supposing more than merely a transfer of virtual currencies. The second element requires that this is a single or multi-party transaction. The final element requires that the performance of the transaction is autonomous, requiring little human input after the contractual formation – the 'smart' nature of the contract.

Proposed by notable scholars within *A Guide for Legal and Business Professionals* and accepted by many lawyers, the above definition misses the true purpose of a smart contracts.[51] Szabo was the first to theorize smart contracts in 1994, when he defines them as: "[a] set of promises, specified in digital form including

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[46] *See* Pedro Franco, *Understanding Bitcoin: Cryptography, Engineering and Economics*, WILEY FINANCE SERIES 108 (2015) ("This currency generation algorithm is considered immutable by the community.").

[47] *See* SHAWN AMUIAL ET AL., THE BLOCKCHAIN: A GUIDE FOR LEGAL AND BUS. PROF. §§ 2:2-2:3 (2016) (highlighting the confusion involved in the regulation of blockchain technology).

[48] *See* Angela Walch, *The Path to the Blockchain Lexicon*, 36 REV. BANKING & FIN. L. 713, 717-18 (2017) (discussing the complex vocabulary involved in blockchain and the issues it presents).

[49] *See id.* (highlighting the unsettled terminology found throughout the blockchain technology).

[50] *See* AMUIAL ET AL., *supra* note 47, at § 2:2 (identifying the elements of a smart contract).

[51] *See* AMUIAL ET AL., *supra* note 47, at § 2:2 (noting the general acceptance of the proffered definitions among many lawyers).

protocols within which the parties perform on the other promises automatically". [52] The adoption of this definition has two principal effects: 1) this definition implies a legal characteristic, created by promissory obligations – "promises"; and 2) said obligations are ensured by automatic performance – "automatically". The refined definition elucidates a legal dimension and the automation mechanism – characteristics necessary for the discussion on smart contract legality. Nonetheless, this concept needs a few more qualifications.

ii. A Legal Dimension of Smart Contracts

Clack et al. elucidate the most contested aspect of this technology:

> [A] smart contract is an automatable and enforceable agreement. Automatable by computer, although some parts may require human input and control. Enforceable either by legal enforcement of rights and obligation or tamper-proof execution of computer code.[53]

This definition has two noteworthy distinctions. First, autonomous performance could be partial as to extent of human control – requiring no human interaction at all. Second, the self-executing nature is a result of the legal system's acceptance of existing obligations ("legal enforcement") or because of the impossibility to revert the transaction after contractual formation (due to the immutable nature of blockchain – "tamper-proof execution"). Precisely this – the ability to automate execution – is a central schism for many scholars: if contracts are enforced by code, and not by law, court involvement is excluded; despite statutorily required.

3. Basic Mechanics of Smart Contracts

To recapitulate, blockchain is a multi-purpose technology that acts as a communication pathway for trusted transactions. [54]

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[52] *See Relationships on Public Networks*, *supra* note 6 (defining and analyzing the concept of "smart" contracts).

[53] *See* CHRISTOPHER CLACK ET AL., SMART CONTRACT TEMPLATES: FOUNDATIONS, DESIGN LANDSCAPE AND RESEARCH DIRECTIONS 2 (Barclays Bank PLC, 2016) (attempting to define the smart contracts in the realm of blockchain technology).

[54] *See* DYLAN YAGA ET AL., BLOCKCHAIN TECHNOLOGY OVERVIEW ii, iv (Nat'l Inst. of Standards and Tech. 2018) (providing abstract overview of transactions

Parties use this technology to securely transfer and store data. The true innovation of this technology, however, lies within the possibilities of smart contracts. Smart contracts are much the like this data, and can be created, exchanged and stored on the blockchain.

i. Comparing Smart and Traditional Contracts

In simple terms, Greenspan explains smart contracts as "a piece of code which is stored on an Blockchain […] which reads and writes data in that blockchain's database". [55] This snippet of code instantiates – after creation, it is stored on the blockchain – when the network's virtual machines interpret this data input and execute the code (the terms of the contract). One may ask: so how does this snippet of code compare to traditional contracts?

Traditional contracts have conditional terms. Similarly, smart contracts have the same conditional terms that execute automatically – through code. While the specificity of programming languages does not allow for clauses in natural language, code expresses these terms in a similar way: if party A does X, party B receives Y. [56] Conditionality, allows to digitalize traditional contracts by executing performance automatically – the 'smart' nature. As a result, a smart contract is a set of 'agreed' terms written in code and executed with minimal human input.[57] Our comparison supposes that there are other analogies to be made within private law. Let us explore these analogies and see if they justify the legality of smart contracts.

within blockchain technology).

[55] *See* Gideon Greenspan, *Beware of the Impossible Smart Contract*, MULTICHAIN (Apr. 12, 2016), *archived at* https://perma.cc/3Q33-DCTT (simplifying the definition of a smart contract as "a fancy name for code which runs on a blockchain, and interacts with that blockchain's state.").

[56] See DON TAPSCOTT & ALEX TAPSCOTT, REALIZING THE POTENTIAL OF BLOCKCHAIN: A MULTISTAKEHOLDER APPROACH TO THE STEWARDSHIP OF BLOCKCHAIN AND CRYPTOCURRENCIES 5 (World Econ. F. 2017) (clarifying how each block must refer to the preceding block in the structure in order to be valid); *see also* ANDREAS SHERBONE, BLOCKCHAIN, SMART CONTRACTS AND LAWYERS 1 (Int'l B. Ass'n Dec. 2017) (explaining that once action A occurs, it triggers a performance from action B).

[57] *See* SHERBONE, *supra* note 56 (defining what a smart contract is). Smart contracts can execute coded contractual terms without a lawyer. *Id.*

4. Analogies and Differences to Traditional Contracts

i. Automation of Performance

Contract law evolved[58] and adapted due to contextual changes. [59] This adaptation builds on an established body of doctrine by extending its scope. If this premise is agreeable, existing technologies can insight the regulation of smart contracts. In agreement, Easterbrook[60] confirms that technical innovations seldom necessitate novel doctrines because "fact patters are fundamentally unchanged". [61]

On the surface, one dissimilarity of smart contracts is the shape of contractual freedom.[62] A progressive society streamlined contracting – minimize transaction cost and human involvement – by adopting digital contracts. [63] While digital contracts are generally accepted, smart contracts go beyond their scope by autonomously performing some of the conditional terms. Yet, is the automation of performance a novel phenomenon?

The body of works by Werbach – amongst others – takes the same line of reasoning as he states: "it is not a novel phenomenon […b]illions of dollars of derivatives trades are executed each day with no human intervention […] computers are programmed with the contractual terms, and perform the trade when specified circumstances occur". [64] Thus, automated performance is not such a new concept. In fact, 20 years ago, Szabo

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[58] *See* IAN MACNEIL, THE NEW SOCIAL CONTRACT: AN INQUIRY INTO MOD. CONTRACTUAL RELATIONS 4 (Yale Univ. Press 1980) (providing for how a contract is nothing more than the process of projecting exchange into the future).

[59] *See* GUIDO CALABRESI, A COMMON LAW FOR THE AGE OF STATUTES 59 (Harvard Univ. Press 1982) (discussing how there are limited changes in the legislative process, changes that "accept stautorification" and "retain the structure of checks and balances").

[60] *See* Frank Easterbrook, *Cyberspace and the Law of the Horse*, 1996 U. CHI. LEGAL F. 207, 207 (1996) (observing that lawyers should be hesitant to prescribe legal adaptations for cyberspace).

[61] *See* Werbach & Cornell, *supra* note 34, at 344 (paraphrasing that Judge Frank has argued that the rise of new technologies does not manifest a need for new legal doctrines).

[62] *See* Savelyev, *supra* note 2, at 7 (commenting on the increased automation of smart contracts deteriorating the "freedom of contract" principles).

[63] *See* Savelyev, *supra* note 2, at 7 ("[Progressive and] [i]nformation society will tend to go further [than streamlining contracts] by minimizing human involvement not only in defining the contractual terms but also in their enforcement.").

[64] *See* Kevin Werbach, *Trust, but Verify: Why the Blockchain Needs the La*w, 33 BERKELEY TECH. L. J. 487, 526 (2018) (noting the common usage of automating large financial transactions and contractual agreements).

made a similar argument in his first account of smart contracts; with the discourse on the history of vending machines[65]. Let us explore Szabo's example to better understand the automation of performance.

ii. The Vending Machine Example

What we may call a 'vending machine' was first documented by Hero of Alexandria (1st century CE) in *Pneumatika*.[66] This Greek mathematician described a device that dispensed holy water –atomization of performance – within Egyptian temples, for an exchange of a coin. The same automation of performance was later used by 17th century English publishers – in circumvention of libel laws.[67] Modern vending machines, similarly, are programmed with a set of conditions that are performed autonomously, after the fulfillment of a condition – the insertion of a coin. In this way, vending machines, present an offer and after selection by a human – the acceptance – they facilitate the automated performance – vending a product.

Smart contracts are also pre-coded – with condition terms that perform after a 'trigger event' – and placed on the blockchain.[68] After a trigger action occurs, the contract is performed according to the programmed terms. This contract cannot be reverted or stopped during the performance (the immutable and irreversible limitations of blockchain). Vending machines do not exist on the blockchain (or at least not yet) but this example illustrates that: aspects of smart contracts have comparable patters in our everyday life. Precisely these patterns will become important for our legal analysis.

iii. Digital Form

The digital form of smart contracts is also a source of

[65] *See Relationships on Public Networks*, *supra* note 6, at 3 ("A canonical real-life example, which we might consider to be the primitive ancestor of smart contracts, is the humble vending machine.").

[66] *See* Savelyev, *supra* note 2, at 8 (providing a historical anecdote on the first documented vending machine).

[67] *See* Raskin, *supra* note 33, at 315-16 (highlighting the use of vending machines for books in 17th century England to "avoid prosecution under the country's libel and sedition laws").

[68] *See* James Ray, *A Next-Generation Smart Contract and Decentralized Application Platform*, GITHUB (Jan. 27, 2019), *archived at* https://perma.cc/3GYM-5G58 (describing the workflow of an automated contract when a condition is met).

complexity for doctrinal reconciliation. [69] It could be argued that Szabo himself, was not sure about legal enforceability and purposefully kept his definition ambiguous.[70] So, does the digital form of smart contracts affect their legal validity?

Digitalization changed the dynamics of business operations. Today, we communicate by electronic messages, account with digital spreadsheets and validate transactions online. This supposes that digital contracts, at least in some cases, are legal validity.[71] In American, for example, fifteen years of congressional legislation led to digital signatures having the same equivalence to traditional 'wet' signatures. [72] In fact, three legal instruments were created to regulate digital agreements (introduced below).

Drafters of the Electronic Signatures in Global and National Commerce Act (E-SIGN) and the Uniform Electronic Transaction Act (UETA) dealt with one of the most fundamental aspects of digital contracts: a person's ability to formulate obligations online. [73] Now, it is matter of policy to make these agreements equally enforceable even with respect to notary acts and sworn affidavits. [74] E-SIGN also expanded the scope of transactions to property

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[69] *See* ANDREAS SHERBORNE, BLOCKCHAIN, SMART CONTRACTS AND LAWYERS 5 (Int'l Bus. Ass'n 2017) (highlighting the difficulties in determining the body of law to apply in smart contractual issues); *see also* Scott Farrell et al., *Lost and Found in Smart Contract Translation – Considerations in Transitioning to Automation in Legal Architecture,* UNICITRAL (2017), *archived at* https://perma.cc/2Y3N-VYMQ ("In such cases, basic contractual formation issues can cause concerns, such as . . . the time of creation and the governing law.").

[70] *See Smart Contracts*, *supra* note 6 (failing to provide a concrete definition of "enforceability"); *see also Relationships on Public Networks*, *supra* note 6 (defining "privity of contract" as "[t]he relation which subsists between two contracting purposes").

[71] *See* Gregory Maggs, *Regulating Electronic Commerce*, 50 AM. J. COMP. L. 665, 666 (identifying how an electronic contract can be easily formed, because the U.C.C. allows contract formation "by any method sufficient to show an agreement.").

[72] *See id.* at 675 (noting how Congress' enactment of the Electronic Signatures in Global and National Commerce Act of 2000 allows "electronic records and signatures [to] take the place of traditional paper and ink.").

[73] *See* Electronic Signatures in Global and National Commerce Act (ESIGN), 15 U.S.C. § 7001 (2000) (establishing that a signature is not invalid simply because "it is in electronic form."); *see also Uniform Electronic Transactions Act Law and Legal Definition*, USLEGAL (Mar. 6, 2019), *archived* at https://perma.cc/VM4E-FS66 [hereinafter *Uniform Electronic Transactions*] (providing that a contract may not be denied legal effect solely because it was in electronic form); *see also* Maggs, *supra* note 71, at 674-75 (analyzing how the ESIGN and UETA statutes, respectively, remedy some statute of frauds concerns regarding the enforceability of electronic contracts).

[74] *See* 15 U.S.C. § 7001(a) (describing the general rules of validity for electronic

law.[75] The concept of a "transferable record" allowed 'eNotes' to replace contracts – such as promissory notes – whose essential elements of validity, in the past, had strict formal conditions – such as possession. [76]

Possession was replaced by proving that the contracting party has 'control' over the transferable record.[77] In this way, legal validity is proved "if a system employed for evidencing the transfer of interests in the transferable record reliably establishes that person as the person to which the transferable record was issued or transferred…".[78] There are six requirements to the establishment of control but all of them relate to: the identification of the party; a proven record of communication; and the unaltered state of the document.[79] Could the same requirements not apply to smart contracts[80]; especially given the fact that UETA was designed to expand the scope of electronic transactions? [81]

If we consider the words of O'Shields as he states that "UETA was the first comprehensive attempt to prepare state law for the electronic commerce era and provide uniform rules for electronic commerce transactions", we may consider that this body of law is capable of addressing smart contracts – it regulates the same subject area within a new uncertain environment. [82] Most

signatures).

[75] *See* 15 U.S.C. § 7001(a); *see also* 5 U.S.C. § 7021(a)(1)(C) (defining "transferable record," in part, as "an electronic record that . . .relates to a loan secured by real property.").

[76] *See* 15 U.S.C. § 7021 (implying that transferable records can allow eNotes to substitute written contracts).

[77] *See* 15 U.S.C. § 7021(b) (defining what it means for a person to have control over a transferable record).

[78] *See* 15 U.S.C. § 7021(b) (outlining the requirements to show that someone has control over a "transferrable record").

[79] *See* 15 U.S.C. § 7021 (c)(1)-(6) (analyzing what the requirements are to establish control).

[80] See AMUIAL ET AL., *supra* note 47, § 2:23 (arguing that UETA is applicable to smart contracts despite its enactment before their existence).

[81] *See Uniform Electronic Transaction*, *supra* note 73 (expressing UETA was designed to support and complement the statute to "removed barriers to electronic commerce"); *see also* Uniform Real Property Electronic Recording Act ("URPERA"), NCCUSL §1-8 (2005) (stating that the URPERA was designed to accept electronic information relating to land records that would be harmonized between other jurisdictions and states).

[82] *See* Reggie O'Shields, *Smart Contracts: Legal Agreements for the Blockchain* 21 N.C. BANKING INST. 177 (2017) (highlighting UETA was the first initiative to prepare a state for electronic commerce transactions by uniform rules); *see also Uniform Electronic Transactions*, supra note 73 (asserting that a physical contract with an electronic signature is still an enforceable contract and will not be legally denied).

strikingly, the aforementioned instruments adopt legal concepts in response to technological changes without altering substantive law. [83] Amuial takes this idea further by stating that:

> Existing legal principles [within E-SIGN or UETA] will be adapted and perhaps modified, either statutorily or judicially, to deal explicitly with smart contracts and other emerging technologies - albeit most likely with a substantial lag time between adoption of the technology and adjustment of the law.[84]

The above claim has a great importance for our proposition on how the *Lex Cryptographia* will evolve, yet, we need to consider a few impracticalities of this approach; before we analyze these sources of law.

iv. Conflicts of Natural Language and Code

Smart contracts are different to electronic agreements, because the latter, unlike smart contracts, are written in natural language.[85] Judges can clearly read the contents of a digital agreement and therein, apply contract law to interpret them. [86]A smart contract, on the other hand, is written in code.[87] As Farrell states: "[t]his raises a critical issue – whether contractual provision which are expressed in computer code can be valid and effective under law". [88] More so, there are more than a few ways in which

[83] *See* SHAWN AMUIAL, JOSIAS DEWEY AND JEFF SEUL, THE BLOCKCHAIN: A GUIDE FOR LEGAL AND BUS. PROF., § 2:25 (Thompson Reuters 2016) (debating whether or not smart contracts will conflict with the regulatory structures that are currently in place).

[84] *See id.* at § 2:24 (commenting that it will take years for paper contracts to be phased out and replaced with electronic signatures and notarization).

[85] *See* SCOTT FARRELL, HEIDI MACHIN & ROSLYN HINCHLIFFE, LOST AND FOUND IN SMART CONTRACT TRANSLATION – CONSIDERATIONS IN TRANSITIONING TO AUTOMATION IN LEGAL ARCHITECTURE 3 (King & Wood Mallesons, 2017) (outlining that the two provisions differ based on the "natural language between the meaning of the original contractual provision and its expression in code").

[86] *See id*. at 10 (suggesting that with smart contracts the courts should recognize the need for adjustment into our current law).

[87] *See id*. at 4 (analyzing the problems that can arise from a contract being written in code).

[88] *See id*. at 2 (questioning the validity of a computer generated contractual provision).

code combines with natural language. Surden[89] explains this by recognizing that smart contracts are a natural extension of electronic contracts but with various conceptual differences – originating from their form. Surden proposes a set of classifications which may help us assert if our analogies to traditional contracts are sensible.[90]

'Data-Oriented Contracts' are contracts formulated in a computer readable way.[91] These are similar to the vending machine where the primary recipient is a computer.[92] Yet, smart contracts go further than 'Data-Oriented Contracts'.[93] As Savalyev points out, "Blockchain can be regarded as a 'paradigm-shifter'… [because] it allows to automate the process of performance for both parties". [94] If the performance of both parties is automated then we have something quite different to a vending machine or Data-Oriented Contract – 'Computable Contracts'.[95] These contracts give computers the autonomy to make an assessment about the essential terms of a contract and initiate performance. [96] In this way, only the formation of a contract relies on human inputs: a snippet of code and its underlying infrastructure will be able to handle the entire life-cycle of a contract. [97]

The most important about Surden's classifications is how they impact the automation of *enforcement* and not *performance* –

[89] *See* Harry Surden, *Computable Contracts* 46 U.C. DAVIS L. REV. 629, 642 (2012) (describing the evolution of contract technology from reorganizing ordinary language to structured data).

[90] *See id.* at 687-88 (addressing the issue that contemporary technology cannot successfully translate the language formed in which contracts have traditionally expressed).

[91] *See id.* at 699 (explaining "data-oriented contracts" as contracts that "express core parts of their contract in the form of highly-structured data).

[92] *See* Savelyev, *supra* note 2, at 8-9 (discussing the relationship between vending machines and automatic machines).

[93] *See* Savelyev, *supra* note 2, at 8-9 (asserting that contracts can proceed further because "it allows to automate the process of performance contractual process of both parties.").

[94] *See* Savelyev, *supra* note 2, at 9 (indicating the author's point of view regarding how Blockchain will affect contracts).

[95]*See* Surden, *supra* note 89, at 635-36 (introducing the theory of contract performance through automated services and how they may affect the contractual arrangements).

[96]*See* Surden, *supra* note 89, at 636 (detailing the terms of when computers have replaced the parties to a contract and are left to automate the prima-facie assessments).

[97]*See* CLACK, *supra* note 53, at 3 (suggesting that the only part of a contract that need rely on human input is the formation and automated code could create the rest); *see also* FARRELL, MACHIN, & HINCHLIFFE, *supra* note 85, at 2 (defining what a smart contract entails).

our previously defined schism. Traditional contracts allow for the revision or restitution by court action. Surden's smart contracts do not consider this option. Werbach summarizes the effect of automating enforcement as: "[s]mart contracts automate contractual enforcement by ceding all power to the decentralize network […] eliminating the legal system from the contractual process". [98] The legal system may not accept such an approach to enforcement and therein, our legal analysis does not consider the automation of enforcement; as a feasible solution to the legality of smart contracts.[99] Thus, we have arrived at a running hypothesis on legality: smart contracts compare to private law concepts only in the case that they automate the performance of conditional terms within digital agreements.

B: Lex Cryptographia as Justification for the Smart Contract Legality

1. The Heart of Doctrinal Challenges: 'Is Code Law?'

One of the major doctrinal challenges of smart contract legality surrounds the question: 'is code law?' This proposition was firstly advanced by Lessig[100] in 1999 and further academic work reinforced it. [101] The proposition implies that smart contracts do not need to fit the domain of law because they represent a "de facto […] technological alternative to the whole legal system" – due to automated *enforcement*. [102] Proponents and opponents of this theory, are agreeable with the automation of *performance* but the automation of *enforcement* is a point of disagreement.

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[98] *See* Werbach & Cornell, *supra* note 34, at 315 (stressing how the automation asset of smart contracts enforce contractual obligations).

[99] See *infra* Part I, Section 5.

[100] *See* Lawrence Lessig, *The Law of the Horse: What Cyberlaw Might Teach*, 113 HARV. L. REV. 501, 548 (1999) (comparing the levels of scrutiny for code carrying the force of law).

[101] *See* Paul M. Schwartz, *Beyond Lessig's Code for Internet Privacy: Cyberspace Filters, Privacy Control and Fair Information Practices*, 2000 WIS. L. REV. 743, 744-745 (2000) (critiquing Lessig's proposal for internet privacy and property rights in personal information); *see also* James Grimmelmann, *Regulation by software*, 114 YALE L. J. 1719, 1722-23 (2004) (expanding on Lessig's analogy that software is a form of architecture); *see also* Greg Lastowka, *Decoding Cyberproperty*, 40 IND. L. REV. 23, 24 (2003) (praising Lessig, but arguing his theory, that "code is law," needs further explanation).

[102] *See* Savelyev, *supra* note 2, at 21 (detailing how smart contracts are a transnational, uniform alternative to the legal system). Savelyev argues smart contracts are "a perfect example of new type of regulator governing relations in cyberspace… [such as] Lessig's 'code is law.'" *Id.*

Automated *enforcement* has considerable consequences. If this were true, smart contracts would replace the legal system as we know it. Yet, there are considerable reasons to refute this claim. Firstly, many argue that the judiciary is unlikely to give up its coercive powers in governing individual relationships. [103] Irrespective of political idealism, the judiciary may be the only organ that may use this power adequately. Agreeing with the many others[104], power should exist within the judiciary because smart contracts have no access to dispute resolution mechanisms. This means that a smart contracts would not be able to achieve one of the main purposes of contract law: a remedial nature which adjudicates grievances ex ante and ex post.[105] Finck recapitulates this point by stating: "smart contracts are unable to interpret parties' intention and cannot replace contract law's function as a remedial institution".[106]

Surden highlights another dimension of this remedial problem: unconditionally and immutability of smart contracts will not allow parties to terminate at will. [107] Consider laws that interrupt or reverse contractual performance; requiring smart contracts to be flexible – to facilitate restitution and modification. Other laws change contractual terms because they have an implied

[103] *See* Werbach & Cornell, *supra* note 34, at 314 (raising the possibility that emerging technologies could displace the enforcement of the law, which is historically an "essential province."); *see also* Anthony Kronman, *Contract Law and the State of Nature*, 1 J. L. ECON. & ORG. 5, 5 (1985) (referring to Thomas Hobbes' "Leviathan").

[104] *See* Carla Reyes, *Moving Beyond Bitcoin to an Endogenous Theory of Decentralized Ledger Technology Regulation*, 61 VILL. L. REV. 191, 213 (2016) (addressing the long-term legal implications that block chain technology could have on judicial decision-making); *see also* Savelyev, *supra* note 2, at 9 (concluding that the implementation of blockchain-based smart contracts will promote efficiency, cost-effectiveness, and a competitive marketplace); Werbach, *supra* note 64, at 545 (recognizing both the benefits of smart contracts as well as the limitations that stem from their lack of dispute resolution capabilities).

[105] *See* E. ALLAN FARNSWORTH, COMPARATIVE CONTRACT LAW ch.7 (Mathias Reimann & Reinhard Zimmerman eds. 2006) (providing a wide-ranging and highly diverse survey and critical assessment of comparative law in the 21st century).

[106] *See* Michèle Finck, *Blockchain Regulation*, GERMAN L. J. 2018 (forthcoming) (evaluating regulatory techniques designed to regulate the technology in its early stages); *see also* Werbach & Cornell, *supra* note 34, at 314-15 (exploring the role and development of smart contracts).

[107] *See* Surden, *supra* note 83, at 678 (implying that parties must "explicitly agree in a threshold agreement to make their contractual obligations dependent upon any reasonable criterion" in order to have flexibility in enforcing the contract).

nature. [108] This too asks for the ability to interpret, avoid and rescind a contract. If no human or institution can either stop, alter or reinstate the performance of a contract; what would be a remedy for an aggrieved party in a smart contract transaction?[109]

As a result, we must side with Werbach[110] in asserting that smart contracts may only "[…d]isplace [rather than replace] the legal system and later our behavior" – answering a partial 'no' to the 'code is law' question. Said *displacement* and not *replacement* is the only alternative for a number of other reasons. Firstly, code may not anticipate all the complexities of a contract. It is impossible for the current state of technology to create code that is "deterministic of every possible outcome that could result from the relationship between two or more parties". [111] Practitioners struggle to do so utilizing traditional contracts while anticipating all the potential outcomes presumed under the contract. Second, the practical consequence of this inflexibility of code: ex ante outcomes of a contract diverge greatly from initial intent. If we agree that legal systems evolved to address this non-deterministic nature by filling the void with legal doctrine, do we really believe that a programmer can achieve the same result through code? [112] Even so, the likes of Levy explain that contracts have more than a performative function, they are "social mechanisms […] that serve many functions that are not explicitly legal in nature". [113]

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[108] *See* ELIZA MIK, CONTRACT FORMATION ONLINE, CONTRACT FORMATION, LAW AND PRACTICE 159-94 (Oxford Univ. Press 2010) (describing the process of an automated transaction through an example using vending machines).

[109] *See* DON TAPSCOTT & ALEX TAPSCOTT, BLOCKCHAIN REVOLUTION: HOW THE TECHNOLOGY BEHIND BITCOIN IS CHANGING MONEY, BUSINESS, AND THE WORLD (Portfolio ed., Penguin Random House 2016) (questioning the potential remedy for aggrieved parties in smart contracts).

[110] *See* Werbach, *supra* note 64, at 534 (exploring the different scenarios in which blockchain could potentially supplement, complement, or substitute the law).

[111] *See* AMUIAL ET AL., *supra* note 47, at § 2:7 (recognizing the "complex game theory and microeconomic theory" that makes relying on deterministic code to govern a relationship so difficult).

[112] *See* Eric Kades, *The Laws of Complexity and the Complexity of Laws: The Implications of Computational Complexity Theory for the Law*, 49 RUTGERS L. REV. 403, 409 (1997) (inferring that if corporate law cannot be simplified into "theoretical boxes"); *see also* Gary Edmond, *Legal Engineering: Contested Representations of Law, Science (and Non-Science) and Society*, 32 SOC. STUD. SCI. 371, 400 (2002) (suggesting that "separate entities" may "simultaneously [function] to mediate the socio-legal economy.").

[113] *See* Karen E. C. Levy, *Book-Smart, Not Street-Smart: Blockchain-Based Smart Contracts and The Social Workings of Law*, 3 ENGAGING SCI., TECH., & SOC'Y 1, 2 (2017) (highlighting that contracts function "in a multitude of ways and accomplish a multitude of aims that are unaccounted for by the smart

We may certainty desire to draft technically – leaving no room for interpretation – but currently, we are not that technically advanced. [114] Mathematics, albeit a universal language, has certain deficiencies. Surely, many academics are now advancing theories of computational law, supposing a 'legal engineering' approach to drafting contracts. [115] These approaches, however, have only been successfully adopted within derivatives trading. [116] Resultantly, we can conclude: if smart contracts were to mimic aspects of traditional contracts, their coded terms would require a greater flexibility or a greater simplicity as to the type of possible transactions.

2. How Flexible is Code?

A simple truth: some contracts require reason and conscience, where the behavior of the parties relies on normative interpretations. [117] These aspects are impossible to code but we may recognize that these aspects are not always present. Therein, can we suppose that contracts would only be partially in code? In fact, many authors[118] and practicing firms[119] discuss this as the only

contract framework.").

[114] *See Smart Contracts Template Summit*, R3 CEV, 1, 29 (2016), *archived at* https://perma.cc/Z43A-FPEL (articulating that modern lawyers have various challenges, and by implementing new innovative ways of working, they can be more efficient).

[115] *See* Oliver Goodenough, *Justice Holmes, Meet Dr. Turing: Law is Computational*, HUFFINGTON POST (May 7, 2016*), archived at* https://perma.cc/ZV9Q-PNTD (proposing one of the theories, computational theory, which is "any rule governed, step-wise process" that "provides a means for specifying such processes in a formal way").

[116] *See* LINKLATERS, *supra* note 31 (noting the advantages of smart contracts includes that "there are not multiple competing sets of records that need to be reconciled but just on, albeit maintained on multiple nodes.").

[117] *See* FARRELL, MACHIN & HINCHLIFFE, *supra* note 85, at 3 (highlighting that computer codes are able to "represent terms which are expressions of logic but not terms which are based in concepts such as reason or conscience.").

[118] *See* FARRELL, MACHIN & HINCHLIFFE, *supra* note 85, at 3 (reasoning that the solution to having some parts of contract behavior that cannot be coded through the use of "blend[ing] of both code and natural language terms"); *see also* Kristian Lauslahti et al., *Smart contracts–How will Blockchain Technology Affect Contractual Practices?*, 68 RES. INST. OF THE FINNISH ECON. 1, 2 (Jan. 9, 2017) (pointing out that "[t]he evolution of digital platforms requires an approach with a combination of technological economic and legal perspectives.").

[119] *See* BLOCKCHAIN AND THE LAW: AN UNCHARTED LANDSCAPE, *supra* note 29 (showing that international law firm Clyde & Co. is putting an emphasis on blockchain law); *see also Can Smart Contracts Be Legally Binding Contracts?*, *supra* note 27 (showing that an international law firm provides "clarity on these

route to the legality of smart contracts. The expression of smart contracts would be formulated in blended, split or dual integration systems.[120] That is to say: the executory function of smart contracts would only exist as a partial term – executing performance while being translated into natural language – within natural law contracts. Precisely this partial function within natural langue contracts, allows us to revise of our running hypothesis – a concept that we will test in Part II.

Even if this partial approach to smart contracts would be possible, fusing legal norms with conditional mathematics would require some harmonization with local laws. Farrell, as should regulators, considers three specific issues in relation to this approach. [121] Firstly, a blended contract – in both natural language and code – may require the same legitimacy as multilingual contracts; wherein code could be considered a different language. If these 'split-translated' contracts are recognized in a particular jurisdiction, they could be legal. Second, the interpretation of said terms relies on their understanding not only from a consumer perspective but also from that of the court. This supposes that – amongst other essential elements of a contract – offer and acceptance as well as sufficiency of mutual assent must be attested, in accordance to established doctrine. This brings us to the third element, evidentiary rules that qualify the admissibility of these terms during judicial proceedings.

There are also issues of a slightly grander scope. These are often termed: 'conflicts beyond code and law'. [122] These are a result of the distributed nature of the blockchain. Namely, a smart contract works by being instantiated on the blockchain and executed across the entire network of computers with no centralized servers. The state of the distributed ledger changes across several nodes within different jurisdictions – facilitating

issues.").

[120] *See* AMUIAL et al., *supra* note 47 § 2:23 (noting the many different ways smart contracts can be formulated from an algorithm standpoint); *see also* Lauslahti et al., *supra* note 118, at 21-22 (highlighting that dual integration is one potential option for the implementation of smart contracts); *see also* O'Shields, *supra* note 82, at 177-78 (offering a summary of potential uses that smart contracts could play in existing financial infrastructures).

[121] *See* FARRELL, MACHIN & HINCHCLIFFE, *supra* note 85, at 5 (opining that in order for smart contracts to be implemented into society, they must be flexible enough to operate with existing laws).

[122] *See* J. DAX HANSEN & CARLA L. REYES, LEGAL ASPECTS OF SMART CONTRACT APPLICATIONS 4 (Perkins Cole LLP 2017) (articulating that while smart contracts may be more efficient, they will still use many of the traditional contract law approaches used throughout history).

business transactions across borders. What is the applicable law and jurisdiction in this situation?

The above discussion concludes that code is not law. Law, creates the formative requirements of code and therein, attests legality or illegality. While we have addressed numerous issues with respect to our 'partially valid' concept of smart contracts, we cannot address all of these within the scope of this work. Essential elements for the validity of traditional contracts are of primary importance for any discussion on smart contract legality. Thus, the question we are going to answer: could 'coded' agreements fulfill the doctrinal requirements of contractual agreements? To this extent, the next section considers: could smart contracts really be legally enforceable agreements according to the definitions and requirements of traditional contracts?

3. Origins of the Lex Cryptographia

A *'Lex Cryptographia'* approach to smart contract legality exists in various forms of contemporary academic discourse. Wright and De Filippi were first to advocate "an expansion of a new set of law[s]" – the emergence of *Lex Cryptographia.*[123] Werbach[124], on the other hand, further proposes that this approach may displace contract law. Even more radically Abramowitz nuances a peer-to-peer law that will replace regulation with autonomous agents[125].

Other, like Atzori, elucidate the theme of decentralized state action, by viewing smart contracts as future "hyper-political tools". [126] Leonard[127] and Mathiopoulos[128] agree by specifying specific

[123] *See* Wright & De Filippi, *supra* note 1, at 4 (explaining the benefits of rules "administered through self-executing smart contracts").
[124] *See* Werbach & Cornell, *supra* note 34, at 315 (opining that smart contracts could threaten the legal frameworks that have existed for many years).
[125] *See* Michael Abramowicz, *Cryptocurrency-Based Law*, 9 GEO. WASH. LEG. STUD. 53, 362-63 (2015) (noting that smart contracts will demonstrate an element of computerized judgment, yet still need human interaction to determine ambiguities that computers cannot solve).
[126] *See* Marcella Atzori, Blockchain Technology and Decentralized Governance: Is the State Still Necessary? (Dec. 2015) (unpublished manuscript) (on file with University College of London - Center for Blockchain Technologies) (explaining blockchain as a decentralized platform managing social interactions).
[127] *See* Robert Leonhard, Corporate Governance on Ethereum's Blockchain, W. Va. U. C. of L. (2017) (unpublished manuscript) (arguing that smart contracts will soon enter a multitude of different legal industries, and has the potential to be used in a political manner).
[128] *See* Jim Apollo Mathiopoulos, The Decentralized Autonomous Organization

areas of the law; soon to be disrupted. This academic stream of thought highlights two important realities: 1) multiple forms of emergence for a *Lex Cryptographia*; and 2) one common test to disprove a *Lex Cryptographia* – if private law can, and is better positioned to regulate legality.

C. Faster than Obsolescence: The Likely Development of a Lex Cryptographia

Calabresi in his work *A Common Law for the Age of Statutes*[129], aims to advance two approaches for the evolution of statues; in light of time and innovation.[130] Paradoxically, this need for an adaptation to new realities is exactly what Raskin and Werbach use when arguing for a *displacement* of private law by means of a de facto alternative to law – *Lex Cryptographia.* On the other hand, Calabresi would argue for an *integration* of this *Lex Cryptographia* into private law. In this sense either: 1) courts are instilled with the legal authority to update statues; or 2) and to a lesser extent, parliaments will enact new legislation. [131]

Calabresi constructs his argument in a similarly dynamic environment of technological change, by highlighting *Sony Corp. v Universal City Studios*[132] also known as the 'Betamax Case'. Albeit addressing copy right law, the case considers a similar – to smart contracts – environment of industry evolution; new patterns of behavior emerge as a result of technology adoption. The aspect of technological adoption has an important gravity, as the court notes:

> If there are millions of owners of VTR's who make copies [which allegedly infringe copy right law according to statues of that time] … and if

(DAO) and Ethereum: Self-Regulation Taken to New Heights 5-6 (2016) (unpublished comment) (on file with Deakin Law School Centre for Corporate Governance) (highlighting the inevitable automation of ADR and other negotiation strategies).

[129] *See* Calabresi, *supra* note 59, at 59 (noting the Sunset Law approach to facilitate the ease of changing statutes outdated as a result of technological advances).

[130] *See* Louis Vogel, Book Note, *A Common Law for the Age of Statutes*, 58 IND. L. J. 287, 287-88 (1983) (reviewing Guido Calabresi, A COMMON LAW FOR THE AGE OF STATUTES (1982)).

[131] *See* Calabresi, *supra* note 59, at 34 (articulating that "the great judicial debate was not over whether the Court should live with the outdated laws, but rather over which technique of interpretation would best serve the object of updating and what the updated law should look like.").

[132] 464 U.S. 417, 418 (1984) (interpreting the Copyright Act in regards to the sale of home video tape recorders).

> proprietors of those program welcome the practice, the business of supplying the equipment [this new technology] that makes such copying feasible should not be stifled simply because the equipment is used by some individuals to make unauthorized reproductions […].[133]

This example compares well with distrusted ledger technology, which also has a significant user adoption but is not as such legally recognized. This case begs to consider: 'can we rightfully believe that misuse by some can forbid the legality for the many'? Strangely enough this has been the position of many blockchain regulators, thus far. The Supreme Court goes further than merely questioning potential illegality. The Court recognizes that the point of contention:

> […i]s wholly statutory, and, in a case like this, in which Congress has not plainly marked the course to be followed by the judiciary, this Court must be circumspect in construction the scope of rights created by a statute that never contemplated such a calculus of interest.[134]

The later implies that some statues no longer consider the existence of a new way of operating technology. More so, statutes may not anticipate such a use by a widely adopting public. To this end, Court's must decide against or rather by extension of the obsolete statute. This same statute originating from the United States Copyright Act of 1976[135], was later amended and reconfigured into the Audio Home Recording Act (AHRA) – with the edition of a new Chapter 10.[136] While statutes may change over time, this approach to asserting 'fair use' in similar liability scenarios has not changed since 1984 – date of the Supreme Court's decision of the 'Betamax case' – and was reasserted in *MGM Studios, Inc. v. Grokster, Ltd*[137] as the Supreme Court noted that "[t]he rule on inducement of infringement as developed in early cases is no

[133] *See id*. at 446 (discussing industry revolution through the use of VTR's which allows for unauthorized reproductions of televised events).
[134] *See id.* at 417 (noting that protection to copyright is wholly statutory).
[135] *See* 17 U.S.C. §§ 101, 107 (2012) (providing the permitted limitations on exclusive rights and defining fair use in the Copyright Act of 1976 which reformulated national copyright law).
[136] *See* Audio Home Recording Act of 1992, Pub. L. No. 102-563, 106 Stat. 4237 (codified as amended at 17 U.S.C.A. §§ 1001 to 1010) (amending the Copyright Act to include "Digital Audio Recording Devices and Media").
[137] 380 F.3d 1154, 1167 (9th Cir. 2004) (confirming prior Supreme Court precedent on the Fair Use doctrine).

different today".[138]

Although distant as to the fundamental facts, the legislative stance on copy right mediums closely mimics what is now happening with distributed ledger technology. To date, distributed ledger technology experiences the same uncoordinated actions of regulators who act within their subject matter jurisdiction.[139] This 'wait-and-see' approach is adopted because it may be hard to recognize the obsolescence of established statutes. Unlike in the Betamax Case, current American legislators have acted before the creation of case law and corresponding legal rules. They have been able to analogize smart contract with digital contracts; placing them, by way of state bills, within the existing body of private law – UETA and E-SIGN.[140] For this reason, we must agree with Calabresi's conjectures and suppose that smart contract law, will evolve according to the progression he proposes – an update of existing statutes.

Calabresi's work goes further than this. Overtime, he foresees that updating will transcend into structuring based on a criterion where "the court's judgement must be based primarily on whether the statute fits the legal landscape, because that is what a court is good at discerning and because 'fit' is correlated with majoritarian support". [141] This 'updating', in the words of Louis Vogel – who references Calabresi – "really means recognizing and enforcing consistently within the legal system". [142] If we have seen

[138] *See id.* at 1167 (noting that the rule of inducement infringement has not changed). "Evidence of active steps taken to encourage direct infringement … when a defendant merely sells a commercial product suitable for some lawful use." *Id*.

[139] *See* Blemus, *supra* note 17, at 7 (noting the "no-size-fits-all" approach in the jurisdictional regulation of distributed ledgers and ICOs).

[140] *See* 15 U.S.C.A § 7001 (2001) (asserting how a contract affecting interstate or foreign commerce may "not be denied legal effect, validity, or enforceability solely because an electronic signature or electronic record was used in its formation."); *see also* Uniform Electronic Transactions Act ("UETA") §§ 1-21 (1999) (listing jurisdictions where Uniform Electronic Transfer Act has been adopted).

[141] *See* Calabresi, *supra* note 59, at 121 (recognizing that the court's primary objective is to make sure the statute matches the legal landscape); *see also* Vogel, *supra* note 130, at 287 (quoting Calabresi's theory that certain criteria must be taken into account to determine when courts should act in order to keep the law up to date).

[142] *See* Calabresi, *supra* note 59, at 97 (recognizing that the "consistency with the fabric [of law] can be taken to be a reasonably accurate account of what has evolved from past popular desires, and the judge's task is to do what is needed to accommodate that account to present needs."); *see also* Vogel, *supra* note 130, at 287 (noting that the updating of statutes with technological innovations is critical to maintaining consistency).

more than 7 states introduce bills that recognize the legality of smart contracts, we can only expect that more states will follow. We may equally anticipate that regulatory actions of state bodies could lead to federal enforceability. We can even expect that other common law jurisdictions, such as the United Kingdom, may gravitate towards this 'American approach'.

One may rightfully ask: what about Civil law countries? Calabresi has something to say about these systems as well. He sees the "legal topography" not as an "isolated set of consistent rules and principles" but as a negative landscape.[143] That is to say: the legal framework, irrespective of its structural distinctions, controls the content of private transactions – such as smart contract technology – by including or excluding said content from the legal scope. In this way, "the legal environment is complete […] integrating civil statutes as well as common law". [144] For these reasons, comparative differences are significant but not unassailable; given that they consider the same fact patterns.

If, as Calabresi contends, the law is dynamic, overtime we can expect the universal legality of smart contracts where "the engine for change is constituted by the permanent discrepancy between the majoritarian desires and the legal framework". [145] Surely, one may contend: 'not all legal systems appreciate such dynamism'. Considering what we learned from American legislature – passed only months ago – we can agree, only in part. This 'engine' for change may merely be less efficient; either majoritarian desires are not yet pervasive or the context has not yet sufficiently changed. If we assert that even a fraction of what blockchain technology promises to achieve, is possible, we have sufficient proof to believe: overtime, this engine will propel the question on the legality of smart contracts far beyond common law jurisdictions and into civil law. While only time can tell if this is

[143] *See* Calabresi, *supra* note 59, at 24 ("[t]he approach looks to a legal topography that include both statutes and common law. A statute inconsistent with that topography would become anachronistic."); *see also* Vogel, *supra* 130, at 288 (viewing the legal landscape through the lens of what it excludes, as opposed to what it includes).

[144] *See* Vogel, *supra* 130, at 288 (highlighting Calabresi's observations of the fluid characteristics of the legal system); *see also* Calabresi, *supra* note 59, at 136 (observing the New Deal laws that were passed as an example of statutory changes applied to uniform common law as those particular common laws become older).

[145] *See Vogel*, *supra* note 130, at 288 (explaining the concept of Calabresi's legal system as a combination of common law and statues); *see also* Calabresi, *supra* note 59, at 74 (noting the challenges in applying change to the common law due to its uniformity).

true, we can agree that a *Lex Cryptographia* would not need to emerge; it would be integrated into private law by legislators who – as we have seen – have already started acting. Thus, the role of the regulators is to review the doctrine, in the way that we have in this work, and access to what extent and by which means it is applicable. If private law concepts are not sufficiently addressed, statutes could be updated in ways that are now being considered by American legislation.

II. Conclusion

This work contested the notion of a *Lex Cryptographia.* This organically emerging set of rules is supposed to replace statutes and regulate smart contracts. The underlying effect of this is an organization of private transactions outside the legal scope; albeit with clear legal elements. As this work recognizes, a Lex Cryptographia is not to be necessary.

Fist we have considered the foundations of smart contract technology – elements of the blockchain infrastructure. Asserting blockchain's limits, such as the immutability of transitions, we approached the concept of a smart contract. Establishing the communality between the definitions of Farrell, Szabo, and Clack et al. we were able illustrate the legal dimensions of smart contract agreements. In turn, these dimensions illustrated why the law is reticent to regulate.

Scholarly discussion revealed major doctrinal concerns. Werbach, Farrell and Amuial highlighted the inflexibility of forming contracts in code and thus, constrained the feasibility of legal, smart contracts. On the other hand, Raskin and Savelyev analogized smart contracts with comparable private law concepts. These parallels suggested a narrow field of application – the automation of performance. As a result, we asserted that digital agreements formulated in code, which automate performance of conditional terms, could in principle, compare to private law concepts.

Further, we, much like Amuial, O'Shields, and Lauslahti, inquired: 'are smart contracts legal agreements'? Comparisons to essential elements of contracts proposed a possible vector to tackle this question and allowed us to place smart contracts within private law. A final step of our discussion aimed to address: 'if legality is possible, how best do we achieve it'? Calabresi's work answered the later question: legislators will update statutes that no longer consider new technological developments and integrate these phenomena within existing private law concepts. In summary, we

can soon expect legislators to uphold the legality of smart contracts by extension of existing private law concepts.