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BLOCKCHAIN LAW – AN INTRODUCTION

Abstract

Blockchain technology is the more successful side-product of Bitcoin and crypto-currencies. Blockchains, distributed ledgers and smart contracts challenge traditional private-ordering beliefs. This paper examines whether there is still room for law. It offers an introduction into recent codification efforts conferring erga-omnes effects on blockchain-related contracts and value stored on electronic ledgers. U.S. blockchain statutes and national legislative projects in Europe will be assessed. As the legislative policies of the new General Data Protection Regulation of the European Union are beginning to unfold, regulators will also have to address the interface between blockchains and data protection.

Keywords: *Blockchains, distributed ledger technology, digitisation, private law standards, regulation*

I. Blockchains – Where Do We Stand?

1. A New Challenge to Law

Blockchain technology is the successful side-product of Bitcoin and cryptocurrencies[1]. Blockchains and decentralised ledger technology are belie-

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1 See See P. Rosenberger, Bitcoin and Blockchain – Vom Scheitern einer Ideologie und dem Erfolg einer revolutionären Technik (Springer Vieweg Berlin 2018), 63 et seq.; United Kingdom Government Office for Science, Distributed Ledger Technology: beyond block chain (London 2015) (available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf). See the speech by the governor of Sweden's Riksbank C. Skingsley, Should the Riksbank Issue e-Krona?, Stockholm 16 November 2016 (available at http://archive.riksbank.se/Documents/Tal/Skingsley/2016/tal_skingsley_161116_eng.pdf).

ved to revolutionise modern finance, industry and public services[2]. Transactions can be carried out in 'real time' without the intervention of traditional intermediaries[3]. The upshot of this development is an interface between blockchain technology and artificial intelligence, coordinating the activities of swarms of robots and drones[4].

Blockchain technology has brought forth a new infrastructure for transmitting and storing data. Blockchains operate differently from traditional data bases as they do not have to be centrally maintained. Each computer which participates in the blockchain system will carry the memory of the whole network of decentralised nodes[5]. By downloading the specific software on a computer, the user will be able to transmit electronic signals, to trigger transactions. Each incoming signal, each electronic signature is unique and cannot be forged. As soon as a signal enters the network, it will be time-stamped, grouped into blocks (hence 'blockchain'), and validated in order to ensure that it is not a replica of the previous one[6]. Once this validation has taken place, the

2 See Report by the United Kingdom House of Lords, Distributed Ledger Technologies for Public Good: leadership, collaboration and innovation (London 2017), at p. 18 et seq. (available at http://chrisholmes.co.uk/wp-content/uploads/2017/11/Distributed-Ledger-Technologies-for-Public-Good_leadership-collaboration-and-innovation.pdf).

3 See comments by ISDA Chief Executive Officer S. O'Malia, The Legal Aspects of Smart Contracts, on the efficiency potential of smart contracts, 9 August 2017 (available at https://www.isda.org/2017/08/09/the-legal-aspects-of-smart-contracts/). For a general evaluation of the positive and negative effects of distributed ledger technology: United Kingdom Financial Conduct Authority, Discussion paper DP 17/3 on distributed ledger technology (London April 2017) (available at https://www.fca.org.uk/publication/discussion/dp17-03.pdf); US Financial Industry Regulatory Authority (Finra), Regulators Forum on Distributed Ledger Technology (DLT), 13 July 2017 (available at http://www.finra.org/sites/default/files/2017_BC_Regulators_Forum.pdf).

4 See E. Castelló Ferrer, The blockchain: a new framework for robotic swarm systems (6 August 2016, available at https://www.researchgate.net/publication/305807446_The_blockchain_a_new_framework_for_robotic_swarm_systems/download); Ledger Insights, Boeing launches blockchain, AI drone venture (November 2018, available at https://www.ledgerinsights.com/boeing-blockchain-aidrone-skygrid/).

5 For a general introduction see P. De Filippi/A. Wright, Blockchain and the Law – The Rule of Code (Harvard University Press, Cambridge 2018), 13 et seq.; M. Finck, Blockchain Regulation and Governance in Europe (Cambridge University Press, Cambridge 2019), 6 et seq.; W. Mougayar, The Business Blockchain ((Wiley, Hoboken 2016), 1 et seq., 124 et seq.; R. Lai/D. Lee Kuo Chen, in: D. Lee Kuo Chen/R. Deng (eds.) Handbook of Blockchain, Finance, and Inclusion, Vol. 2 (Academic Press – Elsevier, London 2018), 145 (157 et seq.).

6 R. Vilarroig Moya/C. Pastor Sempere, Blockchain: Aspectos Tecnológicos, Empresariales y Legales (Thompson Reuters/Aranzadi, Cizur Meno 2018), 56 et seq.; E. Rutland, Blockchain Byte (R3Research,2017), at p. 2 et seq. (available at https://www.finra.org/sites/default/files/2017_BC_Byte.pdf). Ergänzen

transaction will be stored in a distributed ledger, accessible via the individual computer. In fact, the distributed ledger is the record of consensus of cryptographic audit trails, validated after originating from an individual node[7]. In the Bitcoin scenario, participants send value across the network. The transferor is equipped with a private key to make his bitcoins enter the system, whereas the transferee operates a public key to accede to a network where validated, electronic 'value messages' may be sent to his or her address[8]. Blockchain systems have become considerably sophisticated since their Bitcoin beginnings[9]. A distributed ledger will not only operate as the memory of the system, it may also be used to store value[10].

Blockchain and distributed ledger systems can be organised as permissionless or private networks[11]. For private or permissioned blockchain and distributed ledger systems, the software cannot be freely downloaded. Instead, participants will have to seek access, frequently from the organisers of the platform[12], by accepting the terms of operation (including validation) and the standards of digital trading[13]. Private blockchain systems benefit from low verification costs, but still cannot dispense with the costs of running trusted nodes[14]. Moreover, computer and finance specialists will have to explore to what extent contracting and clearing processes can be translated into algorithms without jeopardising the efficiencies of international trade[15]. Especially

7 D. Tapscott/A. Tapscott, Blockchain Revolution – How the Technology behind Bitcoin is Changing Money, Business and the World (Portfolio/Penguin, 2016), 30 et seq.

8 J.W. Ibáñez Jiménez, Derecho de Blockchain y de la tecnología de registros distribuidos (Thompson Reuters/Aranzadi, Cizur Meno, 2018), 36 et seq.

9 Di Filippi/Wright, supra sub FN 5, at p. 27 et seq.; Tapscott/Tapscott, supra FN 7, p. 55 et seq.; Virarroig Moya/Sempere, supra sub FN 6, at p. 256 et seq.

10 See the analysis by the Swiss Federal Government on the potential of distributed ledger technology: Schweizerische Eidgenossenschaft, Der Bundesrat, Rechtliche Grundlagen für *Distributed Ledger*-Technologie und Blockchain in der Schweiz – Eine Auslegeordnung mit Fokus auf dem Finanzsektor, p. 39 et seq. (Bern 14 December 2018, available at https://www.mme.ch/fileadmin/files/documents/Publikationen/2018/181207_Bericht_Bundesrat_Blockchain.pdf).

11 De Filippi/Wright, supra sub FN 5, 31 et seq.

12 For a survey see Moya/Pastor Sempere, supra sub FN 6, p. 60 et seq.

13 See C. Catalini/J.S. Gans, Some Simple Economics of the Blockchain, NBER Working Paper Series, Working Paper No. 22952 (December 2016), at p. 11 et seq. (available at http://www.nber.org/papers/w22952.pdf).

14 Ibid., at p. 12.

15 See Ibáñez Jiménez, supra FN 8, 89 et seq. ; A. Garapon/J. Lassègue, Justice digital – Révolution graphique et rupture (Presses Universitaires de France, Paris 2018), at p. 140 et seq., and J. Dewey/S. Amuial/J. Seul, The Blockchain: A Guide for Legal and Business Professionals (Thompson Reuters 2016),, at § 2:5, on programing smart contracts.

the international finance community has begun to assess the potential of permissioned blockchains. Permissioned blockchain systems are thought to assure a high degree of compliance with local regulatory interventions[16], since the 'gatekeeper' of the permissioned system normally has to apply for a licence from local capital market authorities. Although algorithms as such do not qualify for protection by an intellectual property right[17], specific applications of blockchain technology can be recognised as patentable[18]. To reinforce their position as blockchain innovators, U.S. banks have begun to file for patent protection for newly-developed applications[19]. Patent protection allows developers of specific blockchain applications to reap the exclusionary benefits of their creativity, but it might also raise competition concerns[20].

Cryptocurrencies, smart securities and derivatives and the organisational products of blockchain technology generate both, positive and negative

16 ISDA/Linklaters, Whitepaper – Smart Contracts and Distributed Ledger – A Legal Perspective (August 2017), (available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf).

17 For an overview see: C. Wild et al., Electronic and Mobile Commerce Law (University of Hertfordshire Press Hatfield, 2011) (134 et seq.); C. Reed (ed.), Computer Law (Oxford University Press Oxford, 7th ed. 2011), 373 et seq.

18 See F. Marrella/C.S. Yoo, Is Open Source Software the New Lex Mercatoria?, 47 Va. J. Int'l L. 807 (831 et seq.) (2007), and United States Patent Application U.S. 2015/0332395 of 19 November 2015 (Cryptographic Currency for Securities Settlement) by Goldman Sachs & Co, New York City (available at http://www.freepatentsonline.com/20150332395.pdf); Financial Times on-line 3 December 2015, Jennifer Hughes, Goldman Sachs files patent for virtual settlement currency (available at https://www.ft.com/content/b0d8f614-997c-11e5-9228-87e603d47bdc).

19 O. Kharif, Big Banks Are Stocking Up on Blockchain Patents (21 December 2016, available at https://www.bloomberg.com/news/articles/2016-12-21/who-owns-blockchain-goldman-bofa-amass-patents-for-coming-wars); Finextra Blog, Bank of America loads up on blockchain patents (29 January 2016, available at https://www.finextra.com/newsarticle/28401/bank-of-america-loads-up-on-blockchain-patents); J. Hughes, Goldman Sachs files patent for virtual settlement system, Financial Times on-line 3 December 2015 (available at https://www.ft.com/content/b0d8f614-997c-11e5-9228-87e603d47bdc); M. Arnold, Big banks plan to coin new digital currency – Group of major lenders seeks industry standard for settlements, Financial Times on-line 23 august 2016 (available at https://www.ft.com/content/1a962c16-6952-11e6-ae5b-a7cc5dd5a28c).

20 See OECD, Directorate for Financial and Enterprise Affairs (Competition Committee), Blockchain Technology and Competition Policy – Issues Paper by the Secretariat (DAF/COMP)WD(2018)47), Paris 8 June 2018, para. 12 et seq. (available at https://one.oecd.org/document/DAF/COMP/WD(2018)47/en/pdf); European Parliament, Directorate-General for Internal Policies, Competition issues in the Area of Financial Technology (FinTech) (Study IP/A/ECON/2017-20, July 2018, available at http://www.europarl.europa.eu/RegData/etudes/STUD/2018/619027/IPOL_STU(2018)619027_EN.pdf).

externalities[21]. Nonetheless, regulators appear to have decided not to interfere too early with digitisation in the making. A regulatory sandbox approach or supportive blockchain statutes are recommended as an element of regulatory competition to attract business[22].

As smart contracts and artificial intelligence are beginning to merge with blockchain technology, the debate concentrates on how the claim that 'code is law'[23] can be reconciled with traditional notions of offer and acceptance. In the context of FinTech, the question arises how assets can be stored digitally and whether they produce *erga-omnes* effects[24]. Once recognised as a 'thing', a piece of property, digital assets could be traded like any other merchandise[25]. Recent codifications on blockchain-based contracts go beyond consumer protection. They are about to modify the laws of contract and property[26]. Last year, the European Union's law on data protection added a new

21 For a general evaluation of the positive and negative effects of distributed ledger technology: FCA Discussion Paper, supra sub FN 3; US Financial Industry Regulatory Authority (Finra), Regulators Forum on Distributed Ledger Technology (DLT), 13 July 2017 (available at http://www.finra.org-/sites/default/files/2017_BC_Regulators_Forum.pdf). See also David Mills et al., Distributed ledger technology in payments, clearing, and settlement, Federal Reserve Board, Washington, D.C., Staff Working Paper – Finance and Economics and Discussion Series 2016-095 (available at https://www.federalreserve.gov/econresdata/feds/2016/files/2016095pap.pdf), and comments by ISDA Chief Executive Officer S. O'Malia, The Legal Aspects of Smart Contracts, on the efficiency potential of smart contracts, 9 August 2017 (available at https://www.isda.org/2017/08/09/the-legal-aspects-of-smart-contracts/).

22 See United Kingdom Financial Conduct Authority, Discussion Paper on distributed ledger technology (DP 17/3, London April 2017) (available at https://www.fca.org.uk/publication/discussion/dp17-03.pdf) for a regulatory sandbox approach, and the legislative proposal by the Liechtenstein Government: Vernehmlassungsbericht der Regierung betreffend die Schaffung eines Gesetzes über auf vertrauenswürdigen Technologien (VT) beruhende Transaktionsaktionssysteme (Blockchain-Gesetz; VT-Gesetz, VTG) (Vaduz 28 August 2018, available at https://www.llv.li/files/srk/vnb-blockchain-gesetz.pdf).

23 See L. Lessig, Code Version 2.0 (Basic Books 2006), 5, 77 et seq.; cf. Di Filippi/Wright, supra sub FN 5, at p. 74 et seq.

24 See the distinction between payment, utility and asset tokens by the Swiss Financial Market Supervisory Authority (FINMA): Swiss FINMA Guidelines for enquiries regarding the regulatory framework for initial coin offerings (ICOs)of 16 February 2018 (available at https://www.finma.ch/en/news/2018/02/20180216-mm-ico-wegleitung/), and the assessment under what circumstances blockchain transactions need to attain 'legal value' (*'valeur légale'*): T. Bonneau/T. Verbiest, Fintech et Droit (EB Édition, Paris 2017), p. 77 et seq.

25 Cf. Vilarroig Moya/Pastor Sempere, supra sub FN 6, 178 et seq.

26 See infra sub III.3.

aspect to the legal analysis on blockchains[27]. Data protection law and the individual's 'right to be forgotten' are bound to shape the private law on blockchains[28].

2. Outline of the Paper

This paper will first survey the current debate on smart contracts and whether the very nature of legal contracts generated by algorithms places them beyond judicial scrutiny. Regulatory intervention by supplying private law is predicated on the belief that private ordering may not always bring forth efficient results[29]. A pure private-ordering approach cannot explain under what circumstances contracts are capable of generating *erga-omnes* effects with a corresponding recognition under property law. The analysis will focus on blockchain statutes in off-shore jurisdictions and some U.S. states, before it turns to French legislation on mini-bonds and non-listed securities and the recent Liechtenstein draft law on blockchains. A final section on the challenges for regulators in the age of cross-border blockchains and data protection concludes.

II. Private Law for Blockchains

1. Smart Contracts

Blockchains have the reputation of being faultless since they record any transaction between their users since the very first day of trading[30]. From the perspective of private contracting this seems to imply that any transaction recorded on the distributed ledger is immune from subsequently being challenged in court. This would extend to both, rules of substantive law and the law of civil procedure, including evidence of electronically stored 'facts'[31]. If the infallibility of blockchains and distributed ledger technology is carried to the extreme, this would also frustrate any meaningful attempt by regulators to

27 Regulation (EU) 2016/679 of 27 April 2016 (General Data Protection Regulation), O.J. L 119/1 of 4 May 2016.

28 For an introduction into the interface between data protection and blockchain technology: Finck, supra sub FN 5, p. 88 et seq.

29 Di Filippi/Wright, supra sub FN 5, at p. 185, suggest that governments should focus on influencing the underlying dynamics of blockchain controlled markets.

30 See Tapscott/Tapscott, supra sub FN 7, at p. 4 et seq. (on the trust function); Garapon/Lassègue, supra sub FN 15, at p. 140 et seq.

31 See Ibáñez Jiménez, supra sub FN 8, 56 et seq.

ensure compatibility with mandatory law, e.g. for the financial markets. Thus digitisation appears to accelerate the permanent de-stabilisation of law[32].

The history of Bitcoin and its (more sophisticated) progeny demonstrates that forging algorithms and siphoning off virtual currencies from exchanges occur in spite of the proclaimed infallibility of the system[33]. Moreover, the infallibility claim rests on assumptions about smart contracts and the underlying algorithms which are debatable. Transactions via blockchains and distributed ledgers under '2.0 blockchain platforms'[34] are frequently predicated on initial negotiations between the parties, sometimes including an agreement with the organiser of a permissioned blockchain. These negotiations aim at implementing contractual stipulations via the blockchain and distributed ledger, but they also trigger an exercise in standardisation[35]. Contractual stipulations are converted into code, computer programmes, in order to generate a stable climate of enforcement and to avert violations of law. Thus, algorithms may also produce positive norm-stabilising effects[36].

On the other hand, the digitisation of the market for global payment services highlights potential negative externalities from privately-controlled blockchain models: One of the major payment services provider, PayPal has made a plea for a 'Smart Governance Cycle' which relies on algorithms to speed up decision-making processes and to minimise the risk of intervening customer default by accelerating money transfers[37]. The upshot of this proposal is a scenario where regulatory intervention is inappropriate because 'smart

32 But see also the nuanced approaches by Finck, supra sub FN 5, at p. 43 et seq., and by De Filippi/Wright, supra sub FN 5, at p. 196 et seq.

33 See the Mt. Gox insolvency: R.S. Grossman, Something to like about bitcoin (5 March 2014) (OUP blog, available at https://blog.oup.com/2014/03/bitcoin-economics/); A. Hern, A history of bitcoin hacks, The Guardian online 18 March 2014 (available at https://www.theguardian.com/technology/2014/mar/18/history-of-bitcoin-hacks-alternative-currency).

34 See: Vilarroig Moya/Pastor Sempre, supra sub FN 6, at p. 60 et seq.

35 See the standardisation efforts in digitising contracts by the International Swaps and Derivatives Organization (ISDA), ISDA/Linklaters, Whitepaper, supra sub FN 16.

36 Finck, supra sub FN 5, at p. 43 et seq.

37 See PayPal's Booklet on PayPal – A Smart Step: Putting Innovation at the Heart of Payments Regulation, at p. 16 et seq. (Brussels ebayEU Liaison Office, 2013, available at https://www.paypalobjects.com/webstatic/en_US/mktg/public-policy/PayPal-Payment-Regulations-Booklet-EU.pdf., p. 23 et seq.; PayPal/ebay Booklet, 21st Century Regulation – Putting Innovation at the Heart of Payments Regulation p. 20 et seq. (Washington, D.C., 2013, available at https://www.paypalobjects.com/webstatic/en_US/mktg/public-policy/PayPal-Payment-Regulations-Booklet-US.pdf).

governance' addresses potential inefficiencies and negative externalities[38], as code has become law[39]. Once a party has accepted a code, it might be taken to have renounced the right to attack in court the result of the code's workings, the digitised contract. This redefines the balance between the courts and digitisation, but it also changes the role of the judge who is thought to become just an executor of the smart contract, i.e. the computer programme[40]. Those who control the code have acquired the power to control the trade[41].

The argument about the normative consequences emanating from a smart contract or even a digitised contract generated by blockchains and DLT suffers from a certain circularity. In the context of private contracting, whether by a traditional exchange of declaration of intent or by an automated contracting mechanism, parties can establish a legal order between themselves without third-party effects. But the jurisprudence of the Court of Justice of the European Union (CJEU) has made it clear that consumer protection rules even apply in the context of digitisation and contracts concluded in an online scenario[42]. Thus, the very existence of an electronic contract generated by blockchain and DLT is unable to exclude regulatory intervention *per se*. Under Directive 2011/83/EU[43] consumers have a right to withdraw from an online contract, including contracts on the supply of digital content. *De facto*, this confers a right to challenge an online transaction on the basis of an error. As a corollary, it is unlikely that by applying for accession to a permissioned, privately-administered blockchain clearing system one of the parties renounces completely to having its rights enforced either by a court or by an arbitration procedure. In the context of consumer protection, the CJEU has observed

38 For an early assessment of „the perils of Being PayPal": C. Kaminski, Online Peer-to-Peer Payments: PayPal Primes the Pump, Will Banks Follow?, 7 N.C. Banking Inst 7 N.C. Bank. Inst. 375 (380 et seq.) (2003).

39 Lessig, supra sub FN 23, 5, 77 et seq.; cf. Di Filippi/Wright, supra sub FN 5, at p. 74 et seq.

40 Garrapon/Lassègue, supra sub FN 93.

41 Lessig, supra sub FN 23, at p. 79.

42 CJEU judgment of 7 December 2010, joint cases no. C-585/08, Pommer v. Reederei Karl Schlüter GmbH & Co. KG, [2010] ECR I-12527; and no. C-144/09, Hotel Alpemhof GesmbH v. Oliver Heller, [2010] ECR I- 12527, and the analysis by D.J. Svantesson, Digital Contracts in Global Surroundings, in: S. Grundmann (ed.), European Contract Law in the Digital Age (Intersentia Cambridge 2018), 49 (at p. 75 et seq.).

43 Art. 6 of the Directive 2011/83/EU of 25 October 2011 on consumer rights, amending Council Directive 93/13/EEC and Directive 1999/44/EC of the European Parliament and of the Council and repealing Council Directive 85/577/EEC and Directive 97/7/EC of the European Parliament and of the Council, O.J. L 304/64 of 22 November 2011.

that consumers are entitled to having their day in court[44]. This is not to suggest that smart contracts and algorithms are automatically open to comprehensive scrutiny. Conversely, the assertion that blockchain codes and smart contracts, triggered by the operation of blockchain technology, automatically excludes any judicial scrutiny is not tenable either. As the mandatory rules of the new General Data Protection Regulation[45] unfold, the operation of smart contracts, blockchains, and decentralised ledgers and underlying 'legal' contracts may yet have to adapt irrespective from where they are located.

2. Oracles

In introducing digitisation to the international trade in derivatives and clearing processes the International Swaps and Derivatives Association (ISDA) has emphasised the need to distinguish between operational and non-operational clauses[46]. Clearing processes on the basis of smart contracts and distributed ledger technology can only operate if (automated) payments and deliveries under the respective contracts are triggered by pre-determined, well-defined events ("conditional logic")[47]. Smart contracts implementing a traditional, 'legal' framework contracts have to be conditioned on verifiable events, triggering the workings of an algorithmic programme without requiring a value judgment[48]. A smart contract may become operative if information has been received that an outside event has occurred[49]. Outside events requiring a judgment whether fulfilment of contractual obligations can be certified, defy easy translation into algorithms[50]. Such judgment may be retrieved from another distributed ledger, but it can also require the intervention of a so-called oracle where a human being decides. Conceivably, such an oracle could also be programmed to provide for private dispute solution or arbitration[51].

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44 See supra sub FN 42.

45 See infra sub III.4.

46 ISDA/Linklaters, Whitepaper, supra sub FN 16.

47 Ibid.

48 Ibid.

49 See M. Kaulartz/J. Heckmann, Smart Contracts – Anwendungen der Blockchain-Technologie, Computer und Recht, 9/2016, 618, and M. Bartoletti/L. Pompianu, An empirical analysis of smart contract: platforms, applications, and design patterns (18 March 2017) (available at https://arxiv.org/pdf/1703.06322.pdf).

50 ISDA/Linklaters, Whitepaper, supra sub FN 16.

51 De Filippi/Wright, supra sub FN 9, at p. 75. Dewey/Amuial/Seul, supra sub FN 15, § 2.5., caution, however, that the use of extrinsic information has to be shielded from manipulative practices

III. Blockchain Statutes

1. The Regulatory Problem

International banking consortia and clearing institutions have an interest in forging private cross-border standards in order to reap the benefits of digitisation, but also to circumvent the intricacies of conflicting national concepts. However, this private ordering approach faces its litmus test once a practical case 'touches down' on a national legal order. This is most likely to happen when trading via smart contracts, blockchains and distributed ledgers meets national mandatory law or attempts to cross the borderline between the law of obligations and property law. In June 2016, the German Supreme Court (*Bundesgerichtshof*) decided that the international practice of adding and subtracting claims based upon a master agreement for netting was in breach of national insolvency law[52]. As a consequence of this holding, the parties to a series of contracts on derivatives would be obliged to modify their risk management strategies in order to comply with national insolvency law[53].The German legislator quickly stepped in to remedy the court holding. The amended Insolvency Code classifies all claims and counter-claims as one single transaction, occurring before the initiation of proceedings[54]. This is a case where the legislator confers exclusionary third-party effects on a system of contracts under the law of obligations in order to escape creditors' claims under insolvency law.

Both, the UNCITRAL Model on Electronic Commerce[55] and the EU Directive on e-commerce[56] approach the digitisation of offer and acceptance

52 Bundesgerichtshof (German Federal Supreme Court), judgment of 9 June 2016 (available at http://juris.bundesgerichtshof.de/cgi-bin/rechtsprechung/document.py?Gericht=bgh&Art=en&nr=74978&pos=0&anz=1).

53 See in this context art. 295 of the EU's Regulation no. 575/2013 (corrigendum in O.J. L 321/6 of 30 November 2013) on prudential requirements for credit institutions and investment firms (recognition of contractual netting as risk reducing) (available at https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2013:321:0006:0342:EN:PDF), and BaFin (Bundesanstalt für Finanzdienstleistungsaufsicht), H. Thonfeld, Netting-Klauseln: Rechtssicherheit für Rahmenverträge über Finanztermingeschäfte (16 January 2017) (available at https://www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Fachartikel/2017/fa_bj_1701_Netting_Klauseln.html).

54 See amended s. 104 of the German Insolvency Code.

55 UNCITRALModel Law on Electronic Commerce with Guide to Enactment1996 with additional article 5 bis as adopted in 1998 (available at https://www.uncitral.org/pdf/english/texts/electcom/05-89450_Ebook.pdf).

56 Directive 2000/31/EC of the European Parliament and of the Council of 8 June 2000 on certain legal aspects of information society services, in particular electronic commerce, in the Internal

by expanding traditional concepts of private contracting. The EU's Regulation on electronic identification and trust services for electronic transactions acknowledges that digitised contracting challenges also evidentiary standards, but does not yet reflect on evidentiary standards or third-party effects of electronic records[57]. The UNCITRAL Model Law on Electronic Transferable Records[58] refrains from laying down rules of substantive law[59]. But it relies on an analogy between transferable documents or instruments and electronic transferable records, including distributed ledgers (blockchain)[60]. Moreover, the UNCITRAL Model Law appears to place electronic (negotiable instruments) instruments in the realm of negotiable instruments, and hence, tangible assets[61]. The transfer of an electronic asset recorded in a distributed ledger is perfected (with *erga-omnes* effects) once the transferee acquires control over the electronic transferable record, i.e. the access code, from the transferor[62]. In commenting on the blockchain-based investments for securities, the Swiss FINMA emphasises that the commodification of electronic signals is a gradual process: Cryptocurrencies exclusively used for payment purposes will not transcend the borderline between the law of contract and property law. Specific electronic keys, utility tokens, do not qualify as securities as long as they provide for digital access rights only[63]. Asset tokens, electronic commodities, may represent physical assets to be traded via blockchains. Such tokens are similar to equities, bonds or derivatives. They attain legal status with *erga-*

Market (Directive on electronic commerce), O.J. L 178/1 of 17 July 2000 (available at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32000L0031&from=EN).

57 Regulation (EU) 910/2014 of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market, O.J. L 257/73 of 28 August 2014.

58 United Nations Commission on International Trade Law (UNCITRAL), Press Release UNIS/L/251 of 17 July 2017, UN Commission on International Trade Law adopts the UNCITRAL Model Law on Electronic Transferable Records (available at http://www.unis.unvienna.org/unis/en/pressrels/2017/unisl251.html); UNCITRAL Explanatory Note on the Model Law (13 July 2017) (available at http://www.uncitral.org/uncitral/en/uncitral_texts/electronic_commerce/2017model.html).

59 Art. 1 para. 3 of the Model Law.

60 Ibid.

61 K. Takahashi, Implications of the Blockchain Technology for the UNICTRAL Works, in: Modernizing International Trade Law to Support Innovation and Sustainable Development - Proceedings of the Congress of the United Nations Commission on International Trade Law Vienna July 2017, p. 81 et seq. (available at http://www.uncitral.org/pdf/english/congress/17-06783_ebook.pdf).;

62 See commentary on art. 11 of the Model Law.

63 See supra sub FN 24, at 3.2.2.

omnes effects if digitally recorded on a blockchain, clearing the way for mass standardised trading[64].

2. Blockchain Laws in the US

Various states in the U.S. have enacted blockchain statutes. In fact, the legislative development of the past five years have generated several generations of blockchain enactments. Contrary to their European counterparts, most statutes go beyond prescribing specific rules for FinTech investments via blockchain technology. As a matter of legislative technique, U.S. blockchain statutes attempt to expand the regulatory framework proposed by the Uniform Electronic Transactions Act of 1999[65].

A 2018 New York bill on the creation of distributed ledger technology and business entities that develop such technologies expressly defines "distributed ledger technology" *inter alia* "[as] mathematical secured, chronological, and decentralized consensus ledger or database, whether maintained via internet, interaction, peer-to-peer network, or otherwise used to authenticate, record, share and synchronize transactions in their respective electronic ledgers or databases"[66]. A proposed 2018 amendment to the New York technology law introduces an interesting analogy to the law of contracts. Signatures secured through blockchain technology and smart contracts will be deemed to be in electronic form and, therefore capable of bringing forth a contract. The envisaged amendment carries this approach even further. Although not necessarily triggered by specific *ad-hoc* statement, smart contracts are recognised in commerce and contract will remain valid and enforceable. There is a somewhat opaque passage in the draft statute reflecting on property law aspects of blockchain technology. Ownership of information will not be lost even if such information is processed by blockchain technology[67].

64 Ibid.

65 National Conference of Conference of Commissioners on Uniform State Laws, Uniform Electronic Transactions Act (1999) (available at http://euro.ecom.cmu.edu/program/law/08-732/Transactions/ueta.pdf).

66 New York Assembly Bill A 10854 of 23 May 2018, relating to the development and creation of distributed ledger technology and business entities that develop such technology (available at https://www.nysenate.gov/legislation/bills/2017/a10854).

67 New York Senate Bill S 8858 (2017-2018 Legislative Session), allowing signatures secured through blockchain technology to be considered an electronic signature (available at https://www.nysenate.gov/legislation/bills/2017/s8858).

Arizona and Tennessee[68] have chosen a comparable approach. The Arizona statute expressly observes that "the data on the ledger is protected with cryptography, is immutable and auditable and provides an uncensored truth"[69]. Arizona law tacitly acknowledges that blockchain technology and smart contracts create property law effects. Blockchain technology is understood to include tokenised crypto-economics, electronic certificates evidencing ownership of an information or an asset. 'Smart contracts' within the meaning of the statute are "event-driven programs" that "can custody over and instruct transfer of assets on … [a] ledger"[70].

Vermont law defines a 'participant' in a blockchain as a "person in control of any digital asset native to the … blockchain technology"[71] without specifying the criteria for 'control'. What is still unclear under these blockchain statutes how valid smart contracts triggering commercial transactions can be reconciled with the traditional notion of freely negotiated private law contracts. The Wyoming 2018 law has moved into the property law effects of blockchains by providing for 'open blockchain tokens' in exchange for the receipt of goods, services or content, including rights of access thereto[72].

68 See § 47-10-201 et seq.of the Tennessee Code Annotated (State of Tennessee, 110th General Assembly, 2017-2018, SB 1662, public chapter no. 591, available at https://legiscan.com/TN/text/SB1662/2017).

69 44-7061 Arizona Statutes (as amended by Arizona House of Representatives Bill HB 2417 (53rd Legislature, First Regular Session 2017, available at https://www.azleg.gov/legtext/53leg-/1r/bills/hb2417p.pdf).

70 Ibid.

71 12 V.S.A. § 1913 (2) (A) (available at https://law.justia.com/codes/vermont/2016/title-12/chapter-81/section-1913).

72 See the of an ‚open blockchain token' in § 17-4-206 (e) of the Wyoming Statutes:

(e) As used in this section, "open blockchain token" means a digital unit which is:

(i) Created:

(A) In response to the verification or collection of a specified number of transactions relating to a digital ledger or database;

(B) By deploying computer code to a blockchain network that allows for the creation of digital tokens or other units; or

(C) Using any combination of the methods specified in subparagraphs (A) and (B) of this paragraph.

(ii) Recorded in a digital ledger or database which is chronological, consensus-based, decentralized and mathematically verified in nature, especially relating to the supply of units and their distribution; and

(iii) Capable of being traded or transferred between persons without an intermediary or custodian of value.

However, if the token at the time of sale is not ready for 'consumptive purposes' the buyer is barred from reselling prior to maturity[73].

Several states have enacted specific provisions on the evidentiary value of distributed ledgers. These are intended to address problems of property law, but they also relate to burden-of-proof problems when blockchain technology reaches the courts. Generally, information stored on a distributed ledger can be classified as duly registered in an electronic record. Under a lenient regulatory approach transactions via blockchains and smart contracts should be recognised. Nonetheless, the parties may occasionally request a print-out of the respective agreement[74]. State legislators have decided to replace physical registers of shareholders by blockchain technology[75]. Conceivably, blockchain technology can also be employed to generate electronic proxies for voting in the general meetings of shareholders, as long as the holder of an electronic share registered on a distributed ledger can be identified[76].

A Vermont 2016 statute provides for rules of evidence if 'a digital record electronically registered in a blockchain' reaches litigation[77]. Such record shall be considered as self-authenticating if accompanied by a written declaration under oath by a qualified person, certifying the propriety of the use of blockchain technology[78]. The statute carries a presumption that a record verified through blockchain technology is authentic. Nonetheless the presumption does not cover the truthfulness, the validity or legal status of the contents of the fact or record[79]. A Michigan 2018 draft bill challenges the com-

73 § 17-4-206 (a) (3) of the Wyoming Statutes.

74 New Jersey Statute Senate Bill No. 2462, 218th Legislature 2018 (available at https://legiscan.com/NJ/text/S2462/2018).

75 See e.g. Delaware State Senate Bill no. 69 (149th General Assembly) amending § 151 (f) Title 8 of the Delaware Code (available at https://legis.delaware.gov/json/BillDetail/GenerateHtmlDocument?legislationId=25730&legislationTypeId=1&docTypeId=2&legislationName=SB69), and Arizona House of Representatives, Chapter 122 House Bill 2603 (53th Legislature, Second Regular Session 2018), amending §§ 10-140 and 44-7003 Arizona Revised Statutes (available at https://legiscan.com/AZ/text/HB2603/id/1718691).

76 See Wyoming House of Representatives Bill HB 0101 (64th Legislature 2018 Budget Session), amending the state's Business Corporation Act (available at https://www.wyoleg.gov/Legislation/2018/HB0101).

77 12 V.S.A. § 1913 (see supra sub FN 71).

78 12 V.S.A. § 1913 (b) (1).

79 12 V.S.A. § 1913 (b) (4).

mon belief that blockchains cannot be forged: The alteration of a record made utilising distributed ledger technology shall be declared a felony[80].

3. Europe – National Blockchain Codifications

On the European Union level, the growing importance of blockchains has not yet triggered legislative activities. The EU Commission has supported the establishment of advisory bodies. Both, the European Blockchain Partnership[81] and the EU Blockchain Observatory & Forum[82] are to collect factual evidence and to sharpen the awareness where regulatory intervention might be apposite. So far, the only major jurisdiction to have moved for rules on trading certain securities via blockchains with *erga-omnes* is France[83]. On the other hand, some minor European jurisdictions have embraced blockchain statutes to enhance their attractiveness as an off-shore centre for digitised finance.

a. Gibraltar

The 2017 Gibraltar Regulations on Financial Services (Distributed Ledger Technology) specify that DLT may be used "for storing and transmitting value belonging to others"[84]. However, from the perspective of a civilian lawyer it remains unclear what property status the 'values' have which are stored on distributed ledger. Apparently, 'value' can be both, a piece of property, but also "rights or interests, with or without related information, such as agreements or transactions for the transfer of value or its payment, clearing or settlement"[85].

b. Malta

In July 2018, Malta passed the Digital Innovation Authority Act[86] in an attempt to develop the innovative technology sector while protecting consu-

80 Michigan House Bill No. 6257 of 12 June 2018 (available at https://www.legislature.mi.gov/(S(mws4vloduoupi33tzbtkhlnv))/mileg.aspx?page=getobject&objectname=2018-HB-6257).

81 See 2018 Declaration on European Partnership on Blockchain (available at https://ec.europa.eu/digital-single-market/en/news/european-countries-join-blockchain-partnership).

82 Website at https://www.eublockchainforum.eu/.

83 See infra sub III.3.e.

84 Gibraltar Financial Services (Distributed Ledger Technology Providers) Regulations 2017 (Schedule 1 Amendments to the Principal Act) (LN. 2017/204) (available at http://gibraltarlaws.gov.gi/articles/2017s204.pdf).

85 Ibid.

86 Ch. 591 of the laws of Malta (available at http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12873&l=1).

mers, investors and the integrity of the market[87]. To implement this regulatory policy choice, the Malta legislator adopted the Virtual Financial Assets Act[88] which allows for initial offerings of virtual financial assets on distributed ledger facilities[89]. Initial offerings of virtual financial assets shall be accompanied by 'whitepaper' which serves as an abridged prospectus. Initial offerors and other providers of services must be licenses[90]. S. 2 (2) of the Malta Virtual Financial Assets Act, defines a "DLT asset" as a virtual token, a virtual financial asset, electronic money or a financial instrument. The statute makes it clear that " 'assets' mean[…] movable and any immovable property of any kind"[91].

c. Monaco

Monaco's draft law on blockchains is clearly motivated by competitive concerns[92]. The preparatory report notes the legislative and regulatory developments in 'blockchain-friendly' jurisdictions[93]. The statute is intended to apply to cryptocurrencies, blockchains, smart contracts and algorithmic processes and, by implication, to cryptoassets[94]. Art. 2 of the draft law defines 'smart contracts' as mechanism for moving value or informations via a blockchain. In the language of the draft statute smart contracts are 'legal acts' (*actes juridiques*) which are capable of generating consequences in law and are, as such, subject to the law of contracts[95]. The Monaco draft statute recognises the legal 'value' of smart contracts, but does not subscribe to the notion that 'code is law'. Regrettably, the draft does not explain how principles of contract law may impinge on smart contracts. On the other hand, art. 3 of the

87 See s. 3 of the Act.

88 Virtual Financial Assets Act 2018, ch. 590 of the laws of Malta (available at http://www.justiceservices.gov.mt/DownloadDocument.aspx?app=lom&itemid=12872&l=1). In force since 1 November 2018 (Times of Malta, 4 November 2018, available at https://www.timesofmalta.com/articles/view/20181104/business-news/the-virtual-financial-assets-act-enters-into-force.693392).

89 s. 3 et seq. of the Act.

90 s. 3 (4) of the Act.

91 S. 2 (2) of the Act.

92 See Conseil National de Monaco, Proposition de loi no. 237, 4 December 2017 (available at http://www.conseil-national.mc/index.php/textes-et-lois/propositions-de-loi/item/600-237-proposition-de-loi-relative-a-la-blockchain).

93 Ibid.

94 Art. 1 of the Dispositif No. 237 (Texte consolidé, 14 December 2017) (available at http://www.conseil-national.mc/index.php/textes-et-lois/propositions-de-loi/item/600-237-proposition-de-loi-relative-a-la-blockchain).

95 Art. 2 of the draft statute

draft law recognises that smart contracts are capable of creating *erga-omnes* effects. The Monaco draft statute attempts to accommodate the ubiquity of blockchain systems by adopting an 'effects-approach': Monaco's law shall be applicable to blockchains, smart contracts and algorithmic processes if the establishment of the foregoing takes place in the principality or produces effects therein (art. 5)[96]. Art. 7 of the blockchain draft statute opts for a regulatory-sandbox approach under the auspices of newly organised 'Autorité Monégasque des Blockchains'[97].

d. Luxembourg

Earlier this year, Luxembourg amended the law on circulating securities in reaction to the growing influence of blockchain trading on the financial markets[98]. In a seemingly inconspicuous manner, the legislator opted for an analogy in order to pave the way for digitised finance via centralised and distributed ledgers[99]. In fact, the analogy expands the electronic registration mechanism for intermediated securities to include blockchain-based trading of securities. The legislative report classifies blockchain-based securities as a category of dematerialised securities[100]. As a corollary, Luxembourg law accepts the concept of tokens, cryptographic assets, stored centrally or on a distributed ledger. Tokens are capable of generating the same *erga-omnes* effects as any other electronic security[101]. Although the new law remains silent on contract law aspects of this tokenisation, trading of securities via blockchains shall be considered as normal bank transfers[102]. Arguably, this seems to suggest that traditional private law principles shall prevail even if trading is undertaken with the help of smart contracts.

96 Ibid.

97 Ibid.

98 Loi of 1 March 2019 portant modification de loi modifiée du 1er août 2001 concernant la modification la circulation de titres, Mémorial A no. 111 de 2019 (5 March 2019, available at http://legilux.public.lu/eli/etat/leg/loi/2019/03/01/a111/jo); see also report by A. Alexandre, Luxembourg Passes Blockchain Bill into Law, Cointelegraph 14 February 2019 (available at https://cointelegraph.com/news/luxembourg-passes-blockchain-framework-bill-into-law).

99 Art. 18bis of the Loi modifiée du 1er août 2001 concernant la circulation des titres (supra FN 98).

100 See Luxembourg Chambre de Députés, Session ordinaire 2017-2018, Projet de loi no. 7363 (6 November 2018) (available at https://www.chd.lu/wps/PA_RoleDesAffaires/FTSByteServingServletImpl?path=C9D0C9CB5AC1682F8AD1DC36175252FF26530FBAB20F896BDEC2D74A3FBAB31A3C2CAC62A625123D0A0B697273B03BC6$7517CFC69E1CF4D4FAD36945BC69A3E3).

101 Ibid.

102 Ibid.

e. France

On a limited scale, French law has also acknowledged the crucial importance of property-law effects of transaction engineered by blockchains and distributed ledgers. The French 'Ordonnance' no. 2016-520 of 28 April 2016[103] authorises non-listed companies to issue minibonds via crowdfunding platforms[104]. In order to facilitate authentication of transactions, crowdfunding companies shall be entitled to rely on DLT[105]. An amendment to the Code Monétaire et Financier specifies that the transfer of property of a minibond results from entering the assignment of title in the blockchain[106]. The assignment via blockchain technology substitutes a written contract for the assignment of title to a minibond[107]. It is clear from the wording of the statute that the establishment of a blockchain[108] serves to replace the physical register of transactions in the shadow of the existing law of assignment of titles, and thus creates third-party effects under property law[109]. In December 2018, a decree was issued setting out the technical requirements of distributed led-

103 Ordonnance no. 2016-520 du 28 avril 2016 relative aux bons de caisse, JORF no. 101 du 29 avril 2016 (texte no. 16).

104 H. de Vauplane, RTDF No. 2 – 2016, 64 et seq.

105 BNP Paribas Press Release of 19 September 2016, BNP Paribas Securities Services renforce sa plateforme blockchain pour les titres d'entreprise non cotés (available at https://group.bnpparibas/communique-de-presse/bnp-paribas-securities-services-renforce-plateforme-blockchain-titres-entreprises-cotees).

106 See art. 2, section 2 (L-223-12; L-223-13) of the Ordonnance no. 2016-520:
Art. L. 223-12:
Sans préjudice des dispositions de l'article L. 223-4, l'émission et la cession de minibons peuvent également être inscrites dans un dispositif d'enregistrement électronique partagé permettant l'authentification de ces opérations, dans ces conditions, notamment de sécurité ´, définies par décret en Conseil d'État.
Art. L. 223-13
Le transfert de propriété de minibons résulte de l'inscription de la cession dans le dispositif d'enregistrement électronique mentionné à l'article L. 223-12, qui tient lieu de contrat écrit pour l'application des articles 1321 et 1322 du code civil. A défaut, par dérogation aux dispositions de l'article 1323 de ce code, le transfert de propriété de minibons résulte de leur inscription au nom de l'acquéreur dans le registre prévu à l'article L. 223-4… .

107 Ibid.

108 See H. de Vauplane, Le financement des entreprises par la *blockchain* : le cas des «minibons », RTDF No. 2 – 2016, 64 (66).

109 ‚opposable aux tiers': see the press release of the French Ministry of Finance, Direction générale du trésor, Modernisation du régime des bons de caisse, Paris 27 May 2016 (available at https://www.tresor.economie.gouv.fr/Ressources/13778_modernisation-du-regime-des-bons-de-caisse).

gers[110]. In reiterating a commentary to the UNCITRAL model on electronic transferable records, the decree requires that ledger allow directly or indirectly the identification of the owner of the securities[111]. This acknowledges the tokenisation of electronic trading via blockchains and distributed ledgers, but it also emphasises that non-physical transactions are capable of generating *erga-omnes* effects. Comparable to requirements for intermediated securities the decree provides for owners' access to statement of transactions undertaken with this technology. A new law to be enacted during the first half of 2019 is scheduled to introduce rules for initial coin offerings[112], similar to the initial offer of virtual assets under Maltese law. So far, France appears to be the only European jurisdiction where the impact of the new Data Protection Regulation on blockchain laws has been assessed by the national data protection authority[113].

f. Liechtenstein

The Liechtenstein draft law on blockchain technology undertakes to reconcile traditional property law concepts with the (new) requirements of digital units registered on a distributed ledger and the rights pertaining to these digital units. A 'token' evidences the right to dispose of an asset registered in digital form on an asset. The owner of the token is therefore entitled to introduce the digital asset into a commercial transaction (including the market for securities). The Liechtenstein draft law introduces the 'physical validator', an institution mildly reminiscent of the functions of an oracle or a central counterparty. The physical validator is responsible for facilitating the trajectory from a digital asset to a physical entity recognised as a thing under the

110 Décret n° 2018-1226 du 24 décembre 2018 relatif à l'utilisation d'un dispositif d'enregistrement électronique partagé pour la représentation et la transmission de titres financiers et pour l'émission et la cession de minibons (available at https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000037852460&dateTexte=20190104).

111 Ibid.

112 See Assemblée Nationale, 15e Législature, Rapport no. 1237 – Tome I, comment on art. 26 of the Loi Pacte (available at http://www.assemblee-nationale.fr/15/pdf/rapports/r1237-tI.pdf); for the accounting treatment of initial coin offerings see Autorité des Normes Comptabels, Règlement no. 2018-07 of 10 December 2018 (available at http://www.anc.gouv.fr/files/live/sites/anc/files/contributed/ANC/1.%20Normes%20fran%c3%a7aises/Reglements/2018/Reglt_2018_07/Reglt_2018-07_ICO_jeton.pdf).

113 Commission Nationale Informatique et Libertés, Premiers éléments d'analyse de la CNIL – Blockchain (September 2018, available at https://www.cnil.fr/sites/default/files/atoms/files/la_blockchain.pdf).

Liechtenstein law of property[114]. In fact, the physical validator certifies the existence of a token and is required to defend the legal existence of a token[115]. In this, Liechtenstein law will expect the physical validator to assume the role of a trustee administering the rights of the owner of the token. Although this (projected) legislative approach appears to be somewhat convoluted, it intends to bear in mind the specificities of blockchains and DLT. Beyond individualisation by time-stamps and a registration code, digital units and their owners remain anonymous[116]. The physical validator with his certifying function takes the role of both a trustee protecting the rights of the owner of a digital asset and the creative link between a non-physical asset and a thing in the sense of property law[117].

g. The Swiss Regulatory Approach

Switzerland has decided not to intervene in the developing blockchain industry by mandatory law. Nonetheless, Swiss capital market authorities apply an analogy with existing securities regulation in order to confer third-party effects on tokens. A study by the Swiss Federal Government notes that tokens as such are creatures of the law of contract, generally unable to produce *erga-omnes* effects[118]. Nonetheless, the Swiss government favours an instrumentalist approach. If a token can be assimilated to an existing right of value, recognised by the existing law as endowed with third-party effects (*Wertpapier*), it becomes freely tradable as a 'thing'[119]. Ultimately, this turns into an issue of how much discretion capital market administrators enjoy in interpreting statutes without an express authorisation to stretch the law to accommodate blockchain and distributed ledger technology[120].

h. The United Kingdom

The United Kingdom Financial Conduct Authority (FCA) has decided against premature regulation. Whilst emphasising an attitude of technological

114 See p. 60 of the Vernehmlassungsbericht, supra sub FN 22.

115 Ibid., at p. 61 et seq.

116 Ibid., at p. 62 et seq.

117 See artt. 20 of the Liechtenstein draft law on blockchains.

118 See supra sub FN 10.

119 See 3.2. of the Swiss FINMA Guidelines, supra sub FN 24.

120 In a German criminal law case against a bitcoin exchange which had offered exchange services without an appropriate license to handle financial instruments, the Berlin court of appeal refused to uphold a sanction because there was no statutory basis to classify bitcoins as financial instruments: Kammergericht, judgment of 25 September 2018, Neue Juristische Wochenschrift 2018, 3734.

neutrality the FCA explores emerging business models, their competitive effects and potential risks to market integrity and consumers. The FCA pursues a regulatory sandbox approach whereby applicant firms are certified by the authority to participate in this programme and supply information on their experiences[121]. Current sandbox use cases include cross-border payment schemes with an intermediate, digital currency, issuance processes for short-term debt processes, share management and corporate governance mechanisms, and automated verification of documents[122].

The problematic relationship between the law of contracts and assets stored on a distributed ledger has not gone unnoticed to common law scholars. Especially, in the scenario of a permissioned blockchain and DLT where participants have to apply for access, it might be considered that a trust is created[123], charged with administering the digital assets. This would solve concerns with respect to third-party claims as the rights pertaining to digital assets would generate *erga-omnes* effects. The Liechtenstein draft law on blockchains is inspired by trust law thinking, but it expressly provides for the establishment of a physical administrator discharging *de facto* a trustee's duties[124]. In view of the current Master Agreements and their prospective digital successors operating on the basis of a blockchain and distributed ledgers it is, however, unlikely that a trust could be construed. Moreover, the first generation of blockchain statutes appear to suggest that legislators are cautious about recognising third-party effects of (digitised) contracts on digital assets in a broad brush mood.

4. The EU's General Data Protection Regulation

When the legislative authorities of the European Union began to draft the General Data Protection Regulation they were guided by the paradigm of centralised data storage and the need to protect the interest of those potentially affected by data storage mechanisms[125]. Blockchain and distributed ledger technology is difficult to reconcile with the legislative of the new data protec-

121 See FCA Discussion Paper, supra sub FN 3.

122 See comments on sandbox use cases in FCA, Distributed Ledger Technology – Feedback Statement on Discussion Paper 17/03 (FS 17/4, London December 2017) (available at https://www.fca.org.uk/publication/feedback/fs17-04.pdf).

123 See R. Herian, Blockchain and the (re)imagining of trusts jurisprudence, 26 (5) Strategic Change 453 (459.) (2017)

124 See supra sub III.3.f.

125 Finck, supra sub FN 5, at p. 88 et seq.

tion regulation[126]. In fact, decentralised storage of personal data is crucial for assuring the efficiency of distributed ledger system which operates in the context of smart contracts and artificial intelligence. As the use of blockchain technology spreads there should be a growing awareness that the scope of potential data controllers, and hence addressees of the data protection regulation is much larger than initially thought[127]. Notaries using blockchain technology for notarisation and mortgage conveyances are also deemed to be data controllers and should adopt specific data protection measures for their clients. Likewise, if the participants of public, permissionless blockchains are classified members of a rudimentary partnership, they might also be thought to assume the role of data controllers, potentially liable to fines in case of breach of the obligations under the data protection regulation. As the data protection regulation imposes duties of minimisation and modification, it is difficult to see how this requirement can be implemented in a blockchain context. Moreover, it is as yet a matter of speculation whether art. 17 of the data protection regulation and its right be forgotten ('right to erasure') pose a threat to blockchain technology, or whether the system of distributed ledgers constitutes the embodiment of data sovereignty[128]. The French Data Protection Authority has warned against the potential risks of being a data controller. A group of participants envisaging the operation of a blockchain system should consider the establishment of legal person operating the chain, thereby avoiding direct personal liability[129]. Moreover, in operating a blockchain smart contracts should so devised that stores data will remain in the ledger for evidentiary purposes, but will not be accessible to every participant of the system[130]. However, according to the French Authority, the information storage mechanisms of blockchains and distributed ledgers are not illegal per se[131]. What needs to be averted, is the potential for human intervention and access to the information[132]. It is also unclear whether a data controller retains this quality as soon as artificial intelligence takes over, producing results unforeseen by the data controller.

126 EU Blockchain Observatory and Forum, Blockchain and the GDPR (Thematic Report – 16 October 2018), at p. 17 et seq.) (available at https://www.eublockchainforum.eu/sites/default/files/reports/20181016_report_gdpr.pdf).

127 See Finck, supra FN 5, at 99 et seq.

128 Ibid., at p. 113 et seq.

129 See supra FN 113.

130 Ibid. See also the principles developed by the EU Blockchain Observatory and Forum, supra sub FN 126, at p. 28 et seq.

131 Ibid.

132 Cf. Finck, supra FN 5, at p. 108.

5. Blockchains – A Challenge for Private Law and Regulators

Blockchains have emancipated themselves from their early cryptocurrency beginnings. Blockchain technology is the cornerstone of FinTech. But blockchain applications go well beyond electronic trading via a finance platform. They operate as to introduce digitisation into asset management, production processes in industry[133], land registry with electronic mortgages[134] and e-notarisation, and e-government[135]. Blockchain technology will also be decisive for integrating the internet of things into daily life applications[136].

The current regulatory debate on blockchains oscillates between intervention and leniency[137]. In this context, it is often overlooked that blockchains, distributed ledgers and smart contracts challenge traditional law beliefs[138]. A more comprehensive approach is necessary, combining insights from digital processes with law of contract, liability and property law principles. This may usher in special liability rules for those who do nothing more than generating electronic signals to be stored ledgers[139]. Moreover, rules of property law and capital market regulations will have to be modified in order to advance the commodification of electronic signals, conferring on them the status of a 'thing' or, a financial instrument. The upcoming debate on the European General Data Protection Regulation suggests that liability concepts under data protection law and the private law on blockchains need to be calibrated. Moreover, a comprehensive legal approach towards blockchain technology will also have to consider that the involvement of artificial intelligence reshapes established causation and liability concepts[140].

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133 See survey in the FCA Feedback Statement, supra sub FN 122.

134 See the report in: Coincentral, D. Hamilton, Blockchain Land Registry: The New Kid on the Block (11 January 2019, available at https://coincentral.com/blockchain-land-registry/).

135 See Report by the United Kingdom House of Lords, Distributed Ledger Technologies for Public Good: leadership, collaboration and innovation (London 2017), at p. 18 et seq. (available at http://chrisholmes.co.uk/wp-content/uploads/2017/11/Distributed-Ledger-Technologies-for-Public-Good_leadership-collaboration-and-innovation.pdf).

136 See M. Conoscenti et al., Blockchain for the Internet of Things: a Systematic Literature Review, Conference Paper, 2016 IEEE/ACS 13th Conference of Computer Systems and Applications (AICCSA) (available at https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7945805).

137 See supra sub III.3.h. on the regulatory sandbox approach.

138 For an analysis in the context of secured transactions: T. Rodríguez de las Heras Ballell, Digital Technology-based Solutions for Enhanced Effectiveness of Secured Transactions Law: The Road to Perfection?, 81 L. & Contemp. Prob. 21 (34 et seq.) (2018).

139 See Ibáñez Jiménez, supra sub FN 8, at p. 284 et seq.

140 See e.g. US Federal Trade Commission Press Release (27 February 2017), Third FinTech Forum to discuss artificial intelligence and blockchain (available at https://www.ftc.gov/news-events/blogs/busi-

The UNICTRAL Model Law does not offer much guidance on private international law principles[141], although it opts for the cross-border recognition of electronic transferable records. The principle of cross-border recognition is subject to an important qualification. If the host state does not recognise electronic transferable records, it is not bound by the Model Law to recognise a foreign electronic transferable record. Likewise, neither the point of access to the information nor a specific electronic do justify acceptance of jurisdiction of a specific country[142]. If the 'country of origin' rejects the notion of electronic transferable records, the (foreign) host state may nonetheless acknowledge a foreign electronic record if its own domestic legal order does so[143]. This stipulation supports legislative policies by (off-shore) jurisdictions which have enacted or are likely to enact blockchains statutes as an instrument to attract foreign business. Moreover, meaningful private law rules on blockchain technology (including the commodification of 'electronic signals') and, if necessary, corresponding capital market rules provide an incentive for opting for a jurisdiction which favours digitisation and protects investors. On the other hand, permissionless, decentralised ledgers continue to be a challenge for practitioners. Art. 14 of the Model Law emphasises that the very location of the information system (with DLT) does not establish a presumption in favour of a place of business. But even the combination of blockchain technology and smart contracts is unable to overcome the barriers imposed by mandatory law.

For practical purposes, private international law problems may lose some of their relevance as blockchains and associated platforms structures fre-

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ness-blog/2017/02/third-fintech-forum-discuss-artificial-intelligence); for a healthcare perspective: P. Mamoshina et al., Converging blockchain and next-generation artificial intelligence technologies to decentralize healthcare and accelerate biomedical research and healthcare, Oncotarget. 2018 Jan 19; 9(5): 5665 et seq. (available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5814166/).

141 See art. 19 para. 2 of the Model Law
Nothing in this Law affects the application to transferable records of rules of private international law governing a transferable document or instrument.

142 See art. 14 (Place of Business) of the Model Law:
1. A location is not a place of business merely because that is:
(a) Where equipment and technology supporting an information system used by a party in connection with electronic transferable records or located; or
(b) Where the information system may be accessed by other parties.
2. The sole fact that a party makes use of an electronic address or other element of an information system connected to a specific country does not create a presumption that its place of business is l located in that country.

143 Commentary on art. 19 para 1 of the Model Law (supra sub FN 55).

quently operate as permissioned, private systems[144]. Admission to such a platform structure is granted by those who devised or run the platform, frequently assuming the role of gatekeepers. The U.S. Finra opines that the governance structure of a private network with DLT is crucial for the success of digitisation[145]. Moreover, the governance structure should also provide for a clear definition of responsibilities for handling emergencies or disruptions or deficiencies of the blockchain[146]. Finra's concern for specific governance mechanisms extends to introducing basic requirements for the operational structure of an automated trading platform, including access and off-boarding criteria, documentation of the undertakings of each participant, and electronic validation requirements[147]. Ultimately this requires an assessment whether the private law rules for permissioned blockchains are capable of averting externalities without regulatory intervention.

144 See the analysis of private blockchains in Vilarroig Moya/Sempere, supra sub FN 6, pp. 61, 71 et seq.

145 See: US Financial Industry Regulatory Authority (Finra), Regulators Forum on Distributed Ledger Technology (DLT), 13 July 2017 (available at http://www.finra.org/sites/default/files/2017_BC_Regulators_Forum.pdf).

146 Ibid.

147 Ibid.