This is a pre-copyedited, author-produced version of an article accepted for publication in Global Jurist following peer review. The version of record, Paolini, A. The Disruptive Effect of Distributed Ledger Technology and Blockchain in the over the Counter Derivatives Market is available online at: https://www.degruyter.com/view/journals/gj/ahead-of-print/article-10.1515-gj-2019-0048/article-10.1515-gj-2019-0048.xml

DOI: https://doi.org/10.1515/gj-2019-0048

The Disruptive Effect of Distributed Ledger Technology and Blockchain in the over the counter derivatives market

By Dr Adolfo Paolini, University of Buckingham UK and Clyde & Co LLP

The Problem

D + D + S = ERT

Descentralisation + Deregulation + Secrecy = Excessive Risk Taking

Introduction

The market for derivatives has endured a substantial transformation and scrutiny since the 2007/08 financial crisis.[1] This subprime or credit crunch disaster seriously undermined what fuels business 'Trust', therefore customers lost faith in financial institutions. Banks' ledger manipulation reached unacceptable levels by moving debt off the books during auditing times and assigning speculative high values to hard-to-value assets, which ultimately had not value at all.[2] All of these led to serious concerns about financial services integrity. Understandably, the market was hurt thus; sharp expressions like 'Lehman Brothers is often Exhibit A in the breakdown of trust in the twenty-first century'[3] are used. At the heart of the subprime crisis laid collateralised debt obligations (CDO's), credit default swaps (CDS's) and the derivative financial instruments created and privately traded over the counter. There were three main features in the over the counter derivatives market (OTC), namely Deregulation, Secrecy and Descentralisation which added to or triggered the crisis.

The unregulated (OTC) market operated under the premise that banks would design products and adapt to the incumbent demands of the financial ecosystem therefore develop their own rules. Sadly, excessive unethical profit driven practices infested this liberalised segment of the market. Secrecy on the other hand exacerbated the problem because OTC derivatives traded bilaterally or privately and did not need to go through any central clearing counterparty so the system was mainly uncontrollable. This explains why governments could not exactly assess from the onset the magnitude of the financial crisis.

The question at that time was whether stakeholders including Fintech[4] startups, should remain passive or proactive hence, the 'Dichotomy' faced by financial innovators,

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[1] ISDA *Whitepaper The Future of Derivatives Processing and Market Infrastructure*, 2016 available at https://www.isda.org/a/B9EDE/infrastructure-white-paper.pdf. [Accessed 20 Jan. 2019]

[2] Casey MJ & Vigna P, *The Truth Machine The Blockchain and the Future of Everything*, Harper Collins Publishers, 2018 at 21

[3] Ibid

[4] Fintech simply means the "use of technology to deliver financial services and products to consumers." Madir J, Fintech Law and Regulation, Edward Elgar Publishing, 2019 at 1

was to insist with a system based on trust in financial institutions, or explore others more transparent where neither trust nor were banks, as intermediaries, indispensable for the successful and safe completion of financial transactions.

The latter idea prevailed and developed a series of important platforms,[5] which came to disrupt or incrementally benefit financial services thus changing not only the payments landscape, but also the structure of the service itself. The OTC market is experiencing these changes and it is gradually becoming a smart system.

One could look at the smart OTC market from three different angles: as depository or record keeping of transactions (Blockchain), as contract executing system (Smart Contracts) and regulatory (Regulation).

The aim of this piece of research is to analyse to what extent innovative technology such Blockchain with embedded smart contracts, may affect the way the 'Over the Counter' (OTC) market operates, by providing investors with a trustworthy platform for the efficient assessment of the risk behind certain financial instruments. Consequently, the market will be more resilient when another financial crisis strikes. It approaches the problem from a pure practical or investment perspective namely how to deliver the OTC service to consumers. Albeit this article touches upon regulatory matters and the desirable use of central counterparties (CCP's) for clearing, regulation per se will be the subject matter of the author's future research outputs. It is necessary to emphasise indeed that the over the counter derivative market still softly regulated therefore, identifying some advantages and disadvantages of using Blockchain may help future legislation.

1. What is Blockchain?

One of the most prominent post financial crisis innovations was the possibility of transacting with a digitally created currency 'Bitcoin' by using an open yet secure system called 'Blockchain',[6] which built on distributed ledger technology 'DLT' developed several years earlier.[7] The main feature of a DLT is that a number of copies or records disseminate across stakeholders in contrast with a centralised ledger system, as shown by figure 1 below. The monopoly of having a unique centralised copy disappears along with its controlling power. In a DLT, each participant has a copy of the ledger, which ultimately needs to match the content of the so-called main copy.

[5] Peer-to-peer lending, asset management, mobile payments, remittances and fundraising
[6] Nakamoto, S, *Bitcoin: a peer-to-peer electronic cash system*, available at https://bitcoin.org/bitcoin.pdf. [Accessed 30 Nov. 2018].
[7] Narayanan A & Clark J, *Bitcoin's Academic Pedigree*, (2017) available at https://users.encs.concordia.ca/~clark/papers/2017_cacm.pdf

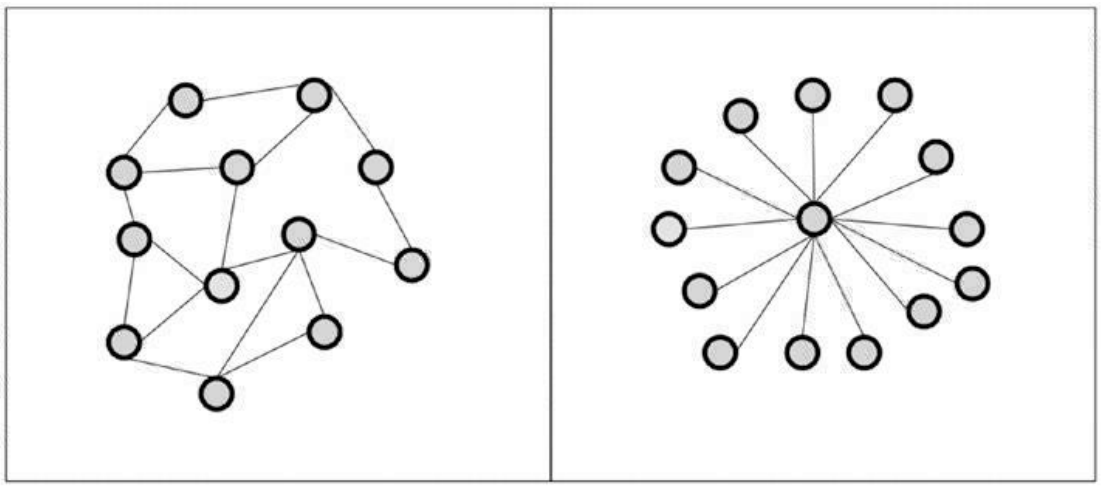

Fig 1 Source: Distributed (left) vs. centralized (right) system architecture in Drescher D, BLOCKCHAIN BASICS, A NON-TECHNICAL INTRODUCTION IN 25 STEPS, Apress, 2017 p 11.

However, DLT was never efficient in both dealing and controlling the tampering of single copies because they were scattered in several computers and networks. Then Blockchain appeared.

Blockchain supplemented DLT by incorporating an algorithmically controlled system whereby, the information added to the ledger is vetted by consensus, resistant to changes, shared peer-to-peer and retrievable. Even though the launching of Bitcoin unraveled Blockchain technology, both concepts are different so a distinction is important. Blockchain is the underlying system used to transact with the cryptocurrency and Bitcoin or indeed any other cryptocurrency, is the transferable intangible asset itself.[8] They are both connected yet they do not mean the same.

Defining Blockchain could either be too narrow or too wide nevertheless in general it is as an underlying DLT technology supported by an unknown number of users (Nodes) who by joining and contributing with their own computational resources, run a decentralised peer-to-peer network for the verification, authentication and exchange of data. Such data is organised in tamper resistant blocks or ledgers connected with a crypto key or algorithm without which, their content and history is irretrievable thus, making the stored information safe and trustworthy.

In no time Blockchain resolved at least two of the flaws of DLT technology namely, there was no need to maintain a centralised main copy because every stakeholder would have an identical one and the tampering of one copy would automatically generate new algorithms, which will not pass the consensus or validation mechanism hence, keeping the records transparent and immutable.

[8] There are more than one thousand cryptocurrencies operating worldwide. More recently, the United Kingdom Jurisdiction Taskforce has confirmed that cryptocurrencies are assets as any other thus susceptible of ownership. The LawTech Delivery Panel , UK Jurisdiction Taskforce, *Legal statement on cryptoassets and smart contracts*, Nov 2019

From the above definition, five features underpinning blockchains are worth mentioning:

- It is a peer-to-peer network whose partakers (Nodes) do not necessarily know each other nor need to trust each other. They could be located in different places and jurisdictions.
- The network transfers data in ledgers also called blocks, which contain all relevant information for example: assets, price, party's names and timestamp, leading to a chronological sequence of records, transactions or inputs.
- Each block has its own digital signature or cryptographic hash, which makes it distinguishable and unique.
- In order to join the chain, the cryptographic hash is subject to a validation process, which consists in decrypting the algorithm, by using deep internet computational resources and rewarding the miner (whoever decrypts the algorithm) with part of the proceeds of the original transaction.
- Once validation takes place, the block affixes to the chain by consensus mechanisms also called proof algorithms.

A very simple illustration of how a blockchain would look like is the following:

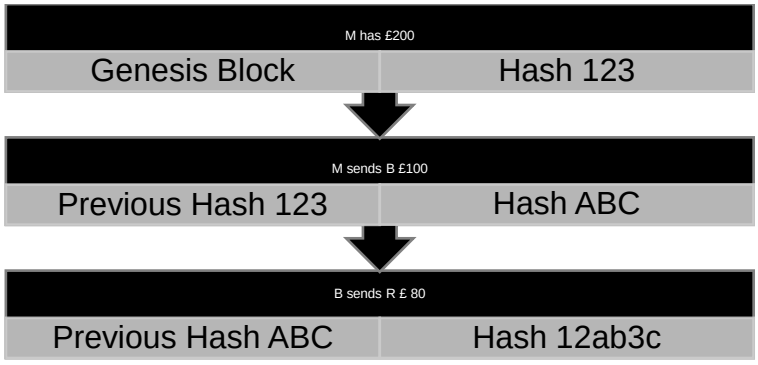

Fig 2 source: Adolfo Paolini (algorithms use far more complex combinations of letters and numbers)

1.1 Types of Blockchains (Advantages and Disadvantages)

One could try to find what the rationale for classifying blockchains in public and private is. There is not a single argument in favour of either nevertheless; it seems that two main features drive this distinction**.** The first one is who can actually access the chain and the second what incentive motivates participants.

Open or public permissionless blockchains, as their name suggests, are freely accessible to whoever wants to join. In permissionless blockchains, trust is virtually irrelevant in the sense that anybody from anywhere could take part. One pitfall is nevertheless that this ecosystem is perfect for market predators and malicious participants who could freely connect. A brilliant feature of Bitcoin is that it addresses the above concern by motivating honest behavior thus rewarding miners with a share of the transaction. Another fear is that 51% stake in the network would give the majority required to validate fraudulent transactions so the blockchain system is flawed however, the cost of acquiring the computational resources to dominate the network will arguably outweigh any fraudulent gain. In other words, why one would invest on one occasion £1000 to steal £1 once?

Closed or private permissioned blockchains work slightly different. In fact identifying beforehand the stakeholders enlightens its trustworthy feature and gives a better sense of security. These types of blockchains incentivize their members by giving the possibility of achieving common purposes or goals thus, the decryption reward is less important. What matters is fulfilling the objective. Permissioned blockchains design includes a controller party of consortium whose main job is to develop the criteria for joining and scrutinising and approving the nodes in the system. Consequently, vetted nodes provide a sense of trustworthiness to the chain. In other words, the governance of private blockchains is tailor-made to the needs of a group and its objectives.

One could suggest that individual governance or centralised governance impinges on the real purpose of blockchain namely distributing vetted ledgers across participants, yet monopolising the power to control the network.[9] For the purpose of this research, the question therefore is how the market for financial derivatives could control transactions if nobody has the authority to decide who could or not take part in the network. An early conclusion would be that permissioned blockchains are the most suitable types to effectively regulate and control the derivatives market.

It is also important to emphasise that network members may have different rights and roles: read, write and /or commit. The following table by Hileman and Rauch[10] clearly shows these rights and roles.

[9] Finck M, *Blockchain Regulation and Governance in Europe*, Cambridge University Press, 2019 pp 196

[10] Hileman, G and Rauchs, M, 2017 *Global Blockchain Benchmarking Study* (September 22, 2017). Available at SSRN: https://ssrn.com/abstract=3040224 or http://dx.doi.org/10.2139/ssrn.3040224

			Read	Write	Commit	Example
Blockchaintypes	Open	*Public permissionless*	Open to anyone	Anyone	Anyone*	Bitcoin, Ethereum
		Public permissioned	Open to anyone	Authorised participants	All or subset of authorised participants	Sovrin
	Closed	*Consortium*	Restricted to an authorised set of participants	Authorised participants	All or subset of authorised participants	Multiple banks operating a shared ledger
		Private permissioned ('Enterprise')	Fully private or restricted to a limited set of authorised nodes	Network operator only	Network operator only	Internal bank ledger shared between parent company and subsidiaries

Fig 3 source: Hileman, G and Rauchs, M, 2017 *Global Blockchain Benchmarking Study* (September 22, 2017). Available at SSRN: https://ssrn.com/abstract=3040224 or http://dx.doi.org/10.2139/ssrn.3040224 at p 20

Consequently, what are the advantages and disadvantages of public v. private blockchains? Let us deal with some of them accordingly

- Public Blockchains have the advantage of being open access therefore allowing nodes to take part and locate in different jurisdictions without restrictions. Private Blockchains restrict access to specific nodes in the network so the advantage is that of accepting only vetted nodes, leaving outside market predators or nodes whose previous financial records or credit history may cause concerns.
- Public Blockchains may substantially reduce computational costs because nodes will freely join and provide their own computational resources. Some jurisdictions where energy costs are cheap are more attractive to mining farmers. Private on the other hand are selective and may choose where the majority of nodes or the required 51%, are in order to control and effectively monitor the network.
- Previous one leads to the next private blockchain disadvantage, the cost of running and controlling the chain is far more expensive that a totally distributed or public one.
- Network governance happens to be the most important advantage for the purpose of this case study. In Private Blockchains, the consortia

will choose whom takes part by additionally granting access to, for example, financial regulators and anti- money laundering policing bodies. This seems the most effective way to tackle financial crime and prevent data miss-use.

- Joining a Private Blockchain may carry large membership costs, which could be minimal in public ones.

2. Smart Contracts

Fintech also welcomed 'Ethereum',[11] and the brilliance of Vitalik Buterin whose major contribution was to expand the application of Blockchain beyond Bitcoins, creating the possibility of using this underlying technology in a wide range of activities namely, personal identity, dynamic health records, remittances, settlement and clearing systems, public voting just to mention some.[12] All of this has been possible thanks to the development of 'Smart Contracts'[13] the pillar of Ethereum success.

Smart contracts carry two different yet related meanings namely legal and computational (software). The first one is as smart legal contract in the sense that it is a contract like any other yet its performance executes automatically on distributed ledger technology; the second one, more properly defined as smart contract code, is the software that automates the legal contract.[14]

Contract execution improves by having a Smart Contract at the application layer of the blockchain stack[15] with the resulting outcome of speeding up transaction processes and reducing costs. As algorithmic, self-executing and self-enforcing computer programmes,[16] smart contracts embedded in the blockchain will be essential in the so-called Smart OTC platform.

Smart contracts are very efficient in completing transactions for example, dividing payments between stakeholders however, agreements may require and usually do, certain rules of conduct that contracting parties must fulfil. For example, an insurance policy may require the insured to lock the windows before leaving the house

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[11] Buterin V, *A Next Generation Smart Contract & Decentralised Application Platform*, Ethereum White Paper available at http://blockchainlab.com/pdf/Ethereum_white_paper a_next_generation_smart_contract_and_decentralized_application_platform-vitalik-buterin.pdf

[12] Diedrich H, *Ethereum: what is Ethereum Used for?*, Wildfire Publishing, 2015, at 58

[13] Szabo N, *Formalizing and Securing Relationships on Public Networks*, First Monday 2, No 9 September 1997, available at http://ojphi.org/ojs/index.php/fm/article/view/548/469

[14] Clack CD & Vanca G, *Temporal Aspects of Smart Contracts for Financial Derivatives, Centre for Blockchain Technologies*, Department of Computer Science, University College London, p1, available at http://www0.cs.ucl.ac.uk/staff/C.Clack/research/ClackTemporalAspectsSmartContracts.pdf

[15] Deminors M, *Opening Remarks: Ethereum Classic Summit Hong Kong*. Available at https://etcsummit.com/wp-content/uploads/2017/11/ETCSummit_Day-1_MD-Intro-Slides.pdf (Accessed 4 Dec 2019)

[16] Lauslahti K, Mattila J & Seppala T, *Smart Contracts- How will Blockchain Technology Affect Contractual Practices?* The Research Institute of the Finnish Economy, 2017, No 68 at 2.

unattended, even statutes require company directors to act in good faith (very subjective indeed), for the benefit of the company. Smart contracts cannot resolve or account for these 'open-ended rights'[17] and rules of conduct consequently, it is crucial that developers address the issue of contract formation, in the first place, so the execution of the OTC clearing and settling would be more functional or at least less vulnerable to trading disputes. In other words, developers need to address the issue of events, which occur outside the pre-coded contractual language and may affect contractual enforceability.[18] Clark and Vanca have cleverly provided a definition of smart contracts, which includes both internal and external elements, as follows:

"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 obligations or via tamper-proof execution of computer code."[19]

A potential solution or innovative idea to these open-ended legal events is the application of artificial intelligence in a kind of cognitive app for testing legal hypotheses,[20] albeit this sounds very ambitious indeed.

3. The OTC Market New Dimension and the Road to Smart Centralised Counterparties

Following the 2007/08 collapse of the subprime mortgage market, investors lost significant amounts, and most painfully still, unsuccessfully claimed for negligent misrepresentation. UK courts were of the view, that sophisticated investors knew market volatility and were in a position to assess the risk.[21] The Libor[22] scandal did not help either, it was then clear that banks manipulated the interest rates used to price financial instruments. It was impossible for investors, other than banks, to know the real value of such instruments therefore; they heavily relied on credit rating agencies (also part of the culprits list).[23]

All of these significantly affected the appetite for credit default swaps whose notional amounts of contracts fell from $61.2 trillion in 2007 to $ 9.4 trillion ten years later;

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[17] De Filippi P, Wright A, *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press. 2018 at p.77

[18] Bacon L, Brook N, Bazinas G, *Smart Contracts: Where Law Meets Technology, Clyde and Co Inside,* available: https://www.clydeco.com/insight/article/smart-contracts-where-law-meets-technology. [June 2016]

[19] Clack CD & Vanca G, *Temporal Aspects of Smart Contracts for Financial Derivatives,* Centre for Blockchain Technologies, Department of Computer Science, University College London, p 2, available at http://www0.cs.ucl.ac.uk/staff/C.Clack/research/Clack-TemporalAspectsSmartContracts.pdf

[20] Ashley, K, *Artificial Intelligence and Legal Analytics*. Cambridge, United Kingdom: Cambridge University Press. 2017 p.354

[21] Paolini A, '*Lending Sub-Prime and Advising on Financial Investments from a D&O Insurance Perspective'*, JBL [2012] Issue 5, pages 432-448.

[22] London Inter-Bank Offered Rate

[23] Labrosse JR, Olivares-Caminal R & Singh Dalvinder, *Financial Crisis Management and Bank Resolution*, London, UK, 2009 Informa

furthermore, the share of inter-dealer trades fell from 53% to 25% between mid-2011 and end-2017.[24] Conversely the amounts cleared via central counterparties (CCPs), went up from 17% to 55% within the same period.[25] As a result, market stakeholders developed specific concerns about the operation of OTC's as follows:

• It was very difficult to quantify the OTC market in the sense that it has grown to such an extent that it poses a risk to the financial market.

• OTC's are bilateral thus the parties involved could create a variety of contracts, which could lead to unknown risks to the financial system.

• Being privately negotiated, outside regulated exchanges, means that they are usually beyond regulators control. [26] Regulators then acted accordingly.

Unsurprisingly, regulators did not waste any time and started to join efforts in finding responses to the 2007/08 crisis. In the United States for example The Volcker Rule, supported by The Federal Reserve Board, the Federal Deposit Insurance Corporation (FDIC), the Office of the Comptroller of the Currency (OCC), the Commodity Futures Trading Commission (CFTC), and the Securities and Exchange Commission (SEC),[27] came into force on April 1 2014, with full implementation as from July 21 2015, was enacted. It is part of the Dodd- Frank Wall Street Reform and Consumer Protection Act 2010, which aims at preventing investment banks from 'prop trading or making bets with their own capital',[28] thus limiting the possibility of making speculative investments with their own accounts which if wrong, could trigger a systemic risk. According to CBInsights, the trading of JP Morgan, Citigroup, Bank of America, Goldman Sacks and Morgan Stanley in 2009 was almost $100 Billion for speculative trading alone. This figure, following the Volcker's rule came down to a combined profit of $71 Billion in 2017, which represents 30% fall compared to the previous decade.[29]

The United Kingdom also welcomed the Vickers Report, which introduced the ring fencing principle, applicable to banks offering both retail (private) and investment or universal banking services. The principle literally consists in ring fencing retail banking capital and exposure from the investment banking one, so the high risk to which the latter is exposed to may not affect or at least reduce the risk of the enclosed or protected private banking limb of the financial institution.

In regard to the OTC market in particular, One of its loopholes was (or still is) the fact that bilateral or non-central counter party agreements (non-CCPs) were private, unavailable to the general public thus lacked transparency with the undesired outcome

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[24] Aldasoro I & Ehlers T, *The Credit Default Swap Market: what a difference a decade makes*, BIS Quarterly Review, June 2018 pp 1-10 at 2
[25] Aldasoro I & Ehlers T, *The Credit Default Swap Market: what a difference a decade makes*, BIS Quarterly Review, June 2018 pp 1-10 at 4
[26] Brian O'Loughlin B and O'Brien F, *Fundamentals of Investments a Practitioners Guide*, 3rd Edition, Routledge 2019 p 201
[27] CFA Institute, *the Volcker Rule*, available at https://www.cfainstitute.org/en/advocacy/issues/volcker-rule
[28] CB Insights, *Killing The I-Bank: The Disruption Of Investment Banking*, available at https://www.cbinsights.com/research/report/disrupting-investment-banking/ p 37
[29] Ibid

of making it very difficult to monitor. The main idea was to replace this with a system, which incentivizes centralised clearing then the European Union also responded.

The European Market Infrastructure Regulation on Derivatives, Central Counterparties and Trade Repositories (EMIR) as from June 2016, aims at increasing transparency in the OTC derivatives markets, mitigating credit risk and reducing operational risk.[30] It requires using centralised clearing system, for all standardised OTC derivative contracts otherwise CCPs must apply risk mitigation techniques and comply with stringent prudential, organisational and conduct of business requirements.[31]

For the purpose of this piece of research, it is necessary to highlight that EMIR, concerned with reducing the operational risk associated with fraud and human error, encourages the use of 'electronic means' to speed up the confirmation stage of the OTC contractual terms.[32] Furthermore, in order to enhance transparency EMIR has introduced reporting requirements, which are worth quoting in here:

"Under the regulation

- detailed information on each derivative contract has to be reported to trade repositories and made available to supervisory authorities
- trade repositories have to publish aggregate positions by class of derivatives, for both OTC and listed derivatives
- the European Securities and Markets Authority (ESMA) is responsible for surveillance of trade repositories and for granting and withdrawing accreditation"[33]

Arguably, DLT and blockchain technologies could play wonders in assisting with tamper resistant electronic data including trade repositories so the goals of EMIR regulation will be easy achievable.

Basel III also reacted to the financial crisis and implemented some innovative ideas aim at minimizing the effects of systemic risk by promoting amongst other 'central clearing'. Now, it will be impossible to address all the Basel III reaction to the 2007/08 crisis thus let us focus on some of the more relevant, as they affect the OTC market.

First, as part of the counterparty credit risk strategy, it promotes capital incentives to use counterparties for derivatives. As clearing houses guarantee by novation, with or without margins, that payments, deliveries and settlements happen; it becomes obvious that using trustworthy CCPs will result, in principle, in more stable markets.

Secondly, reduced reliance on external credit rating requires banks to conduct enough due diligence when using external rating agencies or data and demands, having sufficient and detailed non-ratings-based approach for other jurisdictions unable or reluctant to rely external credit ratings.[34] According to the then Financial Services

[30] European Commission, *Derivatives / EMIR*, available at https://ec.europa.eu/info/business-economy-euro/banking-and-finance/financial-markets/post-trade-services/derivatives-emir_en
[31] Ibid
[32] Ibid
[33] Ibid
[34] Basel Committee on Banking Supervision, Bank for International Settlements, *Finalising Basel III in Brief*, December 2017, available at https://www.bis.org/bcbs/publ/d424_inbrief.pdf

Authority, between 2007-2009 the estimated actual default losses, incurred by banks, were five times smaller than the losses connected with the credit rating risk associated with the counterparty.[35] Accordingly, Basel III introduced the CVA capital charge as "a protection against mark-to- market losses caused by increase in the credit spread of the counterparty"[36] and most importantly, such charge was exempted in exposures to CCPs therefore significantly reducing the trading cost.[37]

The message is therefore clear, market stakeholders are favoring centralised regulated settlements and clearing systems rather than bilateral (dealer-investor) softly regulated ones. The International Swaps and Derivatives Association (ISDA) is not an exception and its 2018 annual survey shows, despite the market pushing for a centralised clearing, that 83% of the survey respondents are confident that the market will and/or remain the same, yet the future poses certain challenges mainly linked to regulatory compliance. As a result, almost half the respondents believe that the numbers of dealers will decrease and almost 66% think the costs of dealing with derivatives will go in the opposite direction.[38] Good and bad news one would say.

4. Could technology deliver what the market expects?

Even though high volume of financial derivatives are exchange- traded and go through heavily regulated centralised clearing systems and organizations, like the National Association of Securities Dealers Automated Quotation System (Nasdaq), the over the counter derivatives are offered on a bilateral basis between dealers, without any need to use regulated intermediaries or CCPs, who may absorb the credit risk.[39] As a result, some risks are readily apparent; 'access to information' with the resulting lack of transparency seems to be the obvious one, to say nothing of facing the insolvency of the counterparty. Lack of regulation was in fact the reason why financial regulators and governments struggled to measure the magnitude of the subprime crisis and its consequences.[40]

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[35] Financial Services Authority, *The prudential regime for trading activities A fundamental review*, August 2010, available at http://www.fsa.gov.uk/pubs/discussion/dp10_04.pdf.

[36] Candese G, Ranaldo A and Vasios M, *Staff Working Paper No 751 OTC Premia*, Bank of England, August 2018 at 11.

[37] Candese G, Ranaldo A and Vasios M, *Staff Working Paper No 751 OTC Premia*, Bank of England, August 2018 at 11. "Counterparty capital charges differentiate between margined and unmargined non CCP transactions too. This is because initial margin reduces the amount of exposure for OTC derivatives transactions"… "With respect to the leverage ratio, its calculation does not recognize collateral or other credit risk mitigants as an offset to derivatives exposures. This is fundamentally different to the risk-weighted framework, which favours the exchange of initial margin in centrally or bilaterally cleared transactions."

[38] International Swaps and Derivatives Association, *ISDA Future of Derivatives Survey*, available at https://www.isda.org/2018/04/24/isda-future-of-derivatives-survey/

[39] Avgouleas E and Kiayias A, *The Promise of Blockchain Technology for Global Securities and Derivatives Markets: The New Financial Ecosystem and the "Holy Grail" of Systemic Risk Containment*, University of Edinburg, School of Law, Research Paper Series, No 2018/43 at p 4

[40] De Filippi P, Wright A, *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press, 2018 at 93

As instantaneous settlements are unneeded in OTC's[41] blockchains, as underlying distribute ledger technology, seem to be the way forward to avoid the above scenario. A smart OTC system will develop a transparent tamper –resistant and resilient platform to create, execute, trade, trace and fairly value derivatives.[42] Investing in collateralised debts obligations and/or credit default swaps, on a blockchain, will enable market participants to trace back the pool of mortgages converted into CDO's, assess original mortgagors credit history and value the tranches[43] without having to rely on third party valuations. Consequently, investors could not only identify whether CDO's or CDS's refer to prime or subprime markets, but also whether the issuer has entered into other transactions which may impinge on his financial capability to fulfill its obligations. Banks liquidity ratios, accounts auditing and repo practices[44] would be efficiently controlled and monitored. In other words, CDS's investors could more efficiently asses the two types of risk behind these financial instruments namely: "the underlying credit risk of the reference entity and the counterparty risk faced by the CDS protection buyer."[45]

The International Swaps and Derivatives Association has not only acknowledged how fertile territory OTCs are for smart contracts[46] but also has endorsed the use of blockchain/DLT and smart contracts technology to further develop and improve 'derivative processes' and recognizes that failing to adapt and/or adopt the changes, " the derivatives infrastructure stands to become increasingly costly, risky and inefficient."[47] It also recognises that due to the nature of the transactions or events underpinning derivatives trade, not all those events needs automation therefore, it becomes paramount to identify in what parts of a derivative contract automation would be efficient and effective.[48]Nonetheless, ISDA is also concerned that new technologies, regardless of their usefulness, should not disrupt the legal pillars on which its documentation architecture is founded.[49] This foundation links with ISDA Master Agreement and in fact, it is suggested that automation (smart contract code) is in

[41] Samia E quoting Chadwick S, 2018, *Blockchain to make big impact in OTC derivatives, syndicated loans and VCPE*, available at in https://www.unlock-bc.com/news/2018-04-04/blockchain-to-make-big-impact-in-otc-derivatives-syndicated-loans-and-vcpe.
[42] De Filippi P, Wright A, *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press, 2018, at 93
[43] McCoy P & Engel K, *The Subprime Virus, reckless credit, regulatory failure and next steps*, New York, USA, Oxford University Press 2011
[44] A repo is an agreement to sell a financial product with the obligation to buy it back at a late stage.
[45] Aldasoro I & Ehlers T, *The Credit Default Swap Market: what a difference a decade makes*, BIS Quarterly Review, June 2018 pp 1-10 at 7
[46] ISDA, *Guidelines for Smart Derivatives Contracts: Introduction*. January 2019 p 4,, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/
[47] ISDA and Linklaters LLP, *Smart Contracts and Distributed Ledger – A Legal Perspective*, August 2017, available at https://www.isda.org/a/6EKDE/smart-contractsand-distributed-ledger-a-legal-perspective.pdf
[48] ISDA and King and Wood Mallesons, *Whitepaper Smart Derivatives Contracts: From Concept to Construction*, August 2018 at 4, available at https://www.isda.org/a/cHvEE/Smart-Derivatives-Contracts-From-Concept-to-Construction-Oct-2018.pdf
[49] ISDA, *Guidelines for Smart Derivatives Contracts: Introduction*. January 2019 p 5, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/

principle used for payment obligations so in terms of contract formation, the master agreement should be the central pillar.[50]

The ISDA whitepaper distinguishes between operational and non-operational clauses the latter of which are less susceptible to automation. Operational clauses refer to the happening of specified event, time or action to trigger the execution of the derivatives agreement.[51] For example, futures, forwards, call or put options and swaps all depend on the happening of certain or indeed uncertain events, which activate the execution of the agreements thus, these seem to 'embed some form of conditional logic'[52] therefore are suitable for being automatically executed by smart contracts code.

Conversely, there also are the so-called non-operational clauses in which such embedded logic is missing since they depend upon the bilateral legal relationship between the contracting parties.[53] This lack of conditional logic makes them less suitable or entirely unsuitable for automation. For example, choice of law and jurisdiction clauses,[54] contractual representations, delivery of certain documents to the counterparty, obligation subject to withholding tax, parties default,[55] good faith in contractual formation and execution,[56] even, as highlighted earlier,[57] the happening of

[50] ISDA, *Guidelines for Smart Derivatives Contracts: Introduction*. January 2019 p 7, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/

[51] ISDA and Linklaters LLP, Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf. At 10

[52] ISDA and Linklaters LLP, Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf. At 10… "Examples include: • A clause that requires an amount to be payable on a payment date equal to the product of a calculation amount, a floating rate (plus or minus a spread) and a day count fraction1; • A clause that requires an amount to be payable on an exercise date equal to the number of options exercised multiplied by a strike price differential1; • A clause that provides that one party to the contract pays the other an amount equal to the difference between the settlement price and a forward price, with the party required to make such payment being determined by whether the settlement price exceeds the forward price or vice versa; and • A clause that requires a party to transfer assets on a particular date that have a value equal to the amount by which a required credit support amount is less than the value of collateral provided, subject to certain formulaic haircuts and adjustments."

[53] ISDA and Linklaters LLP, Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf. At 11

[54] See below Validating and executing the Agreement

[55] ISDA, *Guidelines for Smart Derivatives Contracts: Introduction*. January 2019 p 4, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/

[56] ISDA and Linklaters LLP, Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf. At 11 … " … A clause providing that the written legal document represents the entire agreement between the parties; • A representation that a party's obligations under the legal agreement constitute legal, valid and binding obligations; • A clause that dictates that when making a decision or a determination, the person making the calculation shall do so in good faith and in a commercially reasonable manner; and • A clause that provides that all transactions entered into under a master agreement form a single agreement between the parties."

[57] Bacon L, Brook N, Bazinas G, *Smart Contracts: Where Law Meets Technology, Clyde and Co Inside,* available: https://www.clydeco.com/insight/article/smart-contracts-where-law-meets-technology. [June 2016]

events, which occur outside the pre-coded contractual language and may affect contractual enforceability e.g. Fraud, Force Majeure and Frustration.[58]

Consequently, ISDA 2018 whitepaper has highlighted "four fundamental principles for…. the development of smart derivative contracts:

1. Smart derivative contracts should be compatible with existing standards
2. Only those parts of a derivatives contract that are capable of being automated should be considered
3. Effective automation should be based on legal validation
4. Only those parts of a derivatives contracts where there exists sufficient benefit in automating should be considered for automation."[59]

4.1 Validating and executing the agreement: What should or not be automated?

The market for financial derivatives is technologically developed, most parties use the standard terms of agreements (ISDA agreement), accounts are settled in an organised, repeatable and predictable way, save for market fluctuations which affect returns. According to the International Swaps and Derivatives Association, there are more than 875 member institutions from 68 countries and the market is worth trillions of US dollars. Stakeholders include issuers, investors, intermediaries, regulators; in the case of collateralised debt obligations, even original mortgagors may have interest. Consequently, without technological assistance clearing counterparties will struggle and should start planning for mass events e.g., data reconciliation. ISDA recognises that the market urgently needs DLT/Blockchain technology to speed up clearing, reconciliation and modularisation (identifying regulation where multiple legal sources apply to individual transactions).

The ISDA master agreement, the customary contract governing all transactions, provides the market with a good deal of standardisation thus solid foundations for implementing technology. Arguably, the bilateral nature of OTC's leaves room for tailor-made or customised contractual terms leading to a complex combination of documents with a variety of obligations,[60] for example, collateral documentation, protocols, amendments agreements and clearing documentation.[61]The following illustration corroborates this argument.

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[58] Bacon L, Brook N, Bazinas G, *Smart Contracts: Where Law Meets Technology, Clyde and Co Inside*. Available: https://www.clydeco.com/insight/article/smart-contracts-where-law-meets-technology. [June 2016]

[59] ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction, January 2019 pp 10-12, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/

[60] ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction, January 2019 p 13, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/

[61] Ibid at 21. See also Section 1(c) of the ISDA 2002 Master Agreement.

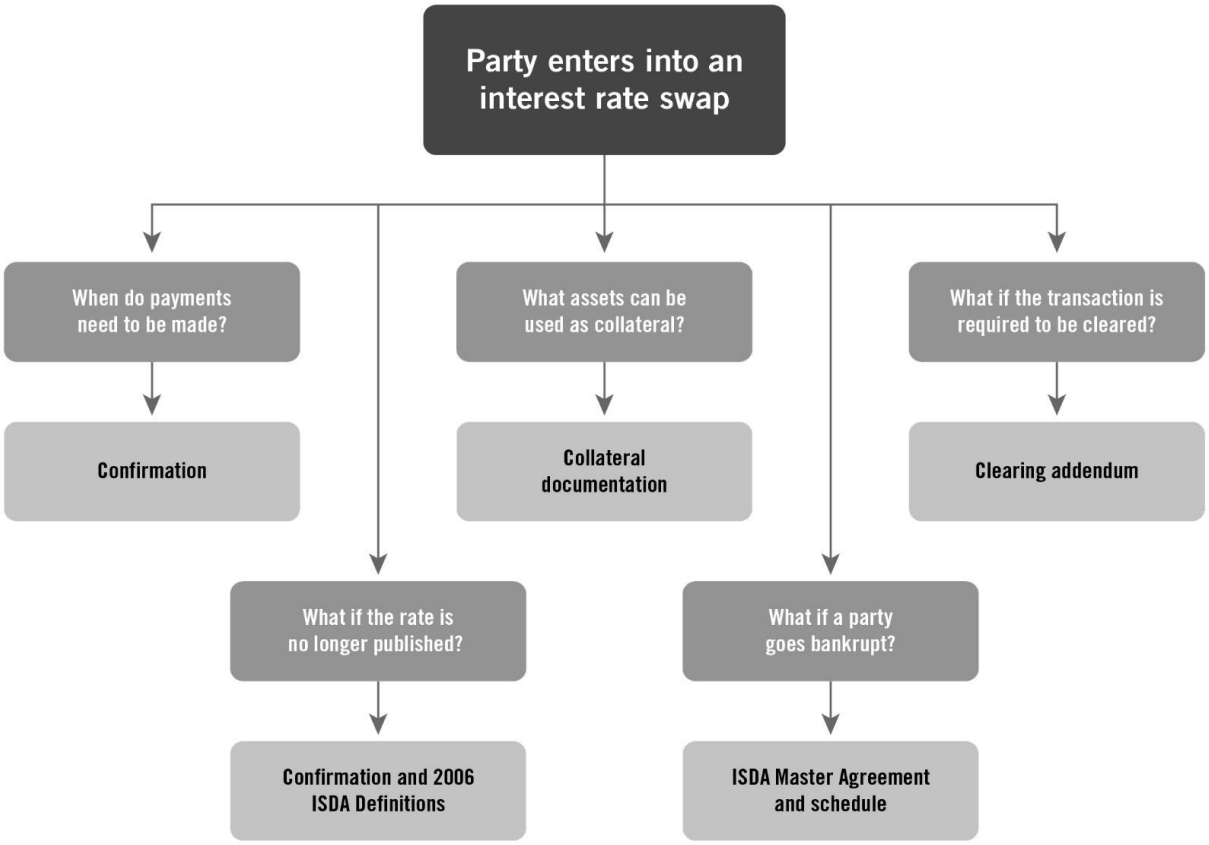

Fig 4 Source: Figure 5 ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction, January 2019 p 13, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/

ISDA guidelines for smart derivatives contracts is clear that validating the agreement poses a very serious task, especially for lawyers who must do their best endeavor to align the effect of the smart code with the legal effect of the contract.[62] The situation becomes more difficult still because some derivative agreements hedge the financial exposure created by other derivatives contract[63] thus both contracts, to some extent work in conjunction with each other.

There are nevertheless, at least three issues, which are worth covering in here. The first one is the automation of contract formation and the pre-contractual and post-contractual duty of 'Good Faith'. The concept implies the use of a subjective test to ascertain whether any contractual party has acted in a way that impinges either contract formation or execution, in other words in an unreasonable manner. Some comparative comments may assist in understanding the issue.

[62] ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction, January 2019 p 11, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/
[63] Ibid.

The contractual duty of good faith is a principle of no legal general application in the United Kingdom;[64] nevertheless, the High Court in *Yam Seng Pte Ltd v International Trade Corp Ltd*[65] took the prominent view that in long-term contractual relationships the duty of good faith should be present during the entire existence of the contract namely formation and execution. Thus, Mr. Justice Leggatt concluded, "traditional English hostility towards a doctrine of good faith in the performance of contracts, to the extent that it still persists, is misplaced"[66]

Conversely, in Germany contractual parties could incur 'Culpa in Contraendo (fault in contracting)' in accordance with Art 311 II BGB " a party that fails to observe diligence in negotiating contracts commits a breach of its contractual obligations and is accountable for the other party reliance losses." Thus, groundless breaking of a contract in formation could lead to a claim for damages if the innocent party justifiably counted on a contract coming into existence. Equally, in France in accordance with the principle of 'Abuse de Droit' (bad faith without malice will suffice) parties must act in good faith not only during contract execution yet during contract formation so "Responsabilite Precontractuelle" is a clear possibility.

The above comments have not been made in isolation; on the contrary, they endorse ISDA concerns about subjective factors which may affect contract formation and smart derivative agreements, using or not blockchain technology, may assist very little with parties' 'state of mind' at the time they enter or execute the agreement.

One argument, which favours automation, is nevertheless, the possibility of having access to the contractual history of the counterparty so it would become apparent when such party, acting in good or bad faith, enters into agreements or other obligations, which may affect his/her, ability to perform the derivatives agreement. Blockchain technology could effectively retrieve this tamper-resistant data.

The second issue connects with the misselling of financial products claims. They have found almost an unsurmountable obstacle when UK courts took the approach that sophisticated investors, those with accurate knowledge and experience in the market for financial derivatives for example, are in a position of understanding, accessing the risk and valuing the instruments in which they invest portfolios. Such level of sophistication made it impossible for claimants to prove 'inducement' as requirement to succeed in a claim for misrepresentation.[67] In other words, the victim of a misleading

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[64] Lord Bingham in *Interfoto Picture Library Ltd v Stiletto Visual Programmes Ltd* [1989] 1 QB 433 at 439 are often quoted: "In many civil law systems, and perhaps in most legal systems outside the common law world, the law of obligations recognises and enforces an overriding principle that in making and carrying out contracts parties should act in good faith. This does not simply mean that they should not deceive each other, a principle which any legal system must recognise; its effect is perhaps most aptly conveyed by such metaphorical colloquialisms as 'playing fair', 'coming clean' or 'putting one's cards face upwards on the table.' It is in essence a principle of fair open dealing… English law has, characteristically, committed itself to no such overriding principle but has developed piecemeal solutions in response to demonstrated problems of unfairness."

[65] [2013] EWHC 111 (QB)

[66] Ibid at para 153

[67] Several cases were decided on these grounds e.g. *JP Morgan Bank (formerly Chase Manhattan Bank) v Springwell Navigation Corp* [2008] EWHC 1186 (Comm); *IFE Fund SA v Goldman Sachs International* [2007] 2 Lloyd's Rep 449; *Peekay Intermark Ltd v Australia & New Zealand Banking Group Ltd* [2006] 2 Lloyd's Rep 511; *Titan Steel Wheels Ltd v Royal Bank of Scotland Plc* [2010] 2 Lloyd's Rep. 92 QBD

statement must prove that he/she relied on it and was induced to enter into the agreement in such terms or that without that statement he/she would not have entered into the agreement at all or would have done it but on different terms.

Two questions without potential legal answer are "how do I know the code, as written in the contract, reflects my intentions if I cannot read it? And how do I know the effect of the code, when executed by a machine, will be what I intend?"[68] Potential solutions are twofold either for lawyers, as legal advisors, to learn and understand the relevant language used to write the code or for the industry to come up with standard codes for 'particular pieces of conditional logic'.[69]

Regardless of concerns about smart codes embedded in DLT/Blockchain, it is the author's view that the use of smart derivatives contracts could potentially end claims for negligent misrepresentation. The nature and features of blockchain will allow market participants to verify and double check the veracity and marketability of the financial instrument and most importantly, reject by lack of consensus inaccurate or tampered data. It may happen that even though ISDA's concerns about subjective elements are valid and worth taken into consideration, the benefits of automation may lead to a significant reduction of misrepresentation claims.

The third issue is about choice of law and jurisdiction to resolve derivatives disputes, as correctly emphasised by the ISDA/Linklaters white paper.[70] In relation to financial contracts, as far as English Law is concerned, the applicable law to determine place of performance is the law where the contractual obligation is or will be discharged. In the same line, the place of payment is where the debtor is domiciled.[71] However, other jurisdictions may have different rules of construction for example, when a dematerialised asset is created, the law applicable to the place where it has been registered and/or where the register is situated.[72] Interestingly enough, should the system move to DLT/Blockchain technology, where by definition nodes distribute across the globe, ascertaining the applicable law and jurisdiction[73] is very challenging indeed. One answer could be requiring the majority of nodes to come from a specific jurisdiction or even granting access only to nodes in selected places.

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[68] Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, pp 16, 17, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[69] Ibid at 17
[70] Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[71] Morris, *The Conflicts of Laws*, Sweet & Maxwell 9th Edition p 112
[72] Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, p 9, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[73] This should be understood 'in the absence of clear contractual choice of law and jurisdiction' agreed by the contracting parties.

5. **Possible Structure and Functioning of Smart OTC's Derivatives**

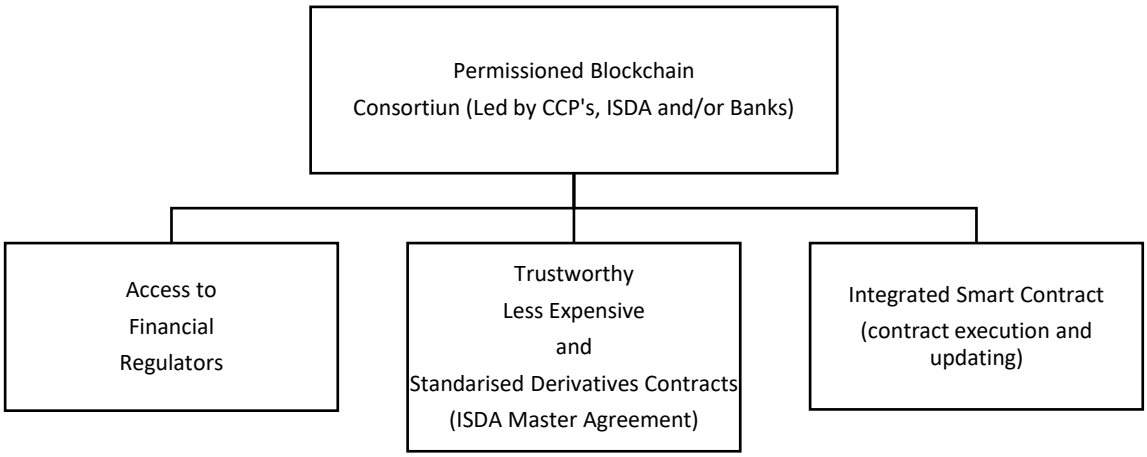

Fig 5 source: Adolfo Paolini

The underlying complexity, size and control of this segment of the financial market, would require a permissioned (consortium) private blockchain led by CCP's, ISDA or participating banks, with access to financial regulators,[74] allowing the latter to control anti-money laundering, fair competition, the financing of illegal activities alongside the contractual execution of derivatives trade agreements. The advantage of DLT/Blockchain at this point would be to provide regulators with more efficient tools to trace back the proceeds of crime and guarantee efficiency and transparency in the market thus ameliorating or substantially avoiding the effects of systemic risks. Regulatory compliance is a high hurdle indeed and Regtech is meant to play its role in here, by further developing a private blockchain with access to regulators and algorithms specially written to control money laundering e.g. silk road,[75] free competition and where applicable financial regulation, monetary policy and liquidity.

Secondly, the author is of the view that using a standardised contract like the ISDA master agreement, substantially simplifies the OTC smart process and gives stakeholders high levels of security and scrutiny. Entering into similar contracts with other partakers arguably benefits certainty. The final layer is the automation itself where the integrated smart contact would execute the agreement by adjusting margins, novation, settlements or just making the order to deliver either the price difference or the physical asset. Automation needs to be at the spine of derivative trading where, contrary to what happen in securities trading (short periods), derivatives need

[74] ISDA and Linklaters LLP, *Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective*, 2017, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[75] Narayanan A, Bonneau J, Felten E, Miller A & Goldfeder S, *Bitcoin and Cryptocurrency Technologies*, Princeton New Jersey, Princeton University Press, 2016

intermediation for the entire duration of the agreement (long periods) which, could last several years,[76] therefore exposing the counter parties to longer periods of risk.

5.1 Platform and Network Requirements

Highlighting the basic features, including a basic definition, of what a derivative is, may help in understanding what problems, if any, technology is to resolve. A derivative is a contract which derives its value from something else or "… a financial instrument (or more simply an agreement between two people) that has a value determined by the price of something else."[77] The three main purposes for using these instruments are gambling or speculation, hedging solutions or risk management and arbitrage.[78] These three purposes underpin all three types of derivatives, futures or forwards,[79] options and swaps. What seems to be common denominators of any type of derivative contract are the facts that they all mirror the underlying asset (subject matter of the derivative agreement) and contracting parties worry about prices falling or rising therefore, both parties hedge the risk. Furthermore, contracting parties could get out of the contract by novation (deleting the original agreement and replacing it with a new one), including the possibility of physically honoring the agreement or just receiving the price variation. Novation is in fact what happens where clearing takes place through a central clearing counterparty (CCP) contrary to that in bilateral trading where the parties are always the same until the end of the agreement.[80]

Consequently, the OTC is very time and effort consuming indeed, since it uses a significant number of interacting parties. A smart OTC platform will significantly shorten the multi-party machine of modern finance, which includes the originating bank, correspondent, clearinghouse, a broker, settlement agency and payment processor.[81]

Due to the size of this market and the high pace at which transactions take place, latency becomes a serious issue. The Depository Trust and Clearing Corporation for example, deals with 10000 transactions per second[82] so any new model cannot afford delays before the execution of a transaction begins, this could be very costly indeed. It is suggested that latency may be induced by the requirement that all nodes need to communicate in synchronise way.[83] Developing or implementing a consensus algorithm like Ripple, which uses a number of trusted subnetworks, thus requiring

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[76] Loesch S, *A Guide to Financial Regulation for Fintech Entrepreneurs*, Wiley, 2018, at 115
[77] McDonald R L, *Fundamentals of Derivatives Markets*, Pearson 2009, at 2
[78] Arbitrage consists in taking financial advantage of market anomalies. For example, speculating about a sudden fall of commodities prices due to unforeseen circumstances.
[79]There is no difference between futures and forwards, apart from the fact that the former uses centralized exchanges for trading, whereas the latter trade without it.
Forwards: Without exchange trading
[80] Loesch S, *A Guide to Financial Regulation for Fintech Entrepreneurs*, Wiley, 2018, at 109
[81] Casey MJ & Vigna P, *The Truth Machine The Blockchain and the Future of Everything*, Harper Collins Publishers, 2018 at 153
[82] Ibid at 162
[83] Schwartz D, Young N & Britto A, *The Ripple Protocol Consensus Algorithm.* 2014, available at https://ripple.com/files/ripple_consensus_whitepaper.pdf. Accessed on 19/01/19

minimal connectivity to achieve consensus[84] could help to this end. Financial institutions and other payment providers use RippleNet (Xcurrent, Xrapid and Xvia) to exchange in a very expeditious and low cost way foreign currency, cryptocurrencies and other tokens, by using a number of liquidity providers who compete each other to provide the best exchange rate thus its low cost and speedy process or real time settlements.[85] Should the system adopt a more quicker/safer platform arguably will accelerate transactions and the releasing of moneys and/or other assets held as collaterals, unlocking trillions of dollars[86], to finance new ventures and market growth.

Looking for example at new products like Interdax with a capability of 300.000 transactions per second,[87] one can clearly see the magnitude of computational capacity required to efficiently run the consensus platform. The way forward seems to be liaising with Fintech start-ups and/or global consortia,[88] as suggested in the structure of this smart system.

Building on the above comments, two complications unfold storage and speed**.** The first one does not seem to be serious bearing in mind than banks are major stakeholders and should have the hardware resources. Regarding speed, as already suggested, Ripple alike systems could be advantageous to say nothing of new market player e.g. Interdax and Axoni.[89]

Additionally, the networking layer will require several nodes, it is impossible to keep a record, as full node, of every transaction in the clearing system. Derivatives depend on future events, which require periodical updates therefore the need for a very comprehensive network of contributors who could actually keep the ecosystem in motion. Banks could also act as exchangers to facilitate access to the so-called clearing platform, albeit OTC's may trade bilaterally.

The design also requires the integration of smart contracts and distributed ledger technology in the following terms: DLT/Blockchain will store data and host the smart contract; to this end, it will recall all the information using code.[90] Smart contracts would guarantee that trading actions (OTC creation, margins, execution and trade) happen automatically finally, the DLT/Blockchain will record changes to the transactions[91] thus keeping a traceable or historical record of both the underlying contract and the financial instrument. ISDA suggest that this implementation uses

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[84] Schwartz D, Young N & Britto A, *The Ripple Protocol Consensus Algorithm*. 2014, available at https://ripple.com/files/ripple_consensus_whitepaper.pdf. Accessed on 19/01/19

[85] www.ripple.com; See also Ganne E, *Can Blockchain Revolutionize International Trade?* , World Tarde Organization, 2018

[86] Casey MJ & Vigna P, *The Truth Machine The Blockchain and the Future of Everything*, Harper Collins Publishers, 2018 at 156

[87] Derivatives Exchange Interdax Nears Launch with over $1 Million in Prizes, 2018, available at https://nulltx.com/derivatives-exchange-interdax-nears-launch-with-over-1-million-in-prizes/.

[88] https://www.hyperledger.org/members see also R3 platform at https://www.r3.com/

[89] See https://www.interdax.com/ and https://axoni.com/technology/

[90] De Filippi P & Wright A, *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press. 2018 at 95

[91] Whitepaper Smart Contracts and Distributed Ledger a Legal Perspective, 2017, available at https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.

separate pieces of smart contract code because no transaction is alike therefore, they could have different parameters e.g. inputs, times and calculation methodologies.[92]

It is necessary to emphasise nevertheless, the potential need for oracles to adjust the constant market value fluctuation of the instrument, affected by interest rates, Libor rates and stock prices.[93] Oracles are outsiders, either individuals or programmes who help the blockchain to interact with the outside world in order to make any adjustments in real time.[94] This interaction could prove costly nonetheless market players, in the OTC ecosystem, are wealthy enough to put in motion the best possible technological solutions to tackle scalability, efficiency, fair trade and lack of trust. A good example is the ISDA Common Domain Model version 1.0, which builds on Financial Products Markup Language (FpML).[95] This is a machine-readable programme able to represent happening of events during the life of the derivative agreement such as transaction-level clauses and in the future will be covering equity derivatives products and collateral data.[96]

Additionally and without wanting to sound too ambitious indeed, a single decentralised cryptocurrency could simplify and reduce costs in the clearing and settlement process. This idea of course carries high risk namely the volatility of any cryptocurrency.[97] To this end, JP Morgan has announced plans to use JPM crypto coins to settle payments between clients,[98] thus the future is already here. Central Banks on the other hand may soon move to fiat digital currency and the project is already under consideration,[99] with the immediate effect of simplifying even further derivative trading and possibly disrupting currency swaps due to the fact that foreign conversion rates may not be needed.

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[92] ISDA, *Guidelines for Smart Derivatives Contracts: Introduction*. January 2019 p 7 available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/
[93] De Filippi P & Wright A, *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press. 2018 at 95
[94] Ibid at 75
[95] https://www.isda.org/category/infrastructure/fpml/
[96] ISDA, Legal Guidelines for Smart Derivatives Contracts: Introduction, January 2019 p 8, available at https://www.isda.org/2019/01/30/legal-guidelines-for-smart-derivatives-contracts-introduction/
[97] CB Insights. *Blockchain investment trends in review*, available: https://www.cbinsights.com/research/report/blockchain-trends-opportunities/ 2017, December 10
[98] CB Insights, Killing The I-Bank: The Disruption Of Investment Banking available at https://www.cbinsights.com/research/report/disrupting-investment-banking/ at 43
[99] Casey MJ & Vigna P, *The Truth Machine The Blockchain and the Future of Everything*, Harper Collins Publishers, 2018 at 164

The following figure may depict what it is proposed:

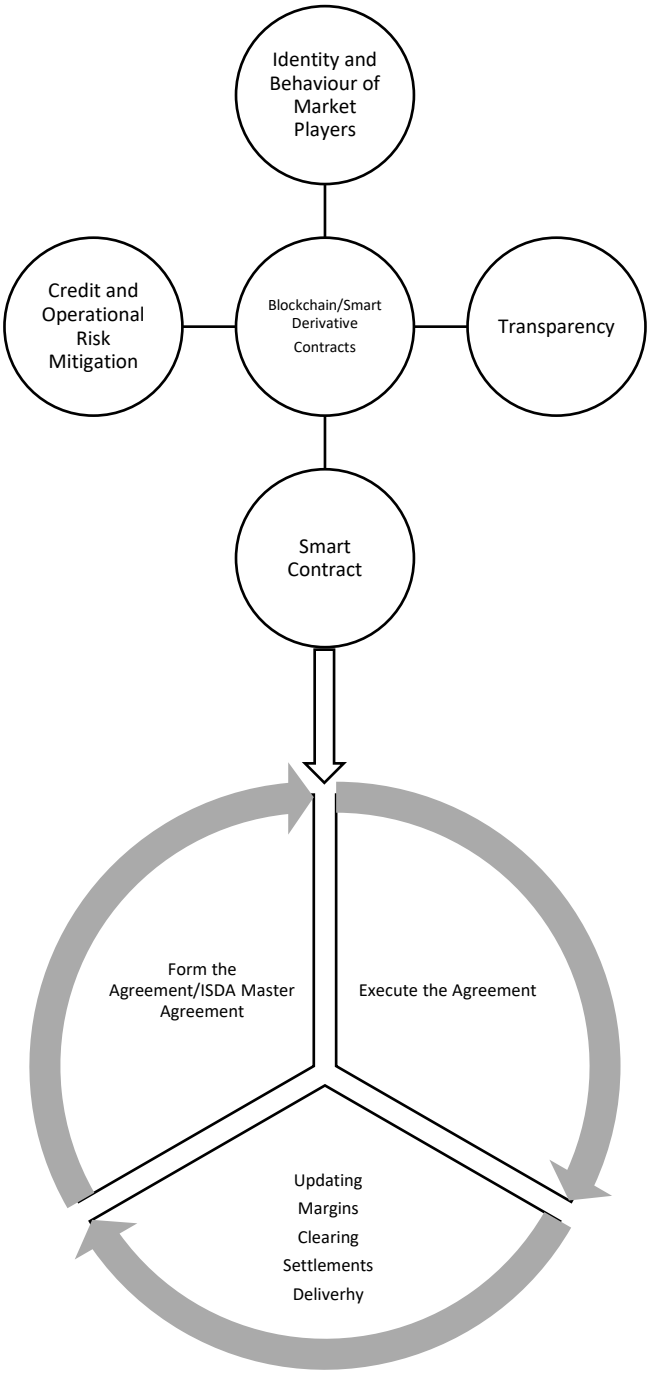

Fig 6 source: Adolfo Paolini

5.2 Application Layer Advantages

Crucial to the ongoing discussion is to identify whom would use and benefit from the OTC smart system and the list contains at least the following stakeholders:

- The European Market Infrastructure Regulation on Derivatives, Central Counterparties and Trade Repositories (EMIR) requires central clearing counterparties, which are arguably the one who will control, scrutinise and grant access to the permissioned smart system. The International Swap Derivatives Association and participating banks for example, will manage the private blockchain.
- The second stakeholder, as already emphasised above, is the financial regulator whose supervisory and controlling power would exercise real time monitoring of the chain of transactions. Direct access to the blockchain system gives the financial regulator the opportunity to identify early bad players, including money-laundering concerns alongside the normal supervision of the market financial stability.
- The third stakeholder is the trader itself who benefits from taking part in a more expeditious and trustworthy system. Blockchains are unamendable hence; data inputs will remain unchangeable in the chain therefore some data concerns arise.
- Brokers and other intermediaries like DTCC[100] may no need to maintain physical stock certificates[101] or any other relevant documentation to which the OTC's refer.

In a market, which exceeds 11 Trillion US dollars, one could identity several advantages for sophisticated investors who will be enable to trace the underlying contract from which the derivate instrument steams in the first place. The benefit is immeasurable in the sense that the market will have the opportunity of credibly assessing the value and risk of OTC's, to say nothing of putting in motion a system which could earlier identity 'bad actors'. As a result, the market expects significant behavioral changes in consumers and issuers of derivatives in the sense that the system would be more reliable and trustworthy thus, propelling financial investment even further.

Therefore, the behavioral change in consumers at the execution phase of the process is necessary. Whereas contract formation will change very little, the challenge is with contract execution. The disruption caused by moving from traditional ways to execute OTC's, needs replacing by a trustworthy and auditable system where intermediary may become redundant. At this stage, it would be crucial that stakeholders educate users and explain the benefits of the automation or technology integration of the clearing process.

Behavioral changes, at the core of financial institutions, are also expected. Adopting a more efficient, cheaper and trustworthy OTC clearing platform may have an effect on

[100] The Depository Trust and Clearing Corporation. See http://www.dtcc.com/
[101] De Filippi P, Wright A. *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press, 2018 at 90

competitive behavior allowing new players with innovative or disruptive ideas, to access the market and gain a share of it.[102]

Even though OTC's are privately traded and there is or was no need to go through a clearing counterparty, as major players in the OTC market, Banks' workflow will significantly reduce by replacing several layers in their organisational structure for example, due diligence, compliance, reporting, all of which could be simplified and audited quicker and cheaper. This explains why 20% of blockchain technology patents belong to banks and the market presumes that the industry would spend in the region of US$ 400 million on related projects.[103]

Regarding value, it verifies stakeholders' liquidity, collaterals and contributions; using code, margins could automatically adjust to reflect changes in the market and most importantly its tamper- resistant record of transactions will help in verifying the underlying transaction and whether investors have entered into other agreements which may impinge in their ability to fulfil obligations.[104]All resulting in a more transparent and profitable market for OTC trade.

Arguably, blockchain will facilitate market players' identity[105] and sophisticated investors could hugely benefit from it. The challenge is that large-scale identification processes could in essence be difficult to achieve.[106] However, having a reliable and secure identification system would open more doors for accessing credit, enforcing, protecting, transferring and claiming legal rights, to say nothing of being a quicker and more effective ways to resolve crimes or commercial disputes. The burden of proof could be easier in the sense that behavior patterns or predictions,[107] digitally recorded, could effectively identify the wrongdoer and protect the market.

5.3 Exponential Growth, Know Your Customer and Privacy Concerns

Bearing in mind that by providing diversity and access to more market participants (private and small businesses) financial gains is just another additional motive for the implementation of a more efficient smart system. However, market growth is fraught with new regulatory, monitoring and supervising tests. As trustworthy and less expensive new system, the market is likely to attract not only 'highly standardised

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[102] Competition and Markets Authority, *Making Banks Work Harder for You*, available:https://www.gov.uk/government/publications/retail-banking-market-investigation-overview. [2016]. Para 24-25

[103] Ganne E, *Can Blockchain Revolutionize International Trade?* , World Tarde Organization, 2018, p 46. Quoting McKinsey & Company 2017.

[104] De Filippi P & Wright A, *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press, 2018 at 92

[105] Thomason, J, *The importance of blockchain* (Part 1). [Podcast]. 2018, available at https://oxford.onlinecampus.getsmarter.com/mod/video/view.php?id=6894. [Accessed 30 Nov. 2018].

[106] James-Lubin, K, *Blockchain scalability A look at the stumbling blocks to blockchain scalability and some high-level technical solutions*. [Online], 2015, available at: https://www.oreilly.com/ideas/blockchain-scalability. [Accessed 30 Nov. 2018].

[107] Ashley, K, *Artificial Intelligence and Legal Analytics*. Cambridge, United Kingdom: Cambridge University Press. 2017, p.123

derivatives contacts but also tailor-made ones,'[108] nevertheless the question still open as to whether exceptionally risky and/or complex contracts would need to use CCPs' premium services.[109] Undoubtedly, blockchain technology will catapult the number of market participants (customers) in financial services. As Emmanuelle Ganne[110] clearly identified, there are three possible ways in which Blockchain is about to propelled access to finance at all levels including OTC trade: first this tampered resistant innovative system can be used to reconcile customers credit history and creditworthiness which happens to be difficult for sole traders of small/medium size enterprises. Secondly, as resources scarce, small market participants do not have the ability to deal with complex financial negotiations thus, blockchain will open new income streams for banks by allowing access to a large number of new traders. Thirdly, intermediary banks may become redundant, as blockchain, on a peer-to-peer basis, allows new market players to partake in international trade without having to secure conventional trade finance[111] in other words, at a much lower cost. The WE.trade platform is one of the most eloquent examples already providing services to small and medium enterprises.[112] This exponential growth increases data protection concerns.

Building on previous comments, one crucial problem faced not only by central clearing counterparties but also financial services providers in general, is data protection. All information will be visible to the nodes and this creates potential concerns with privacy. Private Blockchains would potentially resolved this problem alongside using specific codes in compliance with regulation and cross border control e.g. Money laundering and consumer protection. In fact, the algorithmic code could include the possibility of identifying what sort of information consumers or market players are happy to share. The challenge of course is 'controlling financial crime' in a system where fraudsters only share the clean side of their credit history.

Data protection is therefore a problem because individuals or nodes with 51% stake in the system do have the power to 'attack and effectively take over the network'[113] to update personal records, opening wide the doors for fictitious use or misuse of real identities.[114] How could the system authenticate whether one's identity is real and not robotic? How could it verify that individual skills, legal status, claimed ownership is genuine? Additionally, privacy rights will potentially disappear unless individuals could control what personal information is shared in a given moment. The

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[108] Avgouleas E and Kiayias A, *The Promise of Blockchain Technology for Global Securities and Derivatives Markets: The New Financial Ecosystem and the "Holy Grail" of Systemic Risk Containment*, University of Edinburg, School of Law, Research Paper Series, No 2018/43 at pp 7-8

[109] Avgouleas E and Kiayias A, *The Promise of Blockchain Technology for Global Securities and Derivatives Markets: The New Financial Ecosystem and the "Holy Grail" of Systemic Risk Containment*, University of Edinburg, School of Law, Research Paper Series, No 2018/43 at p 8

[110] Ganne E, *Can Blockchain Revolutionize International Trade?* , World Tarde Organization, 2018

[111] Ibid at 84

[112] Ibid

[113] De Filippi P, Wright A, *Blockchain and The Law*. Cambridge, Massachusetts: Harvard University Press. 2018, p.25 see also Nakamoto, S, *Bitcoin: a peer-to-peer electronic cash system*. Available at https://bitcoin.org/ bitcoin.pdf. p 1 "The system is secure as long as honest nodes collectively control more CPU power than any cooperating group of attacker node"

[114] Blake H, *5 Identity Problems Blockchain Doesn't Solve*. [Online]. 2016, available at https://medium.com/@blake_hall/5-identity-problems-blockchain-doesnt-solve-ed4badb94398. [Accessed 30 Nov 2018]

reputational damage suffered by individuals whose potentially whole identity is misused will undoubtedly be more severe and difficult to rebuild.

Nakamoto whitepaper has already given the answer to privacy concerns namely the use of public keys. Keeping such keys anonymous will prevent the public for linking information to someone so they can only see the subject matter of the transaction and not the identity of the parties involved.[115] The actual OTC and banking system give us little choice thus we need to trust them as custodians of our money, repositories of our transactions and the way assets are electronically transferred, "we have to trust them with our privacy, trust them not to let identity thieves drain our accounts."[116]

It is not the aim of this article to explore how the new European Union General Data Protection Regulation (GDPR) may affect Blockchain technology. In its own right, it is the subject matter of another piece of research nevertheless; it is worth making some brief comments, which build on the excellent material published by Michele Fick.[117]

In order to be within the remit of GDPR rules, data must be personal and identifiable and/or attributable to natural persons. This means that total anonymity will exclude the application of GDPR rules because 'it is no longer deemed' as personal data. Finck distinguishes nevertheless two sets of data, which could, in principle, be described as personal therefore covered by GDPR: Transactional data stored in the Blockchain and public keys.[118] The first one refers to personal data, which could identify financial records and behavior.

Public keys namely the combination of letters and numbers, which make it possible to identify natural or corporate persons, represent a more serious challenge for GDPR,[119] it all depends on anonymity. Should the public key be entirely anonymous GDPR rules will not apply conversely, where suck keys matched, with additional information are attributable to identified individuals, GDPR operates in full.[120] However, it is too early to predict how GDPR rules will be interpreted in specific scenarios.[121]

Looking at other regulatory concerns, Michele Finck has also rightly identified four drivers affecting current and future regulation namely: the cross-jurisdictional nature of OTC's, decentralisation, anonymity and increased adoption.[122]

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[115] Nakamoto, S, *Bitcoin: a peer-to-peer electronic cash system*, available at https://bitcoin.org/bitcoin.pdf. p6 "This is similar to the level of information released by stock exchanges, where the time and size of individual trades, the "tape", is made public, but without telling who the parties were."
[116] Nakamoto S, *Bitcoin open source implementation of P2P currency*, 2009, available at http://p2pfoundation.ning.com/forum/topics/bitcoin-open-source
[117] Finck M, *Blockchain Regulation and Governance in Europe*, Cambridge University Press, 2019
[118] Finck M, *Blockchain Regulation and Governance in Europe*, Cambridge University Press, 2019 at 93
[119] See Pseudonymisation Article 4(5) General Data Protection Regulation.
[120] Finck M, *Blockchain Regulation and Governance in Europe*, Cambridge University Press, 2019 at 96
[121] For an excellent analysis about Blockchain and GDPR please see Finck M, *Blockchain Regulation and Governance in Europe*, Cambridge University Press, 2019 Chapter 4 pp 88-116
[122] Finck M, *Blockchain Regulation and Governance in Europe*, Cambridge University Press, 2019 pp 58-64

Let us briefly cover each. The international nature of derivatives, as discussed above, poses difficulties in ascertaining several legal aspects associated with applicable law and enforceability for example where the agreement has entered into, executed or breached, where payment is made, parties domicile. To this end, some jurisdictions like Germany and UK are suggesting global regulation for innovative financial technology.[123]

Decentralisation peer-to-peer interconnectivity (Nodes) could be and in fact are dispersed around the world therefore; users could download, upload and exchange data without effective monitoring and supervision control by financial regulators.

The pseudonymous nature of DLT/Blockchain requires vast financial investment in computational resources to identify users including bad ones. There could be confrontational issues between fighting anonymity and privacy rights protection and it is Finck's view that Blockchain is not anonymous enough to meet the requirements of the General Data Protection Regulation.[124]

Finally, scalability or increased adoption makes enforcing the rules technically challenging e.g. uncontrollable with the obvious consequence of creating a social rejection of regulatory intervention.[125] Irrespective of our views on these matters, it is too early to challenge and/or defy the law because Blockchain technology, in both historical and legal cycles, is still very young so there is a long way ahead to explore first.

6. Conclusion

C+Q+T+FC+RC=BM

Cheaper + Quicker + Trustworthy +Fair Competition +Risk Control = Better Market

The value transfer of DLT/Blockchain in OTC's is immense. Several benefits are seemingly apparent: less intermediaries would significantly reduce cost, the time for settling payments would almost be instantaneous and the accuracy of the information would be thoroughly scrutinised by consensus (Cost-time-veracity).

Blockchains would allow for diversity and competing systems, which would not be necessary, connected to each other, therefore spreading the risk between smaller market players (CCPs) so the failure of a clearinghouse, may not result in systemic

[123] Finck M, *Blockchain Regulation and Governance in Europe*, Cambridge University Press, 2019 pp 59
[124] Ibid at 64
[125] Ibid

risks.[126] The market expects competitive behavior linked to financial innovation, leading to a more equitable share of its benefits.

Immutable records are paramount for the smart OTC market. Should data insecurely mutate, tracing records, the history of transactions and most importantly financial settlements would be virtually impossible to scrutinise. Mutability poses a serious actual risk to the clearing and settlement system and this new technology will help in resolving it. An immutable record would guarantee transparency and trust so investors would have access to tamper-resistant data to better asses the risk. Using a ledger visible to participants could also spot inaccurate information and reject it in addition to identifying, much earlier, bad market actors.

Behavioural changes in consumers due to moving out of traditional ways to do business will soon follow so the task for stakeholders is to disseminate and educate the market in the sense that well-educated markets thrive in businesses.

Financial Institutions would adopt more efficient, cheaper and trustworthy clearing platforms where current legal standards and principles will interact with smart contracts. Clarifying what the correct legal construction of a smart contract and/or code is, would trigger its use and benefits.

A robust Legal framework is also paramount. There are several questions without clear-cut answers namely, what law would apply to resolve disputes? Breaches will happen in the cyberspace thus, which court would have jurisdiction to hear the claim? May we need cyber courts?[127] Most importantly and since this is a peer -to -peer system, would all peers share responsibility? Alternatively, would the victim have to identify the individual wrongdoer, which would be almost impossible?

The authors humble answer to the question will DLT/Blockchain disrupt the financial derivatives market? *YES IT WILL* making it more transparent, diverse, efficient, cheaper and more socially inclusive.

"The services industry has, like other industries, been affected by the rise of new technologies, in particular the internet. New business models have emerged. *The advent of blockchain technology could further reshuffle the deck.*"[128]

Dr Adolfo Paolini

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[126] Avgouleas E and Kiayias A, *The Promise of Blockchain Technology for Global Securities and Derivatives Markets: The New Financial Ecosystem and the "Holy Grail" of Systemic Risk Containment*, University of Edinburg, School of Law, Research Paper Series, No 2018/43 at p 8

[127] Ashley, K, *Artificial Intelligence and Legal Analytics*. Cambridge, United Kingdom: Cambridge University Press 2017, p. 174

[128] Ganne E, *Can Blockchain Revolutionize International Trade?* , World Tarde Organization, 2018, p 46 (emphasis added)

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19-Feb-2020

Dear Dr. Paolini:

I would like to thank you for submitting your manuscript entitled "The Disruptive Effect of Distributed Ledger Technology and Blockchain in the over the counter derivatives market" to Global Jurist (GJ). Your manuscript has been reviewed, and it is a pleasure to accept it for publication in GJ.

The GJ production office will contact you for proofreading in the near future. Your article will be published ahead of print as soon as possible, and in the printed edition at a later time.

Thank you for your fine contribution. On behalf of the Editors of Global Jurist we look forward to your continued contributions to the Journal.

Kind regards
Guest Editor, Global Jurist