The Effect That the Advent of Blockchain Could Have on Risk Management Infrastructure of the Derivatives Industry

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Introduction

The US derivatives markets serve an important role in the American economy by providing opportunities for hedging and risk management as well as limited speculation. Inherent in these diverse markets are various forms of risk. And pursuant to the Commodity Exchange Act (CEA), the US Commodity Futures Trading Commission (CFTC or Commission) – the primary regulator of these markets – has constructed a regulatory infrastructure to address these risks. This infrastructure is multi-faceted involving a web of requirements including, inter alia, mandatory clearing, mandatory trade execution, reporting, and registration. But how well would today's regulatory infrastructure suit the risk profile of tomorrow's blockchain-based derivatives markets?

Though end-to-end blockchain-based derivatives markets are not likely in the near future,[1] there is a lot of present activity that is pointing ultimately in that direction. Thus, it would be wise for us to consider how blockchain could shift the risks in the derivatives markets, and therefore how the regulatory structure may need to shift to address the new risk paradigm. In the below, I discuss: (1) the basic regulatory infrastructure designed to address the risks of the derivatives markets today, including its registration regime; (2) how blockchain could be applied in the derivatives markets; (3) ways in which a blockchain-based derivatives market could possibly reduce risk; (4) some of the risk concerns about blockchain raised by market participants and how they may be addressed; and (5) a risk concern that has not received much discussion – how the application of today's risk-based registration regime on tomorrow's market may actually increase risk.

I. Today's, non-blockchain based derivatives regulatory infrastructure

A. Basic regulatory structure

The CEA and CFTC regulations are incredibly complex, but for the sake of this discussion, generally, regarding swaps, the CFTC has determined that some contracts must be cleared, and of those, a subset of contracts must be executed on approved trading platforms. And all swaps, with certain exceptions, must be reported. Now while many requirements, such as clearing, trade execution, reporting, anti-fraud, and anti-manipulation, apply to all swap participants, there are certain participants whose activities in the market are of such significance that they must be registered with the CFTC. The Commission endeavors to subject all significant market participants, i.e., all those who could meaningfully influence the risk profile of its markets, to its registration regime.

B. Registration regime

[1] *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 10. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.

Registration is central to the CFTC's oversight in that it allows the CFTC to, inter alia:

(1) Identify the key participants in the markets;
(2) Form a regulatory relationship with these key participants;
(3) Require these key participants to meet certain requirements aimed at risk mitigation;
(4) Have ready access to these participants during times of relative peace and crisis; and
(5) Require key participants to self-report significant events.

There are several registration categories required by the CFTC, but the specific ones we will discuss in this paper are:

(1) Introducing Broker (IB): Subject to certain exceptions, an intermediary who solicits and accepts orders from US customers, but does not hold customer funds, must register as an IB.[2] Relative to other registrants, IBs are not subject to many regulatory requirements – mainly resource requirements and some business conduct standards.[3]

(2) Futures Commission Merchant (FCM): Subject to certain exceptions, an intermediary who solicits and accepts orders from US customers and maintains customer accounts, must register as an FCM.[4] FCMs are subject to several regulatory requirements including financial resource requirements (capital), risk management, supervision, treatment of customer funds, and business conduct.[5]

(3) Swap Dealer (SD): Subject to certain exceptions, an intermediary that basically makes a market in swaps for US customers (over a certain threshold of activity), must register as a SD. SDs are subject to a considerable amount of regulation including capital requirements,[6] margin, risk management, know your customer, portfolio compression, and much more.[7]

(4) Swap Execution Facility (SEF): Subject to certain exceptions, an entity that provides swaps trading between multiple participants facing multiple participants (as opposed to a single participant facing multiple participants) must register as a SEF. All SEF participants must meet resource requirements (meet the requirements of Eligible Contract Participant). SEFs are self-regulatory organizations (SROs) and subject to numerous regulations including resource requirements, technology requirements, participant access, and more.

(5) Designated Contract Market (DCM): Subject to certain exceptions, a trading venue that offers futures (and swaps) to US retail investors must register as a DCM. As they serve retail investors, DCMs are even more highly regulated than SEFs, and are also SROs.

[2] 7 U.S. Code § 1a(31)
[3] See NFA. "Introducing brokers," available at https://www.nfa.futures.org/members/ib/index.html.
[4] 7 U.S. Code § 1a(28)
[5] 7 U.S. Code § 1a(49)
[6] Capital rules are not yet finalized for US swap dealers, though proposed.
[7] 17 C.F.R 240.

(6) Derivatives Clearing Organization (DCO): Subject to certain exceptions, a central counterparty (CCP), i.e., an entity that novates contracts between parties so that it becomes the buyer to every seller and the seller to every buyer, for US persons, must register as a DCO. DCOs are highly regulated including resource requirements, access requirements, margin methodology, product and participant requirements and more. They also serve an important risk management function by determining the initial and daily variation margin for their numerous counterparties.

(7) Swap Data Repository (SDR): An entity that reports swaps to the CFTC must register as an SDR.

The CEA designates these market participants as registrants because their actions have the potential of impacting enough of the market to justify obligating them to have a direct relationship with the Commission that goes beyond the obligations of the average market participant.

C. Basic lifecyle of today's derivatives contracts

The registrants described above are integral players in the lifecycle of derivatives contracts. For on-exchange trades, typically, IBs and FCMs are responsible for ushering customers (end-users) onto the platforms. The trades are then executed on a SEF or DCM, and if required (or voluntarily), cleared on a DCO. The DCO then sends the trades to an SDR for reporting to the market and the Commission. The FCM acts as the sponsor to the end-user on the DCO by determining appropriate margin and allocating it throughout the life of the contract. Off-exchange or over-the-counter (OTC) trades are most often chaperoned by SDs, and thus subject to margin requirements. They may also be sent to clearing, but whether cleared or uncleared, they too must be reported to the SDR.

Throughout the lifecycle of the contract, there also are entities that play pivotal roles in the derivatives markets that are not required to register with the Commission. These participants include settlement banks, which are regulated by prudential regulators. They also include a wide variety of third-party providers that engage in: pre-trade credit checks for FCMs prior to placing orders on the exchange, compression exercises for the portfolios of market participants, confirmation of the terms of contracts prior to submission to clearing, and much more.

II. Possible end-to-end derivatives blockchain

In order to consider the potential transformation of the risk profile of the derivatives markets as a result of blockchain, it would be helpful to paint the picture of what an end-to-end blockchain-based derivatives market may look like. Surujnath describes it thusly:

> A blockchain-based derivatives contract market would likely involve a system of several interoperable ledgers that use multi-sig smart contracts for effectuating transfers and oracles for asset monitoring and collateral management. Parties to a blockchain derivatives transaction would submit bids and asks as usual.… They could upload asks directly to the blockchain and rely on its computing to automatically choose the highest

> bid. Because of public-key cryptography, the publicly viewable addresses would serve as aliases that conceal identifying information of the counterparties. Once the parties are matched … [t]he contracts are then uploaded to the derivatives ledger, which contains the logic and execution algorithms for all the clearing members' agreements. … Throughout the lifespan of the agreement, the collateral ledger uses oracles to reference agreed upon external data sources (like Bloomberg) to track price movements in the underlying assets and to automatically adjust positions.[8]

As described above, a possible end-to-end blockchain-based derivatives market would include a set of interoperable ledgers (or one ledger) that multiple participants can access as nodes on the network. It would have smart contracts that have self-executing properties as well as multi-signature (multi-sig) decision points. In a largely automated fashion, these contracts would, inter alia, receive and send messages to counterparties, match trades, assess and reassess collateral, access information from oracles, and re-allocate collateral in customer accounts. Additionally, some subset of participants would validate transactions, and all participants, including the CFTC, could see the evolution of the transactions in near real time.

Thus, an end-to-end blockchain would fundamentally change the transaction process in the derivatives markets. Instead of the transaction evolving as it moves from one entity to another in a linear fashion from pre-trade credit check to reporting, the entire lifecycle of the contract would take place in one space where all participants can view, and continually validate, the entire history of the contract in near real time.

III. How blockchain could reduce risk in the derivatives markets

As several authors have noted, the risk reduction that would result from a blockchain-based derivatives market are obvious. It would create a "golden record" that all the participants would agree to in real time,[9] thereby avoiding duplication,[10] and reducing, if not eliminating, disputes.[11] It is extremely efficient. Smart contracts would precisely and logically carry out the contract terms without unnecessary interference.[12] And thereby, the blockchain would provide the opportunity for enhanced collateral management.[13] It would also provide a very direct way for participants to verify transactions; by simply looking at the chain, participants could easily see whether a transaction was illegitimate.[14] Moreover, from a cybersecurity perspective, because

[8] Surujnath, R. (2017). Off the Chain: A Guide to Blockchain derivatives markets and the implications on systemic risk. *Fordham Journal of Corporate and Financial Law*, 22(257), 9.
[9] "The Future of Derivatives processing and market infrastructure," at 22-23. *White Paper*. ISDA, Sept. 2016, https://www.isda.org/a/UEKDE/infrastructure-white-paper.pdf.
[10] Mainelli, M. & Milne, A. "The Impact and Potential of Blockchain on the Securities Transaction Lifecycle, at 17. *Working Paper No. 2015-007*. Swift Institute, 9 May 2016.
[11] *See* ESMA. ISDA reply to esma's discussion paper on the distributed ledger technology applied to securities markets, p. 9
[12] Metjahic, L. (2018). Deconstructing the DAO: The need for legal recognition and the application of securities laws to decentralized organizations. *Cardozo Law Review*, 39(1533), 192.
[13] *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 9. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[14] Svikhart, R. (2017). Blockchain's big hurdle. *Stanford Law Review Online*, 70(100), 134 (note 12).

all blockchain participants have their own copy of the ledger, it reduces the risk posed by a single point of failure.[15]

A. A transformed regulator

But I would argue that one of the greatest potential risk reduction attributes of the blockchain is the transformation of the regulator. The nearly instantaneous reporting that blockchain allows would be a game changer for the CFTC and other regulators. Among other things, blockchain allows for a comprehensive record of ownership,[16] and provides enhanced transparency.[17] Blockchain allows regulators to notice irregularities and address wrongdoing.[18] The transparency of blockchain enhances regulatory oversight and allows for statistical analyses in real time.[19] Moreover, it puts the information in a single source, with fast reporting that is retraceable throughout history.[20] Regulators are also able to access that data at any time.[21] It allows for continuous monitoring, increased efficiency, decreased investigation times, real time insights, and the use of artificial intelligence to better predict systemic risk events.[22]

No longer would the regulator have to wait for market participants to send data at periodic intervals. Rather the regulators would sit on blockchain itself and see the market as it unfolds in near real time. This would result in changing, among other things, the fundamental dynamics between regulator and market participants by "revolutioniz[ing] financial regulation,"[23] and making it more forward-looking.[24] Therefore, Blockchain allows for a whole new level of regulatory oversight. Regulators would be able to not only respond to market conditions but to work collaboratively with market participants to influence them earlier if they create systemic risk.

IV. Common risk concerns raised

[15] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 17. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[16] *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 8. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[17] *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 8. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[18] Batog, C. (2015). Blockchain: A proposal to reform high frequency trading regulation. *Cardozo Arts & Entertainment Law Journal*, 33, 166.
[19] Batog, C. (2015). Blockchain: A proposal to reform high frequency trading regulation. *Cardozo Arts & Entertainment Law Journal*, 33, 165.
[20] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 11. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[21] *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 8. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[22] Arner, D. W., Barberis, J., & Buckley, R.P. (2017). Fintech, regtech, and the reconceptualization of financial regulation. *Northwestern Journal of International Law and Business*, 37, 341.
[23] Arner, D. W., Barberis, J., & Buckley, R.P. (2017). Fintech, regtech, and the reconceptualization of financial regulation. *Northwestern Journal of International Law and Business*, 37, 350.
[24] Arner, D. W., Barberis, J., & Buckley, R.P. (2017). Fintech, regtech, and the reconceptualization of financial regulation. *Northwestern Journal of International Law and Business*, 37, 355.

Authors have also noted, however, some risks that may be introduced by blockchain. In the below, I discuss some of those concerns, and comment on the degree to which the current regulatory paradigm may be able to address newly-introduced risks.

A. Language gap risk

Many authors have cited language issues. The bare truth is that relatively few people in finance, in the market, at regulator or in the legal community know how to read code. It looks like gibberish to all but the relatively few people who are versed in the field. This has raised concerns for writers and regulators. *Walch* states it this way:

> [A]s with all software, only a small percentage of the population understands how software works. Software coders have a particular expertise that makes the quality of their code, and even the basic functions it performs, opaque to people who are not experts in the relevant software language. … Software coding is truly an area in which knowledge (of code) is power."[25]

Walch goes on to note the risks of centralizing this power in the hands of a few in the context of bitcoin saying:

> The fact that only a very limited portion of the population truly understands how Bitcoin operates gives rise to systemic operational risks. This is because it requires the population to put extreme amounts of trust in the skill and integrity of the people making decisions about the Bitcoin code and network. … We should proceed with caution in building complex, opaque systems that carry out tasks of significant systemic importance."[26]

Authors have specifically identified the gap between coder and non-coder in regard to finance and law.

i. Language gap between the coder and the finance professional

As one author notes, the typical coder may not be suited to writing financial contracts. Walch notes that "smart contract programming requires an "economic thinking' perspective that traditional programmers may not have acquired."[27] Walch describes the dilemma, in the context of bitcoin, as an "expertise problem."[28] Authors have also cited the opposite concern: that risk management experts would be unable to understand the code. The European Securities and Markets Authority (ESMA) notes in its 2016 discussion paper that "[u]se of complex encryption techniques … could have negative implications from a risk management or oversight perspective …the encryption of the information could make it harder to disentangle it and to process it, at

[25] Walch, A. (2015). The bitcoin blockchain as a financial market infrastructure: a consideration of operational risk. *NYU Journal of Legislation and Public Policy*, 18(837), 281.
[26] Walch, A. (2015). The bitcoin blockchain as a financial market infrastructure: a consideration of operational risk. *NYU Journal of Legislation and Public Policy*, 18(837), 282.
[27] Butler, T., Al Khalil, F., Ceci, M., & O'Brien, L. (2017). Smart contracts and distributed ledger technologies in financial services: keeping lawyers in the loop. *Banking & Financial Services Report*, 36(9), 407
[28] Walch, A. (2015). The bitcoin blockchain as a financial market infrastructure: a consideration of operational risk. *NYU Journal of Legislation and Public Policy*, 18(837), 285-6.

least in the short term …"[29] Thus, there certainly is a language divide between the coder – the smart contract writer, for instance – and the typical business person. One could see however, how this gap could be addressed by coders and business people working closely to ensure that they effectively communicate concepts in both directions.

ii. Language gap between the coder and the legal professional

Many authors have cited the difference between coding language and legal language. For instance, Butler et al., note that "a lawyer can neither understand, nor predict the behavior of, the smart contract code, as there is no intermediate language that bridges the gap."[30] Contracts today are legally complex, [31] that legal complexity is not going to automatically disappear because they are written in code. Because of its nuance, coders would find it difficult to predict all of the permutations of legal issues that could arise from a contract.[32] And while some aspects of a contract can be reduced to simple "if, then" statements, there are aspects of contract that are inherently nuanced and ambiguous. For instance, Butler, et al., note that contracts can be divided into two elements: operational semantics (pertaining to the execution of contract on the platform) and denotational semantics (pertaining to the legal meaning of contract).[33] And in their 2017 white paper, ISDA / Linklaters similarly makes the distinction between "operational" versus "non-operational" clauses in contracts.[34] They go on to note that the latter, such as dispute resolution and good faith, are not easily expressed in Boolean language.[35] Moreover, it is not beneficial to remove all ambiguity from contracts since some aspects of contract are necessarily contextual and, as the context changes, the parties would benefit from the flexibility that the ambiguity provides.[36]

The gap between compliance counsel and technology providers is not new; there is one now. However, the stakes are far higher in the blockchain environment because the technology is that much more complicated, interconnected, and partly self-executing, so that it is much more important to get it right. While in an ideal world, single individuals would be fully versed in law and coding, "expecting a lawyer to acquire the type of technological expertise required to code smart contracts is unrealistic"[37] As Butler, et al. notes, "trust, by all stakeholders, including

[29] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 19. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[30] Butler, T., Al Khalil, F., Ceci, M., & O'Brien, L. (2017). Smart contracts and distributed ledger technologies in financial services: keeping lawyers in the loop. *Banking & Financial Services Report*, 36(9), 409.
[31] "Smart contracts and distributed ledger – a legal perspective," at p. 12. *White Paper*. ISDA, Aug. 2017, https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[32] "Smart contracts and distributed ledger – a legal perspective," at p. 12. *White Paper*. ISDA, Aug. 2017, https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[33] Butler, T., Al Khalil, F., Ceci, M., & O'Brien, L. (2017). Smart contracts and distributed ledger technologies in financial services: keeping lawyers in the loop. *Banking & Financial Services Report*, 36(9), 409
[34] "Smart contracts and distributed ledger – a legal perspective," at p. 11. *White Paper*. ISDA, Aug. 2017, https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[35] "Smart contracts and distributed ledger – a legal perspective," at p. 11. *White Paper*. ISDA, Aug. 2017, https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[36] "Smart contracts and distributed ledger – a legal perspective," at p. 13. *White Paper*. ISDA, Aug. 2017, https://www.isda.org/a/6EKDE/smart-contracts-and-distributed-ledger-a-legal-perspective.pdf.
[37] Butler, T., Al Khalil, F., Ceci, M., & O'Brien, L. (2017). Smart contracts and distributed ledger technologies in financial services: keeping lawyers in the loop. *Banking & Financial Services Report*, 36(9), 411.

regulators, in smart contracts can only stem from the ability of lawyers in financial institutions to understand, express and ultimately validate the denotational semantics of a contract."[38]

In order to have effective compliance, the communication between lawyers and coders also needs to be able to flow in both directions. Counsel need to understand what the code means in order to opine on its compatibility with ever-changing laws. And coders need to understand the law enough to integrate it into the code. There are efforts under way to bridge the coder / non-coder divide and create a common language.[39] For instance, ISDA has published its "common domain model" which is "meant to establish some common parameters to allow for interoperability.[40] Efforts like these are critical for moving the technology forward.

B. Technology risk

Several authors raise concerns about a blockchain-based derivatives market that really are endemic to any technology. Authors note risks that are inherent to software such as bugs, the need for continual update, and, as noted above, specialized knowledge.[41] Authors have also noted that private keys could be stolen,[42] and glitches or errors could be catastrophic.[43] Another issue is that since, as noted, an end-to-end system is unlikely in the near future, there will be a transition period in which blockchain structures would have to operate with non-blockchain structures,[44] which could introduce risk.

The most common technology risk cited, however, is cybersecurity. For instance, while acknowledging that blockchain could reduce cybersecurity risk because a copy of the common ledger is held by many entities, not just one,[45] ESMA nonetheless argues that blockchain poses greater cybersecurity issues because, if successful, an attack would increase the likelihood of the contagion since the markets would be so tightly integrated.[46] Importantly, however, blockchain has the benefit of substantial cryptography[47] creating robustness.[48] Moreover, cybersecurity

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[38] Butler, T., Al Khalil, F., Ceci, M., & O'Brien, L. (2017). Smart contracts and distributed ledger technologies in financial services: keeping lawyers in the loop. *Banking & Financial Services Report*, 36(9), 409.
[39] Butler, T., Al Khalil, F., Ceci, M., & O'Brien, L. (2017). Smart contracts and distributed ledger technologies in financial services: keeping lawyers in the loop. *Banking & Financial Services Report*, 36(9), 409-10.
[40] "ISDA common domain model version 1.0 design definition document," October 2017, *available a*t https://www.isda.org/a/gVKDE/CDM-FINAL.pdf.
[41] Walch, A. (2015). The bitcoin blockchain as a financial market infrastructure: a consideration of operational risk. *NYU Journal of Legislation and Public Policy*, 18(837), 277-8.
[42] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 17. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[43] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 18. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[44] Mainelli, M. & Milne, A. "The Impact and Potential of Blockchain on the Securities Transaction Lifecycle, at 20. *Working Paper No. 2015-007*. Swift Institute, 9 May 2016.
[45] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 17. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[46] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 17. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[47] Werbach, K. & Cornell, N. (2017). Contracts ex machina. *Duke Law Journal*, 67(313), 227
[48] Mainelli, M. & Milne, A. "The Impact and Potential of Blockchain on the Securities Transaction Lifecycle, at 18. *Working Paper No. 2015-007*. Swift Institute, 9 May 2016.

concerns are in every aspect of our lives where technology is involved. While all market participants, blockchain-based or not, should remain vigilant about cybersecurity, it would be an undesirable outcome for these concerns to inhibit the development of efficient systems like a blockchain-based derivatives market.

C. Permanency risk

Another risk often cited is the absence of a recourse mechanism.[49] According to this argument, as blockchain data cannot be erased, problems caused by errors or malfeasance cannot be fixed.[50] However, just because a contract cannot be reversed, does not mean it cannot be corrected. A court could obligate the losing litigant to enter in an opposite transaction on the blockchain to address the invalid contract through surrendering keys or the like.[51] The blockchain does not inhibit correction, it simply keeps a record of all changes to the ledger – including corrections. *Werbach* notes that, in this way, smart contracts clarify that contract law is not about ensuring performance but adjudicating grievances,[52] which can be ably achieved through appropriate programming.

D. Transparency risk

Several authors, often with the bitcoin model in mind, have raised concerns over transparency risk. They argue that because all the participants can see the movement on the blockchain, even if they cannot see the name of the participant, they can see major activity and potentially front-run to manipulate the market.[53] However, unlike the bitcoin blockchain, permissioned systems do not have to be fully transparent.[54] The use of pseudonyms, public addresses (and private keys) allow for anonymity and security.[55] While regulators (and chosen counterparties)[56] may be able to see all the participant information, programming can obfuscate certain information from the rest of the market. Moreover, developing technology like the Lightning Network holds promise for creating private spaces on the broader blockchain where participants can build a transaction and not record it on the ledger until they both agree.[57]

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[49] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 15. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[50] *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 12. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[51] Werbach, K. & Cornell, N. (2017). Contracts ex machina. *Duke Law Journal*, 67(313), 244
[52] Werbach, K. & Cornell, N. (2017). Contracts ex machina. *Duke Law Journal*, 67(313), 224
[53] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 18. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.
[54] Ross, E.S. (2017). Nobody puts blockchain in a corner: the disruptive role of blockchain technology in the financial services industry and current regulatory issues. *Catholic University Journal of Law & Technology*, 25, 104.
[55] Batog, C. (2015). Blockchain: A proposal to reform high frequency trading regulation. *Cardozo Arts & Entertainment Law Journal*, 33, 165.
[56] Ryan, R. & Donohue, M. (2017-8). Securities on Blockchain. *Business Lawyer*, 73, 144
[57] *See* https://lightning.network/. There are a host of other risks raised by authors not discussed here:

V. The risk posed by applying today's registration requirements to tomorrow's markets

As described above, a major cornerstone of the CFTC's regulatory regime is registration. The CFTC endeavors to require registration of all the significant entities in its market from a risk creation perspective in order to make sure that they have appropriate risk management practices. But with blockchain, risk shifts. The individuals who were important in the non-blockchain paradigm, are not necessarily important within a blockchain paradigm. In a blockchain-based derivatives market, some of the important players are: (a) the blockchain itself; (b) the smart contract writers; (c) the smart contract itself; (d) oracles; (e) nodes; and (f) validators. And as seen below, the mold of the current registration regime may not fit the future paradigm.

A. The blockchain

The blockchain itself would clearly be a significant player in these markets. Under the current regulatory regime, a blockchain (or a group of interlocking blockchains) that operates as described above would, in the first instance, have to register as a SEF or DCM since it is matching customers through a series of smart contracts. The determination of whether it would have to register as either or both would depend on several factors including: whether its members are all ECPs, whether it trades only swaps, and what methods of execution it employs. But the blockchain-based derivatives market described above would also have to register as a DCO since it is, inter alia, novating contracts and making margin calls, which are all functions of a DCO. Moreover, since it maintains a regulator node, it is providing reporting data to the regulator and thus would arguably have to register as an SDR as well. In today's derivatives markets, we have examples of financial market infrastructures (FMIs) that share common ownership including DCM/DCO/SDR.[58] But each has separate staff, separate networks, and separate business models. In blockchain-based markets, all of these functions would operate almost

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(1) Enforceability: There is also the risk that blockchain contracts will not be enforceable in a cross-border context. Blockchains are easily international so in the occurrence of a conflict, different jurisdictions and therefore different laws may apply. *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 16. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets. Despite claims that the smart contracts are a law onto themselves, or as one author noted, "it is the code that is law," "borderless enforceability" is not practical. *See* Ross, E.S. (2017). Nobody puts blockchain in a corner: the disruptive role of blockchain technology in the financial services industry and current regulatory issues. *Catholic University Journal of Law & Technology*, 25, 103.

(2) Block trading limitation: While that technology is not fully developed now, promising technology that could potential allow separate lines of communication between consenting parties to transact until they both agree to post to blockchain. *See* https://lightning.network/.

(3) Netting limitation: ISDA has opined on potential solutions. *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 12. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets. ("[F]unctionally embedded into the blockchain – are able to transpose the gross level information in to a net movement … daily 'lock down' process that nets all cash flows to be exchange on a given value date to be locked and then it becomes a case of merely funding your accounts …").

(4) Margin finance limitation: But smart contracts could potentially be coded to record a transaction at one point, but not retrieve the funds until a later date.

(5) Short-selling limitation: ISDA has proposed a potential solution to make lendable securities available. *See* ESMA. ISDA reply to ESMA's discussion paper on the distributed ledger technology applied to securities markets, at 13. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.

[58] Three SDRs and are also both DCMs and DCOs.

simultaneously in the same network thus creating super-FMIs with transactions moving seamlessly within one network. This raises a number of questions.

Given that the Commission likely would, in this scenario, take the position that the entity could not double count the resources dedicated to one registrant class for another, it would require a considerable amount of capital to support all the multiple functions. And what risk management requirements would the CFTC consider sufficient for an entity of such significance to the marketplace? Would the Commission conclude that the requirements of a DCO would be sufficient for an entity that is a DCM, DCO and SDR in one?

And what of the concentration charges often leveled at CCPs; if high-volume CCPs today are considered as a concentration of risk then what of a DCM/SEF, DCO, SDR combination? Another solution would be to create another registrant class if Congress determines that the sum is not equal to the collection of its parts – that a DCM/DCO/SDR operating in real time based on blockchain technology creates a unique risk profile with new risks such that it requires a different set of regulatory requirements.

Another important issue for registration is that of personhood. It is highly unlikely that the Commission would be satisfied that the ultimate owner of a significant segment of market activity is a computer network that they can analyze but which cannot be hold accountable. The Commission and other regulators would undoubtedly require access to the individuals who can explain errors,[59] answer questions, and ultimately be held accountable for malfeasance.

So, there would most likely have to be an "owner" of the blockchain. But who or what would fill that role? Within a permissioned system, blockchains would most likely be sponsored by a consortium of market participants – like the intermediated CCP. But in the clearinghouse example, the clearinghouse itself is a stand-alone business so the CFTC can require registration of the CCP itself and police its leaders as needed. Thus, the closest parallel would be to form a standalone company that is the blockchain and people it and resource it in order to meet the requirements of multiple CCP registrations. But with a DCM/DCO/SDR, requiring personhood would encourage centralization, and the concentration concerns that centralization raises.

But what if the blockchain intends to operate as a classic blockchain – a diffuse network, without a central entity of any kind. Then, the risk formation would be diffuse – the CFTC would not be able to look to one entity to police (and register) regarding activity on the blockchain, and instead would have to look to the individual nodes. This arrangement would certainly satisfy the concentration concerns, but would the Commission be able to effectively oversee and police the risk of that many players without a central authority.

B. The smart contract writer

As discussed above, the role of the smart contract writer is incredibly significant. Smart contracts are extremely complex. One helpful definition of a smart contract is: a "series of

[59] *See* ESMA. (June 2, 2016). *Discussion Paper: The distributed ledger technology applied to securities markets*, at 16. Retrieved from https://www.esma.europa.eu/press-news/consultations/consultation-distributed-ledger-technology-applied-securities-markets.

instructions that execute autonomously based on predetermined inputs."[60] They can be programmed to inter alia process customer requests, pull data from oracles, recalculate margin, withdraw and submit value in customer accounts, use oracles to compute exposure, and recalculate variation margin.[61] While every contract is forward-looking, it is all the more important to get the smart contract right because many (and, in some cases, all) elements are self-executing.[62] So within the coding, the writer has to insert all current and anticipated risks,[63] including determining which oracles to link to, and determining if and when multi-signatures are required.[64] And importantly, since these contracts would have access to customer accounts, they could affect liquidity.[65] Their importance to risk formation in a block-based derivatives market is undeniable as these smart contracts could affect the entire market as they self-execute over time.[66]

As such, smart contracts shift more of the risk management earlier in the transaction lifecycle. In the current market, the DCO calculates risk at the novation of the contract – initial margin, but then the DCO continues to reassess risk over the life of the contract and daily revises that risk and requires variation margin to address it. As circumstances change, the DCO continues to assess and reassess how these circumstances have altered the risk and therefore the risk management necessary.

Another key risk management player in today's market is the FCM. The FCM, as a member of the DCO, continues to engage in a risk management assessment of its customers and requires margin as well. The FCM also vouches for its customers. The DCO and the other clearing members are actually putting their trust in the FCM – its capital holding and its risk management apparatus – when allowing the FCM's customers to trade through the FCM's account.

With the blockchain, because the contracts are self-executing (or largely self-executing), they are pre-programmed to respond in specified ways to changes in circumstances. Unlike the CCP, which has the benefit of the initial risk assessment and then continual correction, the smart contract writer has to anticipate future risks in a way that the DCO does not since the stakes are much higher. Now there are certainly ways to reassess risk management during the life of the contract for important decisions – e.g., smart contracts can require the use of multi-sig to approve meaningful changes to the contract. But the contract writer has to be able to make those choices (e.g., when multi-sig would be necessary) at the initiation of the contract.

The significance of these contracts within the derivatives markets means that the smart contract writers are extremely significant. The question then becomes: what registrant category, if any, applies to smart contract writers? In truth, there is no current registration requirement for individuals who draft contracts unless they are client-facing. If the contract writer is not engaged

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[60] Ryan, R. & Donohue, M. (2017-8). Securities on Blockchain. *Business Lawyer*, 73, 141.
[61] *See* Blockchain technology will profoundly change the derivatives industry, Matt O'Brien, *available at* https://bitcoinmagazine.com/articles/blockchain-technology-will-profoundly-change-the-derivatives-industry-1464368431/
[62] Werbach, K. & Cornell, N. (2017). Contracts ex machina. *Duke Law Journal*, 67(313), 243.
[63] Werbach, K. & Cornell, N. (2017). Contracts ex machina. *Duke Law Journal*, 67(313), 240.
[64] Werbach, K. & Cornell, N. (2017). Contracts ex machina. *Duke Law Journal*, 67(313), 243.
[65] Mainelli, M. & Milne, A. "The Impact and Potential of Blockchain on the Securities Transaction Lifecycle, at 31. *Working Paper No. 2015-007*. Swift Institute, 9 May 2016.
[66] Some recommend starting with "dumb short contracts" instead of "smart long contracts" in order to minimize risk. *See* Mainelli, M. & Milne, A. "The Impact and Potential of Blockchain on the Securities Transaction Lifecycle, at 30. *Working Paper No. 2015-007*. Swift Institute, 9 May 2016.

in customer-facing activity, then he or she would not have to register in any intermediary category.

But that begs the question: could the Commission determine that the smart contract writer is engaging in customer-facing activity? When someone codes a contract and puts it on the blockchain – are they, in essence, soliciting customers? To answer that question, much would likely depend on their mode of compensation. Are they compensated whenever a person chooses to use the contract to transact? Then the Commission may classify them as a swap dealer – someone who is making a market in that commodity. Or the Commission may view them as an introducing broker – by coding the contract, they are soliciting customers to the marketplace – to the blockchain. And if they are compensated when the customer engages with the exchange, they could be viewed as introducing trades to a registered exchange and therefore acting as an IB.

Another option is for the congress to institute a new registrant category in order to capture contract writers. However, whether the CFTC were to define smart contract writers as captured by a current registration category, or Congress were to create a category for them, it would still pose the same challenge: expertise. In order to regulate someone, you have to understand what they are doing. When you register someone, you are, in essence, giving them a seal of approval. So, if the CFTC were to register smart contract writers, the regulator would have to understand enough about the substance of their business – coding – in order to know, inter alia, if they were competent, if they were violative, what information to ask for, and what to do with the information once received.

Another option is to treat the contract writer as any other technology provider and attempt to hold the customer-facing entity responsible for the risk management of the contract – so that the registrant would police the smart contract. [67] But who would this customer-facing entity be? Arguably, it would most likely be whoever pays the contract writer. So, if the blockchain network, for instance, compensates the contract writer, then the Commission may require the blockchain owner to ensure that the contract writer is acting in compliance with the blockchain's regulatory requirements. Or if another intermediary compensates the contract writer then it would have to engage in the policing. Another option is for the CFTC to rely on the registration of another agency that has the expertise to understand the technical activity of smart contract writers and establish appropriate risk management parameters for them.

C. The contract

In today's derivative markets, it would be laughable to consider registering a contract. But the smart contract is inherently different from today's contract because it not only indicates what must happen, it *acts*. It is self-executing. Once programed, the contract runs itself. It is not like an ISDA agreement where it is only as good as the people who enforce it. In other words, in today's ISDA, if both parties decide to ignore a clause, then the clause has no effect – the contract cannot effectuate itself. But a smart contract is different. What makes it smart is that it can effectuate itself. Even if the participants change their mind about the original program, the

[67] *See* CFTC. (September 2018). *Technology based innovations for regulatory compliance ("regtech") in the securities industry, a report from FINRA*, at 7-8.

contract is pre-programmed to carry out their original wishes. Yet the contract cannot be held accountable for its decisions.

So what registrant categories could a smart contract fall into? That would truly depend on its activity. In truth, if a smart contract is matching customers, or providing a market for all comers, and / or moving monies out of margin accounts, under the current paradigm, it itself could be considered a SEF/DCM, a SD, or a DCO. But subjecting individual contracts to registration under the current paradigm would be burdensome to the technology, and of little use since it cannot be held accountable. A variation on that idea would be to require that significant contracts hold risk-based capital as insurance against its own malfunctioning. A final option would be to hold other registrants – whoever profits from the contract – to policing it.

D. Oracles, Nodes, and Validators

The oracles for the contracts would most likely be established information sources such as Bloomberg or Moody's, which are subject to their own regulatory oversight, and no additional registration would be required. In keeping with the current registration paradigm, nodes and validators could also be subject to registration depending on the interpretation of their actions. Despite the claim that blockchain "eliminates the role of a financial intermediary,"[68] some super-nodes may be considered a kind of intermediary. A super-node that intermediates between other nodes and the blockchain may be just considered a technology provider or an IB based on the services it provides its node customers. Validators are partly doing the work of exchanges today by validating trades, though arguably their function is also similar to a technology provider, such as those that engage in confirmation, which does not require registration under our current regime.

Conclusion

The current regulatory scheme for derivatives markets is calibrated for the risks inherent to today's markets, but it is not fully suited to the risks of tomorrow's blockchain-based derivatives markets. Blockchain fundamentally changes the risk profile of the derivatives markets by, inter alia: (1) introducing significant players to the market like smart contract writers, and the smart contracts themselves, that were not ever anticipated in today's markets; (2) reducing risk through empowering the regulator to engage in more robust engagement with the market; (3) introducing technical languages that require translation; and (4) moving risk management further up the lifespan of the typical contract. By mitigating risk in some areas and introducing different dynamics to the markets, end-to-end blockchain would fundamentally change the way the market does business. And, in order not to inhibit the great promise that blockchain has for market efficiency and transparency, the regulatory infrastructure may have to fundamentally change with it.

[68] Ross, E.S. (2017). Nobody puts blockchain in a corner: the disruptive role of blockchain technology in the financial services industry and current regulatory issues. *Catholic University Journal of Law & Technology,* 25, 103.