Decentralized Markets and Self-Regulation

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Abstract

Distributed ledger technology, such as blockchains, is changing financial markets by creating a new foundation for transacting with digital assets. Simultaneously, major blockchain-enabled intermediaries—crypto-exchanges—have emerged to trade, broker, and settle transactions with digital assets. U.S. regulators seek to place crypto-exchanges within the ambit of existing regulation and registration requirements for legacy intermediaries. A critical underexplored corollary of this approach is converting crypto-exchanges into legacy self-regulatory organizations ("SROs") or members of SROs. Put differently, U.S. agencies seek to bring not only conventional regulation but also self-regulation into blockchain-enabled markets. In imposing the traditional models without reform, however, policymakers simultaneously ignore the considerable economic potential of technology-enabled markets and intermediaries and fail to precisely target their risks and transaction costs.

To offer solutions, this Article examines the digital asset market's structure and microstructure and associated risks. Comparing centralized crypto-exchanges, decentralized crypto-exchanges, and legacy trading venues, this Article agrees with the basic intuition to introduce formal self-regulation and refines possible self-regulatory models. The proposed frameworks aggregate the decentralized knowledge of individual participants in the global technology-enabled market to ensure better coordination and well-informed regulation. Building on market expertise, the proposed SROs would promote regulatory efficiency, improve digital asset trading, reduce the costs of coordination among heterogeneous and globally dispersed participants in blockchain-enabled markets, and nudge them toward comprehensive self-regulatory and technological solutions.

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INTRODUCTION

Technologies such as blockchain[1] have created a novel foundation for transacting with digital assets.[2] Initially emerging under the moniker of cryptocurrencies, these assets have evolved to help secure the functionalities of blockchain-enabled projects, streamline payments, and create and trade digital and real-world assets.[3] Bonds, shares of stock, commodities, and other real-world assets may be tokenized en masse and transferred on-chain.[4] Large financial institutions are increasingly involved with these technology-based developments,[5] seeking to tap

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[1]   Blockchains are a form of distributed ledgers.

An online ledger maintained by Distributed Ledger technology is 'distributed' because transactions are stored on up to several thousand computers connected to a common network via the internet. Changes and updates to the ledger may only be made if the network of computers . . . reaches a consensus that the change . . . is valid. . . . A Blockchain is . . . one type of Distributed Ledger; it is a decentralized, Peer-to-Peer network of independent computers recording, sharing, and synchronizing data according to preset protocols.

CAROL GOFORTH & YULIYA GUSEVA, REGULATION OF CRYPTOASSETS 774 (2d ed. 2022). This Article will use the terms "blockchain" and "DLT" interchangeably.

[2]   Blockchains introduce an element of decentralization to ledgers, which are typically maintained by centralized intermediaries, enabling digital asset transfers. *See, e.g.*, Onnig H. Dombalagian, *Bond Trading at the Digital Frontier*, 49 J. CORP. L. 489, 518 (2024) ("By maintaining parallel records of verified transactions, DLT obviates the need for 'centralized' intermediaries to process transactions and maintain ownership records."). The terms "digital assets" and "cryptoassets" include assets that are created and stored digitally and are often transferred on blockchains; both terms are frequently used interchangeably. *See, e.g.*, Yuliya Guseva & Irena Hutton, *Regulatory Fragmentation: Investor Reaction to SEC and CFTC Enforcement in Crypto Markets*, 64 B.C. L. REV. 1555, 1560 (2023).

[3]   *See* Guseva & Hutton, *supra* note 2, at 1563–66 (providing several examples of how blockchain-based assets can use blockchains to trade and transfer assets within the economy).

[4]   "Tokenization is the use of digital tokens to represent the ownership of physical assets." CRAIG JAMES CALCATERRA & WULF ALEXANDER KAAL, DECENTRALIZATION: TECHNOLOGY'S IMPACT ON ORGANIZATIONAL AND SOCIETAL STRUCTURE 180 (2021). Commentators suggest that tokenization may generate efficiencies. *See, e.g.*, Morten Bech, Jenny Hancock, Tara Rice & Amber Wadsworth, *On the Future of Securities Settlement*, BANK FOR INT'L SETTLEMENTS Q. REV., Mar. 2020, at 67, 67; *Breaking down Barriers with New Building Blocks: How Tokenization Streamlines Funds for Faster Settlement, Efficiency and Fractionalization*, DELOITTE, https://www2.deloitte.com/lu/en/pages/investment-management/articles//breaking-down-barriers-with-new-building-blocks.html [https://perma.cc/2WXX-QENE]; H.K. MONETARY AUTH., BOND TOKENISATION IN HONG KONG 19 (2023), https://www.hkma.gov.hk/media/eng/doc/key-information/press-release/2023/20230824e3a1.pdf [https://perma.cc/9DL4-F4PY]; David G.W. Birch, *Larry Fink Says Tokens Are "The Next Generation for Markets,"* FORBES (Mar. 1, 2023, 10:56 AM), https://www.forbes.com/sites/david-birch/2023/03/01/larry-fink-says-tokens-are-the-next-generation-for-markets/ [https://perma.cc/X8LL-P5EY].

[5]   *See, e.g.*, Dombalagian, *supra* note 2, at 520 ("In the United States, some bond issuers are keen to embrace DLT as a tool for raising capital, particularly in issuances targeted at higher-net-worth investors."); Peter Gaffney, *Tokenization and Real-World Assets Take Center Stage*, COINDESK (Mar. 8, 2024, 9:32 AM), https://www.coindesk.com/business/2023/11/22/tokenization-and-real-world-assets-take-center-stage/ [https://perma.cc/X4VU-8RQ3]; Greg Ahlstrand,

into the institutional ecosystems of blockchains and digital assets to benefit from their efficiencies, liquidity, faster transfers, instantaneous settlement, transparency, and customization.[6]

In addition to legacy industry firms, new intermediaries have emerged to trade and process transactions with various digital assets. Commentators, including this Author, typically call them "crypto-exchanges,"[7] although such platforms often combine the functions of several legacy intermediaries, including trading platforms, broker-dealers, and clearinghouses.[8]

By enabling these digital asset intermediaries to operate atop and in reliance on blockchain protocols,[9] blockchains and distributed ledger technology ("DLT") offer institutional innovations in financial, commodity, and other markets.[10] These new forms of assets and transaction execution systems are Schumpeter's "combinations" of process improvements and product innovations.[11] Their associated efficiencies can be considerable, but so can the risks to markets, consumers, and established regulatory frameworks.[12]

Together, these two factors—the risks and the benefits—point toward the need for reform, which, ideally, should incorporate the economic gains from the technologies, control their possible negative externalities and risks, and produce economic-welfare-improving outcomes.[13] To achieve this, it is critical to understand the similarities and

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NYSE Parent ICE Takes Stake in tZERO in Potential Move Toward Tokenized Stocks, Coin Desk (Apr. 9, 2024, 10:20 PM), https://www.coindesk.com/business/2022/02/23/nyse-parent-ice-takes-stake-in-tzero-in-potential-move-toward-tokenized-stocks/ [https://perma.cc/BS4L-YPXV]; Asa Sanon-Jules, *Swiss Bank Cité Gestion Becomes First Private Bank to Tokenize Its Own Shares*, Coin-Desk (May 9, 2023, 12:06 AM), https://www.coindesk.com/business/2023/01/24/swiss-bank-cite-gestion-becomes-first-private-bank-to-tokenize-its-own-shares/ [https://perma.cc/P3C7-XYZB]; *Onyx Coin Systems*, J.P. Morgan, https://www.jpmorgan.com/onyx/coin-system [https://perma.cc/8KXA-GNZ7].

6   *See infra* Part I; H.K. Monetary Auth., *supra* note 4.

7   *See infra* Part II.

8   *See infra* Parts II–III.

9   "A protocol is a standardised set of rules that allows computers to format, process and transmit data." Autorité des Marchés Financiers, Decentralised Finance (DeFi), Trading Protocols and Governance Issues: Overview, Observed Trends, and Regulatory Discussion Points 5 (2023). They are "superimposed into various 'layers' that perform . . . different tasks." *Id.* A blockchain ecosystem may include several layers for transaction recording and settlement, scaling and smart-contract-enabling functionalities such as trading. *See id.*

10   *See, e.g., id.* at 3.

11   For a relevant discussion of Schumpeter's work, see Arnold Heertje, Schumpeter on the Economics of Innovation and the Development of Capitalism 49, 82–84 (2006).

12   *See infra* Parts II–III.

13   Scholars on blockchain-enabled markets have long argued for such reforms. *See, e.g., The Future of Digital Asset Regulation: Hearing Before the Subcomm. on Commodity Exchs., Energy, and Credit of the H. Comm. on Agric.*, 117th Cong. 14–15 (2022), https://democrats-agriculture.house.gov/uploadedfiles/117-36_-_49769.pdf [https://perma.cc/J6EA-HL7Y] (testimony of

differences between the market structure and microstructure of legacy exchanges and digital asset platforms. Unfortunately, policymakers in the United States have yet to grapple with these fundamental questions. Instead, when confronted with new institutions such as crypto-exchanges, U.S. regulators attempt to pigeonhole them within the remit of existing regulation and registration requirements for legacy exchanges, broker-dealers, and clearinghouses.[14]

An underexplored corollary of this regulatory approach is converting crypto-exchanges into either registered self-regulatory organizations ("SRO") or members of legacy SROs.[15] Self-regulation has long been the mainstay of U.S. markets. From the early days of the federal securities and commodities laws, the Securities and Exchange Commission ("SEC") and the Commodity Futures Trading Commission ("CFTC") (together, "Commissions") mandated that registered intermediaries either perform self-regulatory functions or participate in SROs such as the Financial Industry Regulatory Authority ("FINRA") and the National Futures Association ("NFA").[16] Through statements, enforcement actions,[17] and a proposed rule change expanding the definition of

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Dr. Chris Brummer, Professor, Georgetown University Law Center, critiquing the application of Regulation S-K). Some even called for the creation of "a single crypto regulatory agency." Joel Seligman, *The Rise and Fall of Cryptocurrency: The Three Paths Forward*, 19 N.Y.U. J.L. & Bus. 93, 135 (2022). There is also a scholarly and policy debate on whether fintech produces and enhances the same services or introduces new ones, which may support using the existing rules for designing new regulations. *See, e.g.*, Moran Ofir & Ido Sadeh, *More of the Same or Real Transformation: Does FinTech Warrant New Regulations?*, 21 Hous. Bus. & Tax L.J. 280, 284, 287–95 (2021) (discussing the debate and suggesting that new technologies produce new capabilities in financial transactions).

[14] *See, e.g.*, Complaint at 4, SEC v. Coinbase, Inc., No. 1:23-cv-04738 (S.D.N.Y. June 6, 2023).

[15] *See infra* Parts V–VI.

[16] *See* 15 U.S.C. § 78e–f, o; 7 U.S.C. § 7; *Futures Commission Merchants (FCMs)*, CFTC, https://www.cftc.gov/IndustryOversight/Intermediaries/FCMs/fcmib.html [https://perma.cc/AZ4Q-TY9A]; *Register a New Broker-Dealer Firm*, FINRA, https://www.finra.org/registration-exams-ce/broker-dealers/new-firms [https://perma.cc/LV6P-RD4W].

[17] *See generally* Carol R. Goforth, *Regulation of Crypto: Who Is the Securities and Exchange Commission Protecting?*, 58 Am. Bus. L.J. 643 (2021) (discussing the problems of SEC enforcement and selective enforcement); Yuliya Guseva, *When the Means Undermine the End: The Leviathan of Securities Law and Enforcement in Digital-Asset Markets*, 5 Stan. J. Blockchain L. & Pol'y 1, 4 (2022) (describing the SEC's "regulation-via-enforcement approach"); Chris Brummer, Yesha Yadav & David Zaring, *Regulation by Enforcement*, 96 S. Cal. L. Rev. 1297, 1303 (2024). The first SEC statement on crypto assets and crypto-exchanges was Report of Investigation Pursuant to Section 21(a) of the Securities Exchange Act of 1934: The DAO, Exchange Act Release No. 81,207, 117 SEC Docket 745 (July 25, 2017). A momentous development happened in the spring of 2024 when a federal district court denied a major centralized crypto-exchange's motion for judgment on the pleadings and concluded that the SEC's complaint plausibly supported the claim that the crypto-exchange provided a platform for trading securities and operated as several unregistered intermediaries: a broker, an exchange, and a clearing agency. *See* SEC v. Coinbase, Inc., No. 1:23-cv-04738, 2024 WL 1304037, at *1, *17–18, *26–27 (S.D.N.Y. Mar. 27, 2024). On CFTC enforcement against decentralized and centralized exchanges, see, for example, Press Release,

the term "exchange,"[18] the Commissions have pushed the new digital asset exchanges into this well-known SRO territory. The Commissions have effectively attempted to co-opt centralized crypto-exchanges ("CEX") (i.e., venues that provide trading in digital assets but are run mainly off-chain by identifiable firms and individuals[19]) and decentralized platforms (i.e., crypto-exchanges that operate autonomously through applications built on blockchains[20]) into the ranks of SROs.

In their efforts to impose the legacy rules without reform, the Commissions have ignored the valuable economic potential of blockchains as institutional innovations, the unique risks and transaction costs of the new markets, and the differences between digital asset intermediaries and conventional exchanges.[21] They have also elided the distinctiveness of decentralized exchanges ("DEX") and their microstructure.[22] This

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CFTC, CFTC Issues Orders Against Operators of Three DeFi Protocols for Offering Illegal Digital Asset Derivatives Trading (Sept. 7, 2023) [hereinafter Press Release, CFTC, Illegal Derivatives Trading], https://www.cftc.gov/PressRoom/PressReleases/8774-23 [https://perma.cc/X926-8AKQ] (detailing enforcement actions by CFTC against three decentralized platforms that developed blockchain-based digital assets); Guseva & Hutton, *supra* note 2, at 1578 (discussing CFTC cases against centralized exchanges). For an overview of enforcement actions, see, for example, Simona Mola, *SEC Cryptocurrency Enforcement: June 2023 Update*, Cornerstone Rsch., https://www.cornerstone.com/insights/research/sec-cryptocurrency-enforcement-june-2023-update/ [https://perma.cc/Z8RS-NP9T]; Press Release, CFTC, CFTC Releases FY 2023 Enforcement Results (Nov. 7, 2023), https://www.cftc.gov/PressRoom/PressReleases/8822-23 [https://perma.cc/R3LM-8RUJ]; Press Release, CFTC, CFTC Releases Annual Enforcement Results (Oct. 20, 2022), https://www.cftc.gov/PressRoom/PressReleases/8613-22 [https://perma.cc/C2GX-UQ4R].

18 *See* Supplemental Information and Reopening of Comment Period for Amendments Regarding the Definition of "Exchange," Exchange Act Release No. 97,309, 88 Fed. Reg. 29,448 (May 5, 2023).

19 "A centralized . . . exchange resembles traditional asset exchanges, such as stock exchanges, in having an identifiable firm that takes custody of users' assets, maintains an order book, and matches trades." Kevin Werbach, *Digital Asset Regulation: Peering into the Past, Peering into the Future*, 64 Wm. & Mary L. Rev. 1251, 1297 (2023).

20 *See* Autorité des Marchés Financiers, *supra* note 9, at 12 (discussing decentralized exchanges or "DEXes" as autonomous code-based trading platforms). For a discussion of exchanges, see notes 61–63 and accompanying text.

21 *See infra* Parts I–III; *see also* Edoardo D. Martino & W. Georg Ringe, *The Social Cost of Blockchain: Externalities, Allocation of Property Rights, and the Role of the Law* 22–23 (Univ. Hamburg, Inst. L. & Econ., Working Paper No. 80, 2024), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4821063 [https://perma.cc/W947-FJD5] (observing that "plainly applying existing legislation to new phenomena implies potentially significant costs, as existing rules, for instance on securities offerings and trading, may not align with the unique characteristics of blockchain issuance and coin transactions" and "simply applying existing laws to blockchain transactions is deemed desirable (i.e., a Coasean improvement) only if the functionally equivalent off-chain transaction exhibits precisely the same externalities and the same efficiency gains").

22 For a comprehensive comparison of centralized and decentralized exchanges, their microstructure, custody, and settlement, see generally, Campbell R. Harvey, Joel Hasbrouck & Fahad Saleh, The Evolution of Decentralized Exchange: Risks, Benefits, and Oversight (2024), https://wifpr.wharton.upenn.edu/wp-content/uploads/2024/07/WIFPR-Decentralized-Exchange-Harvey-Hasbrouck-and-Saleh.pdf [https://perma.cc/D6HB-MNFU].

regulatory approach seems ossified and manifestly contrary to the Commissions' normative objectives of promoting efficient markets and innovation, ultimately ensuring economic growth.[23] It also strengthens the calls for reform.

In May 2024, the U.S. House of Representatives took up that gauntlet and passed the Financial Innovation and Technology for the 21st Century Act in a rare demonstration of bipartisanship.[24] As of this writing, the chances of the Bill gaining traction in the Senate remain uncertain.[25] Moreover, the Bill itself offers only a partial way forward, failing to appreciate how the fast-paced innovative markets challenge existing regulatory frameworks in novel ways.[26]

With these considerations in mind, this Article aims to offer solutions. It examines and contrasts the structure, microstructure, and transaction costs of digital asset markets with those of legacy markets. Agreeing with the Commissions' intuition to introduce self-regulation, the Article explains why this policy needs more finesse, outlines a new self-regulatory model, and joins the scholarship that calls for self-regulation in digital asset markets.[27] The suggested model takes into account the unique risks

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[23]   *See The Commission*, CFTC, https://www.cftc.gov/About/AboutTheCommission [https://perma.cc/CJ2B-M2TH] (reflecting the mission of the CFTC to "promote . . . integrity, resilience, and vibrancy" and to be "[f]orward-thinking"); *About the SEC*, SEC (Apr. 6, 2023), https://www.sec.gov/about [https://perma.cc/MY75-XSYC](summarizing the mission "[t]o protect investors; maintain fair, orderly, and efficient markets; and facilitate capital formation"); SEC, SEC's FY 2023 Congressional Budget Justification/Annual Performance Plan and FY 2022 Annual Performance Report 9 (2023) (reflecting the SEC's commitment to "innovative, flexible, and pragmatic regulatory approaches"). For a discussion of the impossibility of achieving all agency objectives, see, for example, Chris Brummer & Yesha Yadav, *Fintech and the Innovation Trilemma*, 107 Geo. L.J. 235, 248–64 (2019).

[24]   *See* Press Release, Financial Services Committee, House Passes Financial Innovation and Technology for the 21st Century Act with Overwhelming Bipartisan Support (May 22, 2024), https://financialservices.house.gov/news/documentsingle.aspx?DocumentID=409277 [https://perma.cc/D4SY-5SXH].

[25]   Joseph A. Castelluccio, Andrew Olmem, Anna T. Pinedo, Jennifer Zepralka, Don F. Irwin & Katie Chaffer, *House Passes Digital Asset Market Structure Legislation: Financial Innovation And Technology for the 21st Century Act (FIT21)*, Mayer Brown (June 3, 2024), https://www.mayer-brown.com/en/insights/publications/2024/06/house-passes-digital-asset-market-structure-legisla-tion-financial-innovation-and-technology-for-the-21st-century-act-fit21 [https://perma.cc/U4ZB-9CV6] ("Even with the strong support for FIT21 in the House, however, its future in the Senate is very uncertain."); Steven Stradbrooke, *US House Passes FIT21 but Uncertain Future Awaits in Senate, White House*, CoinGeek (May 23, 2024), https://coingeek.com/us-house-passes-fit21-but-uncertain-future-awaits-in-senate-white-house/ [https://perma.cc/Q4M9-CMNQ]; MacKenzie Sigalos, *Schumer Says a Crypto Bill Can Pass Senate This Year; Key Dems Join 'Crypto4Harris' Call*, CNBC (Aug. 14, 2024), https://www.cnbc.com/2024/08/14/schumer-says-crypto-legislation-can-pass-the-senate-this-year-on-crypto4harris-.html [https://perma.cc/J7JK-P3JW].

[26]   *See infra* Section II.C; Parts IV–VI.

[27]   *See infra* Parts V–VI. Note that there are concerns about SROs' effectiveness. *See infra* Section IV.B. Some scholars have also argued against new SROs in securities markets. *See, e.g.,*

and contributions of the technology and blockchain-enabled market infrastructure, as well as the critical differences and spillovers between centralized and decentralized trading systems.

This Article develops in three main segments: it starts with the projected economic benefits of DLT, proceeds to demonstrate how these theoretical expectations conflict with the existing transaction costs and risks in digital asset offerings and trading, and concludes with offering policy solutions based on self-regulation. Part I examines blockchains as an institutional innovation built to reduce transaction costs through decentralization and self-governance. In Parts II and III, this Article demonstrates how reality clashes with this theoretical potential, explores why blockchain-enabled markets need regulatory intervention, and explores how the new intermediaries introduce novel risks—or recreate old ones—throughout the lifecycle of digital assets (i.e., from their offering to exchange trading and settlement.) In Parts IV, V, and VI, this Article concludes with a possible solution—an organized, formal self-regulatory system. Part IV takes a deep dive into the pros and cons of self-regulation in blockchain-enabled markets and the failures of private self-regulation; Part V discusses the need for a formal self-regulatory approach; Part VI builds off the two major proposals on crypto asset SROs, merges them, and develops a new model capitalizing on the benefits of SROs and targeting the risks of blockchain-enabled crypto-exchanges.

I. Economics and Blockchains

Traditional capital and commodity markets rely on institutions providing some form of intermediation, reducing transaction costs, and improving coordination among market participants. These typical intermediaries include, among others, trading platforms, broker-dealers, and clearinghouses, all regulated and registered with the SEC or the CFTC and relevant SROs.[28] These intermediaries are imperfect, and scholars and regulators periodically voice concerns about SROs' conflicts of interest and relevant transaction costs.[29] In contrast to the conventional institution-based system, the avowed promise of blockchain technology is a disintermediated system enhancing efficiency, addressing Coasean

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Donna M. Nagy, *Regulating the Mutual Fund Industry*, 1 Brooklyn J. Corp. Fin. & Com. L. 11, 33 (2006).

[28] *See, e.g.*, Marco Dell'Erba, *Crypto-Trading Platforms as Exchanges*, 2024 Mich. State L. Rev. (forthcoming 2024) (manuscript at 12–27), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4405361 [https://perma.cc/ZCR4-YS3K] (discussing how legacy intermediaries are regulated).

[29] *See infra* Section IV.B.

and Williamsonian transaction costs,[30] and simplifying human interaction[31] and economic coordination.[32]

The relevant oft-cited features of DLT are decentralization and transparency, which reduce adverse selection, improve transaction execution and security, and produce untampered records.[33] The public nature of blockchain-enabled transacting leads to a better distribution of knowledge and communication.[34] It, thus, may tackle the costs associated with searching for prices, contracting, controlling transactional opportunism, and others.[35] In part, the proffered theoretical value of DLT rests on managing trust,[36] a vital component in all economic

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[30] *See generally* OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM (1985) (describing the costs of coordinating economic activity in traditional markets); R.H. Coase, *The Nature of the Firm*, 4 ECONOMICA 386 (1937) (same). For an explanation of how blockchain technology can reduce transaction costs, see generally Daniil Frolov, *Blockchain and Institutional Complexity: An Extended Institutional Approach*, 17 J. INSTITUTIONAL ECON. 21 (2021); Martino & Ringe, *supra* note 21, at 4 ("In fact, blockchain aims to efficiently allocate entitlements through a decentralised process. In the Coasean framework, this guarantees superior outcomes compared to centralised public policies when it comes to handling externalities. Crucially, this holds true only under the assumptions of very low transaction costs and a clear initial allocation of property rights. As long as these assumptions hold, market participants may exchange property rights, ensuring that these entitlements are allocated to the party who values them the most, thereby internalising the externalities.").

[31] Organizationally, blockchain protocols could work as "constitutions," enabling participants to decide how they are governed. *See, e.g.*, Eric Alston, *Blockchain and the Law—Legality, Law-Like Characteristics, and Legal Applications*, *in* THE ECONOMICS OF BLOCKCHAIN AND CRYPTOCURRENCY: A TRANSACTION COSTS REVOLUTION 117, 128–29 (James Lee Caton ed., 2022); Alastair Berg, Chris Berg & Mikayla Novak, *Blockchains and Constitutional Catallaxy*, 31 CONST. POL. ECON. 188, 193–94 (2020).

[32] *See generally* Sinclair Davidson, Primavera De Filippi & Jason Potts, *Blockchains and the Economic Institutions of Capitalism*, 14 J. INSTITUTIONAL ECON. 639 (2018) (describing how blockchains coordinate economic activity to improve efficiency and reduce transaction costs). For the major institutional theory, see generally DOUGLASS C. NORTH, INSTITUTIONS, INSTITUTIONAL CHANGE AND ECONOMIC PERFORMANCE (James Alt et al. eds., 1990).

[33] *See* PRIMAVERA DE FILIPPI & AARON WRIGHT, BLOCKCHAIN AND THE LAW: THE RULE OF CODE 2 (2018).

[34] *See* Davidson et al., *supra* note 32, at 640, 652–53 (describing how blockchains allow peer-to-peer networks to mutually exploit their specialized knowledge to increase efficiencies). For a theory of decentralization of knowledge, see generally F.A. Hayek, *The Use of Knowledge in Society*, 35 AM. ECON. REV. 519, 522 (1945).

[35] On the main transaction costs, see Coase, *supra* note 30, at 390–91. Some scholars have voiced concerns about the costs of encoded interactions on blockchains ("smart contracts"), citing their lack of adaptability, which may reduce economic efficiency. *See, e.g.*, Massimiliano Vatiero, *The 'Dark Side' of Smart Contracts: A Contract Theory Perspective* 21 EUR. MGMT. REV. 516 ("[T]he claim that smart contracts lead to less costly transactions overlooks a central problem of transaction cost economics: the need for an efficient adaptive mechanism."). The transaction cost literature, therefore, underscores both promises and possible downsides of DLT.

[36] For a description of how law can be used to promote trust in DLT, see KEVIN WERBACH, THE BLOCKCHAIN AND THE NEW ARCHITECTURE OF TRUST 163 (2018).

systems.[37] With better trust and lower costs, firms may be more willing to transact,[38] ideally suggesting that new participants may enter markets previously unavailable due to attendant costs or risky intermediation.[39]

Some of these benefits should be particularly visible in securities markets and finance because "[t]he financial sector is, above all else, about gathering and processing information, on the basis of which capital resources can be efficiently allocated."[40] Specific improvements could accrue in reducing information asymmetry;[41] mitigating counterparty risk;[42] ensuring more open corporate governance;[43] facilitating the traceability of shares;[44] expediting payment of dividends, interest, and other distributions;[45] and minimizing back-office, transfer, and information verification functions of various intermediaries.[46]

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[37] *See, e.g.*, Rafael La Porta, Florencio Lopez-de-Silanes, Andrei Shleifer & Robert W. Vishny, *Trust in Large Organizations*, 87 Am. Econ. Rev. 333, 336 (1997) (finding that trust is associated with enhanced economic performance); Luigi Guiso, Paola Sapienza & Luigi Zingales, *Trusting the Stock Market*, 63 J. Fin. 2557, 2557 (2008) (arguing that individuals will invest in stocks when they trust that the information is reliable and the system is fair).

[38] *See, e.g.*, Guiso et al., *supra* note 37; Nicola Gennaioli, Andrei Shleifer & Robert Vishny, *Money Doctors*, 70 J. Fin. 91, 93 (2015).

[39] *But see* Cameron Harwick, *Signals and Incentives in Blockchain Applications*, *in* The Economics of Blockchain and Cryptocurrency, *supra* note 31, at 145, 158 (discussing relevant incentive hurdles and the need for inalienable identity for some financial transactions to work in blockchain-enabled financial markets); Agostino Capponi, Ruizhe Jia & Ye Wang, *Maximal Extractable Value and Allocative Inefficiencies in Public Blockchains*, SSRN 1–4 (Nov. 15, 2023), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3997796 [https://perma.cc/58XV-3YRY] (observing that the decentralized design of blockchains relying on self-interested parties validating transactions and adding blocks ("validators") may create a misalignment of incentives, affect efficiency, and deter exploitable users of decentralized finance from submitting valuable transactions).

[40] Joseph Stiglitz, *The Revolution of Information Economics: The Past and the Future*, *in* The State of Economics, the State of the World 101, 102 (Kaushik Basu et al. eds., 2020).

[41] *See, e.g.*, Katrin Schuler, Ann Sofie Cloots & Fabian Schär, *On DeFi and On-Chain CeFi: How (Not) to Regulate Decentralized Finance*, 10 J. Fin. Reg. (forthcoming 2024) (manuscript at 10), https://academic.oup.com/jfr/advance-article/doi/10.1093/jfr/fjad014/7606986 [https://perma.cc/MX7P-4F2B].

[42] *See id.* at 16.

[43] *See, e.g.*, De Filippi & Wright, *supra* note 33, at 133–35 (describing how blockchain technology can improve the efficiency and transparency of management of corporations).

[44] George S. Geis, *Traceable Shares and Corporate Law*, 113 Nw. U. L. Rev. 227, 230–31 (2018); Kevin V. Tu, *Blockchain Stock Ledgers*, 96 Ind. L.J. 223, 248 (2020).

[45] Raphael Auer, *Embedded Supervision: How to Build Regulation into Decentralised Finance* 8 (Bank for Int'l Settlements, Working Paper No. 811, 2019).

[46] Legacy firms have already availed themselves of these benefits by issuing tokenized securities on blockchains. *See, e.g.*, Press Release, Eur. Inv. Bank, EIB Issues Its First Ever Digital Bond on a Public Blockchain (Apr. 28, 2021), https://www.eib.org/en/press/all/2021-141-european-investment-bank-eib-issues-its-first-ever-digital-bond-on-a-public-blockchain [https://perma.cc/Q6Z5-8V9J]; *Digitizing Bonds on the Blockchain*, Goldman Sachs (June 10, 2021), https://www.goldmansachs.com/intelligence/pages/from_briefings_10-june-2021.html [https://perma.cc/67U2-J7G5]. Copies of ledgers could be maintained not by a single intermediary but instead

The additional value of the technology derives from the potential changes in the market structure and microstructure. For instance, DLT-enabled trading may reduce the information monopoly of conventional profit-seeking intermediaries, such as legacy exchanges,[47] and produce more cost-efficient trading platforms.[48] Scholars suggest that code-driven, blockchain-based DEXs could save U.S. investors billions in trading costs, and capital locked in centralized intermediaries might be used productively through a decentralized institutional design.[49] A blockchain-enabled market could thus produce allocative efficiencies. Purely theoretically, DLT could also turn market participants away from integrating into larger firms and toward transacting in open markets and thus alter market organization[50] by lowering Coasean transaction costs.[51]

The reality of digital asset markets differs from these theories, and some forms of centralized intermediation and associated risks have returned and remain front and center.[52] One root cause of these trends is the market itself: market actors continue to innovate and experiment while relying on the efficiencies, improved governance, and security

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distributed among parties, making them more secure and transparent. Bech et al., *supra* note 4, at 74 ("DLT supports the wider distribution of ownership records and transaction histories.").

[47] On the central role of exchanges, see, for example, Onnig H. Dombalagian, *Are Cryptoexchanges the Exchange Act's Trojan Horse?*, 21 BERKELEY BUS. L.J. (forthcoming 2024) (manuscript at 45, 67–68), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4703013 [https://perma.cc/82Q2-J9PE].

[48] *See* Katya Malinova & Andreas Park, *Learning from DeFi: Would Automated Market Makers Improve Equity Trading?* 4 (Apr. 21, 2024), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4531670 [https://perma.cc/L4V4-X88F] (suggesting that automated market makers, a subtype of DEXs, can increase liquidity and reduce trading costs); *see also* DE FILIPPI & WRIGHT, *supra* note 33, at 99 (arguing that DLT can "facilitate the trading of financial instruments on a global scale" and acknowledging legal risks).

[49] Malinova & Park, *supra* note 48, at 5 ("Currently, a substantial portion of shares remains idle at brokerages, with only a small fraction lent to short sellers. Even this lending activity is often bilateral, making it expensive and cumbersome to arrange. AMMs offer a systematic way for investors to deploy their capital, earning extra income while providing proper risk sharing and compensation for adverse selection.").

[50] Thus, DLT could "provide[] many of the benefits of consolidation—trust [and lower transaction costs]—without the costs in administrative bloat and inefficiency." Chris Berg, Sinclair Davidson & Jason Potts, *Trustless Architecture and the V-Form Organization*, *in* THE ECONOMICS OF BLOCKCHAIN AND CRYPTOCURRENCY, *supra* note 31, at 165, 174.

[51] Recall that sources of market transaction costs include learning about prices, negotiating and drafting contracts, i.e., activities that can be avoided within a firm. *See generally* Coase, *supra* note 30.

[52] *See generally* Yesha Yadav, *The Centralization Paradox in Cryptocurrency Markets*, 100 WASH. U. L. REV. 1725 (2023).

of blockchains,[53] particularly the foundational Layer 1 protocols.[54] As market actors capitalize on these benefits and blockchain ecosystems' amenability to customization, they build new assets and services atop that foundational layer. Their initiatives can develop away from pure decentralization and disintermediation, with Layers 2 and 3[55] and various applications allowing different levels of centralization.[56] In other words, markets may introduce vectors of centralization into their projects and applications.[57]

One such vector is large, centralized intermediaries—CEXs. CEXs bring together buyers and sellers of digital assets, and trading typically takes place on an off-chain limit order book with bundled transfers thereafter recorded on-chain.[58] The rise of CEXs not only illustrates how financial intermediation remains sticky as it adapts to new technologies[59] but also risks reintroducing the standard transaction costs, conflicts of interest, and agency costs faced by more conventional financial intermediaries.[60]

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[53]   *See* Alston, *supra* note 31, at 131, 133; Cesare Fracassi, Moazzam Khoja & Fabian Schär, Decentralized Crypto Governance? Transparency and Concentration in Ethereum Decision-Making 41–44 (Jan. 2024) (unpublished manuscript), https://www.law.nyu.edu/sites/default/files/paper%20Decentralized%20Crypto%20Governance.pdf [https://perma.cc/R58E-HCXN] (finding that only a group of identifiable developers on Ethereum advance implemented proposals but noting transparency and increasing decentralization). *But see* Angela Walch, *The Bitcoin Blockchain as Financial Market Infrastructure: A Consideration of Operational Risk*, 18 N.Y.U. J. Legis. & Pub. Pol'y 837, 837–38 (2015) (questioning blockchain governance and design).

[54]   An example of a Layer 1 blockchain is Ethereum, which validates and finalizes transactions. *See* Fracassi et al., *supra* note 53, at 3 n.2. However, as discussed in more detail below, Layer 1 (also called the "settlement layer") itself has exhibited inefficiencies, including the phenomenon called "Maximal Extractable Value." For a description and review of relevant scholarship, see Capponi et al., *supra* note 39, at 1–13; *infra* notes 246–47 and accompanying text.

[55]   "Layer 2" is software built to improve the scalability and transaction speed of Layer 1 protocols, and "Level 3" is the application layer. *See, e.g.*, Carla L. Reyes, *Law's Detrimental Reliance on Intermediaries*, 92 Geo. Wash. L. Rev. 1343, 1355–56 (2024). Decentralization, security, and application of Layers 2 and 3 in transacting differs from those in the foundational layer. *See id.*

[56]   *See id.*; *see also* Schuler et al., *supra* note 41 (manuscript at 9, 14) (discussing layers and centralization vectors, particularly in Layer 2 solutions).

[57]   *See* Schuler et al., *supra* note 41 (manuscript at 9).

[58]   *See* Reyes, *supra* note 55, at 1373–74 (describing how centralized exchanges record trades throughout the day on an internal record, then upload the day's end positions onto the public blockchain). CEXs' centrality in crypto asset markets is natural because "[f]inding a counterparty [could be] challenging in an environment where identities are obscured behind pseudonymous handles" on blockchains. Yesha Yadav, *Toward Crypto-Exchange Oversight*, SSRN 8 (Dec. 26, 2023), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4241062 [https://perma.cc/3GDB-AU8D].

[59]   *See, e.g.*, Tom C.W. Lin, *Infinite Financial Intermediation*, 50 Wake Forest L. Rev. 643, 654–55 (2015) (noting the evolution of intermediaries "has been one of the most incredible developments in finance over the last few decades" but "the intermediated functions . . . remain unchanged").

[60]   For a discussion of transaction costs and conflicts of financial intermediaries, see *infra* Section II.C and Part III.

Even when digital asset intermediaries, such as DEXs, are built directly on blockchains, centralization valences may remain. On the one hand, as is the case with all blockchain-based applications, DEX governance and performance depend on the overall security, design, and transparency of the underlying blockchains. On the other hand, questions of DEX operations and design touch upon the quality of the code of the underlying smart contracts[61] and decentralized applications,[62] as well as their developers' influence over governance and protocol operations, which could be on-chain or off-chain.[63] Blockchain-native mechanisms may not fully control these activities or even introduce new risks.[64]

To summarize, digital asset trading involves varying levels of centralization and concerns the insufficiency of blockchain-native control mechanisms. Under these conditions, if the new intermediaries do not properly perform transaction-cost-reducing tasks—i.e., the functions of regulated legacy intermediaries—blockchain-enabled markets may fail to deliver on their economic promises. Not all contracts in digital asset markets are self-enforcing and optimally executed on blockchains,[65] and not all applications built on top of blockchains incentivize all parties to consistently act cooperatively.[66] In expecta-

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[61] Smart contracts are essentially programs executing agreements. *See* De Filippi & Wright, *supra* note 33, at 74–75. One recent court decision described smart contracts as follows:

> There are two kinds of Ethereum accounts: (1) "externally owned" accounts, which are effectively wallets that may be controlled by anyone with the corresponding private keys, and (2) "smart contracts," or "pools" which are software programs deployed directly onto the Ethereum network, and which may be run by Ethereum users who satisfy the program's conditions.

Van Loon v. U.S. Dep't of Treasury, 688 F. Supp. 3d 454, 459–60 (W.D. Tex. 2023).

[62] "Decentralised applications (DApps) are software applications that allow users to engage with the functionalities of smart contracts." Autorité des Marchés Financiers, *supra* note 9, at 7; *see also* Vanessa Villanueva Collao, *DeFi: A Framework of the Automated Financial System*, 26 Tul. J. Tech. & Intell. Prop. (forthcoming 2024) (manuscript at 21), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4419373 [https://perma.cc/NB37-LYJU] (describing how smart contract developers create decentralized applications).

[63] *See* Dombalagian, *supra* note 47 (manuscript at 15) (describing how DEXs can use a variety of on-chain and off-chain trading mechanisms, such as automated market makers or traditional limit order books); *see also* Kaushal Shah, Dhruvil Lathiya, Naimish Lukhi, Keyur Parmar & Harshal Sanghvi, *A Systematic Review of Decentralized Finance Protocols*, 4 Int'l J. Intelligent Networks 171, 172, 176–79 (2023) (discussing protocol designs).

[64] For a comprehensive literature review on the risks of decentralized finance and interconnections, see, for example, Schuler et al., *supra* note 41 (manuscript at 3–6). In addition, blockchain-native intermediaries themselves may present risks and exploit DEX users through systematic frontrunning. *See, e.g.*, Capponi et al., *supra* note 39, at 1–13.

[65] Alston, *supra* note 31, at 132–34.

[66] *See* Sinclair Davidson & Jason Potts, *Institutional Cryptoeconomics*, *in* The Economics of Blockchain and Cryptocurrency, *supra* note 31, at 1, 6–7 (describing how smart contracts and distributive ledger technology suppress some, but not all, instances of opportunism).

tion, without blockchain-based or regulatory guardrails, some market actors might *prefer* to act opportunistically—or even fraudulently—in search of profit maximization and rent extraction.[67] In the next Part, the discussion turns to the resulting conflicts, opportunism, and transaction costs, and the role of CEXs and DEXs in mitigating or exacerbating these costs.

II.   Asset-Level and Issuer Information

A.   *Issuer Disclosure*

This Section starts with the costs and verification of information—the lifeblood of all markets, including financial markets.[68] At a basic level, any person may possess considerable information about their own assets, projects, and businesses. If this information is important and not released, it becomes material and nonpublic, giving insiders an edge in interacting with outsiders. When this information asymmetry is combined with incentives to profit from asset offerings and sales, it triggers considerable conflicts of interest and moral hazard.[69] Some markets, such as conventional commodity markets, may have fewer asymmetries and conflicts at scale, while others, such as securities markets, have more.[70]

U.S. securities law—and some foreign regulations that have adopted a securities-law-like model of disclosure for crypto asset distributions[71]—deals with these costs by mandating standardized issuer

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[67]   Opportunism is a less technical term than adverse selection and moral hazard. It suggests, correctly, that the troublesome behavior in question is not an arcane economic condition but is familiar and pervasive. Not only are the failures to self-disclose true attributes *ex ante* (adverse selection) and true performance *ex post* (moral hazard) both subsumed under opportunism, but the failure to tell the truth, the whole truth and nothing but the truth is implicated by opportunism. . . . The possibility that an economic agent will conform to the letter but violate the spirit of an agreement is admitted.

Oliver E. Williamson, *Opportunism and Its Critics*, 14 Managerial & Decision Econ. 97, 101 (1993). "Opportunism is a variety of self-interest seeking but extends simple self-interest seeking to include self-interest seeking with guile. . . . [E]ven among the less opportunistic, most have their price." Oliver E. Williamson, *Transaction-Cost Economics: The Governance of Contractual Relations*, 22 J.L. & Econ. 233, 234 n.3 (1979) [hereinafter Williamson, *Transaction-Cost Economics*].

[68]   *See* Stiglitz, *supra* note 40, at 102 (describing the centrality of information to the financial market).

[69]   *See, e.g.*, Moran Ofir & Ido Sadeh, *ICO vs. IPO: Empirical Findings, Information Asymmetry, and the Appropriate Regulatory Framework*, 53 Vand. J. Transnat'l L. 525, 529–30, 588–89 (2020).

[70]   *See, e.g.*, Dombalagian, *supra* note 47 (manuscript at 38).

[71]   *See, e.g.*, Regulation 2023/1114, of the European Parliament and of the Council of 31 May 2023 on markets in crypto assets, and Amending Regulations No 1093/2010 and No 1095/2010 and Directives 2013/36/EU and 2019/1937, 2023 O.J. (L 150) 40 [hereinafter MiCA].

disclosure, with some limited exemptions.[72] Disclosures are achieved through filing Securities Act[73] registration statements and prospectuses, as well as Exchange Act[74] periodic reports filed after offerings.[75] It is often argued that "consumers" of these documents are mainly institutions, while individual retail investors are less engaged in parsing corporate reports and prospectuses.[76] Retail investors, therefore, benefit from the vigilance of institutions and professionals in efficient markets.[77]

Digital asset offerings differ in several respects in handling this information problem. Some commentators argue that there is no material information advantage because blockchains are public and smart contracts and asset codes are accessible to everyone.[78] Any ownership concentration, which may endow large asset owners with considerable voting power or potential trading advantages, could be visible on-chain as wallet addresses are public—albeit pseudonymous. Next, asset valuation and utility may depend primarily on market factors, not the efforts of issuers and promoters.[79] When these propositions hold, information asymmetry is reduced, and outsiders can price asset-related risks. Because of these benefits of the technology, imposing securities-law-like disclosure obligations would be unwarranted, fail to maximize social welfare, and burden the market with unnecessary compliance costs.[80]

The reality of blockchain-enabled markets today diverges from these propositions. As mentioned above, projects relying on blockchains as an institutional infrastructure often have different levels of centralization.[81] For example, issuers may be selling digital assets via smart contracts—which ensures on-chain transparency of fundraising—to finance off-chain or under-decentralized business projects—which negates transparency.[82] Some issuers thus possess material nonpublic information that is inaccessible either on-chain or from public

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72   *See* 15 U.S.C. §§ 77e, 78m.

73   Securities Act of 1933, 15 U.S.C. § 77.

74   Securities Exchange Act of 1934, 15 U.S.C. § 78.

75   *See* 15 U.S.C. §§ 77e, 78m.

76   *See* Frank H. Easterbrook & Daniel R. Fischel, *Mandatory Disclosure and the Protection of Investors*, 70 Va. L. Rev. 669, 694 (1984). *But see* Merritt B. Fox, *Regulating Public Offerings of Truly New Securities: First Principles*, 66 Duke L.J. 673, 719–20 (2016) (explaining the value of mandatory disclosures).

77   *See* Easterbrook & Fischel, *supra* note 76.

78   *See, e.g.*, Guseva, *supra* note 17, at 35–37, 55–57. Note that tokenized shares and other securities would still carry disclosure obligations under securities law.

79   *Id.* at 40–41, 51–52 (arguing that asset valuation may depend primarily on factors such as developer activity, network effect, and platform membership, i.e., not securities law disclosures).

80   *See id.* at 60.

81   *See supra* notes 52–66 and accompanying text.

82   *See* Guseva, *supra* note 17, at 36 (discussing the lack of decentralization and need for formal disclosure).

sources.[83] Even when blockchain-enabled projects are transparent, the "consumers" of this publicly available information are not only well-resourced institutions—a scenario typical of legacy markets— but also, and perhaps mainly, retail investors.[84] Less sophisticated *per definitionem*, retail investors may fail to assay assets and price risks.[85]

The next difference between traditional issuers and crypto asset issuers is that the latter typically provide information purely voluntarily through white papers and code disclosure.[86] Relevant scholarship on legacy markets, however, indicates that, without mandatory disclosure, firms may underproduce information, which is a form of public good.[87] This proposition seems to translate to crypto asset markets where white papers exhibited different degrees of accuracy.[88] Moreover, the disclosure incentives of developers may differ from those of traditional firms domiciled in a specific jurisdiction and going public on national securities exchanges. Being transparent and bonding to the U.S. legal regime and its vaunted exchanges may be a meaningful variable for the latter but not the former.[89] Some crypto asset distributions even deliberately geofenced the United States,

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83   *See, e.g.*, *id.* at 35–36. At the very least, they know if they plan to continue supporting their projects and ecosystems, which would align their reputational or financial incentives with those of crypto asset purchasers.

84   *See, e.g.*, Betsy Vereckey, *How Crypto Investors Behave—and Why the Industry Needs Regulation*, MIT Sloan Sch. of Mgmt. (Dec. 4, 2023), https://mitsloan.mit.edu/ideas-made-to-matter/how-crypto-investors-behave-and-why-industry-needs-regulation [https://perma.cc/579R-DDGH] (discussing research on how large institutions and retail investors behave in markets for crypto assets).

85   Some investment choices may be too complex to properly value and regulate. *See generally* Steven L. Schwarcz, *Regulating Complexity in Financial Markets*, 87 Wash. U. L. Rev. 211 (2009).

86   Guseva, *supra* note 17, at 26–27.

87   *See* Merritt B. Fox, *Retaining Mandatory Securities Disclosure: Why Issuer Choice Is Not Investor Empowerment*, 85 Va. L. Rev. 1335, 1344, 1365 (1999) (arguing that, when given the choice, firms will disclose less than the "socially optimal level of disclosure").

88   *See generally* Shaanan Cohney, David Hoffman, Jeremy Sklaroff & David Wishnick, *Coin-Operated Capitalism*, 119 Colum. L. Rev. 591 (2019).

89   Crypto asset issuers' incentives to disclose remain underexplored, complicating the extrapolation of findings from the scholarship on traditional firms. For example, the prominent bonding theory postulates that foreign corporations offer securities in the United States to "bond" to its high-quality institutions and regulatory regime. John C. Coffee Jr., *Law and the Market: The Impact of Enforcement*, 156 U. Pa. L. Rev. 229, 285 (2007) (arguing that foreign firms "bonded" to U.S. regulatory regimes by subjecting themselves to enforcement powers and disclosure requirements). For regular startups, initial public offerings and listing on exchanges are considered "rite[s] of passage" leading to corporate adulthood. *E.g.*, Robert B. Thompson & Donald C. Langevoort, *Redrawing the Public-Private Boundaries in Entrepreneurial Capital Raising*, 98 Cornell L. Rev. 1573, 1580 (2013); Donald C. Langevoort & Hillary A. Sale, *Corporate Adolescence: Why Did "We" Not Work?*, 99 Tex. L. Rev. 1347, 1349 & n.8 (2021).

suggesting that compliance with its law did not seem important to developers and, perhaps, even investors.[90]

The very term "issuer" in crypto asset markets could apply fairly loosely.[91] It may encompass not only identifiable entities but also various formal and informal associations of individuals, developers, foundations, and others that launch crypto asset projects, update the underlying code, or have a right to participate in project governance.[92] Their incentive structures and agency costs remain underexplored compared with those of corporate executives, particularly in conventional startups making disclosure and listing decisions.[93]

Under these conditions, formalized disclosure guidelines may be needed, provided that such guidelines can capture the benefits of the technology and efficiently supply markets with relevant information. Foreign regulators have already developed tailored disclosure regimes for crypto assets.[94] In the United States, the much-needed and overdue congressional bills, such as the May 2024 U.S. House Bill, that proffer principles of issuer disclosure may stall.[95] Instead, reporting projects mainly originate with private initiatives and scholars,[96] with some experts even suggesting that information reporting could be built on

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90 *See, e.g.*, Ofir & Sadeh, *supra* note 69, at 574–75 (describing how U.S. investors were excluded from opportunities to receive newly issued digital tokens); Goforth, *supra* note 17, at 646 (explaining how many crypto asset deals are conducted to prevent U.S. investors from participating).

91 The new House Bill aims to clarify the term "digital asset issuer" and defines it as follows:

(27) DIGITAL ASSET ISSUER.—

(A) IN GENERAL.—With respect to a digital asset, the term 'digital asset issuer' means any person that, in exchange for any consideration—

(i) issues or causes to be issued a unit of such digital asset to a person; or

(ii) offers or sells a right to a future issuance of a unit of such digital asset to a person.

(B) EXCLUSION.—The term 'digital asset issuer' does not include any person solely because such person deploys source code that creates or issues units of a digital asset that are only distributed in end user distributions.

Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. § 101(27) (2024).

92 Compare this broad understanding of the term "issuer" in crypto asset markets with the traditional definition of the term in 15 U.S.C. § 78c(a)(8), which defines the term "issuer" as "any person who issues or proposes to issue any security," with some exceptions. 15 U.S.C. § 78c(a)(8).

93 *See, e.g.*, Adam Pritchard, *Self-Regulation and Securities Markets*, REGUL., Spring 2003, at 32, 37 ("Agency costs are lower for a start-up company because the corporate managers making the listing decision usually own a substantial portion of the company's equity.").

94 *See, e.g.*, MiCA, *supra* note 71. Although the pros and cons of MiCA are beyond the scope of this Article, MiCA is nonetheless an important regulatory framework introduced in a major market—the European Union.

95 *See* H.R. 4763 § 303.

96 This Author is participating in one such initiative. *See Proposed Information Guidelines for Certain Tokens Made Available in the United States*, GLOB. DCA, https://global-dca.org/proposed-u-s-disclosure-guidelines/ [https://perma.cc/3P6D-2MDQ].

decentralized applications on blockchains.[97] An implicit objective of these projects is optimizing the disclosure regime where blockchain ecosystems support transmission and verification of some information and formal disclosures alleviate remaining information asymmetry.

B.   *Underwriters and CEXs*

To the extent that issuer and asset-level disclosures need verification, financial market intermediaries assist with this task. In legacy markets, the first such intermediary is the underwriter serving as a reputational gatekeeper conducting due diligence on issuers.[98] Firms selling securities to the public enter into underwriting agreements with registered broker-dealers, i.e., investment banks.[99] As underwriters, the investment banks are members of FINRA, an SRO charged with overseeing broker-dealers.[100] Under a typical agreement, underwriters acquire offered securities from the issuer and resell them to investors— which is called "firm commitment" underwriting.[101] In a typical initial public offering, for example, an issuer retains an investment bank to help advertise the offering and sell a certain number of round lots to institutions before having its shares listed on an exchange.[102] The underwriter does due diligence on the issuer and disclosures, puts its reputation on the line, and faces securities law liability alongside the issuer.[103] More recent public offerings, such as "direct listings" in which a firm "sell[s]

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[97] For instance, Chris Brummer proposed "Disclosure NFTs" (non-fungible tokens), "Disclosure DAOs" (decentralized autonomous organizations), and other decentralized tools to improve disclosures. Chris Brummer, *Disclosure, Dapps and DeFi*, 5 Stan. J. Blockchain L. & Pol'y 137, 140 (2022).

[98] *See* James J. Park, *Investor Protection in an Age of Entrepreneurship*, 12 Harv. Bus. L. Rev. 107, 109–10 (2022) (describing how the underwriter evaluates a new company's future profitability based on due diligence).

[99] *See generally 5100. Securities Offerings, Underwriting and Compensation*, FINRA, https://www.finra.org/rules-guidance/rulebooks/finra-rules/5100 [https://perma.cc/C45G-QAMZ].

[100] FINRA, for instance, would receive offering-related documentation and sign off on the agreement between an issuer and an underwriter. *5110. Corporate Financing Rule—Underwriting Terms and Arrangements*, FINRA, https://www.finra.org/rules-guidance/rulebooks/finra-rules/5110 [https://perma.cc/GYZ3-SJEG].

[101] Joseph A. Grundfest, Morrison, *the Restricted Scope of Securities Act Section 11 Liability, and Prospects for Regulatory Reform*, 41 J. Corp. L. 1, 8 & n.30 (2015).

[102] *Id.* at 3–4. Note that there also other methods, such as direct listings, where the role of traditional intermediaries is limited. *See, e.g.*, Andrew F. Tuch & Joel Seligman, *The Further Erosion of Investor Protection: Expanded Exemptions, SPAC Mergers, and Direct Listings*, 108 Iowa L. Rev. 303, 363–65 (2022).

[103] *See* 15 U.S.C. § 77k(a) (providing that underwriters may face civil liability for untrue statements of a material fact and material omissions in a registration statement).

shares itself in the opening auction on the first day of trading,"[104] also require some presence of investment banks.[105]

Contrast this approach with the previously discussed potential of blockchain ecosystems where intermediaries become less essential,[106] smart contracts executing programmable transactions distribute assets to investors directly,[107] and issuers advertise their projects online through code disclosure and at various community events.[108] Distributions could be borderless and global and be either free—"airdrops"[109]—or in exchange for payment.[110] Technology, thus, seems to directly reduce issuers' offering and information distribution costs.

Yet a welfare-maximizing outcome does not necessarily follow from these technological benefits and reduced costs because it can only be achieved if issuer disclosures are optimal and not misleading.[111] This first-order condition can be satisfied either within the blockchain ecosystem or off-chain. To date, blockchain-based mechanisms and ecosystems have produced some, but not necessarily optimal, level of disclosure and information verification[112] and have been supplemented by the new intermediaries—crypto-exchanges. Many of them are CEXs, centralized off-chain entities.[113] CEXs do not function as underwriters, but they do evaluate assets and provide access to trading and liquidity

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[104]   Edward F. Greene & Bree Morgan-Davies, *Disintermediation of the US, EU and UK Capital and Financial Markets*, 18 Cap. Mkts. L.J. 457, 477 (2023).

[105]   *Id.* at 478–79 (describing the role of the underwriter, typically an investment bank, in direct listings).

[106]   *See, e.g.*, Tarang Khaitan, *Siemens Issues €60M Digital Bond on Polygon*, Defiant (Feb. 16, 2023), https://thedefiant.io/siemens-60m-euro-bond-polygon [https://perma.cc/ZX5X-L4CB] (describing the sale of a 60 million euro digital bond through a blockchain directly to investors, without using an intermediary bank).

[107]   *See supra* notes 61–64 and accompanying text (describing the many uses for smart contracts); Guseva, *supra* note 17, at 22.

[108]   *See, e.g.*, *In re* Block.one, Securities Act Release No. 10714, 2019 WL 4793292, at *4 (Sept. 30, 2019) (describing how Block.one published beta versions of its software online and used social media and online message boards to engage potential purchasers).

[109]   *See, e.g.*, Joel Agbo, *Top 16 Upcoming Crypto Airdrops in 2024 (Updated)*, CoinGecko (Mar. 5, 2024), https://www.coingecko.com/learn/new-crypto-airdrop-rewards [https://perma.cc/2BVH-Z35C].

[110]   An example would be "initial coin offerings" ("ICO"), which were similar to basic capital raises. SEC v. Coinbase, Inc., No. 1:23-cv-04738, 2024 WL 1304037, at *4 (S.D.N.Y. Mar. 27, 2024). "ICOs are generally executed via a combination of direct placements, initial exchange offerings, and simple agreements for future tokens . . . ." *Id.* On the phasing out of ICOs, see Yuliya Guseva, *The SEC, Digital Assets, and Game Theory*, 46 J. Corp. L. 629, 647 (2021).

[111]   For a discussion about optimizing disclosure requirements to maximize welfare, see generally Fox, *supra* note 87.

[112]   *See, e.g.*, *supra* Section II.A (discussing issuer disclosure); Villanueva Collao, *supra* note 62, at 15, 22, 24 (observing that some new mechanisms, such as code audits and oracles, have emerged but may be insufficient).

[113]   *See* Yadav, *supra* note 52, at 1735–44.

to issuers and asset purchasers.[114] As such, they are the first point of contact and gatekeeper between public investors and digital asset markets.

C.   *Exchanges and Information Asymmetry*

1.   *Legacy Exchanges, CEXs, and Listings*

CEXs differ considerably from traditional derivatives and securities exchanges, which register with the CFTC or the SEC.[115] For securities, national securities exchanges impose a set of obligations on issuers, and the SEC approves issuers' registration statements[116] and certain products such as "exchange-traded funds."[117] Derivatives exchanges self-certify to the CFTC that a new contract complies with law and regulations or voluntarily submit the contract for approval.[118] Although crypto assets are routinely listed, their trading venues are often not registered with the Commissions, which has become a subject of enforcement actions.[119]

In their pleadings, unregistered crypto-exchanges—and their amici—argue that crypto-exchanges do not list or intermediate trading in securities,[120] and, consequently, there is no need to register with the SEC.[121] There is equally no need to register with the CFTC if a crypto-exchange does not provide a trading platform for derivatives or leveraged and margined retail transactions in commodities.[122] Yet a few crypto-exchanges—or their subsidiaries—have registered as broker-dealers such as alternative trading systems ("ATS"), which are members of FINRA.[123]

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114   *See generally* Yadav, *supra* note 52.

115   *See infra* Section V.A.

116   15 U.S.C § 77(h).

117   *See, e.g.*, Gary Gensler, *Statement on the Approval of Spot Bitcoin Exchange-Traded Products*, SEC (Jan. 10, 2024), https://www.sec.gov/news/statement/gensler-statement-spot-bitcoin-011023 [https://perma.cc/JBQ3-EAGT].

118   17 C.F.R. §§ 40.2–40.3, 40.6 (2023).

119   *See, e.g.*, SEC v. Coinbase, Inc., No. 1:23-cv-04738, 2024 WL 1304037, at *1 (S.D.N.Y. Mar. 27, 2024) (considering whether Coinbase, which provides a platform for crypto asset trading, is required to register with the SEC); Press Release, CFTC Orders Tether and Bitfinex to Pay Fines Totaling $42.5 Million, CFTC (Oct. 15, 2021), https://www.cftc.gov/PressRoom/PressReleases/8 [https://perma.cc/VTE2-YPWH] (detailing an order by the CFTC issuing civil penalties against a crypto asset trading platform for failing to register with the CFTC).

120   *See, e.g.*, Reply Memorandum of Law in Support of Coinbase's Motion for Judgment on the Pleadings at 8 n.4, *Coinbase, Inc.*, 2024 WL 1304037 (S.D.N.Y. Mar. 27, 2024) (No. 1:23-cv-04738), 2023 WL 8173716 (arguing that Coinbase does not provide a platform for trading in securities); Amicus Curiae Brief of United States Senator Cynthia M. Lummis at 13–14, *Coinbase, Inc.*, 2024 WL 1304037 (S.D.N.Y. Mar. 27, 2024) (No. 1:23-cv-04738), 2023 WL 5278033.

121   On the registration requirements and exemptions, see 17 C.F.R. § 240.3b-16 (2023).

122   *See* 7 U.S.C. §§ 6(a), 6c(b), 7, 7b-3(a).

123   17 C.F.R. §§ 242.300–301 (2023); Jason Foye, *An Inside Look into FINRA's Crypto Asset Work* (Aug. 3, 2023), https://www.finra.org/media-center/blog/inside-look-finras-crypto-asset-work

In contrast to regulated exchanges and ATSs, unregistered digital asset platforms do not face preset regulatory obligations and establish rules voluntarily, with different substantive and procedural quality.[124] For instance, when crypto asset issuers seek listing on CEXs, as a matter of practice, the CEXs review issuer questionnaires in making listing decisions.[125] Because this listing review is conducted voluntarily and without uniform guidelines, there is a risk that the quality and integrity of vetting are irregular, particularly if a CEX lacks incentives to maintain a high quality of listings.[126] This voluntary, nonstandardized vetting structure may nurture a fertile ground for potential conflicts, low-quality and opaque assets, information asymmetry, and other risks that traditional exchanges are obligated to address by law.[127]

A pertinent feature of CEXs is that they serve as off-chain intermediaries whose interactions with the blockchain ecosystem are limited: listing, trading, and settlement are run through internal operations

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[https://perma.cc/4UWN-NKNB] (explaining how, as of August 2023, nine firms are approved to operate as ATSs for crypto asset securities). These intermediaries, however, are not SROs, like exchanges, and have more limited obligations. *See* 7 U.S.C. § 7(d)(2); 15 U.S.C. §§ 78f(b), 78o-3(b), 78s(g); Merritt B. Fox, Lawrence R. Glosten & Gabriel V. Rauterberg, The New Stock Market: Law, Economics, and Policy 32 (2019). Note also that some crypto-exchanges may register as futures commission merchants ("FCM"). *See, e.g.*, Greg Tusar, *Coinbase Financial Markets, Inc. Secures Approval to Bring Federally Regulated Crypto Futures Trading to Eligible U.S. Customers*, Coinbase (Aug. 16, 2023), https://www.coinbase.com/blog/coinbase-financial-markets-inc-secures-fcm-approval-to-bring-regulated [https://perma.cc/CC33-347X]. Coinbase Financial Markets, Inc., became an FCM in 2023 and is registered with the NFA; FCMs, similarly to brokers and dealers, do not perform the self-regulatory functions of exchanges. *Id.*

124 Yadav points out that crypto-exchanges have listing rules and rules prohibiting, among others, "[b]ehaviors like manipulation, spoofing, wash trading and fraud." Yadav, *supra* note 58, at 36. Massad and Jackson, however, doubt whether such rulebooks are sufficient. Timothy G. Massad & Howell E. Jackson, *How to Improve Regulation of Crypto Today—Without Congressional Action—and Make the Industry Pay for It* 12, 18 (Hutchins Ctr., Working Paper No. 79, 2022), https://www.brookings.edu/wp-content/uploads/2022/10/WP79-Massad-Jackson-updated-2.pdf [https://perma.cc/W4D6-J6TN]. Additionally, there have been limited private attempts at self-regulation. *See, e.g.*, Letter from Michelle Bond, Chief Exec. Officer, Ass'n for Digit. Asset Mkts., to Vanessa Countryman, Sec'y, SEC (Apr. 18, 2022), https://www.sec.gov/comments/s7-02-22/s70222-20124008-280142.pdf [https://perma.cc/9MKY-KXVX] (discussing a code of conduct addressing the professional standards to which all members of the Association for Digital Asset Markets agree to adhere).

125 For a description, see *Coinbase, Inc.*, 2024 WL 1304037, at *4, *17 (describing how Coinbase reviews the crypto asset developer's listing application to identify potential roadblocks and decide whether to list it on its platform). Exchanges also list crypto assets, such as Bitcoin, which has no formal issuer. *See, e.g.*, *Listings Prioritization Process and Standards*, Coinbase (Aug. 8, 2023), https://www.coinbase.com/exchange/asset-listings [https://perma.cc/PU96-6TEL].

126 *But see* Yadav, *supra* note 58, at 38–39 (suggesting that there are financial and reputational incentives to ensure proper vetting).

127 *See infra* Part IV.

under exchanges' rules and procedures.[128] Consequently, as unregistered off-chain firms, CEXs simultaneously face less accountability from the Commissions *and* less feedback from blockchain communities.[129] Without these control mechanisms, the capacity and incentives of CEXs to ensure optimal vetting, thus reducing information asymmetry and information costs, are disputable.

2. *DEXs*

CEXs are not the sole trading venues for digital assets. Instead, they operate in parallel with DLT-enabled, intermediary-less, smart-contract-based, and autonomous mechanisms—DEXs.[130] Do DEXs reduce information costs and verify asset and issuer information better than CEXs do?

On the plus side, DEXs tap the blockchain-based market infrastructure with its promised transparency and public access to the underlying transaction history and code.[131] Many DEXs are automated market makers ("AMM") where buyers and sellers transact against liquidity pools in a decentralized trading environment.[132] A DEX does not have intermediaries but facilitates transactions between users and smart contracts built directly on a blockchain.[133] On AMMs, traders "do not need to be paired to complete a transaction" but "gain immediate access to liquidity by trading against the pooled deposits."[134]

Scholarship points toward the vast economic potential of this intermediary-less, technology-enabled system, including reducing trading costs for investors, increasing trade transparency, and mitigating the risk

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128   *See Coinbase, Inc.*, 2024 WL 1304037, at *4, *6, *26 (describing how Coinbase offers brokerage, trading, and settlement services on its platform and holds its customers' assets in Coinbase-controlled wallets).

129   Various CEXs, however, are registered money transmitters. *See* Guseva & Hutton, *supra* note 2, at 1569 (describing how some crypto assets fall within the ambit of money transmitter regulations).

130   *See supra* notes 61–64 and accompanying text (discussing DEX operations).

131   Dombalagian, *supra* note 47 (manuscript at 15).

132   Jiahua Xu, Krzysztof Paruch, Simon Cousaert & Yebo Feng, *SoK: Decentralized Exchanges (DEX) with Automated Market Maker (AMM) Protocols*, Ass'n for Computing Mach. Computing Survs., Feb. 2023, at 2. Some reports differentiate between DEXs and AMMs, but this Article will use AMMs as the main subtype of DEXs. For different models—e.g., order-book exchanges and AMMs—see, for example Autorité des Marchés Financiers, *supra* note 9, at 13–19; Fin. Stability Bd., The Financial Stability Risks of Decentralised Finance 14 (2023).

133   *See, e.g.*, Harvey et al., *supra* note 22, at 1; Agostino Capponi & Ruizhe Jia, The Adoption of Blockchain-based Decentralized Exchanges 7 (June 1, 2022) (unpublished manuscript) (on file with the author).

134   Capponi & Jia, *supra* note 133, at 2.

of hacking.[135] Yet DEXs largely omit traditional listing review, and even though the code of the DEXs and assets is public, traders may fail to properly price DEX-listed crypto assets and relevant risks. The resulting information costs should remain considerable.

The District Court for the Southern District of New York described these problems in an order on a motion to dismiss a complaint against the developers and investors of Uniswap Lab, a firm developing the code of Uniswap, a major DEX.[136] Uniswap is a large permissionless automated DEX that serves as a gateway for many crypto assets—referred to as "tokens" in the opinion.[137] The version of Uniswap at issue did not require specific issuer information.[138] Using the platform, issuers offered their crypto assets "anonymously, without any sort of conduct verification or background check."[139] Finally, there were only limited options to restrict access to fraudulent assets but not a foolproof route to delist them from the platform, which is based on immutable, autonomous, and decentralized smart contracts.[140]

Traders who transacted with the pools of what the court called "Scam Tokens" apparently lacked the sophistication to understand and price the assets, which were prone to fraud, including "rug pulls," "pump and dump," and Ponzi schemes.[141] These two factors—the inability to understand risks to price the assets and the anonymity of issuers—produced a market failure left unaddressed by the existing legal and blockchain architecture. Judge Failla aptly encapsulated this point as follows: "the identities of the Scam Token issuers are basically unknown and unknowable, leaving Plaintiffs [i.e., individual traders] with an identifiable injury but no identifiable defendant."[142]

3. *Information Costs and Solutions*

Both centralized and decentralized crypto-exchanges may thus raise issuer review and listing quality concerns. Ideally, CEXs could vet issuer

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135   *See, e.g.*, Malinova & Park, *supra* note 48 and accompanying text; *What Is a DEX?*, Coinbase (2024), https://www.coinbase.com/learn/crypto-basics/what-is-a-dex [https://perma.cc/ZN5M-HBER] (listing the benefits and risks of DEXs).

136   *See* Risley v. Universal Navigation Inc., 690 F. Supp. 3d 195, 200 (S.D.N.Y. 2023). In September 2023, a notice of appeal was filed, and the case is currently before the U.S. Court of Appeals for the Second Circuit. Notice of Appeal, Risley v. Universal Navigation Inc., No. 23-1340 (2d Cir. Sept. 28, 2023).

137   *Risley*, 690 F. Supp. at 206.

138   *Id.* at 200, 222 (explaining how the issuers responsible for the fraudulent scheme "are basically unknown and unknowable").

139   *Id.* at 203.

140   *Id.* at 210 (explaining that Uniswap Protocol provides unrestricted access to anyone with Internet connection and cannot fully delist assets).

141   *Id.* at 206–07.

142   *Id.* at 200.

and asset information, while DEXs could rely on blockchain-native solutions. The former, however, may be suboptimal, the latter may be insufficient, and both externalize the resultant costs to investors and the market at large. Neither CEXs nor DEXs follow preset regulatory principles—except for a few registered as broker-dealers[143]—or operate as conventional registered trading venues.

In the United States, pertinent legislative solutions remain unfinished. One germane development was the May 2024 House Bill.[144] The Bill sought to close the regulatory loopholes allowing crypto-exchanges to dispute registration obligations.[145] It introduced a radically improved system under which digital asset platforms would provide trading facilities for the newly defined "digital commodities," i.e., a type of commodities, and "restricted digital assets," i.e., securities.[146] Trading of those assets would take place, respectively, on "digital commodity exchanges" within the jurisdiction of the CFTC and "digital asset trading systems" within the ambit of securities law and the SEC registration authority.[147] A fundamental contribution of the Bill was charging the new registrants with making listing determinations, setting operational and governance standards, and providing customer disclosures.[148]

These provisions aimed at the discussed transaction costs that the unregulated crypto-exchanges currently fail to mitigate. Alas, because the Bill may flounder in the Senate,[149] one can expect that the status quo will endure, and the discussed information costs in digital asset trading will be left unresolved until the political consensus changes.[150]

III.   Trading and Liquidity Provision: Risks and Conflicts

A.   *CEXs, Trading, and Liquidity*

The problem of transaction costs in blockchain-enabled markets is not limited to asset-level and issuer information and its verification by the new intermediaries such as CEXs and DEXs. A set of distinct

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[143]   Several firms have been approved to operate ATS for crypto asset securities. Foye, *supra* note 123.

[144]   Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. (2024).

[145]   *See id.*

[146]   *Id.* §§ 101–104.

[147]   *Id.*

[148]   *See id.* §§ 106–107, 504.

[149]   *See supra* note 25.

[150]   Note that the Bill was only a starting point and incomplete. Being centered on how identifiable parties should register their trading facilities (to wit, CEXs), the House Bill left DEXs in regulatory limbo, instead directing studies of decentralized finance. *See* Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. §§ 106, 107, 403, 504, 605 (2024).

practices entail costs in *secondary* markets for digital assets, and crypto-exchanges form the nexus of these activities.

The fundamental purpose of all trading platforms is to provide liquidity—enabling buyers and sellers to find each other promptly and cost-effectively—and price transparency—providing information to buyers and sellers about market prices—while maintaining fair and efficient markets.[151] Crypto-exchanges simultaneously contrast with legacy exchanges on these metrics and exhibit some similarities in market structure and microstructure.

For instance, both digital assets and securities are traded on multiple trading platforms,[152] but crypto-exchanges are not only numerous but also globally dispersed.[153] As of September 2024, there were nearly 600—often unregistered—crypto-exchanges worldwide listing overlapping crypto assets,[154] sometimes offering derivatives, and competing with one another across borders.[155]

On both legacy and digital asset platforms, traders do not run around trading pits, shouting orders; instead, there is typically an electronic order book of limit orders matched against market orders.[156] Liquidity in these venues is mainly provided by posting limit orders.[157] Legacy exchanges channel broker-dealers toward taking or

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151 *See, e.g.*, Dell'Erba, *supra* note 28 (manuscript at 14) (explaining how traditional stock exchanges provide a platform for issuers to sell stock to buyers and distribute information about stock prices).

152 Today's equity securities are traded on numerous platforms. Merritt B. Fox, Lawrence R. Glosten & Gabriel V. Rauterberg, *The New Stock Market: Sense and Nonsense*, 65 Duke L.J. 191, 198 (2015).

153 *See* Michael Adams & Thanasi Panagiotakopoulos, *Best Crypto Exchanges of September 2024*, Forbes Advisor (Aug. 29, 2024, 1:21 PM), https://www.forbes.com/advisor/investing/cryptocurrency/best-crypto-exchanges/ [https://perma.cc/HE7N-RCJQ]; Top Cryptocurrency Spot Exchanges, CoinMarketCap, https://coinmarketcap.com/rankings/exchanges/ [https://perma.cc/9QE3-TDRN].

154 Adams & Panagiotakopoulos, *supra* note 153.

155 Yadav, *supra* note 58, at 32 (explaining that "[u]sers can easily migrate to other venues").

156 *See, e.g.*, Further Definition of "As a Part of a Regular Business" in the Definition of Dealer and Government Securities Dealer, 87 Fed. Reg. 23,054, 23,055–56 (Apr. 18, 2022) (to be codified 17 C.F.R. pt. 240).

> The rise of electronic trading has similarly impacted the market structure of the securities markets generally. . . . [T]echnological advances have enabled significant market participants to take on an increasingly central role as liquidity providers, largely replacing more traditional types of traditional liquidity providers, such as exchange specialists on manual trading floors and over-the-counter ("OTC") market makers. Technological advancements have prompted changes to trading practices, particularly with regard to the way in which orders are generated, routed, and executed.

Id. (footnote omitted). For a list of cryptomarket makers, see PR Newswire, *Top 10 Crypto Market Makers in 2023*, Yahoo! Fin. (June 27, 2023), https://finance.yahoo.com/news/top-10-crypto-market-makers-120500811.html?guccounter=1 [https://perma.cc/46FX-MGJ4].

157 Fox et al., *supra* note 152, at 206. A market maker "makes money if on average it sells the shares it buys for more than the price paid." *Id.*

making liquidity through fees and rebates.[158] In a similar vein, individual crypto-exchanges have introduced liquidity programs rewarding market takers and makers.[159]

After that point, practices diverge on price transparency and reporting. In legacy securities markets, matched and executed trades are reported to a security information processor,[160] and intermediaries have specific obligations to improve pretrade and post-trade transparency, price discovery, and public information dissemination.[161] Crypto-exchanges, at least to date,[162] are not bound by these trade posting and information dissemination rules[163] and are domiciled in various jurisdictions with different legal requirements (or no regulation).[164]

Scholarship warns that price transparency may be lacking in digital asset trading[165] and that international competition may introduce incentives to manipulate information and cook CEXs' books.[166] Within the global, fragmented, but interconnected, digital asset market, trading activity on large (and potentially unregulated) foreign exchanges may affect price discovery in U.S. markets.[167]

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[158]   *See id.* at 256–58.

[159]   *See, e.g.*, *Liquidity Program Overview*, Coinbase (Sept. 1, 2024), https://www.coinbase.com/exchange/liquidity-program [https://perma.cc/3P72-K8VC] (describing Coinbase's Liquidity Program, which grants special benefits to clients that provide liquidity).

[160]   *See* Fox et al., *supra* note 152, at 215–16, 269–70.

[161]   *See* Regulation NMS, 70 Fed. Reg. 37496, 37496 (June 29, 2005) (codified at 17 C.F.R. pts. 200, 201, 230, 240, 242, 249, 270) (mandating, among other requirements, that trading centers make price quotations accessible and set price transparency standards); *see also* Disclosure of Order Execution Information, 88 Fed. Reg. 3786, 3786 (Jan. 20, 2023) (to be codified at 17 C.F.R. pt. 242) (proposing rules to update disclosure requirements for national market system stocks); 17 C.F.R. § 242.603 (2023) (establishing rules for dissemination, distribution, and display of information by intermediaries and exchanges).

[162]   Note that the May 2024 House Bill covers order display and transaction reporting rules for digital asset trading systems and provides that digital commodity exchanges must comply with the core principles, which include trade processing and providing open and efficient market protecting price discovery. Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. §§ 404, 504 (2024).

[163]   Crypto-exchanges may "volunteer only such data as is cheap to collect [or] provides basic insights." Yadav, *supra* note 58, at 45. They also have some pretrade transparency. *See* Agostino Capponi, Ruizhe Jia & Shihao Yu, Price Discovery on Decentralized Exchanges, SSRN 6 (Nov. 3, 2023), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4236993 [https://perma.cc/BZ7W-JNAY].

[164]   *See supra* notes 88–90 and accompanying text.

[165]   *See, e.g.*, Syren Johnstone, *Secondary Markets in Digital Assets: Rethinking Regulatory Policy in Centralized and Decentralized Environments*, 3 Stan. J. Blockchain L. & Pol'y 146, 149–50 (2020).

[166]   Dan Amiram, Evgeny Lyandres & Daniel Rabetti, Cooking the Order Books: Information Manipulation and Competition Among Crypto Exchanges 25 (Nov. 28, 2022) (unpublished manuscript) (on file with author).

[167]   *See* Carol Alexander, Jaehyuk Choi, Hamish R.A. Massie & Sungbin Sohn, *Price Discovery and Microstructure in Ether Spot and Derivative Markets*, Int'l Rev. Fin. Analysis, Oct. 2020, at 1,

The other set of differences stems from the regulatory requirement that legacy exchanges implement operational, fraud and manipulation prevention, risk management, and other standards.[168] To create a fair and efficient trading environment, the Commissions mandate that exchanges have operational resiliency and ensure a well-regulated market.[169] Conversely, CEXs do not face these guardrails.[170] Over the years, various CEXs have exhibited insufficient operational resilience, poor risk management, low quality of governance, and manipulative practices such as wash trading, which undermine transparent, fair, and efficient markets.[171]

Another set of parallels and distinctions concerns liquidity providers. Much of liquidity in legacy trading, and some in digital asset trading, comes from a special type of trader—the high-frequency trader ("HFT"), who attempts to beat the market and "compete to post limit orders on venues against which marketable orders can transact."[172] These liquidity providers play against informed traders and try to identify them in "the adverse-selection-driven cat-and-mouse game between liquidity suppliers and informed traders."[173] In 2024, the SEC expanded the statutory definition of "dealer" to encompass HFTs as liquidity providers.[174]

The rise of HFTs in legacy trading roughly coincided with dark pools, which emerged "to provide a venue where uninformed buyers and sellers, seeking to trade substantial amounts of stock, can minimize the movement of prices against them and transact at prices potentially much better than the [national best bid and offer, i.e., the best quotes

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2–4, 16 (describing how trading on unregulated foreign exchanges, including trading of derivatives, may dominate spot markets trading and price discovery, including U.S. exchanges such as Coinbase and Kraken).

[168] *See generally* Yadav, *supra* note 58 (describing the role of legacy exchanges in providing oversight in securities trading and arguing that crypto-exchanges could play a similar role).

[169] *See generally id.*

[170] The possibly doomed May 2024 House Bill offers some governance, conflict of interest, operational, and capital requirements. *See* Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. §§ 106, 107, 403, 404, 407, 504 (2024); *supra* note 25.

[171] *See, e.g.*, Kristin N. Johnson, *Decentralized Finance: Regulating Cryptocurrency Exchanges*, 62 Wm. & Mary L. Rev. 1911, 1954, 1972 (2021); Att'y Gen.'s Cyber Digit. Task Force, U.S. Dep't of Just., Cryptocurrency: Enforcement Framework 5–6, 13–16 (2020), https://www.justice.gov/archives/ag/page/file/1326061/download [https://perma.cc/D6NN-HGNG]; Bd. of Int'l Org. Sec. Comm'ns, Policy Recommendations for Crypto and Digital Asset Markets: Final Report 39–40, 49–50 (2023), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD747.pdf [https://perma.cc/BZQ5-ZP84]; Lin William Cong, Xi Li, Ke Tang & Yang Yang, *Crypto Wash Trading*, 69 Mgmt. Sci. 6427, 6427–28 (2023).

[172] Fox et al., *supra* note 152, at 206.

[173] *Id.* at 207.

[174] *See* Further Definition of "As a Part of a Regular Business" in the Definition of Dealer and Government Securities Dealer in Connection with Certain Liquidity Providers, 89 Fed. Reg. 14938, 14970 (Feb. 29, 2024) (to be codified at 17 C.F.R. pt. 240).

based on the national reporting system].”[175] Dark pools, registered as ATSs with the SEC, do not disclose orders and may restrict which parties have access to trading.[176] The order book of dark pools is not public, enabling large orders to be executed without producing a significant price impact.[177]

Dark pools and HFTs demonstrate another parallel and appear largely for the same reasons in crypto asset trading: like in other markets, sizeable orders and block trades should impact prices of digital assets, but investors may want orders posted and matched without causing a major price change.[178] Naturally, the new CEXs followed in the footsteps of the legacy market and began experimenting with dark venues.[179] Next, actively competing HFTs have entered CEXs,[180] which encourage these liquidity suppliers.[181] But unlike legacy trading, a comprehensive regulatory structure for these dark venues and HFTs is absent in the digital asset space.

These realities evince the main concerns raised earlier in this Article: If CEX trading does not run on blockchains, is not controlled through blockchain-native methods, and is not handled through regulation, why shall the CEXs be trusted with optimally reducing the costs of trading, overseeing market participants, and ensuring transparency and information provision?[182] As such, the current system is built on trust in private firms located both in the United States and abroad, largely unregulated, competing with one another and listing identical digital assets. It is unclear, at best, if these firms have sufficient incentives to maintain fair and efficient markets without better regulation, technology-enabled or otherwise.

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[175]   Fox et al., *supra* note 152, at 251.

[176]   For an in-depth analysis of off-exchange trading and transparency of dark pools, *see* Kevin S. Haeberle, *Discrimination Platforms*, 42 J. Corp. L. 809, 820–24 (2017).

[177]   Fox et al., *supra* note 152, at 250–52.

[178]   *See id.* at 251.

[179]   *See Cryptocurrency Dark Pool*, LCX (May 23, 2022), https://www.lcx.com/cryptocurrency-dark-pool/ [https://perma.cc/H55A-89FG]; *A Simple Introduction to Dark Pools*, Binance Acad. (Oct. 13, 2023), https://academy.binance.com/en/articles/a-simple-introduction-to-dark-pools [https://perma.cc/28PQ-YD7Z].

[180]   *See, e.g.*, Johnson, *supra* note 171, at 1966–67; Capponi et al., *supra* note 163, at 6. On DEXs, HFTs are different, however. *See generally* Philip Daian, Steven Goldfeder, Tyler Kell, Yunqi Li, Xueyuan Zhao, Iddo Bentov, Lorenz Breidenbach & Ari Juels, *Flash Boys 2.0: Frontrunning in Decentralized Exchanges, Miner Extractable Value, and Consensus Instability*, 2020 Inst. Elec. & Elecs. Eng'rs Symp. Sec. & Priv. 910, 910 (discussing how arbitrage bots on DEXs act similarly to HFT in legacy markets).

[181]   *See, e.g.*, Johnson, *supra* note 171, at 1966–67; *What Do Crypto Liquidity Providers Do?*, Binance (July 5, 2023), https://www.binance.com/en/blog/vip/what-do-crypto-liquidity-providers-do-3303284536918508301 [https://perma.cc/S29B-PFLB] (explaining how liquidity suppliers buy and sell cryptocurrency to ensure that the market remains liquid).

[182]   The other source of incentives is industry self-regulation, which this Article discusses *infra* Parts IV–VI.

B. *Multifunctional CEXs: Brokers, Trading Platforms, and Clearinghouses*

To better illustrate this problem, let us examine the uniquely multifunctional nature of CEXs, which combine trading facilities with brokerage services. Unlike digital asset trades, legacy securities and commodities trading is run through brokerages—and future commission merchants ("FCM") and other intermediaries in derivatives markets.[183] They either internalize trades (execute them from their inventory), sell them to wholesalers (the practice known under the sobriquet of "payment for order flow"),[184] or route them to trading venues.[185] The brokers, of course, know their customers and the customers' trades and can exploit this information. For this reason, regulations create institutional safeguards against these conflicts.

For instance, brokers have a duty to ensure best execution of orders and must comply with the rules on suitability—as modified by Regulation Best Interest[186]—of securities and derivatives.[187] These rules aim to protect investors by, inter alia, requiring that intermediaries understand the risks and customers' investment profiles and that customers' orders be executed on the best available terms under prevailing market conditions.[188] Brokers and FCMs also comply with

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[183] *See, e.g.*, 15 U.S.C. § 78f(c); 7 U.S.C. § 1a(28), (34); *id.* §§ 6, 7(d)(15).

[184] Payment for order flow ("PFOF") is "a wide variety of cash or in-kind compensation structures that a broker may receive for directing its customers' orders to a particular broker-dealer or trading venue." Memorandum from SEC Div. Trading & Mkts. to Equity Mkt. Structure Advisory Comm. 4–5 (Jan. 26, 2016), https://www.sec.gov/spotlight/equity-market-structure/issues-affecting-customers-emsac-012616.pdf [https://perma.cc/J454-8S4E]; *see also* Tomio Geron, *Regulators Are Going After Payments for Stock Orders. What About Crypto?*, Protocol (Sept. 16, 2021), https://www.protocol.com/crypto-trading-pfof-robinhood [https://perma.cc/7CY7-3JTD]. PFOF may be coming to crypto. Tracy Wang, *DeFi Protocol DFlow Raises $5.5M to Bring Payment for Order Flow to Crypto*, CoinDesk (May 9, 2023, 12:13 AM), https://www.coindesk.com/business/2023/04/25/defi-protocol-dflow-raises-55m-to-bring-purchase-order-flow-to-crypto/ [https://perma.cc/XC48-3XWQ].

[185] Memorandum from SEC Div. Trading & Mkts., *supra* note 184, at 6.

[186] 17 C.F.R. § 240.15l-1 (2023).

[187] *5310. Best Execution and Interpositioning*, FINRA [hereinafter *5310*, FINRA], https://www.finra.org/rules-guidance/rulebooks/finra-rules/5310 [https://perma.cc/D729-CBNC]; *5320. Prohibition Against Trading Ahead of Customer Orders*, FINRA [hereinafter *5320*, FINRA], https://www.finra.org/rules-guidance/rulebooks/finra-rules/5320 [https://perma.cc/YY98-HUD4]; *Compliance Rules*, NFA, https://www.nfa.futures.org/rulebooksql/rules.aspx?Section=4 [https://perma.cc/8X8E-GWJK]. The SEC has proposed rules to improve execution and transparency. *See* Regulation Best Execution, 88 Fed. Reg. 5440 (Jan. 27, 2023) (to be codified at 17 C.F.R. pts. 240, 242); Disclosure of Order Execution Information, 88 Fed. Reg. 3786 (Jan. 20, 2023) (to be codified at 17 C.F.R. pt. 242).

[188] *See, e.g.*, Press Release, FINRA, FINRA Amends Its Suitability, Non-Cash Compensation and Capital Acquisition Broker (CAB) Rules in Response to Regulation Best Interest (June 19, 2020), https://www.finra.org/rules-guidance/notices/20-18 [https://perma.cc/9UHA-8MHJ]

disclosure, net capital, and other obligations ensuring their safety.[189] There is also the SEC Order Protection Rule, which prohibits "trade-throughs" at inferior prices.[190] FINRA, NFA, and exchanges enforce compliance of their members and have detailed rule books promoting fair dealing, equitable principles of trade, and investor protection.[191] In short, broker-dealer obligations are voluminous and bolstered by SRO oversight.

In contrast, investors access crypto-exchanges directly.[192] On CEXs such as Binance or Coinbase, an investor would typically open a custodial "wallet" (account) with the exchange and trade by submitting orders to the exchange.[193] The trades would be matched, cleared, and settled by the CEX itself.[194] In addition, CEXs may also provide margin lending and even stake deposited assets on behalf of users.[195] Despite this variety of services, CEXs are registered neither as broker-dealers—with a few exceptions—nor exchanges, suggesting that many do not need to follow the relevant obligations of legacy intermediaries.[196]

Some CEXs signal their better quality by offering products that ensure better order execution, connecting their clients to several venues via smart contracts, and aggregating liquidity.[197] In other words, CEXs may offer services similar to best execution and other broker duties, but they do so based on *contractual* agreements and voluntary rule books. This trading system emphasizes contractual cooperation and voluntary compliance.

Cooperation, however, routinely fails when profits from misbehavior and defection from cooperation are guaranteed, whereas the risk of detection and ensuing legal or reputational sanctions are

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(addressing compliance with Regulation Best Interest and Rule 2111's suitability standard); *5310*, FINRA, *supra* note 187.

[189] *See* 17 C.F.R. §§ 240.15c3-1, 240.15l-1(a)(2), 1.17, 1.55 (2023); *Guide to Broker-Dealer Registration*, SEC (Apr. 2008), https://www.sec.gov/about/reports-publications/investor-publications/guide-broker-dealer-registration [https://perma.cc/EL6F-2VWQ]; CFTC, *supra* note 16.

[190] 17 C.F.R. § 242.611 (2023).

[191] *See* Yadav, *supra* note 58, at 15–16; 15 U.S.C. § 78f(b).

[192] *Compare* Johnstone, *supra* note 165, at 180 (explaining how investors deal directly with crypto-exchanges), *with* 15 U.S.C. § 78f(b)(2) (providing that registered brokers or dealers may be members of an exchange).

[193] Yadav, *supra* note 58, at 40. Exchanges also offer self-custodial wallets. *See, e.g.*, SEC v. Coinbase, Inc., No. 1:23-cv-4738, 2024 WL 1304037, at *5, *33 (S.D.N.Y. Mar. 27, 2024).

[194] *E.g.*, *Coinbase, Inc.*, 2024 WL 1304037, at *26.

[195] Yadav, *supra* note 58, at 33, 42.

[196] *See Coinbase, Inc.*, 2024 WL 1304037, at *1 (considering if the SEC adequately alleged that Coinbase, a CEX, operated as an unregistered securities exchange, broker, or clearing agency).

[197] *See, e.g.*, PwC, Crypto Trading Report 16 (2022); *Binance Spot Launches "Smart Order Routing (SOR)" Experimental Trading Feature for API Users*, Binance Square (Sept. 13, 2023), https://www.binance.com/en-NG/feed/post/1137112 [https://perma.cc/KG4Z-BW5B]; *Coinbase, Inc.*, 2024 WL 1304037, at *5, *35; Jeff Curry, *Maintaining a Real-Time Order Book Using the Coinbase Prime API*, Coinbase (May 1, 2023), https://www.coinbase.com/blog/maintaining-a-real-time-order-book-using-the-coinbase-prime-api [https://perma.cc/UN8D-JLSJ].

uncertain. Not surprisingly, manipulation and conflicts of interest have been notorious in digital asset markets.[198] Crypto-exchanges have engaged in proprietary trading and operated as unregulated market makers either directly or through affiliated entities.[199] While market making, some CEXs selected assets for listing and invested in them,[200] a scenario uniquely synthesizing conflicts of interest, agency costs, and information asymmetry. Studies indicate that considerable insider trading activity may take place before listing announcements.[201]

The multifunctional nature and combinative business model of unregulated crypto-exchanges may enable them to earn trading profits and beat uninformed outsiders, ultimately raising trading costs.[202] By contrast, born out of the necessity for cooperation among professional broker-dealers, centuries-old trading platforms are just that—trading venues with self-regulatory responsibilities.[203]

Finally, distinct risks and benefits emerge in trade settlement. In conventional markets, after a legacy asset trade is matched on an exchange, the next step is its clearance and settlement, which are run through registered clearinghouses where the trade settles over a number of days.[204] Over time, several leading clearinghouses have nearly monopolized post-trade operations in the United States.[205]

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198   *See* Yadav, *supra* note 58, at 35, 54; Andrew Verstein, *Crypto Assets and Insider Trading Law's Domain*, 105 Iowa L. Rev. 1, 29–30 (2019); Felix Eigelshoven, André Ullrich & Douglas Parry, *Cryptocurrency Market Manipulation: A Systematic Literature Review*, 42 Int'l Conf. on Info Sys., 1, 4–11 (2021).

199   Yadav, *supra* note 58, at 35.

200   *See* Werbach, *supra* note 19, at 1261.

201   *See generally* Ester Félez-Viñas, Luke Johnson & Tālis J. Putniņš, Insider Trading in Cryptocurrency Markets (June 11, 2024) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4184367 [https://perma.cc/AU6A-R6DA].

202   *See, e.g.*, Verstein, *supra* note 198, at 54–55; Yadav, *supra* note 58, at 36.

203   *See, e.g.*, Donna M. Nagy, *Playing Peekaboo with Constitutional Law: The PCAOB and Its Public/Private Status*, 80 Notre Dame L. Rev. 975, 1023 (2005).

> [T]he NYSE's history is particularly rich, dating back to 1792, when, according to the lore, twenty-four brokers signed an agreement under a buttonwood tree located at what is now 68 Wall Street. The NYSE took its self-regulatory responsibilities seriously . . . . [T]he Exchange Act, and particularly its 1975 amendments, evidence an undeniable respect for the NYSE's self-regulatory authority.

Id. (footnotes omitted).

204   For a description of the U.S. securities clearing industry, its history, and regulations, see *A Guide to Clearance & Settlement*, Depository Tr. & Clearing Corp. (2021), https://www.dtcc.com/clearance-settlement-guide/#/dashboard/1 [https://perma.cc/CA2Y-MKLX]. Derivatives clearing differs from spot market clearing. *See, e.g.*, *Clearing Organizations*, CFTC, https://www.cftc.gov/IndustryOversight/ClearingOrganizations/index.htm [https://perma.cc/HML9-TDKN]; *What Is Clearing?*, CME Grp., https://www.cmegroup.com/education/courses/clearing/what-is-clearing.html [https://perma.cc/9SJA-8JB6].

205   This has possibly happened without any congressional intent to centralize settlement and clearing. *See, e.g.*, Dan Awrey & Joshua C. Macey, *Open Access, Interoperability, and DTCC's Unexpected Path to Monopoly*, 132 Yale L.J. 96, 106–08 (2022) (suggesting that Congress and regulators

Compare this with crypto asset trades, which often settle directly on the multiple CEXs' internal ledgers, with totals recorded thereafter in omnibus wallets on a blockchain.[206] These nearly instantaneous post-trade operations enable traders to receive access to their assets much faster than in legacy markets, producing substantial savings and efficiencies.[207] Acknowledging this potential, experiments with multifunctional digital asset entities are afoot in foreign countries.[208]

Yet, despite these potential efficiencies, the unregulated multifunctional CEX model can generate concurrent risks. For instance, because CEXs are custodial, their customers, self-evidently, are exposed to custody risk, including the risk of comingling customer assets with exchange assets.[209] These problems may affect trade clearing and settlement and typically should be controlled through thoughtful regulation, which does not seem to be forthcoming.[210]

C.   *DEXs: Blockchain-Native Solutions and Risks*

Ideally, a future regulatory framework should address the risks of not only CEXs but also DEXs because trading on CEXs may affect DEXs—and vice versa—as their trading activity and liquidity interact.[211] DEXs may avoid the previously discussed quagmire of conflicts of interest, agency costs, custodial risks, and adverse selection but have sui generis problems.

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intended to enhance competition); Yuliya Guseva, *Destructive Collectivism: Dodd-Frank Coordination and Clearinghouses*, 37 Cardozo L. Rev. 1693, 1722–30 (2016) (discussing the history of the clearing industry).

206   *E.g.*, SEC v. Coinbase, Inc., No. 1:23-cv-4738, 2024 WL 1304037, at *26 (S.D.N.Y. Mar. 27, 2024).

207   George S. Geis, *The Historical Context of Stock Settlement and Blockchain*, 26 Chap. L. Rev. 557, 564, 572, 592–95 (2023) (discussing the pros and cons of blockchain-enabled settlement).

208   *See, e.g.*, Bank of Eng., Digital Securities Sandbox Joint Bank of England and FCA Consultation Paper 14–43 (2024), https://www.bankofengland.co.uk/-/media/boe/files/paper/2024/digital-securities-sandbox-joint-bank-of-england-and-fca-consultation-paper.pdf [https://perma.cc/ZR3P-CZCP] (detailing a regime that will allow firms to use DLT to issue and trade securities and to settle securities transactions).

209   *See* Adam J. Levitin, *Not Your Keys, Not Your Coins: Unpriced Credit Risk in Cryptocurrency*, 101 Tex. L. Rev. 877, 892–96 (2023).

210   The May 2024 House Bill, for example, made considerable strides toward advancing pertinent standards for CEXs, including creating new categories of digital asset and digital commodity brokers and dealers, setting principles for customer fund segregation, mandating conflict-of-interest systems, prohibiting exchanges from trading from their own account, and many others. Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. §§ 403–407, 504–506 (2024).

211   Jun Aoyagi & Yuki Ito, *Coexisting Exchange Platforms: Limit Order Books and Automated Market Makers*, SSRN 31 (Jan. 11, 2023), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3808755 [https://perma.cc/N7AU-BJJQ].

On the positive side, all orders and transactions on DEXs are transparent and public.[212] Major DEXs (primarily AMMs[213]) do not even have a limit order book.[214] They enable participants to "list" assets by opening liquidity pools with asset pairs against which any person with a blockchain identity can trade, and every order is executed against the pool.[215] The assets are priced in relation to each other by an encoded algorithm.[216] Participants called "liquidity providers" add assets into pools.[217] Traders then transact against the liquidity pools by sending "the asset they wish to trade into the core contract before calling the 'swap' function that . . . swap[s] their token for the other token in the pool."[218] The core contract tells the traders the exchange rate so that the trader can decide whether to proceed with the transaction.[219]

Because traders, whether retail or institutional, sell and buy assets from the pools directly, they bypass any centralized intermediaries and do not surrender custody of their assets.[220] In sum, this system gives retail and institutional investors direct access to trading, avoiding any third-party off-chain intermediaries and reducing the risk of commingling their assets with those of other traders, broker-dealers, or the exchange. Self-evidently, these features of DEXs help avoid the discussed pitfalls of CEXs.

Researchers argue that DEX design may also reduce trading costs, increase price transparency, reduce custodial risk, and ensure simultaneous settlement and execution.[221] In expectation, traders and liquidity

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212   Mohsen Pourpouneh, Kurt Nielsen & Omri Ross, *Automated Market Makers* 2 (Dep't of Food & Res. Econ. (IFRO), Working Paper No. 08, 2020) (explaining that DEXs are transparent, allow users to maintain custody of their assets, and lack a single point of failure).

213   *See supra* note 132.

214   *See* Aoyagi & Ito, *supra* note 211, at 2 (comparing CEXs, which use limit order books, with AMMs, which do not).

215   *Id.* at 3.

216   A standard formula is $K(\text{Invariant})=x(\text{Asset 1})*y(\text{Asset 2})$. *See How Uniswap Works*, Uniswap Docs, https://docs.uniswap.org/contracts/v2/concepts/protocol-overview/how-uniswap-works [https://perma.cc/N5P6-AWDJ].

217   Aoyagi & Ito, *supra* note 211, at 3.

218   Risley v. Universal Navigation Inc., 690 F. Supp. 3d 195, 204 (S.D.N.Y. 2023).

219   *Id.*

220   *See generally* Harvey et al., *supra* note 22 (providing a comprehensive overview of DEX AMM design and operations). *See also* Bruno Biais, Agostino Capponi, Lin William Cong, Vishal Gaur & Kay Giesecke, *Advances in Blockchain and Crypto Economics*, 69 Mgmt. Sci. 6417, 6421 (2023) (discussing the literature on overcoming moral hazard in decentralized trading platforms); Pourpouneh et al., *supra* note 212, at 2 (summarizing the noncustodial nature and transparency of DEXs); Dombalagian, *supra* note 47 (manuscript at 15) (discussing DEXs, CEXs, and asset custody).

221   Pourpouneh et al., *supra* note 212; Andrea Barbon & Angelo Ranaldo, On the Quality of Cryptocurrency Markets: Centralized Versus Decentralized Exchanges 3 (Nov. 2023) (unpublished manuscript) (on file with author); Agostino Capponi, Nathan Kaplan & Asani Sarkar, *Can Decentralized Finance Provide More Protection for Crypto Investors?*, Liberty St. Econ.

providers could benefit from the cost-efficiency and transparency of blockchains: they could make their own trading decisions so long as a protocol operated as promised.

In addition, technology may help traders achieve best execution and circumnavigate the need for brokers and associated regulation. For example, blockchain-enabled markets experiment with "aggregators"[222] and interexchange routing mechanisms, including "smart order routing" ("a type of trading where an algorithm determines the best price for the requested transaction"),[223] to maximize traders' return.

On the flip side, researchers point out a panoply of problems, warning that AMMs are imperfect,[224] have comparatively fragmented liquidity,[225] generate losses from inefficient prices,[226] and may distort price formation by referencing external data sources ("oracles"), which may be compromised.[227] Separately, DEXs expose traders to the risks of fraud and mistakes in an environment in which erroneous or fraudulent interactions with smart contracts powering DEXs are irreversible.[228]

Perhaps the most fundamental challenge of DEX design is ensuring cost-effective liquidity provision. DEX order execution on blockchain "naturally deter[s] a speed-centric competitive environment[] . . . "of HFT, i.e., important professional liquidity suppliers in legacy markets and CEXs.[229] Instead, liquidity is provided in a way described earlier—by participants depositing assets into pools.[230] DEX protocols incentivize this activity by distributing fees to liquidity suppliers.[231]

This "democratized" liquidity provision is marked by several structural flaws. First, because liquidity supply does not depend on

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(Dec. 21, 2022), https://libertystreeteconomics.newyorkfed.org/2022/12/can-decentralized-finance-provide-more-protection-for-crypto-investors/ [https://perma.cc/C6ZM-AZTA].

222 *Fundamentals: What Is a DEX Aggregator?*, 0x (Apr. 19, 2023), https://0x.org/post/what-is-a-dex-aggregator [https://perma.cc/N4D9-WDFV].

223 PwC, *supra* note 197, at 16.

224 *See infra* notes 232–50 and accompanying text.

225 Alfred Lehar, Christine A. Parlour & Marius Zoican, *Fragmentation and Optimal Liquidity Supply on Decentralized Exchanges*, SSRN 3 (Feb. 13, 2024), https://ssrn.com/abstract=4267429 [https://perma.cc/CR7U-L2ZA]; Capponi et al., *supra* note 163, at 6 n.5 ("Traders' pending orders are fragmented across different private pools . . . .").

226 Pourpouneh et al., *supra* note 212, at 3.

227 "An oracle connects a smart contract to off-chain data that may be an input for that smart contract's functionality." Bd. Int'l Org. Sec. Comm'ns, IOSCO Decentralized Finance Report 8, 13 (2022), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD699.pdf [https://perma.cc/2Y7C-XWLC]. On oracles' vulnerabilities, see *id.* at 40.

228 Traders may not be able to fix mistakes after a transaction has been executed and recorded, even in cases of fraud. *See, e.g.*, *Introduction to Smart Contracts*, Ethereum (Apr. 22, 2024), https://ethereum.org/en/developers/docs/smart-contracts/ [https://perma.cc/7UQD-H6AZ]; Int'l Org. Sec. Comm'ns, *supra* note 227, at 36–40 (summarizing the risks of decentralized finance).

229 Capponi et al., *supra* note 163, at 6.

230 *See supra* notes 212–20 and accompanying text.

231 Risley v. Universal Navigation Inc., 690 F. Supp. 3d 195, 204–05 (S.D.N.Y. 2023).

professionals such as market makers or HFT, it may be drained as protocol participants exit or submit large trades, which incidentally also causes price slippage—a change between the initial market price and the actual trade price.[232] Second, liquidity costs are uniquely affected by arbitrage and informed trading. Third, blockchain-specific front-running activities inhere in DEX trading.

Starting with arbitrage, normal arbitrage activities "do not consume any real resources, have positive economic-welfare effects," and equilibrate prices in different markets.[233] But DEX scholarship warns that "arbitrage problems can arise . . . even without any asymmetric information on fundamentals, because arbitrageurs can exploit liquidity providers even on public information."[234] Because AMMs set prices based on asset holdings within liquidity pools, arbitrageurs can trade those assets at off-market prices, causing losses to liquidity suppliers who provide assets to the pools.[235] In an extreme scenario, by shrinking the profits of liquidity suppliers, new arbitrage strategies may lead to a "liquidity freeze"—i.e., a situation when liquidity providers do not deposit assets into trading protocols—which impedes trading.[236]

The other phenomena are a distinct order execution, front-running, and trading on private information. In DEXs, posted trades are publicly visible and on-chain execution and settlement are slightly delayed.[237] All trades are publicly submitted, then processed over a definable time, and finally settled on-chain.[238] To beat the market, professional arbitrageurs and informed traders armed with private material information can openly pay higher fees to get their orders executed promptly and bid up the fees for transaction execution, willingly divulging their trades to discourage competing trades and ensure faster trade execution.[239] In contradistinction to legacy markets, these activities, including trading on private inside information, are largely unregulated.

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232 *See, e.g.*, AUTORITÉ DES MARCHÉS FINANCIERS, *supra* note 9, at 19 (discussing slippage); Xu et al., *supra* note 132, at 5.

233 Fox et al., *supra* note 152, at 241.

234 Capponi & Jia, *supra* note 133, at 5.

235 HARVEY ET AL., *supra* note 22, at 2–3.

236 Capponi & Jia, *supra* note 133, at 3, 5. This problem is overlayed on top of "excessive leverage due to the repeated use of the same collateral for borrowing and lending." Capponi et al., *supra* note 221.

237 *See* AUTORITÉ DES MARCHÉS FINANCIERS, *supra* note 9, at 19 (explaining how DEXs are vulnerable to price manipulation because a transaction order becomes public before the settlement occurs, giving time for other participants to place their own trades before the settlement); Johnson, *supra* note 171, at 1967–70 (explaining how HFTs can manipulate prices by placing orders immediately before—and also immediately after—a transaction goes through).

238 *See, e.g.*, Risley v. Universal Navigation Inc., 690 F. Supp. 3d 195, 207–08 (S.D.N.Y. 2023) (explaining how traders can access the Protocol and that the execution and settlement of all trades through Uniswap, a DEX, occur entirely on the Ethereum blockchain).

239 Capponi et al., *supra* note 163, at 2, 35.

Next, blockchain-native intermediaries, including "validators"[240] and "block builders,"[241] may earn a substantial abnormal profit from the same features of DEX design. These blockchain-native parties may change order execution while putting together blocks to be added to the blockchain to finalize transaction settlement.[242] Similar to the legacy intermediaries, such as brokers in legacy markets, block builders and validators can front-run or back-run transacting parties (a "sandwich attack") and reorder submitted transactions to their benefit.[243] Submitted trades, particularly large ones, make attractive front-running targets.[244] Unlike broker-dealers who are prohibited from engaging in front-running—i.e., having received an order, a broker-dealer cannot extract profit from this information by trading ahead of a customer[245]— the blockchain-native parties are entirely unregulated.

As profit maximizers, they naturally tend to pursue higher returns, which may be at the expense of digital asset traders and the integrity of blockchain-enabled ecosystems.[246] These "perks" that validators or block builders opportunistically seek to achieve are called "maximal

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240 For background, validators secure blockchains and record transactions. *See* SEC v. Coinbase, Inc., No. 1:23-cv-4738, 2024 WL 1304037, at *27–28 (S.D.N.Y. Mar. 27, 2024). They verify transactions submitted by users, propose to add them to the ledger, and receive rewards for adding blocks of transactions, resulting in transaction finality and settlement. *See id.* On the relevant changes in the Ethereum protocol, see, for example, Mason Marcobello, *What Is the Ethereum Merge?*, Coindesk, https://www.coindesk.com/learn/what-is-the-merge-and-why-has-it-taken-so-long/ [https://perma.cc/R5DM-AJHY].

241 Block builders and block proposers are essentially the new types of intermediaries that emerged when Ethereum switched from the Proof of Work to the Proof of Stake protocol. *See, e.g.*, *What is Proposer/Builder Separation on Ethereum?*, Blocknative (Oct. 24, 2022), https://www.blocknative.com/blog/proposer-builder-separation-ethereum [https://perma.cc/5JHC-SMAU] ("Block proposal is the action of submitting a block of transactions for the approval of network validators, while block building is the action of transaction ordering.").

242 *See, e.g.*, *id.*

243 *See* Mikolaj Barczentewicz, Int'l Ctr. for L. & Econ., MEV on Ethereum: A Policy Analysis 4–8 (2023).

244 *See, e.g.*, Sirio Aramonte, Wenqian Huang & Andreas Schrimpf, *DeFi Risks and the Decentralisation Illusion*, Bank for Int'l Settlements Q. Rev., Dec. 2021, at 21, 35 ("When submitting orders, liquidity-takers are uncertain about the timing of their orders' execution and the execution prices, as these depend on the execution sequence. Importantly, the order quantities become public knowledge *before* their price impact has materialised—which is easily predictable from the bonding curve. . . . [T]he bonding curve implies that the malicious trader's sell order will be executed at a higher price than his buy order, thus generating a profit. Such front-running behaviour is particularly attractive to large validators because they have a higher chance to 'win' the next block and time their front-running trades optimally.").

245 Legacy broker-dealers are prohibited from front-running customer orders. *See 5310*, FINRA, *supra* note 187 (requiring FINRA members to use "reasonable diligence" to ensure that the "price to the customer is as favorable as possible" and addressing interpositioning); *5320*, FINRA, *supra* note 187.

246 For instance, validators may restrict supply of their services to sustain the congestion of blockchains and receive higher transaction fees from users. Bank for Int'l Settlements, The

extractable value" ("MEV").[247] They may be illegal in financial markets when broker-dealers are involved, but in blockchain-enabled transactions, these opportunistic activities are curbed primarily through protocol and application design.[248] The effectiveness of those projects, however, remains debatable.[249]

In general, extracting value from liquidity providers and traders seems to function as a feature, not a bug, of much of blockchain-enabled DEX trading.[250] DEXs may seemingly offer the same functions as legacy trading systems or CEXs but approach them differently, creating and managing risks and costs in novel ways. As a result, some standard regulatory principles may not transfer well to the DEX world.

IV. Voluntary Standards

Up to this Part, this Article has explored the unresolved and unregulated risks, conflicts, and costs of the new digital asset intermediaries. This

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Crypto Ecosystem: Key Elements and Risks 5–7 (2023), https://www.bis.org/publ/othp72.pdf [https://perma.cc/G58U-8GHX].

247 "Validators' ability to arbitrarily include, exclude, or re-order transactions within the blocks they produce (so called maximal extractable value—MEV) can lead to profits for them and losses to parties involved in the crypto-asset transfers." Fin. Stability Bd. & Int'l Monetary Fund, IMF-FSB Synthesis Paper: Policies for Crypto-Assets 15 (2023), https://www.fsb.org/wp-content/uploads/R070923-1.pdf [https://perma.cc/VNG7-DY88]. "MEV arises from 'front' and 'back-running' as well from sandwich trades, all schemes which are illegal under market abuse regulation." *Id.* at 15 n.24.

248 Experts explore how the design of DEXs and the underlying blockchains may provide protection against front-running and arbitrage-related losses. *See, e.g.*, Basile Caparros, Amit Chaudhary & Olga Klein, Blockchain Scaling and Liquidity Concentration on Decentralized Exchanges 2 (Feb. 1, 2024) (unpublished manuscript) (on file with author) (explaining how lower blockchain gas fees help protect against arbitrage by allowing liquidity providers to change their position frequently without incurring high expenses). They propose dark or private venues where "orders . . . are secret, and can only be reconstructed by nodes matching the orders." Michael Borkowski, Daniel McDonald, Christoph Ritzer & Stefan Schulte, Towards Atomic Cross-Chain Token Transfers: State of the Art and Open Questions Within TAST 6 (Aug. 2018) (unpublished manuscript), https://www.researchgate.net/publication/327156161_Towards_Atomic_Cross-Chain_Token_Transfers_State_of_the_Art_and_Open_Questions_within_TAST [https://perma.cc/K4RV-XANW]. For other examples, see Tiantian Gong & Aniket Kate, Order but Not Execute in Order, arXiv 12–13 (Feb. 2, 2023), https://arxiv.org/abs/2302.01177 [https://perma.cc/5WWX-TN7J] (discussing designs that developers can implement to prevent front-running); *Flashbots*, GitHub, https://github.com/flashbots/pm [https://perma.cc/A87W-UA8C] (describing how Flashbots mitigate the negative effects of MEV).

249 Research suggests, however, that dark venues may fail to decrease transaction costs and only slightly increase the payoff of traders. *See* Agostino Capponi, Ruizhe Jia & Ye Wang, *The Evolution of Blockchain: From Lit to Dark*, arXiv 3 (Feb. 11, 2022), https://arxiv.org/pdf/2202.05779.pdf [https://perma.cc/TRM8-TX3C]. Traders in private pools can be shielded from some risk of front-running, but those initiatives may be unsustainable in equilibrium. *See* Capponi et al., *supra* note 39, at 35.

250 *See generally* Harvey et al., *supra* note 22 (discussing DEX microstructure and front-running).

Part begins a review of solutions and starts with private self-regulation as a voluntary set of commitments by CEXs and developers of DEXs.

A.   *CEXs and Private Self-Regulation*

Hypothetically, a better-quality CEX could spend more on voluntary compliance and pass it on to the traders in the form of higher fees. But traders might detest these high costs and leave to plentiful other venues, including foreign ones. Those venues could "compensate" themselves through less obvious insider trading schemes that would be unobservable to traders. An honest CEX would thus lose traders and liquidity.

Even if the traders stayed, any benefits from good standards and their enforcement could be partially captured by the trading parties themselves, while the exchange would bear the full costs of improving compliance. Consequently, it would have an incentive to economize on compliance and set suboptimal standards. And even if a CEX set proper standards voluntarily, it—or its insiders—could defect from compliance in the future and whenever such defection happened to be profitable. At this juncture, only mandatory guardrails could nudge the exchange to implement optimal standards, maximizing economic welfare and maintaining compliance.

Many private initiatives illustrate these points: projects to boost transparency and give "proof of reserves" appear to have produced incomplete information;[251] rules prohibiting trading on inside material nonpublic information have been violated;[252] rules ensuring fair access and trading efficiency have been set aside for affiliated parties.[253] The most notorious case is FTX, whose founder was found guilty on several counts to commit securities and commodity fraud, wire fraud, and money laundering in November 2023.[254] FTX plainly illustrates how agency costs (resulting in extreme corporate mismanagement)

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[251] *See* Mark Maurer, *More Crypto Exchanges Verify Reserves, but Questions About Assets Remain*, Wall St. J. (Dec. 5, 2022, 7:30 AM), https://www.wsj.com/articles/more-crypto-exchanges-verify-reserves-but-questions-about-assets-remain-11670153687 [https://perma.cc/EX4Q-62AT].

[252] *See Coinbase Exchange Trading Rules*, Coinbase, https://www.coinbase.com/legal/trading_rules [https://perma.cc/4TLV-QWS4] (including Rule 3.3 Coinbase Employee Access); *see also* Press Release, SEC, Former Coinbase Manager and His Brother Agree to Settle Insider Trading Charges Relating to Crypto Asset Securities (May 30, 2023), https://www.sec.gov/news/press-release/2023-98 [https://perma.cc/U73A-EZV9].

[253] FTX and Binance, for example, allowed affiliated accounts to trade on preferred terms or exempted them from the insider trading policies. *See, e.g.*, Compl. ¶ 71, CFTC v. Zhao, No. 1:23-cv-01887, 2023 WL 10448932 (N.D. Ill. Dec. 14, 2023), 2023 WL 2664163; Compl. ¶ 3, SEC v. Bankman-Fried, No. 22-cv-10501 (S.D.N.Y. Dec. 13, 2022).

[254] Press Release, U.S. Att'y's Off., S.D.N.Y., DOJ, Statement of U.S. Attorney Damian Williams on the Conviction of Samuel Bankman-Fried (Nov. 2, 2023), https://www.justice.gov/

and information asymmetry (enabling insider trading and comingling of funds) could destroy a CEX operating without a proper regulatory framework.

B. DEXs: Voluntary Rules and Incentives

By the same token, blockchain-based DEXs are not unerring, self-regulating, cost-effective trading systems.[255] As such, blockchain-native systems "ha[ve] not rewritten all of economics or human nature" from decentralized finance,[256] and parties on blockchain may act opportunistically.[257]

Can DEX developers (or other relevant parties) voluntarily address the discussed risks? Given a possible degree of centralization,[258] it appears that certain groups, including DEX developers, may amass considerable influence over protocol changes and governance decisions.[259] In other words, they have the capacity to act. But do they have the right incentives and knowledge to tackle the examined inefficiencies and risks?

Take the implementation of new DEX versions and changes to existing protocols as an example. These highly valuable activities turn on the incentives of developers and DEX governance structure.[260] Efficient governance is important to many decentralized protocols, which need to evolve and tackle code errors and the incompleteness of smart contracts when necessary.[261] The risk here is not that the developers supporting DEXs would engage in fraud but that they could simply act opportunistically, with that Williamsonian "self-interest seeking with guile."[262] In doing so, they might externalize the risks of a poor trading

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usao-sdny/pr/statement-us-attorney-damian-williams-conviction-samuel-bankman-fried [https://perma.cc/XVF7-8RY7].

255   Recall, for example, that validators and savvy traders can front-run other traders and liquidity providers. *See supra* notes 232–50 and accompanying text.

256   Caroline A. Crenshaw, Comm'r, SEC, *Statement on DeFi Risks, Regulations, and Opportunities* (Nov. 9, 2021), https://www.sec.gov/news/statement/crenshaw-defi-20211109 [https://perma.cc/KWR3-CXKJ]. Decentralized finance refers to finance systems based on DLT and operating peer-to-peer. *See id.*

257   *See* Williamson, *Transaction-Cost Economics*, *supra* note 67, at 234 n.3 (discussing opportunism in economic settings). *See generally supra* Part II.

258   *See* Crenshaw, *supra* note 256; Fin. Stability Bd., *supra* note 132, at 11–12.

259   *See* Bd. Int'l Org. Sec. Comm'ns, Policy Recommendations for Decentralized Finance (DeFi): Consultation Report 31 (2023), https://www.iosco.org/library/pubdocs/pdf/IOSCOPD744.pdf [https://perma.cc/GTS8-RSMX] (underscoring importance of developer incentives).

260   *See, e.g.*, *id.* at 23, 31, 87.

261   *See* Bank for Int'l Settlements, *supra* note 246, at 9; Fin. Stability Bd., *supra* note 132, at 11–18; Capponi et al., *supra* note 221; Autorité des Marchés Financiers, *supra* note 9, at 23.

262   Williamson, *Transaction-Cost Economics*, *supra* note 67, at 234 n.3.

environment that they created, particularly if their interests—and reputational risks—were not fully aligned with investors' interests and risks.

The previously discussed decision involving Uniswap Labs provides an opposite illustration. In that class action, plaintiffs alleged, inter alia, that the developers and investors behind Uniswap operated an unregistered exchange and broker-dealer,[263] that various pools included "Scam Tokens,"[264] and that those transactions were subject to rescission under the securities statutes.[265]

The court first distinguished between a lawful DEX as a set of smart contracts containing "self-executing, self-enforcing code" that incorporates trade terms and pricing, and the token contracts created by malicious issuers in liquidity pools.[266] The court suggested that in fraudulent transactions over a platform, "third-party human intervention causes the harm, not the underlying platform."[267]

The court next dispatched the allegations that the defendants, as statutory sellers, were offering and selling unregistered securities and stated, inter alia, that Securities Act section 12(a)(1) "does not apply to software coders who create an exchange to efficiently facilitate trades."[268] Although the court fully acknowledged that those who had caused harm through fraudulent schemes were anonymous, that the DEX did not have the traditional identification protocols and listing review,[269] and that the defendants could have "a degree of governance power," it suggested that these issues were either irrelevant[270] or for Congress to address.[271]

Consider how this approach affects developers' incentives. Although it would be doctrinally inappropriate to consider the developers behind Uniswap "statutory sellers" under securities law,[272] the decision also points toward a lower private liability risk for DEX developers,[273] and the risk of liability generally affects the incentives of private parties. Reputational benefits alone may fall short of motivating *all* DEX developers to create more efficient and less risky DEXs: some developers will invest in improved trading rules reducing specific investor risks

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263   Risley v. Universal Navigation Inc., 690 F. Supp. 3d 195, 213 (S.D.N.Y. 2023).

264   *Id.* at 206.

265   *Id.* at 213.

266   *Id.* at 215.

267   *Id.* at 217.

268   *Id.* at 219–20.

269   *See id.* at 203–13 (describing the DEX protocol and the interface).

270   *Id.* at 221.

271   *Id.* at 222.

272   *See id.* at 218–23 (dismissing the plaintiffs' theories that defendants can be considered a "statutory seller").

273   *See id.* at 220–21. Note that public enforcement is a viable option. For example, the CFTC brought several enforcement actions against DEX operators for failure to register. *See* Press Release, CFTC, Illegal Derivatives Trading, *supra* note 17.

or addressing regulatory concerns; some will not. The code written by both groups will be fully visible to the public due to the transparent nature of blockchain ecosystems.[274] Yet traders may not be adequately informed or sophisticated—or may even have contradictory individual preferences—to reward or penalize the developers.[275] As a result, developers may not internalize either their reputational rewards or penalties. In equilibrium, they should underprioritize projects that do not align with their interests and economize on resources to educate themselves about risks that they externalize.

As an illustration, in October 2023, a new hook deanonymizing transactions through know-your-customer ("KYC") programs was reported in the open-source repository for contracts for Uniswap v4.[276] Private parties using that hook would be able to create KYC-compliant trading pools on a new version of Uniswap, a major DEX.[277] Without commenting on the merits and downsides of this proposal, it is obvious that this and similar solutions could help resolve the identification issues discussed in the decision involving Uniswap Labs.[278] Next, in September 2023, the CFTC targeted Deridex for, inter alia, failing to establish a KYC program.[279] Note that Deridex was organized concurrently with the Uniswap litigation and the rollout of the v4 proposal.[280] Yet heterogeneous and dispersed groups of developers should be expected to experiment in different directions. In doing so, they may direct their efforts toward better technological design and functionalities, not legal theories that other developers incorporate into their decisions.

The problem here is not that the community of developers does not understand the need for better trade execution or for KYC—that is,

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[274]   *Supra* notes 214–23 and accompanying text.

[275]   This is a common information problem in financial markets. *See* Dan Awrey & Kathryn Judge, *Why Financial Regulation Keeps Falling Short*, 61 B.C. L. Rev. 2295, 2311 (2020) *(*"The complexity of modern finance makes it prohibitively costly for market participants . . . to gather, much less analyze, the entire universe of potentially relevant information. As a result, these actors almost invariably operate with only a fraction of the information that may be pertinent to the decisions they are making . . . ."); Bd. Int'l Org. Sec. Comm'ns, *supra* note 259, at 60 ("To the extent data is on-chain, it requires tools and expertise to interpret and may not be in human-readable format. To the extent data is off-chain, it could be inaccessible. Even if off-chain data is made available through, for example, a website or API, the data likely is not audited or otherwise verified, and may be unreliable.").

[276]   Ana Paula Pereira, *KYC Hook for Uniswap v4 Stirs Community Controversy*, Cointelegraph (Oct. 15, 2023), https://cointelegraph.com/news/kyc-hook-uniswap-v4-stirs-community-controversy [https://perma.cc/Z62Q-NNN8].

[277]   *See id.*

[278]   *See* Risley v. Universal Navigation Inc., 690 F. Supp. 3d 195, 204–13 (S.D.N.Y. 2023) (describing the DEX protocol and the interface).

[279]   *In re* Deridex, Inc., CFTC No. 23-42, 2023 WL 5937236, at *1 (Sept. 7, 2023).

[280]   *See id.* at *2 (Deridex began development in mid-2022 and launched on January 1, 2023). *Uniswap* plaintiffs filed a complaint against Uniswap and its developers on April 4, 2022. *See Risley*, 690 F. Supp. 3d at 211.

KYC in regulated markets.[281] The chief concern is that not every developer would work on the code with the complete information on hand, with a full appreciation of the future investor risks, trading efficiencies, or regulatory compliance, and with properly calibrated incentives.

V.   Formal Self-Regulation for Digital Assets

A.   *The Need for Self-Regulation: Hayek Was Right*

If voluntary, market-based self-regulation is insufficient and cannot fully cope with the high costs of organizing transactions, the law should step in.[282] Governments may "impose regulations which state what people must or must not do and which have to be obeyed."[283] The main germane question in technology-enabled financial markets is how the government can do that effectively in a rapidly changing environment.[284] How can the law contribute to better markets by creating conditions promoting technologies and institutions that reduce the costs of private transacting and withstand the test of both time and future innovation?[285] The government—namely, the Commissions—may

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[281]   Recall that the developer community and scholars experiment with possible solutions. On front-running, see generally Dan Cline, Thaddeus Dryja & Neha Narula, ClockWork: An Exchange Protocol for Proofs of Non Front-Running (Feb. 21, 2020) (unpublished manuscript), https://www.media.mit.edu/publications/clockwork-an-exchange-protocol-for-proofs-of-non-front-running/ [https://perma.cc/9FJ4-GLGP]; Matheus V.X. Ferreira & David C. Parkes, *Credible Decentralized Exchange Design via Verifiable Sequencing Rules*, 55 Ass'n for Computing Mach. Symp. on Theory Computing 723 (2023), https://dl.acm.org/doi/10.1145/3564246.3585233 [https://perma.cc/ML5X-XWR2]; Lioba Heimbach, Eric Schertenleib & Roger Wattenhofer, *The Potential of Self-Regulation for Front-Running Prevention on DEXes*, arXiv (June 9, 2023), https://arxiv.org/abs/2306.05756 [https://perma.cc/4KGZ-Q3GC]; *supra* notes 248–49.

[282]   Technology alone may not offer foolproof solutions. Scholars, for example, have expressed concerns about the failures of consensus protocols "to provide an infrastructure that allows transacting parties to internalise externalities privately through decentralised contracting and allocative mechanisms," *see* Martino & Ringe, *supra* note 21, at 17–24.

[283]   Ronald H. Coase, *The Problem of Social Cost*, 3 J.L. & Econ. 1, 17 (1960). The problems of incompleteness of information and high transaction costs create conditions calling for government intervention. Joseph E. Stiglitz, Whither Socialism? 29 (1994). A public intervention in finance may address information asymmetries and transaction costs that are not corrected by prices. *See generally* Bruce C. Greenwald & Joseph E. Stiglitz, *Externalities in Economies with Imperfect Information and Incomplete Markets*, 101 Q.J. Econ. 229 (1986); Joseph E. Stiglitz, *The Role of the State in Financial Markets*, 1993 World Bank Ann. Conf. on Dev. Econ. 19.

[284]   Note that the policy choice here is not a false dichotomy between regulating digital assets via a self-governing technology or through formal laws. In its extreme forms, a strong focus on technological self-regulation replacing humans has been dubbed the "tech nirvana fallacy." Luca Enriques & Dirk A. Zetzsche, *Corporate Technologies and the Tech Nirvana Fallacy*, 72 Hastings L.J. 55, 61–62, 95 (2020).

[285]   *See, e.g.*, Harold Demsetz, *Information and Efficiency: Another Viewpoint*, 12 J.L. & Econ 1, 20 (1969) (describing as the main policy problem "the design of institutional arrangements that provide incentives to encourage experimentation (including the development of new products,

find it difficult to satisfy these conditions alone. Instead, there are theoretical arguments militating for introducing a formal self-regulatory model to achieve superior and efficient outcomes.[286]

Financial regulation is a regulatory-cum-market system that requires detailed knowledge of markets against a steady stream of innovation.[287] It often brings the regulators and markets into a permanent state of collision caused by the obsolescent information that the regulators possess and the dynamic nature of finance and technology.[288] Market knowledge changes at a blistering pace.[289] This change undermines effective data aggregation and the development of lasting regulations by central planners such as the Commissions.[290]

It follows that DLT-based and other technology-enabled markets naturally challenge preexisting and long-term regulatory solutions.[291] The expertise and knowledge of the Commissions will always be obtained earlier in time. But effective regulations must impound emerging data points in real time as, in Friedrich Hayek's words, "economic problems arise always and only in consequence of change."[292]

By way of example, DEX developers assess their designed models in real time and launch new applications through incessant and dynamic experimentation. Uniswap's evolution offers illustrative milestones: in the short span of a few years, Uniswap Labs has rolled out (or is about to roll out) (1) Uniswap v3, which helps liquidity providers mitigate the price risk by specifying price ranges (i.e., concentrated liquidity provision);[293] (2) Uniswap X, which allows traders to receive

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new knowledge, new reputations, and new ways of organizing activities) without overly insulating these experiments from the ultimate test of survival").

286   For a comprehensive overview of self-regulation, see generally William A. Birdthistle & M. Todd Henderson, *Becoming a Fifth Branch*, 99 Cornell L. Rev. 1 (2013).

287   *See* Awrey & Judge, *supra* note 275, at 2300 (discussing the importance of information in regulating financial markets).

288   *See generally id.* Among other factors, timely actions and accurate information are key to better regulation. *See, e.g.*, U.S. Gov't Accountability Off., GAO-23-105346, Blockchain in Finance: Legislative and Regulatory Actions Are Needed to Ensure Comprehensive Oversight of Crypto Assets 52–55 (2023).

289   *See* U.S. Gov't Accountability Off., *supra* note 288, at 53 ("[T]he rapid pace of blockchain innovation makes it challenging to keep regulation up to speed.").

290   *See, e.g.*, Hayek, *supra* note 34, at 519 ("The reason for this is that the 'data' from which the economic calculus starts are never for the whole society 'given' to a single mind which could work out the implications, and can never be so given.").

291   Long-term planning is a complicated task. *See id.* at 523 ("[I]f detailed economic plans could be laid down for fairly long periods in advance and then closely adhered to, . . . the task of drawing up a comprehensive plan governing all economic activity would appear much less formidable.").

292   *Id.*

293   *Introducing Uniswap v3*, Uniswap Labs Blog (Mar. 23, 2021), https://blog.uniswap.org/uniswap-v3 [https://perma.cc/VVG5-74RW].

best execution across pools and liquidity providers;[294] and (3) Uniswap v4 with, among other features, cheaper trade fees ("gas cost") and customizable "hooks," which enable developers to design different market and limit orders[295] or even KYC procedures.[296]

Applying Hayek's framework, the Commissions, as central planners, lack the requisite knowledge about the ever-changing actions, intentions, and decisions of market participants, such as the developers of Uniswap. That "knowledge . . . is not given to the planner but to somebody else," such as DEX developers, CEX management teams, token project developers, traders, and others, and "somehow will have to be conveyed to the planner."[297] The concurrently transnational nature of DLT-enabled markets makes trading global[298] and information inherently decentralized.[299] Only the individual market participants who make decisions across borders based on the information in their possession represent decentralized information generators.[300]

Taking together decentralization, required expertise, and change, it follows "that the ultimate decisions must be left to the people who are familiar with these circumstances, who know directly of the relevant changes."[301] To the extent that governments need to prescribe regulations for technology-enabled markets, it becomes imperative that regulations incorporate industry inputs to approximate this decentralized decision-making.

B.   *Making a Case for SROs*

A suitable prototype to achieve these objectives—i.e., to combine industry expertise with regulatory decision-making and do so at speed—is already in place: it is the uniquely U.S.-specific expert SRO

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294   Hayden Adams, *Introducing the UniswapX Protocol*, Uniswap Labs Blog (July 17, 2023), https://blog.uniswap.org/uniswapx-protocol [https://perma.cc/CK82-GXAG].

295   *Uniswap V4—Hooks*, Uniswap Docs, https://docs.uniswap.org/contracts/v4/overview [https://perma.cc/2XMX-K5M9]; *Architecture*, Uniswap Docs, https://docs.uniswap.org/contracts/v4/concepts/v4-architecture-overview [https://perma.cc/CSV8-JWG9].

296   Pereira, *supra* note 276.

297   Hayek, *supra* note 34, at 520.

298   *See* Hossein Nabilou, *How to Regulate Bitcoin? Decentralized Regulation for a Decentralized Cryptocurrency*, 27 Int'l J.L. & Info. Tech. 266, 291 (2019) (describing crypto assets as, inter alia, global).

299   In a broader sense, this decentralization raises "the problem of what is the best way of utilizing knowledge initially dispersed among all the people [which] is at least one of the main problems of economic policy—or of designing an efficient economic system." Hayek, *supra* note 34, at 520.

300   F.A. von Hayek, *Economics and Knowledge*, 4 Economica 33, 51 (1937); Hayek, *supra* note 34, at 521.

301   Hayek, *supra* note 34, at 524.

model.[302] Throughout their existence, neither Commission functioned without its SRO-helpers in securities and derivatives markets.[303] Digital-asset-focused SROs overseen by the Commissions could approximate decentralized markets by receiving direct inputs from market participants.[304]

The SROs would submit their rules for approval to the regulators and simultaneously relay to them updated and aggregated market information.[305] A positive externality of this rule approval process would be educating the agencies and helping mitigate their limitations, such as bounded rationality and "tunnel vision, sticking to known regulatory schemes."[306] The Commissions would receive current information packaged, assessed, and processed by entities within their jurisdiction.[307]

Provided the new digital-asset SROs had few procedural, design, and incentive problems, they could operate *in concreto* and target cracks in blockchain-enabled institutions and attendant transaction costs. Acting faster than the regulators slowed down by the rulemaking latency under the strictures of the Administrative Procedure Act,[308] the SROs should be in a better position to respond to ongoing change. Thus, by expediting and informing rulemaking, the SROs could overcome a central regulatory challenge—the "allocative inefficiency [resulting

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302   Stavros Gadinis & Howell E. Jackson, *Markets as Regulators: A Survey*, 80 S. Cal. L. Rev. 1239, 1330 (2007).

303   *See, e.g.*, Massad & Jackson, *supra* note 124, at 5.

304   Birdthistle & Henderson, *supra* note 286, at 55 ("Perhaps the greatest single benefit that self-regulation possesses over other forms of regulation is its access to direct industry expertise.").

305   *See* 15 U.S.C. §§ 78f(b), 78s(a); 7 U.S.C. § 7a–2; 17 C.F.R. §§ 40.5–.6 (2023).

306   *See* Stephen J. Choi & A. C. Pritchard, *Behavioral Economics and the SEC*, 56 Stan. L. Rev. 1, 24 (2003).

307   This may mitigate the problems examined by Awrey and Judge. Awrey & Judge, *supra* note 275, at 2311.

> The complexity of modern finance makes it prohibitively costly for market participants and regulators to gather, much less analyze, the entire universe of potentially relevant information. As a result, these actors almost invariably operate with only a fraction of the information that may be pertinent to the decisions they are making . . . . Information that is accurate at one point in time may not be accurate at another . . . . Different regulators have different jurisdictions, mandates, and objectives, limiting both the scope of their authority and their field of vision.

Id.

308   Pub. L. No. 79-404, 60 Stat. 237 (1946) (codified as amended in scattered sections of 4 U.S.C.). On the regulatory delays, see Roberta S. Karmel, *Little Power Struggles Everywhere: Attacks on the Administrative State at the Securities and Exchange Commission*, 72 Admin. L. Rev. 207, 217–20 (2020). *But see* Roberta Romano, *Does Agency Structure Affect Agency Decisionmaking? Implications of the CFPB's Design for Administrative Governance*, 36 Yale J. on Regul. 273, 278 (2019) ("There is . . . a debate in the administrative law literature over whether these procedural developments have so 'ossified' rulemaking as to hinder federal agencies' ability to formulate policy efficiently or are a worthwhile cost of enhancing agencies' democratic legitimacy and accountability.").

from] the necessarily imperfect fit between the coverage of a rule and the conduct sought to be regulated."[309] The SROs could thus reduce "[a]n important cost of legal regulation [which is] the cost of altering rules to keep pace with economic and technological change."[310]

U.S. SROs typically regulate markets and address relevant transaction costs in two ways: by reducing ex ante costs of developing market-wide solutions through standards and rules and through ex post enforcement.[311] In securities markets, for example, SROs such as securities exchanges regulate the behavior of their members and issuers through financial, governance, and other standards, *and* through disciplinary actions and the threat of delisting.[312] Placed in the center of markets, the digital-asset SROs could have a similar ammunition to design and enforce rules, which would be more specific to produce much-valued regulatory certainty.[313] By being closer to decentralized individual sources of information than the regulators, SROs can improve information dissemination and economic coordination.

This better information, in turn, should reduce not only regulatory errors but also challenges against the agencies from the aggrieved market participants, who might otherwise "expend vast resources in checking the actions of the authorities."[314] In fact, the digital asset industry has already initiated complaints and launched an offensive against the SEC's policies.[315] But if a trusted, well-founded self-regulatory model is adopted, both enforcement and opposition should abate to more optimal levels, entailing another corollary: firms are more likely to voluntarily commit to standards of behavior and follow through on their commitments when regulatory oversight is balanced.[316]

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[309] Isaac Ehrlich & Richard A. Posner, *An Economic Analysis of Legal Rulemaking*, 3 J. Legal Stud. 257, 268 (1974).

[310] *Id.* at 277.

[311] Both ex ante and ex post processes must work simultaneously to reduce the costs of transacting. Davidson & Potts, *supra* note 66, at 3–4 (discussing Williamson's framework).

[312] Yadav, *supra* note 58, at 15–18; Massad & Jackson, *supra* note 124, at 2.

[313] Ehrlich & Posner, *supra* note 309, at 262–64 (arguing that uncertain law chills socially valuable activity and behavior and underscoring the benefits of precision). Scholarship suggests that the best new rules should provide certainty to markets and reduce "bureaucratic load." Brummer & Yadav, *supra* note 23, at 247.

[314] Birdthistle & Henderson, *supra* note 286, at 57.

[315] *E.g.*, Douglas S. Eakeley & Yuliya Guseva, *Crypto's Counteroffensive Suits Underscore Need for Regulation*, Bloomberg L. (Apr. 16, 2024, 4:30 AM), https://news.bloomberglaw.com/us-law-week/cryptos-counteroffensive-suits-underscore-need-for-regulation [https://perma.cc/PAV9-2MEL].

[316] *See, e.g.*, Jodi L. Short & Michael W. Toffel, *Making Self-Regulation More Than Merely Symbolic: The Critical Role of the Legal Environment*, 55 Admin. Sci. Q. 361, 386 (2010) ("The findings of this study suggest that the enforcement strategies and relationships of the legal environment play an important role in moderating organizations' implementation of their commitments to self-regulate. Facilities *not* facing regulatory threats that disclosed regulatory violations and committed to self-regulate exhibited improved regulatory outcomes. . . . In contrast, facilities that

C.   *Concerns and Feasibility*

Introducing SROs for digital asset markets is a feasible—and politically acceptable[317]—course of action. The Commissions are already accustomed to relying on legacy intermediaries, such as exchanges that predate the agencies and other SROs, like FINRA and NFA.[318] Coase himself, for instance, underscored the important contributions of stock exchanges in determining "[w]hat can be traded, when it can be traded, the terms of settlement and so on" and laying out "a private law."[319]

Among the many jurisdictions that have some form of self-regulation, the United States stands apart from others concerning affording its SROs a panoply of powers backstopped by the well-resourced Commissions with strong enforcement apparatuses.[320] The SROs also provide resource-constrained regulators with additional regulatory funding: the multipurpose SROs are self-funding,[321] whereas the Commissions are funded by taxpayers and repeatedly ask Congress to approve their annual budgets.[322] On balance, regulatory agencies acknowledge their contributions.[323]

Adding new digital-asset SROs should not disrupt the current system of self-regulation but add to it, ensuring more comprehensive oversight and generating synergies among SROs. The new SROs, for example, may enter into agreements with the legacy SROs to exchange information, assist in enforcement, or provide other material assistance.[324] In the alternative, FINRA and NFA could create a joint task

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disclosed while facing regulatory threats did not improve their regulatory outcomes compared with their matched controls, suggesting that bald displays of coercive power by the state can undermine more normatively based motivations to self-regulate.").

317   *See, e.g.*, Lummis-Gillibrand Responsible Financial Innovation Act, S. 4356, 117th Cong. § 807 (2022) (proposing an analysis of self-regulation).

318   "Self-regulation in the securities industry is nearly as old as the federal government." Marianne K. Smythe, *Government Supervised Self-Regulation in the Securities Industry and the Antitrust Laws: Suggestions for an Accommodation*, 62 N.C. L. Rev. 475, 480 (1984).

319   Ronald H. Coase, The Institutional Structure of Production 10 (1992), https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=1033&context=occasional_papers [https://perma.cc/QB22-TU2V].

320   *See, e.g.*, Gadinis & Jackson, *supra* note 302, at 1329–32.

321   Concept Release Concerning Self-Regulation, 69 Fed. Reg. 71,256, 71,267 (Dec. 8, 2004) (to be codified at 17 C.F.R. pt. 240).

322   *See, e.g.*, Gary Gensler, *Testimony Before the Senate Appropriations Subcommittee on Financial Services and General Government*, SEC (July 19, 2023), https://www.sec.gov/news/testimony/gensler-testimony-fsgg-subcommittee-senate-appropriations-committee-071923 [https://perma.cc/3WPS-D47A].

323   *See, e.g.*, Concept Release Concerning Self-Regulation, 69 Fed. Reg. at 71,258 (concluding that despite some conflicts and a possible need for reform, "it is generally considered that the SRO system has functioned effectively and has served government, industry, and investors well").

324   *8210. Provision of Information and Testimony and Inspection and Copying of Books*, FINRA, https://www.finra.org/rules-guidance/rulebooks/finra-rules/8210 [https://perma.cc/

force that would specialize in and work across digital-asset markets, including commodity, securities, and derivatives markets. So long as the new self-regulatory model accumulates the necessary market expertise and processes it into actionable and efficient self-regulation, it is theoretically irrelevant whether there are brand-new SROs or a new joint task force of existing SROs.

Admittedly, patterning that new self-regulatory approach on existing models may not be a simple endeavor because the existing SROs are arguably imperfect. Scholarship converges on several fault lines, including the ineffectiveness of the current SROs in setting or enforcing standards against members, their conflicts of interest, misaligned incentives, lax supervision, and underenforcement of listing and other SRO rules.[325] The next set of concerns centers on the SROs' "increasing government-like functions,"[326] the relevant issues of constitutionality and democratic legitimacy,[327] and the excessive deference to SROs from both regulators and courts.[328] There is an implicit trend to become the "fifth branch," arguably turning the original concept of self-regulation into an inefficacious nostrum.[329]

These criticisms are valid, and the regulation of the new SROs will undoubtedly need to take these arguments into account. If Congress authorizes the Commissions to devise a new SRO or a new FINRA-NFA task force for digital-asset markets,[330] a better organizational design will be a sine qua non for its success. Ultimately, however, the question policymakers should be asking is not what is wrong with

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KUL7-3Z9C] (listing 8210(b)(2), allowing FINRA staff to share information with other self-regulatory organizations for investigation and enforcement purposes).

325   *See generally* Marcel Kahan, Commentary, *Some Problems with Stock Exchange-Based Securities Regulation*, 83 Va. L. Rev. 1509 (1997) (questioning the claim that SROs are the best-suited tools to regulate the market). *See also* Jonathan R. Macey & Maureen O'Hara, *From Markets to Venues: Securities Regulation in an Evolving World*, 58 Stan. L. Rev. 563, 581–83 (2005) (discussing conflicts of interest in self-regulation); Geeyoung Min & Kwon-Yong Jin, *Relational Enforcement of Stock Exchange Rules*, 47 BYU L. Rev. 149, 183–84 (2021) (describing SROs' tendency not to bring formal enforcement actions against companies); Andrew F. Tuch, *The Self-Regulation of Investment Bankers*, 83 Geo. Wash. L. Rev. 101, 149 (2014) (arguing that FINRA imposes high costs on the financial industry while being largely ineffective at deterring misconduct); Stephen Craig Pirrong, *The Self-Regulation of Commodity Exchanges: The Case of Market Manipulation*, 38 J.L. & Econ. 141, 195–96 (1995) (explaining why, even though enforcement is a powerful deterrent improving market performance, commodity exchanges fail to exercise it).

326   Roberta S. Karmel, *Should Securities Industry Self-Regulatory Organizations Be Considered Government Agencies?*, 14 Stan. J.L. Bus. & Fin. 151, 154 (2008).

327   *See id.* at 185 (discussing due process concerns created by SROs); *see also* James Fallows Tierney, *Overseeing Private Rulemaking: Evidence from SEC Review of SRO Rules*, 26 U. Pa. J. Bus. L. (2024–2025) (forthcoming 2024–2025) (manuscript at 50–53) (on file with authors).

328   Emily Hammond, *Double Deference in Administrative Law*, 116 Colum. L. Rev. 1705, 1748–57 (2016).

329   Birdthistle & Henderson, *supra* note 286, at 5, 54.

330   *See supra* notes 302–16.

today's SROs but whether digital asset markets would function better with formalized self-regulation than without self-regulation.[331] The arguments advanced in this Article suggest that proper self-regulation adds considerable value and that the Commissions alone may lack the capacity to ensure adequate regulatory oversight of technology-based digital asset markets.[332]

VI.   Policy Proposals

A.   SRO Models

Having established a theoretical basis for formal self-regulation in Part V, this Article now dissects what the new organizational SRO model may look like. Three scholars have proffered two well-calibrated and thoughtful digital-asset SRO models. This Section explains their proposals; Section VI.B then suggests merging them and developing a different, embracive model.

First, Professor Yesha Yadav advocates for considering CEXs—i.e., not DEXs—SROs and bringing them "into line with a long-established model of oversight" that would require that they demonstrate "that they are safe, well-governed, and capable of exercising supervision and discipline."[333] To Yadav, "By combining position, power and stature, crypto-exchanges present policymakers with a [relatively] lower-cost, high-coverage monitor that can offer a [sic] regulators a supportive complement to enhance industry surveillance and market integrity."[334]

Yadav's idea is deeply rooted in securities and derivatives regulation. In securities markets, "national securities exchanges" register with the SEC under section 6 of the Exchange Act.[335] These institutions monitor trading to prevent fraud and manipulation, disseminate trade information, discipline their participants, create standards, enforce listing standards, and perform other functions.[336] They operate under the regulatory purview of the SEC, which approves exchange rule proposals

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331   *See, e.g.*, Pritchard, *supra* note 93, at 35; Pirrong, *supra* note 325, at 143.

332   *See, e.g.*, Saule T. Omarova, *Wall Street as Community of Fate: Toward Financial Industry Self-Regulation*, 159 U. Pa. L. Rev. 411, 491 (2011) (observing in conclusion that "without engaging private sector actors in the regulatory process in a new and meaningful way, any efforts to devise an effective system of regulation and supervision in today's increasingly global and complex financial services market will most likely fail, at least in the long run").

333   Yadav, *supra* note 58, at 46–47.

334   *Id.* at 10. On the centrality of exchanges, see also Dell'Erba, *supra* note 28 (manuscript at 37). There are also other proposals, including one allowing DEXs to register voluntarily. Jack Solowey & Jennifer J. Schulp, Regulatory Clarity for Crypto Marketplaces Part I: Decentralized Exchanges 5 (2023).

335   15 U.S.C. § 78f.

336   *Id.* §§ 78f, 78o–3(b)(6).

and changes under section 19 of the Exchange Act.[337] At the same time, exchanges remain mainly private entities, and courts have described their status as "quasi-governmental."[338]

In the commodities and derivatives world, derivatives contract markets ("DCM") are registered with the CFTC and must comply with the Core Principles set forth in the Commodity Exchange Act.[339] Under the Principles, DCMs must have the capacity to detect and prevent manipulation, prohibit abusive practices, disseminate trading information, and discipline their participants, among other obligations.[340] DCMs apparently have more leeway than securities exchanges in rulemaking, product listing, and amending rules, which can be done either by self-certifying compliance with the Commodity Exchange Act and CFTC regulations or by requesting approval.[341] For example, the Chicago Mercantile Exchange listed Bitcoin futures through self-certification.[342]

Just like securities exchanges, DCMs are not state actors.[343] The precedent of the Seventh Circuit, whose seat is in the major commodity

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337 *Id.* § 78s(a)–(b), (g). For background information on relevant statutory changes and rulemaking trends, see, for example, Tierney, *supra* note 327, at 18–23, 39–40.

338 *See, e.g.*, DL Cap. Grp., LLC v. Nasdaq Stock Mkt., Inc., 409 F.3d 93, 95 (2d Cir. 2005).

> As an SRO, the NASD is, like other SROs such as the New York Stock Exchange ("NYSE"), authorized by Congress to "promulgate and enforce rules governing the conduct of its members." *Barbara v. New York Stock Exch. Inc.*, 99 F.3d 49, 51 (2d Cir.1996). In this and other respects, the NASD serves as a critical aid to the SEC in implementing and effectuating compliance with the securities laws. Indeed, this Court has previously stated that SROs effectively "stand [ ] in the shoes of the SEC" because they perform regulatory functions that would otherwise be performed by the SEC, *D'Alessio v. New York Stock Exchange, Inc.*, 258 F.3d 93, 105 (2d Cir. 2001) and that SROs are, as a result, rightly considered "quasi-governmental" authorities. *Id.* . . . The NASD has delegated some of its regulatory powers and responsibilities as an SRO to Nasdaq. Generally speaking, the NASD has authorized Nasdaq to develop, operate, and maintain the Nasdaq Stock Market, to formulate regulatory policies and listing criteria for the Nasdaq Stock Market, and to enforce those policies and rules, subject to the approval of the NASD and ultimately the SEC.

Id.; *see also* Sparta Surgical Corp. v. Nat'l Ass'n of Sec. Dealers, Inc., 159 F.3d 1209, 1214 (9th Cir. 1998) ("The legislative history of the 1975 amendments underscored that self-regulatory organizations 'are intended to be subject to the SEC's control and have no governmentally derived authority to act independently of SEC oversight.' H.R.Rep. No. 123, 94th Cong., 1st Sess., 48–49 (1975).").

339 7 U.S.C § 7(d); *id.* § 7a–2; 17 C.F.R. §§ 38.100–38.1150. Derivatives exchanges also offer a market for spot or cash products. *See, e.g.*, *CME Dairy Spot Markets*, CME Grp., https://www.cme-group.com/education/courses/introduction-to-dairy/cme-dairy-spot-markets.html [https://perma.cc/WLF4-3AMN].

340 *See* 7 U.S.C. § 7(d)(1)–(22).

341 17 C.F.R. §§ 40.2–40.6.

342 CFTC, Off. of Pub. Affs., CFTC Backgrounder on Self-Certified Contracts for Bitcoin Products (2017).

343 *See, e.g.*, Rosee v. Bd. of Trade of Chi., 311 F.2d 524, 526, 528 (7th Cir. 1963) (holding that the Chicago Board of Trade is not a public utility even though it performs some public services).

and derivatives trading hub, is compelling on these issues.[344] Agreeing with Judge Friendly of the Second Circuit, Judge Posner noted:

> The argument for treating a securities or commodity exchange as an arm of the federal government is that federal law imposes on the exchange a duty of policing its members that makes the exchange in effect a law-enforcement agent of the government. But as Judge Friendly pointed out in the *Solomon* case, the agency analogy is upside down. The exchange is the principal rather than the agent; the purpose of the federal law is to strengthen the power and responsibility of the exchange in performing a policing function that preexisted federal regulation.[345]

To summarize, exchanges are a central part of the legacy market's institutional infrastructure directly approved by the regulators. Exchanges provide trading venues, create rules, and enforce them, thereby packaging together their trading, listing, *and* self-regulatory services.[346] Yadav's proposal models CEX regulation on this legacy approach.[347]

Timothy Massad and Professor Howell Jackson have put forward the second proposal.[348] They propound a FINRA-like SRO for regulating CEXs—i.e., the proposal excludes DEXs—with the SEC and CFTC jointly approving the SRO rules, "direct[ing it] to abrogate, amend or adopt a rule," delegating responsibilities to the SROs, and providing general guidance and oversight while relying on the expertise of market participants.[349]

Similar to exchanges, these SROs are also nonstate actors, and "[s]ince 1938, frontline authority over broker-dealers has fallen to *private* entities and *not* the state."[350] At the same time, such SROs are exceptionally powerful, private self-governing organizations that have enforcement authority to bring disciplinary actions against their members[351] and set their own rules, which the regulators review.[352] They

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344   *See, e.g., id.*

345   Bernstein v. Lind-Waldock & Co., 738 F.2d 179, 186 (7th Cir. 1984) (citation omitted).

346   Chris Brummer, *Stock Exchanges and the New Markets for Securities Laws*, 75 U. Chi. L. Rev. 1435, 1455 (2008) ("The dual nature of the services proffered by exchanges" helps them create cumulative competitive advantages).

347   *See supra* notes 333–41.

348   *See* Massad & Jackson, *supra* note 124.

349   *Id.* at 2, 5.

350   Kim v. FINRA., 698 F. Supp. 3d 147, 154, 157, 164 (D.D.C. 2023).

351   SROs such as FINRA decide "which cases to investigate and when to file a complaint," and their decisions are "not binding on the SEC in any subsequent review." Scottsdale Cap. Advisors Corp. v. FINRA., 678 F. Supp. 3d 88, 103 (D.D.C. 2023). FINRA, however, does not have the authority to "bring court actions to collect disciplinary fines it has imposed." Fiero v. FINRA., 660 F.3d 569, 571 (2d Cir. 2011).

352   *See* 15 U.S.C. §§ 78s(b)(1)–(2), 78o-3(b)(2), (7), (8).

are professional associations and "quasi-governmental agencies," as one court put it.[353] Ideally, these SROs should act as industry enforcers disciplining rogue participants and as standard setters for market behavior, providing institutional guardrails to boost compliance and resilience of financial markets.

B.   A Two-Tiered SRO Proposal

1.   Crypto-Exchanges as SROs

Each discussed proposal is necessary, but neither is sufficient, and each bolsters the other. This Section suggests merging the two models proposed by Yadav, Jackson, and Massad[354] to create a two-tiered SRO system. The first argument for this embracive approach is that recreating a replica of FINRA or NFA under the joint jurisdiction of the Commissions would not fully fit the examined-above trading structure, microstructure, and risks of crypto-exchanges. Recall that crypto-exchanges offer direct access to investors.[355] Broker-dealers (i.e., members of FINRA) are not the typical middlemen in crypto asset trading.[356] Today, investors bypass broker-dealers and gain direct access to CEXs—and to DEXs.[357] This would make the traditional FINRA membership inapplicable in the current digital-asset trading infrastructure.[358]

Next, recall that ATSs are registered broker-dealers and, therefore, members of FINRA.[359] Crypto-exchanges, theoretically, could register under a regime similar to Regulation ATS.[360] Indeed, several member firms are already approved as ATSs for crypto asset securities trading.[361] This is where Massad and Jackson's proposal could cover

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353   *See also* Nat'l Ass'n of Sec. Dealers, Inc. v. SEC, 431 F.3d 803, 804 (D.C. Cir. 2005).

354   *See supra* Section IV.A.

355   *Supra* Parts II–III.

356   Note that there are several exceptions. For example, at least one firm is registered as a special purpose broker-dealer, a status that allows registered broker-dealers to custody and interact only with crypto asset securities, and several firms have been approved to operate ATSs for crypto asset securities. Foye, *supra* note 123. For nonsecurity crypto assets, regulatory and registration-related questions remain open.

357   *Supra* notes 192–96 and accompanying text.

358   By the same token, the requirement of the May 2024 House Bill that digital asset and digital commodity broker-dealers be members of FINRA and NFA, respectively, does not fully account for the current trading structure and microstructure in the digital asset markets. Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. §§ 405, 506 (2024).

359   *Supra* note 123 and accompanying text.

360   Regulation of Exchanges and Alternative Trading Systems, 63 Fed. Reg. 70,844, 70,844–48 (Dec. 22, 1998) (codified at 17 C.F.R. pts. 202, 240, 242, 249).

361   *See, e.g.*, Foye, *supra* note 123.

CEXs.[362] Nevertheless, there are reasons militating against a direct transplantation of this model.

Crypto-exchanges are essential loci for crypto asset trading,[363] whereas ATSs were an addition appended to centuries-old markets with well-established broker-dealers and exchanges.[364] CEXs do not operate in parallel with regulated intermediaries. Instead, they are key trading platforms competing with other crypto-exchanges across borders.[365] The centrality of CEXs[366] suggests that they can, and perhaps should, bear the costs of self-regulation. Their market position may justify imposing more duties on them as the least-cost providers of market oversight and self-regulation in a mercurially developing digital asset market. ATSs, in contrast, do not have formal self-regulatory obligations.[367] If all CEXs become omnibus SROs, they could be charged—and ideally, trusted— with developing relevant standards for brokerage, trade execution, and settlement services—i.e., functions that they already perform—under the aegis of a regulated entity.

The centrality of CEXs can also alleviate the problem of disclosure. Because the term "issuer" in blockchain-enabled markets may be a distant approximation of typical corporate issuers,[368] assets could be distributed in relation to and in support of decentralized projects, and traditional firms could give way to decentralized arrangements as projects develop postlaunch. As Part II points out, there are no investment banks conducting issuer due diligence, and listing review is within the remit of CEXs.[369] Theoretically, they are well-positioned and have the wherewithal to monitor initial disclosures in a primary market or even ensure periodic reporting thereafter.

The United Kingdom is already reviewing similar policies: in October 2023, His Majesty's Treasury restated that trading venues could facilitate disclosures for certain crypto assets.[370] The (possibly) doomed-to-failure[371] May 2024 House Bill took a similar approach by imposing listing, product review, and member oversight obligations on

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362   *See supra* notes 348–49 and accompanying text.

363   *See supra* notes 58–60, 152–55 and accompanying text.

364   The SEC formalized its approach to ATS relatively recently. *See* Regulation of Exchanges and Alternative Trading Systems, 63 Fed. Reg. at 70,844.

365   *See supra* notes 58–60 and accompanying text.

366   *See* Dell'Erba, *supra* note 28, at 37.

367   Fox et al., *supra* note 123.

368   *See supra* Section II.A (comparing issuers in blockchain enabled markets to issuers in traditional markets).

369   *See supra* Part II.

370   HM Treasury, Future Financial Services Regulatory Regime for Cryptoassets: Response to the Consultation and Call for Evidence 42–45 (2023). Note that U.S. derivatives regulation also has somewhat similar models for intermediary disclosure. *See* Dombalagian, *supra* note 47, at 38–39, 41.

371   *See supra* note 25.

crypto-exchanges.[372] Assigning self-regulatory functions to all CEXs would strengthen their disclosure-related and self-regulatory duties to reduce the information asymmetry and trading risks and costs discussed in this Article.[373]

2.   *A Policy-Level SRO*

Up to this point, the arguments were in favor of converting CEXs into SROs.[374] But this model alone is equally insufficient, which brings us to Massad and Jackson's proposal to form an overarching FINRA-like SRO.[375] According to Massad and Jackson, a new FINRA, "formed and supervised by regulators, whose mission would be to protect investors and financial markets by developing and enforcing much-needed standards for the crypto industry," could solve many problems facing the regulators and the digital asset markets.[376]

Nothing suggests that this overarching SRO could not have crypto-exchanges-SROs *and* potential other intermediaries as its members.[377] It is also possible that if native crypto assets become mainstream and as real-world assets are tokenized, broader swaths of investors would enter the market. These non-crypto-native investors might prefer the familiarity of trading through a broker, creating more demand for such brokerage services. As markets respond to the demand, the growing ranks of crypto-asset-brokers could become members of the new SRO. Having crypto-exchanges-SROs and a new upper-tier SRO, thus, answers the need for an adaptable intermediary-based approach and a comprehensive, overarching regulatory framework.[378]

This policy-level SRO could develop the best practices or general guidelines for both exchanges and brokers and function as a central aggregator of decentralized market knowledge from a variety of participants.[379] Establishing this lone standard-setter is supported by scholarship: theory suggests that entities like FINRA need to have a self-regulatory monopoly because "the efficacy of even a monopolist's

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372   *See* Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. §§ 106–107 (2024) (setting conditions for persons filing a notice of intent to register as a digital commodity exchange or a digital asset trading system and requiring, inter alia, a description of the listing process and disclosure of other information); *id.* § 504 (outlining registration requirements and the core principles for digital commodity exchanges, including operational standards, disciplinary procedures for members and market participants, and others).

373   *See supra* Parts II–IV.

374   *See supra* Section V.B.1.

375   *See supra* notes 348–49 and accompanying text.

376   Massad & Jackson, *supra* note 124, at 2.

377   *See id.* at 6. The SRO would "approve who may become a member." *Id.*

378   *See* Massad & Jackson, *supra* note 124, at 2 (proposing solution to provide "much-needed standards for the crypto-industry").

379   *See id.* at 13.

power to enforce its rules privately . . . is symmetrical with its power to exclude."[380] A single new SRO or a specialized FINRA-NFA task force could fill the bill. Positioning this new entity in the center of information flows would allow it to develop, update, and promote guidelines, and educate individual CEXs, other intermediaries, and even regulators.

Note that the May 2024 House Bill, animated by similar self-regulatory ideas, would require that digital asset and digital commodity broker-dealers, and even CEXs, be members of FINRA or NFA.[381] It, however, fails to account for the need to have a set of self-regulatory principles and standards for multifunctional CEXs, as well as potential other intermediaries, bringing them within a coherent, adaptable, and well-informed regulatory regime.

In contrast, purposively aggregating best standards and guidelines through a single SRO may lead to cross-pollination among market participants, helping information distribution and setting the baseline for protecting against market manipulation, ensuring fair and orderly markets, establishing safeguards against conflicts of interest, and protecting investors across digital asset markets.[382] Even Yadav, who focuses on CEXs-SROs, acknowledges that "the structure of the cryptocurrency industry raises costly hurdles that impede the creation of common standards of conduct" and that "a multiplicity of venues and their varying models raise the difficulty involved in coordination, information pooling, analysis, and consensus building."[383] An overarching digital-asset SRO could become this information-aggregating, standard-setting mechanism for CEXs-SROs. To recap, either a new SRO or a joint task force of FINRA and NFA would fill this gap.

As Jackson and Massad propose,[384] the policy-level digital asset SRO could fall under the joint jurisdiction of the SEC and CFTC to mitigate the uniquely American debate about classifying digital assets as securities, commodities, or something else.[385] Regardless of the classifications, these markets may need a better self-regulatory framework,

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380   Jonathan Macey & Caroline Novogrod, *Enforcing Self-Regulatory Organization's Penalties and the Nature of Self-Regulation*, 40 Hofstra L. Rev. 963, 967 (2012). Macey and Novogrod's analysis hinges on the absence of a private right of action and court enforcement of FINRA's claims and is applicable to the extent of similar design features of the new SRO. *See id.* at 965.

381   Financial Innovation and Technology for the 21st Century Act, H.R. 4763, 118th Cong. §§ 405, 506 (2024).

382   *See supra* Parts II–IV.

383   Yadav, *supra* note 58, at 42. "These difficulties create fatal setbacks to the coordination game for setting up viable self-regulation where venues cooperatively pursue a collective benefit, forgoing opportunistic, self-interested risk-taking." *Id.* at 44.

384   *Supra* notes 348–53 and accompanying text.

385   *See* Guseva & Hutton, *supra* note 2, at 1558–60 (describing the debate over whether crypto assets should be regulated by the CFTC as commodities or by the SEC as securities). The analysis of the Solana blockchain in the *Coinbase* order provides an example of this critical uncertainty. SEC v. Coinbase, Inc., No. 1:23-cv-4738, 2024 WL 1304037, at *7–8 (S.D.N.Y. Mar. 27, 2024).

particularly as they continue to grow in size.[386] The scholarship on crypto assets does not uniformly advocate for making either the SEC or the CFTC the principal regulator and rather points toward the need for a more efficient and modernized regulatory regime.[387] The trading and microstructure concerns discussed in this Article also support this position.

Having a two-tiered SRO structure with trading platforms as SROs and the overarching SRO for information aggregation and standard setting—with both tiers under the watchful eye of the Commissions—could form a regulatory structure that is flexible and comprehensive enough to leverage the benefits of digital asset markets without externalizing the risks of CEXs. Conversely, without an upper-tier SRO, digital asset trading platforms may fall into the same trap that conventional exchanges struggle with: the fragmentation of trading across multiple trading platforms reduces the effectiveness of exchanges as SROs.[388]

3.   *DEXs and Self-Regulation*

Finally, this need for a general standard-setter SRO is reinforced by the trading on DEXs. Neither Massad and Jackson nor Yadav have addressed decentralized platforms and for good reason.[389] As discussed earlier in this Article, DEXs have practices and exhibit risks that are different from those of CEXs and legacy exchanges.[390] Yet, inasmuch as the current market structure is interconnected, it is imperative to incorporate DEXs within a definable regulatory model. Hundreds of DEXs coexist with CEXs within the blockchain-enabled market.[391] As trading, arbitrage activities, and price formation on CEXs and DEXs

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386   The major relevant concern is systemic risk. *See, e.g.*, Birdthistle & Henderson, *supra* note 286, at 51 ("[T]he commodities industry's dramatic increase in size alone might suggest more systemic risks, which may in turn generate more demand for government-like regulation."). Potentially, systemic interconnections may touch upon not only securities, derivatives, and commodity regulations, but also banking law. *See, e.g.*, Lee Reiners & Sangita Gazi, *Wanted: A Prudential Framework for Crypto Assets*, 76 Ark. L. Rev. 311, 318 (2023).

387   On the one hand, the SEC, as a larger agency, may have some comparative advantages over the CFTC. *See, e.g.*, Arthur E. Wilmarth Jr., *We Must Protect Investors and Our Banking System from the Crypto Industry*, 101 Wash. U. L. Rev. 235, 303–04 (2023); Dombalagian, *supra* note 47 (manuscript at 1–2). On the other hand, it may also be less suitable for innovative markets. *See generally* Guseva & Hutton, *supra* note 2. Additionally, Carol Goforth delivered a strong critique of the SEC's recent rule proposal expanding the definition of "exchange." *See generally* Carol R. Goforth, *Critiquing the SEC's Ongoing Efforts to Regulate Crypto Exchanges*, 14 Wm. & Mary Bus. L. Rev. 305 (2023).

388   *See generally* Yesha Yadav, *Oversight Failure in Securities Markets*, 104 Cornell L. Rev. 1799 (2019).

389   *See* Yadav, *supra* note 58; Massad & Jackson, *supra* note 124.

390   *Supra* Parts II–III.

391   Autorité des Marchés Financiers, *supra* note 9, at 9.

become global, potential inefficiencies and risks may spill over from unregulated to regulated markets across borders.

Due to insufficient legal knowledge, poor risk assessment, preferences for disintermediation, or intent to commit fraud, individual traders could flock to unregulated DEXs, leading to consumer harm.[392] The risks of DEXs could also spill over into global crypto asset prices through arbitrage, smart contract routers, and aggregators affecting price formation and, ultimately, regulated exchanges.[393] With the increasing tokenization of real-world assets—such as securities and commodities—the real economy could be affected. Under these conditions, the limited enforcement resources of the Commissions would be insufficient without proper self-regulation and standard setting by the industry itself.

The SEC and CFTC could, of course, attempt to reel in DEXs either through expanding the definition of the terms "exchange"[394] and "dealer,"[395] which could cover DEXs and liquidity providers, or through enforcement.[396] On the first model, some scholars have vehemently criticized such regulatory expansion.[397] Even those who agree that securities law is suitable for regulating crypto-exchanges are concerned that designating crypto-exchanges as securities exchanges could backfire and affect legacy market regulation.[398] A critical policy concern is that by insisting on converting DEXs into "exchanges" and the applicability of the old rule book, the Commissions miss an opportunity to modify regulations to incorporate the institutional potential of the technology and promote innovation.[399]

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[392] *See What Is a DEX (Decentralized Exchange)?*, CHAINLINK (Aug. 14, 2024), https://chain.link/education-hub/what-is-decentralized-exchange-dex [https://perma.cc/6PFG-LN52].

[393] *See id.*; Dombalagian, *supra* note 47 (manuscript at 3).

[394] Supplemental Information and Reopening of Comment Period for Amendments Regarding the Definition of "Exchange," 88 Fed. Reg. 29,448 (May 5, 2023) (to be codified at 17 C.F.R. pts. 232, 240, 242, 249) (proposed rule by the SEC to redefine "exchange").

[395] Further Definition of "As a Part of a Regular Business" in the Definition of Dealer and Government Securities Dealer in Connection with Certain Liquidity Providers, 89 Fed. Reg 14,938 (Feb. 29, 2024).

[396] *See, e.g.*, Press Release, CFTC, Illegal Derivatives Trading, *supra* note 17 (describing CFTC enforcement actions against three DEX operators).

[397] Citing the rule's possible application to crypto, Carol Goforth listed, among other factors, the virtual impracticability of effecting transactions in registered crypto asset securities, the weak fit of exemptions that require exempt platforms to have publicly available information to prevent manipulation in this global market, and international competition concerns. *See* Goforth, *supra* note 387, at 339–42; *see also* Hester M. Peirce, Comm'r, SEC, *Rendering Innovation Kaput: Statement on Amending the Definition of Exchange* (Apr. 14, 2023), https://www.sec.gov/news/statement/peirce-rendering-inovation-2023-04-12 [https://perma.cc/W7LU-5PSC].

[398] *See, e.g.*, Dombalagian, *supra* note 47 (manuscript at 3).

[399] *See* Goforth, *supra* note 387, at 339–43 (arguing that imposing existing regulations on crypto-exchanges will stifle innovation).

Similarly, the current enforcement-focused stance suffers from short-termism and misunderstands global DLT-enabled markets and ecosystems. The recent enforcement actions against DEXs[400] and a Wells notice sent to DEX developers as a potential enforcement target[401] reveal that enforcement is feasible when and if DEX developers are identifiable U.S. domiciliaries. In the 2023 CFTC orders, the decentralized finance developers were Delaware corporations;[402] and Uniswap Labs, served with a Wells notice from the SEC Division of Enforcement in 2024, is a New York firm working on improvements to the Uniswap protocol.[403]

Without identifiable U.S. residents, the bar for successful enforcement may be much higher. For one, when developers—or those who control protocols and upgrades—are anonymous or foreign, enforcement becomes more difficult, manifestly unrealistic, or prohibitively costly.[404] Furthermore, some developers create new DEXs repurposing the open-source code of other DEXs.[405] In 2020, for instance, pseudonymous developers Chef Nomi and 0xMaki created SushiSwap by copying the open-source code of Uniswap.[406]

Enforcement could become even less feasible if decentralized algorithmic entities emerged without much human participation, and "[b]ecause they lack human bodies, [algorithmic entities] are harder to catch and impossible to punish."[407] Even if human developers remained in the driver's seat, they could leave the United States and continue to experiment with code-based solutions from afar.

Two features of technology will further complicate enforcement-focused solutions. First, financial innovations are marked by an

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[400]   *See, e.g.*, Press Release, CFTC, Illegal Derivatives Trading, *supra* note 17.

[401]   Alexander Osipovich, *SEC Warns DeFi Firm Uniswap Labs of Potential Lawsuit*, WALL ST. J. (Apr. 10, 2024, 8:08 PM), https://www.wsj.com/livecoverage/cpi-report-today-inflation-stock-market-04-10-2024/card/sec-warns-defi-firm-uniswap-labs-of-potential-lawsuit-WBbt-KQFAkh12I28Ds4fm [https://perma.cc/82AZ-ZM2F].

[402]   *In re* Deridex, Inc., CFTC No. 23-42, 2023 WL 5937236, at *2 (Sept. 7, 2023); *In re* ZeroEx, Inc., CFTC No. 23-41, 2023 WL 5937239, at *2 (Sept. 7, 2023); *In re* Opyn, Inc., CFTC No. 23-40, 2023 WL 5937238, at *2 (Sept. 7, 2023).

[403]   Osipovich, *supra* note 401; *see* MacKenzie Sigalos & Kaan Oguz, *Uniswap Fights Back Against SEC as the Ethereum Crackdown Continues*, CNBC (May 21, 2024), https://www.cnbc.com/2024/05/21/uniswap-fights-back-against-sec-as-the-ethereum-crackdown-continues.html [https://perma.cc/RJ3R-N9G8].

[404]   For example, anonymous developers or other centralized parties may hold admin keys that enable them "to execute a restricted function" or governance tokens that allow them to affect protocol upgrades. Schuler et al., *supra* note 41 (manuscript at 21–23). Anonymity would hamstring potential legal actions. *Id.*

[405]   *See, e.g.*, *What is SushiSwap? (SUSHI)*, KRAKEN, https://www.kraken.com/learn/what-is-sushiswap-sushi [https://perma.cc/9QS6-VHU9].

[406]   *Id.*

[407]   Lynn M. LoPucki, *Algorithmic Entities*, 95 WASH. U. L. REV. 887, 891–92 (2018).

unforecastable radical uncertainty[408] concerning the future state of the technology. Second, any technological evolution is based on "mutually reinforcing developments."[409] Blockchains, smart contracts, cloud computing, and artificial intelligence ("AI")[410] can be combined to optimize offerings, trading, and clearing in unpredictable ways.

For example, if we take human coders developing smart contracts and replace them with AI proposing a code to human reviewers and prompt engineers for further improvement, this change could accelerate smart contract deployment, including DEX deployment, at a pace potentially beyond the oversight and enforcement capability of public regulators.[411] Most code underlying blockchain ecosystems is publicly available and open source,[412] which means that AI models can import pieces of code and learn fast from these accessible repositories. If—or rather when—real-world assets become progressively tokenized and capable of being transferred on-chain, the synergies between AI and blockchains should generate much faster economic interactions and geographically dispersed activities.

To illustrate this, this Author asked ChatGPT to write a code to two simplistic queries: (1) "Write a code for a decentralized exchange like Uniswap," and (2) "Write a code for the pair USDC and European Investment Bank Bond to launch a liquidity pool on Uniswap," a DEX. The first query showed how quickly ChatGPT imported data from open-source code repositories to propose a code for a decentralized trading platform,[413] and the second illustrated the speed of creating a liquidity pool contract.[414]

In sum, after referencing two assets, one of which is a tokenized bond (i.e., a security) and another which is a digital medium of exchange

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408 On the overarching analysis of this state of unknown where probability analysis is inapposite, see generally John Kay & Mervyn King, Radical Uncertainty: Decision-Making Beyond the Numbers (2020).

409 W. Paul Strassmann, Risk and Technological Innovation 218 (Cornell Univ. Press 1959).

410 "[AI] is used as an umbrella term to designate a broad set of methods that enable problem-solving via a combination of statistics and computer science." Giulio Bagattini, Zeno Benetti & Claudia Guagliano, Artificial Intelligence in EU Securities Markets, Eur. Sec. & Mkts. Auth. 4 (2023).

411 *See id.* ("[T]he scale at which AI can be used, the speed at which AI systems operate, and the complexity of the underlying models may pose challenges to the market participants intending to use them and to their supervisors.").

412 For a discussion of open-source software, see, for example, Angela Walch, *The Bitcoin Blockchain as Financial Market Infrastructure: A Consideration of Operational Risk*, 18 N.Y.U. J. Legis. & Pub. Pol'y 837, 874–79 (2015).

413 OpenAI, *Response to "Write a code for a decentralized exchange like Uniswap,"* ChatGPT, https://www.chatgpt.com (enter query into "Message ChatGPT" box).

414 OpenAI, *Response to "Write a code for the pair USDC and European Investment Bank Bond to launch a liquidity pool on Uniswap,"* ChatGPT, https://www.chatgpt.com (enter query into "Message ChatGPT" box).

(i.e., a stablecoin),[415] ChatGPT responded within seconds. It gave simple instructions to write a code for a liquidity pool against which anyone could trade the European Investment Bank ("EIB") bond and the USDC.[416] ChatGPT advised creating tokens "representing each asset, deploying a Uniswap pair contract, and providing liquidity."[417] Then, it provided the code with a final warning "to deploy these contracts on a test network first and ensure that [the Author had] the necessary test tokens for USDC and EIB Bond."[418] The code revealed how ChatGPT imported modules of the underlying code from the open-source databases of Uniswap and OpenZeppelin.[419]

Admittedly, this was merely a hypothetical illustration. The query ignored possible encoded restrictions on the transferability of the bonds,[420] the code was imperfect, and trading securities such as EIB bonds is not that simple. However, the intent was not to create a liquidity pool or convert actual tokenized bonds into illegally traded securities.

This simple experiment suggests that, with time, trading tokenized assets and creating venues for trading may be fast and open to many participants. Without some uniform regulatory principles, any investor may interact with a DEX and any entity may deploy one without identifying themselves or staying on to support its operations, exacerbating the risks of the users of that DEX.[421] The composability of blockchain-enabled applications and open-source code disclosure combined with AI will allow code and applications to be reused and repurposed by other applications and by market participants.[422] And the more blockchain-generated data AI models have, the better they will become,[423] strengthening the possible interaction between technologies and expediting transacting.

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415   For background, USDC is a stablecoin, a crypto asset that has a stable value and is secured by a reserve of cash and cash equivalents. *Fully Backed Digital Dollars*, Circle, https://www.circle.com/en/usdc [https://perma.cc/84WB-U75P]. The bonds in the query were issued by the European Investment Bank on Ethereum. *See* Press Release, Eur. Inv. Bank, *supra* note 46.

416   *See* OpenAI, *supra* note 413; OpenAI, *supra* note 414.

417   OpenAI, *supra* note 413.

418   OpenAI, *supra* note 414.

419   *See* OpenAI, *supra* note 413; OpenAI, *supra* note 414; *Factory*, Uniswap Docs, https://docs.uniswap.org/contracts/v2/reference/smart-contracts/factory [https://perma.cc/9498-QSTA]; *Build Secure Smart Contracts in Solidity*, OpenZeppelin, https://www.openzeppelin.com/contracts [https://perma.cc/S47G-XMMC].

420   As discussed elsewhere, protocols may enable blacklists and whitelists of addresses; asset contracts may also blacklist a pool's contract address, in which case transactions by the pool would not be executed. Schuler et al., *supra* note 41 (manuscript at 16–18, 24).

421   *See* Harvey et al., *supra* note 22, at 1, 20.

422   Autorité des Marchés Financiers, *supra* note 9, at 8.

423   The quality of AI and other predictive models is linked to the quality of data. Bagattini et al., *supra* note 410, at 5, 17–18. Here, blockchains may help because they are essentially high-quality, tamper-resistant data repositories.

These realities underscore the need for a coordinated approach concerning DEXs.[424] An efficient legal regime should incentivize developers, including not only those who make easy enforcement targets but also those who do not, to create DEX protocols that address the risks discussed in this Article.[425] This is where the policy-level, digital asset SRO[426] may develop better standards and even whitelist decentralized venues that follow them. It may also carry out a tailored registration or certification regime for DEXs or some of them in the future. Note, however, that this Article does not argue for imposing a specific regulatory or liability regime on DEXs and their developers. Instead, it suggests that the digital asset SRO should start by focusing on high-level standards and best practices for decentralized platforms and their developers.

Approved by U.S. regulators, these guidelines should send a strong signal to future DEX developers, nudging them to follow the standards. Whitelists of compliant DEXs, in turn, could produce a verifiable signal concerning the quality of DEXs and their compliance.[427] This should reveal to traders which platforms could be riskier than others.[428] In an ideal scenario, a separating equilibrium could form between the platforms that followed the best practices and those that did not, draining liquidity from bad venues as traders moved to safety.

These best practices and principles could also reinforce the efforts of developers and the community to design technological solutions to broader transactional and regulatory problems.[429] As examined elsewhere, developers within the blockchain ecosystem continually work on solutions to various transaction costs.[430] These efforts, however, lack baseline coordination. The coordinating standard-setter SRO discussed in this Article could address these problems.[431]

In summation, a self-regulatory system for digital asset markets could synergistically incorporate Massad and Jackson's and Yadav's

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[424] *See, e.g.*, BD. INT'L ORG. SEC. COMM'NS, *supra* note 259, at 119 (citing the need "for a globally coordinated approach").

[425] *See supra* Section VI.B.2.

[426] Yadav cautions, for example, that "[i]nvesting in oversight pays off when it generates liquidity, reduced scrutiny from a regulator, as well as positive network effects where reputational gains attract business. But it can be loss-making." Yadav, *supra* note 58, at 21 (footnote omitted). If decentralized finance remains unregulated, this will diminish the developers' payoff from investing in antimanipulation and antifraud efforts.

[427] *See* Schuler et al., *supra* note 41 (manuscript at 17–18).

[428] *See id.*

[429] *See, e.g.*, Omarova, *supra* note 332, at 418–19 (demonstrating the need for effective self-regulation to include broader regulatory values and observing that "the dynamics of the twenty-first-century global financial market demand a new approach to industry self-regulation, which has the potential to be much more comprehensive and systemic in its scope and operation").

[430] *See supra* Part I.

[431] *See supra* Section VI.B.2.

proposals[432] to address the problems of both CEXs and DEXs in several steps. First, the overarching SRO ("OSRO") could focus on developing comprehensive rules and coordination mechanisms for CEXs and digital asset broker-dealers. The OSRO should also develop codes of best practices for DEXs and whitelist DEXs deemed compliant with the codes. Second, CEXs should become standalone SROs and members of the OSRO to benefit from its activities and reduced coordination costs. Pictorially, the self-regulatory structure may look as follows in the figure:

FIGURE. POTENTIAL SELF-REGULATORY STRUCTURE

CONCLUSION

This Article starts with the argument that blockchains are beneficial institutional technologies that can be effectively employed in financial markets. The new digital asset market structure, however, poses challenges to the regulators and creates risks for market participants. To resolve these challenges and address the gaps in the institutional self-regulation of blockchains, this Article advocates for a two-tiered SRO structure, including a policy-level SRO and CEXs-SROs. Together, these SROs could comprehensively oversee the market, discipline bad actors, reduce transaction costs, and improve market integrity. Although DEXs differ from centralized digital-asset trading venues, the same overarching SRO may develop codes of best practices for DEXs to resolve coordination problems, alter developers' incentives, and nudge the community toward compliant solutions. In light of the global interconnections within the centralized and decentralized digital asset markets, the risks of both CEXs and DEXs need to be addressed in a coordinated and coherent manner. The analysis and solutions presented in this Article aim to help U.S. regulators achieve these goals.

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432   *See supra* Section VI.A.