

PERSPECTIVES ARTICLE

The Evolution of Decentralized Exchanges: Promise, Peril, and Policy Changes

Campbell R. Harvey,[†] Joel Hasbrouck,[‡] Fahad Saleh[§]

Abstract. Decentralized exchanges (DEXs) present challenges for regulation and investor protection; nevertheless, they also present many opportunities for disintermediation and transparency. We explore the past and present state of DEXs, and argue that regulators ought to recognize the both their risks and promises, pursuing oversight strategies that balance flexibility and investor protection.

1. Introduction

Over the past decade, decentralized exchanges (DEXs) have moved from being experimental tools in the cryptoasset ecosystem to serious financial infrastructures with global reach. Unlike centralized exchanges (CEXs), which rely on intermediaries, DEXs are algorithmically governed marketplaces deployed as smart contracts on blockchains. This technological shift has profound implications for market microstructure, investor protection, financial stability, and regulatory policy.

Our recent work provides a systematic analysis of DEXs, detailing their benefits, risks, and possible oversight mechanisms.¹ In this Perspectives piece, we build on that framework, situating DEXs within the broader historical arc of financial innovation, exploring the trade-offs of decentralization, and outlining pragmatic regulatory strategies that balance investor protection with technological progress.

Our research provides the first unified analysis of DEX benefits, investor risks, and regulatory feasibility grounded in market microstructure. It shows that while automated market maker (AMM) pricing can closely approximate limit order books for liquidity demanders, DEXs introduce novel risks that conventional regulation is ill-equipped to address, since DEXs are immutable code on permissionless blockchains where users need not identify themselves. Enforcement actions against supporting labs may perversely increase risk by removing the entities best positioned to patch vulnerabilities. These findings point toward indirect oversight through centralized intermediaries, while also highlighting that protocol-level design innovations such as Uniswap v4's hooks and MEV-internalization mechanisms can internalize costs that regulation alone cannot reach.

[†]C. R. Harvey (cam.harvey@duke.edu) is Professor of Finance at the Fuqua School of Business, Duke University and a Research Associate of the National Bureau of Economic Research in Cambridge, Massachusetts.

[‡]J. Hasbrouck (jh4@stern.nyu.edu) is the Kenneth G. Langone Professor of Business Administration and a Professor of Finance at the Stern School of Business, New York University.

[§]F. Saleh (fahad.saleh@warrington.ufl.edu) is William A. Emerson/Merrill Lynch Professor at the Warrington College of Business at the University of Florida.

2. DEXs in Historical Perspective

Financial markets have continually evolved toward greater transparency, efficiency, and disintermediation. Open outcry trading gave way to electronic limit order books, which in turn facilitated the rise of algorithmic and high-frequency trading. Each shift altered the role of intermediaries, reduced costs, and created new risks. DEXs can be seen as the next logical step: eliminating the need for any trusted third party.

Just as the invention of continuous auctions reshaped theoretical models of liquidity,² or the decimalization of tick sizes transformed competition among market makers, DEXs challenge long-standing assumptions. The novelty lies not just in their decentralized design, but in their global, permissionless accessibility: anyone with an internet connection and a wallet can trade. In this sense, DEXs democratize access to markets, though at the cost of introducing risks unfamiliar to traditional regulatory regimes.

3. Benefits: Transparency, Accessibility, and Settlement Finality

The advantages of DEXs stem from the properties of blockchains and smart contracts. First, pricing transparency is unparalleled: AMM formulas, such as the constant-product invariant, are publicly visible and auditable. Second, accessibility is universal: no broker, custodian, or registration is required. Third, settlement is nearly simultaneous with execution, eliminating the delays and counterparty risks that characterize traditional clearing systems.

These features have implications that extend well beyond crypto. The Bank for International Settlements' Project Mariana (2023) has already tested AMM-based settlement for cross-border central bank digital currencies.³ Proposals have suggested using AMMs for trading tokenized equities and fixed income, especially of smaller firms where illiquidity is problematic. In principle, DEXs could reduce transaction costs across a wide range of asset classes, delivering efficiency gains reminiscent of the dematerialization of paper securities or the introduction of electronic trading (see, *e.g.*, Malinova and Park, 2023).⁴

4. Risks: Code, Custody, and Coordination Failures

Yet as Harvey, Hasbrouck, and Saleh emphasize, the very features that make DEXs powerful also create novel risks:¹

1. *Code Risk (Smart Contract Vulnerabilities)*. Because DEX code is public and immutable, attackers can exploit bugs to drain funds, as seen in a number of high-profile hacks. Unlike centralized exchanges, which can reverse or reimburse fraudulent trades, DEXs offer no recourse.

2. *Custody Risk (Private Key Management)*. Permissionless blockchains require users to safeguard their cryptographic keys. Loss or theft is irreversible—an alien concept in traditional finance, where custodians and insurers provide a safety net.

3. *Coordination Failures (MEV and Front-Running)*. Perhaps the most studied pathology is Maximal Extractable Value (MEV), where block builders reorder transactions for profit (see, *e.g.*, John *et al.* 2025).⁵ For example, suppose there is a large buy order in the pool of pending transactions. This transaction will mechanically increase prices. It is possible for the block

builder to insert their own buy transaction before the large order and a sell transaction just after the large transaction. This is the so-called sandwich attack. Practices such as sandwich attacks or just-in-time liquidity systematically disadvantage ordinary users.^{6,7} These activities are not merely nuisances; they undermine trust in market fairness and efficiency, echoing debates about high-frequency trading “latency arbitrage” in equity markets.

These risks are not theoretical. Estimates suggest that sandwich attacks alone account for hundreds of millions of dollars annually in value extraction. The parallels to historical abuses—spoofing, interpositioning, or specialist manipulation on the NYSE—are striking. In both traditional and decentralized markets, information asymmetries combined with priority mechanisms create opportunities for rent extraction at the expense of uninformed participants.

5. Regulation: Old Statutes, New Realities

A central challenge is regulatory fit. U.S. securities law defines an “exchange” broadly as any group providing a marketplace for securities trading. Yet DEXs are not organizations but smart contracts: once deployed, they persist without managerial discretion. Attempting to regulate “the exchange” is akin to regulating open-source code itself.

This mismatch has led to regulatory uncertainty. The SEC delivered a Wells Notice to Uniswap Labs, suggesting that even the developers of DEX interfaces may be treated as accountable entities. But as Harvey, Hasbrouck and Saleh argue,¹ shutting down labs does not disable the underlying smart contracts, and may perversely increase user risk by removing sources of bug fixes and governance updates.

A more promising route may lie in indirect oversight. Centralized intermediaries—whether custodians, brokers, or centralized exchanges—that interact with DEXs could be required to perform due diligence, much as banks must vet counterparties under anti-money laundering rules. In this way, the existing regulatory perimeter can extend oversight into decentralized domains without attempting the impossible task of banning code.

6. A Global Technology: The Limits of National Regulation

Perhaps the most intractable challenge is that DEXs are borderless. A regulator in one jurisdiction may sanction users or interfaces, but trading can migrate instantly elsewhere. This recalls the experience of derivatives regulation in the 1990s, when attempts to restrict over-the-counter swaps simply pushed activity offshore.

The analogy underscores the need for international coordination, particularly in setting standards for disclosure, custody, and market integrity. The IMF has already recognized that traditional AML/CFT frameworks are ill-suited for DeFi, given the absence of intermediaries.⁸ Without coordination, fragmented national approaches may simply accelerate regulatory arbitrage.

7. Evolution of DEXs: Innovation and Self-Regulation

DEX technology is not static. Uniswap’s progression from v2’s uniform liquidity pools to v3’s concentrated liquidity and v4’s hooks illustrates rapid innovation in design.^{9,10} Features like MEV-internalization or whitelist hooks suggest that market forces may naturally evolve toward mitigating some of the very abuses regulators worry about.

Moreover, aggregators—software that routes trades across multiple DEXs—introduce competitive pressures that can discipline individual pools. This mirrors the role of alternative trading systems in equity markets, which flourished once regulators mandated order display and routing best practices. Over time, one could imagine a similar ecosystem of competing venues, intermediated by aggregators, achieving de facto self-regulation.

8. The Policy Dilemma: Light-Touch Monitoring vs. Heavy-Handed Intervention

What stance should regulators take? A heavy-handed approach risks stifling innovation, driving activity underground, and removing beneficial actors (like development labs). A laissez-faire approach leaves investors exposed to serious risks and undermines confidence.

A middle path—regulatory sandboxes or safe harbors—seems most prudent. Allowing innovation to proceed under observation enables regulators to gather data, understand market dynamics, and intervene only when risks become systemic. This approach has precedent: both the introduction of electronic communications networks (ECNs) in the 1990s and the rollout of derivatives clearinghouses in the 2000s were facilitated by transitional frameworks that prioritized experimentation and data collection.

9. Broader Implications: Tokenization and the Future of Finance

While today’s DEX activity is dominated by speculative crypto trading, the long-term horizon is broader. If stocks, bonds, and real estate are tokenized—and large institutions like BlackRock are already moving in this direction—the liquidity, transparency, and efficiency of DEXs has the potential to reshape capital markets themselves.

In this scenario, the stakes are no longer about protecting retail traders from sandwich attacks, but about the architecture of global finance. Will tokenized assets be intermediated primarily through regulated custodians and CEXs, or will DEXs provide parallel infrastructure? The answer may determine whether financial democratization—the vision of equal access for all wallet holders—remains an aspiration or becomes a lived reality.

10. Conclusion: One Frame of a Long Movie

Decentralized exchanges are both evolutionary and revolutionary. They extend centuries-old ambitions of disintermediation and market transparency, yet they also challenge foundational assumptions of regulation and investor protection. The framework laid out by Harvey, Hasbrouck, and Saleh offers a crucial starting point for this debate.¹

The key insight is that DEXs should not be judged solely by their current state, dominated as it is by cryptoasset speculation. Instead, they should be viewed as the early frames of a longer movie—one whose next scenes may feature tokenized real-world assets, institutional adoption, and new forms of cross-border settlement. Regulators, academics, and market participants must recognize both the risks and the promise, pursuing oversight strategies that are adaptive rather than prohibitive.

The challenge is formidable: to safeguard investors while nurturing innovation. But history suggests that markets evolve through exactly such tensions. If handled with care, DEXs may not only coexist with traditional finance but may ultimately redefine it.

Author Contributions

All authors contributed equally to this article.

Conflict of Interest

The authors declare that they have no known conflicts of interest as per the journal’s Conflict of Interest Policy.

References

- ¹ Harvey, C. R., Hasbrouck, J., Saleh, F. “The Evolution of Decentralized Exchange: Risks, Benefits and Oversight.” *Research Policy* (2026) forthcoming. Available at <https://dx.doi.org/10.2139/ssrn.4861942>.
- ² Kyle, A. S. “Continuous Auctions and Insider Trading.” *Econometrica* **53.6** 1315–1336 (1985) <https://doi.org/10.2307/1913210>.
- ³ No Author. “Project Mariana: Cross-Border Exchange of Wholesale CBDCs Using Automated Market-Makers (Final Report).” *Bank for International Settlements* (2023) <https://www.bis.org/publ/othp75.htm>.
- ⁴ Malinova, K., Park, A. “Learning from DeFi: Would Automated Market Makers Improve Equity Trading?” *SSRN* (2023) <https://dx.doi.org/10.2139/ssrn.4531670>.
- ⁵ John, K., Monnot, B., Mueller, P., Saleh, F., Schwarz-Schilling, C. “Economics of Ethereum.” *Journal of Corporate Finance* **91** 102718 (2025) <https://dx.doi.org/10.2139/ssrn.4783695>.
- ⁶ Park, A. “The Conceptual Flaws of Decentralized Automated Market Making.” *Management Science* **69.11** 6731–6751 (2025) <https://doi.org/10.1287/mnsc.2021.02802>.

⁷ Capponi, A., Jia, R., Zhu, B. “The Paradox of Just-in-Time Liquidity in Decentralized Exchanges: More Providers Can Sometimes Mean Less Liquidity.” *SSRN* (2023)
<https://dx.doi.org/10.2139/ssrn.4648055>.

⁸ No Author. “Elements of Effective Policies for Crypto Assets.” *International Monetary Fund* (2023)
<https://www.imf.org/en/Publications/Policy-Papers/Issues/2023/02/23/Elements-of-Effective-Policies-for-Crypto-Assets-530092>.

⁹ Hasbrouck, J., Rivera, T. J., Saleh, F. "An Economic Model of a Decentralized Exchange with Concentrated Liquidity." *Management Science* **0.0** (2025)
<https://doi.org/10.1287/mnsc.2024.04510>.

¹⁰ Bachu, B., Hasbrouck, J., Saleh, F., Wan, X. “An overview of Uniswap v4 for researchers.” *SSRN* (2025)
<https://dx.doi.org/10.2139/ssrn.5152215>.



Ledger is published by Pitt Open Library Publishing, an imprint of the University Library System, University of Pittsburgh. Articles in the journal are licensed under a Creative Commons Attribution 4.0 License.