

The Effectiveness of Trade Surveillance Models in Identifying Market Manipulation: A Study of Wash Trading and Off-Market Pricing

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Abstract

This study explores trade surveillance models especially for wash trading and off-market pricing. These are few fraud behavior patterns that cause persistent threat to market integrity in traditional equity markets, cryptocurrency exchanges and decentralized ecosystems. Although there is growing regulatory attention but there is less improvement in the current surveillance systems and remain fragmented and inconsistent in their ability to uncover manipulative behavior for different market structures. This paper summarizes findings from three peer-reviewed empirical studies to evaluate the effectiveness of current trade surveillance models and proposes an integrated detection framework that combines graph-based network analysis, econometric modeling, machine learning classifiers, and blockchain transparency tools. These reviewed literatures all together demonstrate that: directed graph algorithms achieve more than 95% detection accuracy for collusive wash-trading patterns in traditional regulated markets; around 70% of reported trading volume on certain cryptocurrency platforms is fabricated using coordinated self-transactions; and AI-assisted blockchain analytics can identify wash-trading loops in decentralized NFT markets with more than 95% precision. Researching and studying these findings, this paper proposes a unified, AI-driven surveillance architecture integrating real-time graph traversal, cross-exchange auditing, and blockchain forensic analysis. The framework designed to improve detection speed, reduce false positives, and support regulatory enforcement for both centralized and decentralized financial environments. Paper discusses the implications for regulatory policy, financial compliance infrastructure, and future surveillance system design.

Key Words: Wash trading; Market manipulation; Trade surveillance; Off-market pricing; Graph-based detection; Blockchain analytics; AI anomaly detection; Cryptocurrency markets; NFT markets; Financial regulation

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1. Introduction

In recent years, studies have shown widespread cases of wash trading, inflated volumes, and off market pricing on traditional, NFT or crypto market. Certain cryptocurrency exchanges reported trading activity can be overstate by 70-200% due to wash trading and repeated self-transactions [1]. These trading practices are less detectable activity, which misleads investors by giving an artificial picture of true market conditions [2,3]. Wash trading is one kind of market fraud that occurs when a trader, or a coordinated set of accounts, repeatedly buys and sells the same asset to create the illusion of real volume, a behavior documented in both traditional and decentralized digital exchanges. This behavior has become even more observable with the shift toward faster, highly automated trading platforms, where financial transactions move so quickly that doubtful patterns are harder to spot.

The rise of decentralized markets and counterfeit trading and inflated volumes and valuation distortions has also created new limitations of the surveillances system, making it difficult for regulators or exchanges to determine who is behind certain trades or whether multiple accounts belong to the same culprit [4,5]. As a result, different surveillance tools vary widely in what they can detect, how they use data, and how well they perform when applied to traditional markets, cryptocurrency platforms, or NFT ecosystems. Using insights from the reviewed literature, this study examines how existing surveillance models operate and proposes an integrated framework that combines graph-based network analysis, blockchain transparency, and AI-supported anomaly detection to enable real-time identification of wash trading and off-market pricing by capturing repeated or circular trading patterns, tracking wallet behavior in pseudonymous environments, and detecting irregular timing, abnormal price deviations, and repetitive transactional structures that traditional rule-based systems may overlook [2,5].

2. Literature Review

2.1. Methodology

Parameters for articles included in the literature review were research within the last 10 years, only research from scholarly sources, and research relevant to the research question. Factors such as type of market structure, the availability and quality of trade data, regulatory reinforcement mechanism and technological tools used to detect manipulation, were reviewed. The databases used to conduct this literature review were the Education database from the monroe university library, as well as research gate; to ensure high-quality articles. The researcher flagged key details from each study, including who conducted the research, when and where data collected, why the research conducted, how the methodology and process structured, and what the main findings revealed. Research did not meet these standards excluded. The relevant data compiled into an Excel Research Tracker to organize and compare key findings. Search terms/key words used to obtain relevant literature included search terms and key words included "wash trading," "off-market pricing," "bond mispricing," "cryptocurrency manipulation," and "NFT market fraud." Among the studies retrieved, three studies selected for in-depth analysis because they aligned directly with the research question.

2.2. Detection of wash trading in traditional financial markets

Cao et al. conducted a quantitative study to develop a computational model for detecting wash trading in traditional stock exchanges, in their research they used datasets from NASDAQ and the London stock exchange [2]. The main aim of study is to identify collusive trading activities creating false market liquidity. Researchers built a two-step algorithmic framework using directed graphs (digraphs) and dynamic programming to identify collusive cliques. For their research researchers collected trade transaction data from NASDAQ and the London Stock Exchange, then applied directed graph modeling and dynamic programming algorithms to map repeated buy-sell patterns among the same traders, quantifying the detection rate across test samples. The process included segmenting raw trade data into smaller transaction clusters, then applying pattern recognition algorithms to identify repetitive, non-random trade cycles between the same counter parties. For validation, researchers used statistical methods and Monte Carlo simulations to evaluate the significance of observed trading loops. Their model detected over 95% of wash-trade patterns, proving the potential of graph-based market surveillance and results showed that detection accuracy improved as the algorithm incorporated time-series filters, confirming its potential for real-time regulatory surveillance in high-frequency markets.

2.3. Wash trading and market manipulation in cryptocurrency exchanges

Likewise, Silaa et al. expanded Cao et al.'s quantitative approach by the application of comparable analytical frameworks to the cryptocurrency market [1,2]. They highlighted similar manipulation risks in less regulated financial ecosystems and build using the same core concept like Cao et al.'s algorithmic that as foundation for detecting coordinated trades in regulated stock markets, Silaa et al. extended the exploration of wash trading into cryptocurrency exchanges, where decentralized and pseudonymous trading introduces new manipulation risks [1,2].

Silaa, et al. conducted a quantitative empirical study that investigated market manipulation behaviors in the cryptocurrency domain [1]. This research was conducted between 2020 and 2022 and the research focused on several large, centralized cryptocurrency exchanges. The purpose of the research was to examine how wash trading affects market liquidity, price accuracy, and investor confidence. Their study used a quantitative research approach in which they applied econometric and forensic modeling to detect repeated buy-sell trades made by the same entities. For this they used methodology that involved building an econometric regression model comparing reported versus actual trading volumes and performing cross-exchange correlation tests to detect abnormal activity patterns. The research team validated results through robustness checks using independent blockchain datasets and transaction-level data from four major cryptocurrency exchanges, which represents millions of trades across multiple digital assets.

These collected and filtered transaction data then used to identify abnormal trading loops and volume inflation patterns. Researchers used statistical tests and cross-exchange comparisons to measure the scale and persistence of wash trading. Furthermore, the researchers enhanced their analysis by performing granger causality and variance decomposition tests to assess how wash trading influenced price volatility. To further strengthen their quantitative framework researchers also used machine learning classifiers to distinguish organic trading from manipulative behavior, this refines detection precision across multiple exchanges. Their Analysis indicated that around 70 percent of the reported trading volume on certain platforms was the result of wash trading. Such inflated activity

generated misleading market signals, giving investors a distorted impression of demand and liquidity. The researcher concluded that stronger regulatory oversight, independent exchange audits, and automated forensic detection systems are necessary to restore transparency and market integrity.

2.4. Advanced detection in decentralized NFT markets

In contrast to Silaa et al. which concentrated on centralized crypto exchanges, Tošić et al. extended the discussion by applying blockchain network analytics and artificial intelligence driven detection within decentralized NFT ecosystems. This captures the evolution of wash-trade behavior in digital asset markets [1,5].

Tošić et al. performed a network-analysis study on decentralized NFT markets [5]. where they analyzed seven NFT collections on the ethereum blockchain, including the meebits series. Their studies tried to expose pseudonymous self-trading patterns undermining NFT price integrity. For identifying cyclical wash-trading loops researchers applied graph traversal and anomaly-detection algorithms and used Ethereum on-chain transaction data to construct wallet-to-wallet interaction graphs. Researchers applied cycle detection algorithms to understand patterns of self-trading within wallet networks and employed clustering metrics to assess the statistical relevance of these connections.

This study reveals that over 90% of trades in certain NFT collections were wash trades, which causes significant distortion in price discovery and market transparency. Researchers employed temporal graph embedding models to track transaction patterns over time, allowing detection of evolving wash-trading networks. These embeddings helped visualize wallet clusters engaging in self-dealing activity. Finding showed up to 93% of Meebits trades were wash trades, confirming blockchain transparency enables effective forensic detection. With this the researchers concluded that blockchain transparency allows for scalable forensic auditing. Their Artificial Intelligence-assisted framework achieved over 95% precision in identifying self-linked wallet networks, suggesting a viable pathway for regulators to detect fraudulent NFT transactions in real time.

2.5. Comparative analysis of literature

The three studies collectively demonstrate that wash trading is a pervasive manipulation strategy across all major market structures, but that no single surveillance approach is sufficient across all environments. Cao et al. established algorithmic foundations for regulated environments using graph-based pattern recognition [2]. Silaa et al. examined behavioral manipulation in emerging crypto markets through econometric and machine-learning techniques [1]. Tošić et al. demonstrated the potential of AI-assisted blockchain analytics for real-time detection in decentralized systems [5].

Despite differences in methodology and scope, all three studies confirm that artificial trading inflates market activity, distorts asset prices, and weakens investor trust. Gaps remain in harmonizing cross-market data standards and establishing global frameworks for digital trade surveillance. Addressing these gaps would strengthen the accuracy, consistency, and fairness of modern financial market oversight.

3. Proposed Integrated Surveillance Framework

Research and observations on the findings of the reviewed literature, this paper proposes an integrated, AI-driven surveillance framework that integrates blockchain data analytics, graph-based anomaly detection, and cross-market auditing to identify wash-trading and off-market pricing behaviors in real time. The framework combines three complimentary analytical process: graph-based network analysis for detecting circular trading patterns, machine learning classifiers for volume anomaly detection and behavioral profiling, and blockchain transparency tools for on-chain forensic auditing. This integrated strategy not only strengthens detection and accountability but also helps to protect investors across both centralized and decentralized markets.

In practice, this framework could be implemented through joint efforts among regulators, exchanges, and data science teams. Regulators would standardize reporting APIs, exchanges would stream anonymized trade data to a shared or hybrid analytic cloud based on the risk assessment of individual groups or companies and based on the visibility of the black box models, can use AI models trained on historic wash-trade patterns would continuously flag suspicious cycles for review. The expected outcome is faster detection of manipulative trading, enhanced investor confidence, and measurable improvement in global market transparency across both traditional and decentralized ecosystems. The implementation of a unified, AI-driven surveillance system is anticipated to generate several improvements across global financial markets. First, detection speed would increase significantly. Real-time AI and blockchain analytics help regulators and exchanges to identify suspicious trading cycles within seconds rather than days or weeks, reducing the window during which harmful manipulation can distort prices. Faster detection directly limits the scale and duration of wash-trading events and prevents abnormal price swings from influencing broader market trends.

Second, the system would improve detection accuracy. By combining graph-based algorithms with machine-learning classifiers technique and blockchain transparency, the framework can distinguish legitimate high-frequency trades from manipulative patterns with greater precision. This reduces false positives while at the same time making sure more meaningful enforcement actions. Over time, retraining models on newly detected behaviors strengthens predictive ability, making surveillance systems more adaptive to evolving manipulation tactics. Finally, the combined system supports long-term market transparency and fairness. Continuous monitoring supported by AI and unchangeable blockchain data contributes to improved accountability, which allows regulators to conduct historical analyses and identify persistent offenders. This transparency discourages future manipulation, promotes ethical market behavior, and aligns market practices with global regulatory expectations.

The framework addresses the key limitations identified across all three reviewed studies: the absence of a unified, cross-market surveillance system capable of operating consistently across regulated equity markets, centralized cryptocurrency exchanges, and decentralized blockchain ecosystems. In combination, these results contribute to a more secure, strong, and reliable financial ecosystem, support fair price discovery and improve overall market integrity across multiple asset classes.

4. Discussion and Policy Implications

Taken together, the findings reviewed here suggest the problem is larger than most current surveillance frameworks were built to handle. Fabricated volume at the scale Silaa et al. and Tošić et al. document 70% in crypto markets, over 90% in certain NFT collections does not represent edge-case manipulation [1,5]. It points to a structural gap between how these markets operate and how they are being monitored.

Addressing that gap is partly a regulatory problem and partly a technical one. On the regulatory side, standardized trade reporting requirements and cross-exchange auditing would make independent verification possible in markets where it currently is not. AI-assisted detection tools also need clearer standing within formal examination frameworks now their adoption is uneven, and their performance standards undefined. Broader coordination between US regulators and their international counterparts is a longer-term challenge, but one that is difficult to avoid given how easily manipulation migrates across jurisdictions.

Institutions managing surveillance programs for Fixed Income, FX, or digital assets face a more immediate version of the same problem. Rule-based systems catch what they were programmed to catch. The graph-based and ML-driven approaches in the reviewed literature detect patterns that emerge from behavior rather than from predefined thresholds which is precisely where the gap in current detection tends to be.

5. Conclusion

The literature reviewed here consistently points in one direction: detection works best when methods are combined rather than applied in isolation. Graph-based pattern recognition is effective in traditional markets but does not translate cleanly to pseudonymous blockchain environments. Volume-comparison models reveal fabricated activity in crypto exchanges but were not designed for NFT wallet networks. Blockchain analytics, meanwhile, depend on the transparency properties that centralized markets do not always provide.

Each method fills gaps with the others leave open. An integrated framework that draws on all three would be more accurate, more adaptable, and harder to evade than any single-approach system currently in use. That case only gets stronger as trading activity becomes more complex and the line between centralized and decentralized markets continues to blur. What remains to be done is moving from framework to test. The proposal outlined here is conceptual its actual performance against live or historical market data is an open question and the most important one for future work. Hybrid market environments, where centralized order books interact with on-chain settlement, seem like the natural starting point for that evaluation.

References

1. Sila J, Kočenda E, Kristoufek L, et al. Determinants of wash trading in major cryptoexchanges. SSRN. 2025.
2. Cao Y, Li Y, Coleman S, et al. Detecting wash trade in financial market using digraphs and dynamic programming. IEEE Trans Neural Netw Learn Syst. 2015;27:2351-63.

3. Choi J, Kronlund M, Oh JY. Stale or off-market pricing and valuation distortion in bond mutual funds. *J Fin Econ*. 2020;137:321-47.
4. Bartram SM, Grinblatt M, Nozawa Y. Book-to-market, mispricing, and the cross-section of corporate bond returns. https://www.nber.org/system/files/working_papers/w27655/w27655.pdf
5. Tošić A, Vičić J, Hrovatin N. Beyond the surface: advanced wash-trading detection in decentralized NFT markets. *Financ Innov*. 2025;11:86.