



Decoding the DNA of stock market microstructure: A comprehensive bibliometric and content review analysis

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ABSTRACT

Market microstructure focuses on how an investor's latent demand translates into stock prices and trading volumes. Studies have explored various facets while this study provides a comprehensive bibliometric and content analysis of 867 Scopus-indexed research articles on market microstructure published during the time period 1983–2024. Using science mapping technique, this study identifies intellectual structures, thematic structure, and knowledge clusters shaping the field. Based on intellectual structure and content analysis we explored five thematic pillars. These are Liquidity & Price Discovery, Information Asymmetry, Trading Mechanisms & Market Design, High-Frequency Trading (HFT) & Low-Latency Markets, and Market Fragmentation & Execution Quality, alongside an emerging cross-cutting theme on Governance, ESG, and Market Fairness. While existing literature has advanced the understanding of price formation, liquidity dynamics, and trading behavior, significant research gaps persist, particularly in the context of emerging markets, ESG-driven trading, and cross-market comparisons. By integrating thematic clustering with a gap-mapping framework, this study connects each intellectual cluster to its underexplored areas, specifies relevant data sources, and proposes robust methodological approaches such as high-frequency econometrics, network analysis, and causal inference designs. This study has made contribution in two ways: firstly, it maps the intellectual evolution of microstructure research over last four decades; secondly, it offers a structured research agenda that transforms bibliometric insights into actionable pathways for advancing theory, policy, and practice in increasingly complex and fragmented financial markets.

1. Introduction

The field of market microstructure studies the internal mechanism of financial markets, such as how trading of securities occurs, how prices are determined, and how liquidity and information asymmetries shape market outcomes (Glosten and Milgrom, 1985; Harris, 2003; O'Hara, 2001). This field basically covered the bid-ask spreads in trading as well as liquidity (dealer-driven) and has

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progressed alongside technologically, regulatory, and on institutional aspects; such as from traditional floor-based trading system to advanced electronic trading system (Huang et al., 2005; Subrahmanyam, 1994). Such microstructure developments resulted in new challenges regarding the trading system for securities, its quality, price subtleties, low and high frequency trading and order book mechanism.

Existing literature discovered a broad range of conceptual studies; however, majority brought mixed results, often discussed single factors instead of integrative phenomena. Such as the study of Zhang et al. (2022) who systematically review decision-fusion approach for stock market prediction, synthesizing various modeling techniques. While such studies contribute to forecasting accuracy, and ignore the structural and institutional dimensions of trading, which are central to market microstructure research. On the other side, the study consolidates fragmented work by identifying intellectual links, highlighting new research directions, and charting thematic developments.

Similarly, the study of Nti et al. (2020) attempted a systematic critical review of stock market prediction using machine learning. About 122 papers were reviewed by classifying prediction models on the basis of fundamental, technical, and sentiment-based indicators. The results discovered that 66%, 23%, and 11% of documents are based on technical analysis, fundamental analysis and sentiment analyses. The study found that, support vector machine and artificial neural network were found to be the most used machine learning algorithms for stock market prediction. Further, the study of Verma et al. (2023) investigate advances in stock market forecasting models, however Ferreira et al. (2021) examine the application of advanced computational techniques in trading strategies. While these studies provide valuable insights into predictive modeling and trading mechanisms, they do not sufficiently address the structural evolution of market microstructure. This study diverges by examining how trading systems are designed and how markets function at the micro level.

While Malgaha Kumbure et al. (2022) offer a broad review of forecasting approaches and data sources used in financial markets, our study shifts the focus toward the foundational structure of financial markets within the market microstructure framework. By applying bibliometric and science-mapping techniques, this research traces the intellectual development of the field and identifies its theoretical underpinnings. A closely related study by Somanathan and Rama (2020) also adopts a bibliometric approach to review stock market prediction research, particularly in emerging markets. However, the present study explores a distinct domain of the field market microstructure by systematically mapping its theoretical foundations and functional evolution.

Other literature reviews take much narrower thematic perspectives than an ensemble-built literature review. For instance, Naik and Reddy (2021) focus on liquidity and its determinants; Tripathi and Dixit (2020) address liquidity dynamics in emerging economies; Dhingra et al. (2024) focus on volatility patterns and modeling approaches; Patel et al. (2022) study global market integration and co-movement; and Otinga et al. (2024) examine trends in investor participation. While contributing valuable insights, each of these literature reviews, however, is limited to examining only one aspect of market operation. Consequently, the present study maps the full intellectual structure of research in market microstructure by linking how liquidity, volatility, transparency of trading, transaction costs, asymmetry of information, and market regulations relate to one another through a collective analytic framework.

The Initial theoretical literature such as the study of Woo et al. (2020) revisit the market efficiency hypothesis which is named as (EMH), then the Adaptive Market Hypothesis (AMH) by the study of Saldanha et al. (2025), and further it is criticized by one of the pioneer study in behavioral finance by (Thaler, 2016; Said et al., 2022; Raza et al., 2023), offering perspectives on securities price efficiency, the investors rationality, and the anomalies concerned with it. Though, these studies are typically framed around stock market operation instead of its institutional and structural processes. The existing study extends these theoretical positions by embedding them into a broader bibliometric cartography and content analysis, showing how EMH, AMH, and behavioral finance research interconnect with the theoretical and empirical advances in the field of market microstructure.

In addition to this, while previous literature reviews only look at qualitative aspects, this study combines science mapping tools (Biblioshiny and VOSviewer), and content analysis. This multi-dimensional approach provides an opportunity to map how the market microstructure theme has evolved over time as well as to visually represent its conceptual, psychological and intellectual frameworks and identify empirical frontiers in this research space. By conducting this process, we have successfully closed the gap between our knowledge of the field of market microstructure and our understanding of how the research landscape surrounding microstructure is being developed and changing. Through this process, we provide a reference point for future researchers when exploring the ever-evolving and complex world of market microstructure research.

This study retrieved and analyzed 867 articles from Scopus database for the time period 1983–2024. The data is analyzed with the help of Biblioshiny package and VOSviewer. Doing so we combine performance metrics and structural networks (co-authorship, co-citation, bibliographic coupling). Finally, we also conducted conceptual trends (co-word analysis, thematic evolution), alongside a comprehensive content review of the sample articles. For formulating the research questions, we followed the steps below,

1. Who are the leading authors, journals, institutions, and countries conducting research on this market microstructure?
2. How co-authorship patterns shape the institutional and international collaboration structures?
3. Which is the foundational work and scholarly influence based on co-citation and bibliographic coupling patterns?
4. How research themes evolved over time? Which are the emerging topics, stable topics, or declining topics?
5. What type of thematic clusters can we retrieve from the intellectual structure on the topic?

The results reveal that leading researcher in the field of market microstructure research are Amihud and Easley, and leading institutions contributing to research are Cornell, NYU, and Monash university. The United States as a country is major contributing country and dominates other nations in terms of output and global influence, followed by China, Australia, and few European countries. We also observed strong collaboration patterns among developed economies. It is really encouraging to see emerging trends

in developing markets such as Pakistan, Tunisia, and Vietnam. The intellectual structure is based on five dominant thematic pillars: information asymmetry, liquidity and price discovery, trading design, high-frequency trading, and market fragmentation and execution quality. The research is also tilting towards new cross-cutting themes such as ESG, governance, and fairness. In 1980s and 90s the research mainly focuses on bid-ask spreads, trading costs, and market efficiency. In the last couple of decades, we noticed that the thematic evolution highlights a clear shift towards integration of high-frequency trading, global financial crises, and systemic risk evaluation. Recently algorithmic trading, market fragmentation, and sustainable finance remains center of attention.

Key efforts are taken for the extension of traditional microstructure measures to cryptocurrency and DeFi markets, reflecting the field's broadened analytical scope. Recent literature also documents the rise of hybrid low-latency and high-frequency algorithmic strategies planned to direct multi-venue fragmentation, particularly within emerging stock markets. One more remarkable development is the integration of ESG indicators directly into price-discovery and adverse-selection contexts, signaling a shift toward sustainability-aligned market microstructure optimal design.

The remaining of the paper is organized as follows. Section two comprised of prior literature reviews and places study contribution within the existing knowledge. Section three designates the collection of data, exclusion and inclusion of the papers, and analytical tools used by the study. Section four of the study offers the findings, start with performance analysis, followed by discussing the thematic evolution and conceptual structure of the field, collaboration networks, and the intellectual structure of the field. Section five came up with thematic interpretations, research gaps identification, discusses theoretical, practical implications, and acknowledging its limitations and sketches research paths for future.

2. Literature review

This section synthesizes the research work on stock market microstructure in a coherent sequence. We begin the discussion by outlining how market microstructure helps in understanding price formation mechanism, trading behavior, role of market design and institutional variation. The discussion also sheds light on core themes such as information asymmetry, liquidity and price discovery. The field of study has passed its embryonic stage and significant advancements is achieved in terms of methodological and conceptual shifts. Such progress transformed the field over time. Such a broader view is helpful in providing a comprehensive synthesis and leads to exploration of research gaps.

The studies on Market microstructure (MM) examines the overall processes and mechanisms through which financial securities are traded and prices are evaluated, offering valuable insights into the mutual interaction of market participants, trading laws, and direction of information flows (O'Hara, 1995; Madhavan, 2000; Said et al., 2024). The foundational information-based models of [Glosten and Milgrom \(1985\)](#) and [Kyle \(1985\)](#) explain how asymmetric information between trader's effect bid-ask spreads and relative market depth. The transition from floor-based trading to fully automated systems together with introduction of electronic communication networks and enhanced execution speed further speedup the process of evolution ([Domowitz and Steil, 1999](#)). Based on the availability of HFT data and advanced computational tools researchers opted for integrated, multi-factor models of market dynamics. Unlike traditional static models, liquidity, volatility, and transaction costs are determined simultaneously by trader specific behavior, market structure, and technological innovation ([Comerton-Forde and Rydge, 2006](#); [Budish et al., 2015](#)).

Market design focuses on improving trading protocols, informational transparency, and tick size shifts. Studies such as [Goldstein and Kavajecz \(2000\)](#) argued that significant reduction demonstrate in tick sizes have reduced the quoted spreads. Similarly, the replacement of dealer-based systems by order-driven systems has positively (negatively) effected transparency (incentives for liquidity provision) ([Pagano and Schwartz, 2003](#); [Madhavan et al., 2005](#)). [Comerton-Forde and Rydge \(2006\)](#) shed light on the importance of institutional heterogeneity, highlight how variation in opening and closing call auctions influence volatility. [Budish et al. \(2015\)](#) found that the integration of continuous limit order books with sub-millisecond latency competition can possibly boost inefficiencies by incentivizing excessive investment in speed rather than in liquidity provision. Such findings underscore that market architecture interacts with trader strategies, producing varied microstructure outcomes across settings.

Information asymmetry remains central to MM theory, influencing spreads, volatility, and market depth. [Easley and O'Hara's \(1987, 1992\)](#) models, along with the PIN measure (Probability of Informed Trading) ([Easley et al., 1997](#)), provide empirical frameworks for quantifying informed trading. Empirical work by [Barclay and Warner \(1993\)](#) shows that medium-sized trades often carry disproportionate price impact, suggesting strategic behavior by informed traders to avoid detection. Recent studies extend these insights to emerging markets and corporate governance contexts. [Lin et al. \(2019\)](#) show that firm size and analyst coverage reduce information asymmetry, improving price efficiency. [Said et al. \(2026\)](#) examine that high corporate disclosure raise stock market informational efficiency in asian emerging stock markets. [Krichene and El-Aroui \(2018\)](#) find that market maturity influences the speed and accuracy of price discovery. Ownership structure also matters, i.e., [Bhakar et al. \(2024\)](#) demonstrate that concentrated ownership can impair market transparency and hinder efficient price formation. Collectively, these studies reinforce that price discovery is not solely a function of information arrival but also of the institutional and corporate settings in which trading occurs.

Liquidity is multidimensional, encompassing tightness (spreads), depth, and resiliency ([Kyle, 1985](#)). [Amihud's \(2002\)](#) illiquidity measure remains a widely used proxy, linking price impact to trading volume. [Chordia et al. \(2000\)](#) identify liquidity commonality while [Kamara et al. \(2008\)](#) show that such commonality often increases during market stress. [Pástor and Stambaugh \(2003\)](#) find that liquidity risk is priced, with investors demanding a premium for holding assets sensitive to market-wide liquidity shocks. Despite the depth of liquidity research, review studies highlight significant gaps in the context of emerging markets. [Tripathi and Dixit \(2020\)](#) point to underexplored areas such as liquidity beyond the best bid-ask quotes, the intraday predictability of returns from microstructure variables (e.g., order imbalances), and the effects of algorithmic trading on liquidity volatility. [Naik and Reddy \(2021\)](#) emphasize the need to study interlinkages between emerging and global markets, considering the multidimensional nature of liquidity.

Trading in high frequency has altered the markets, with the help of providing liquidity and likely instability. Menkveld (2016) research find that such types of trading often act as market makers, tightening spreads and improving depth. Though, during stressed periods, HFTs may worsen volatility and withdraw liquidity (Kirilenko et al., 2017). Budish et al. (2015) argue that the HFT effects feature of occurring repeatedly is due to its heterogenous nature: its returns and risks depend on market situations, particular asset class, and design features such as minimum resting times. This make parallel with the Adaptive Market Hypothesis, where behavior of the investor and market resilience change in response to varying regulatory and regulatory environments.

At ultra-high frequencies, transaction prices are contaminated by microstructure noise arising from bid-ask bounce, discreteness, and other frictions. Zhang et al. (2005) show that ignoring this noise biases realized volatility estimates upward. Hansen and Lunde (2006) propose robust estimators, including pre-averaging and realized kernels, to mitigate such biases. Kwon and Lee (2016) further demonstrate that microstructure noise can serve as a leading indicator of changing market conditions, as rising noise levels often precede liquidity deteriorations. These findings highlight that accurate measurement of volatility in the presence of noise is crucial not only for risk management but also for testing asset pricing models and evaluating trading strategies.

Microstructure research also sheds light on short-horizon return predictability and anomalies. Jegadeesh and Titman (1995) document momentum effects that persist over intermediate horizons, while Chordia et al. (2005) link intraday return patterns to liquidity fluctuations. The “flash crash” of May 6, 2010, underscored the systemic risk implications of microstructure dynamics. Kirilenko et al. (2017) attribute the rapid price collapse partly to feedback loops between algorithmic traders, highlighting the fragility of liquidity under extreme stress. These episodes emphasize that market efficiency cannot be assessed without considering stability and resilience to shocks.

The methodological landscape of MM research has evolved substantially. Bibliometric tools such as VOSviewer and Biblioshiny have been used to map intellectual structures in related fields, including financial market integration (Patel, 2021), stock market liquidity (Naik and Reddy, 2021), and forecasting (Bustos and Pomares-Quimbaya, 2020). Parallel to this, the integration of Artificial Intelligence (AI) and machine learning has opened new research avenues. Ferreira et al. (2021) review AI applications in trading, classifying them into portfolio optimization, price prediction, sentiment analysis, and hybrid approaches. Machine learning-focused reviews (Kumbure et al., 2022; Verma et al., 2023) document the increasing use of deep learning, textual sentiment, and hybrid indicator frameworks. Nti et al. (2020) systematically review just fundamental and technical analysis models, while Somanathan and Rama (2020) emphasize the need for hybrid big data-driven models validated in emerging markets. These methodological developments reflect a broader shift from purely theoretical models to empirically rich, data-intensive approaches, aligning MM research with developments in computational finance and behavioral modeling.

It is a main insight provided by this literature that went from single to multi-factor approaches of market microstructure. The literature now views liquidity/ volatility/ transaction costs as endogenous to the (trading) environment and that information asymmetry, heterogeneity of traders, market structure/design, and technological change are all facets that interact in creating these series. HFT is illustrative of this complexity: it can increase liquidity and efficiency when markets are normal but could introduce instability during stress. The literature also documents that market results are context specific. Institutional design attributes, such as tick size, transparency regulation, and order routing rules produce heterogeneous microstructure patterns across markets. Moreover, empirical measures need to consider microstructure noise in order to obtain unbiased estimates of both volatility and efficiency. Research gaps noted for review studies to fill are; (i) the need to incorporate emerging market evidence in MM theory; (ii) a more detailed study of the pricing of liquidity risk across regimes; (iii) better understanding cross-market liquidity interrelations, and (iv) deploying advanced AI/ ML methods in real-time prediction and market monitoring. Many of these gaps will be filled only by further methodological enhancements and by joint efforts of specialists of market microstructure and computational finance.

While prior research has made substantial progress in explaining individual dimensions of market microstructure, the evidence remains fragmented across specific contexts, asset classes, and methodological approaches. Much of the literature focuses on either developed markets or isolated phenomena such as liquidity, volatility, or information asymmetry, without fully integrating these into a unified, multi-factor framework. Furthermore, the heterogeneity of HFT impacts, the context-dependent nature of liquidity pricing, and the role of microstructure noise in biasing empirical measures remain underexplored in emerging market environments. The existing reviews also tend to be discipline-bound: bibliometric analyses are often separated from systematic content reviews, and advanced computational methods are frequently discussed without direct linkage to traditional market microstructure theory. Against this backdrop, the present study contributes by providing an integrated bibliometric and content analysis of stock market microstructure research, combining HFT data insights, institutional design considerations, and technological dimensions such as algorithmic and AI-driven trading. By mapping the intellectual structure of the field and synthesizing cross-cutting themes, this review offers a more holistic understanding of how market microstructure mechanisms operate in varying economic and technological contexts, thereby addressing several of the research gaps identified in earlier studies.

Aside from empirical limitations, previous literature reviews of microstructure indicate many gaps. The current literature review has served a vital role in mapping broad themes, including liquidity, information asymmetry, trading mechanisms, and HFT dynamics, while also consolidating foundational theories and identifying the main methodological traditions in market microstructure; nevertheless, many of the existing reviews suffer from problems specifically, over half of them are out of date, have a very narrow focus on one or two specific sub-topics, or only focus on developed markets resulting in little to no synthesis of the progression of microstructure research among four decades' worth of literature. Also, the technological shift, institutional designs, and behavioral dimensions are typically treated as an isolated area of study with no combination of all three into one analytical perspective. Furthermore, the few reviews that do combine bibliometric analysis with system-type evaluation utilize and emphasize different areas of research such as the emerging fields of sustainable microstructure, fragmented multi-venue trading, and algorithmic trading design of the marketplace. Therefore, there is a strong need for an increasingly comprehensive and methodologically blended review that captures conceptual

development, empirical trend/development and technological transformation together as one.

3. Methodology

A systematic and bibliometric assessment and the application of content review for determining how and what way the area of stock market microstructure has evolved are employed in this study. This is done using a combination of quantitative bibliometric techniques and qualitative content analysis based on a quali-quantitative methodology (Raza, 2024). Additionally, the bibliometric component will look at the performance of the stock market microstructure area and produce structural patterns through citation-based measures. The content analysis will examine and interpret the significant themes, theoretical progressions, and areas lacking research. The combination of these two approaches provides information about key authors, institutions, and journals, as well as maps to illustrate new and established areas of research.

The review process was conducted according to the methodologies associated with systematic literature review (SLR) methodology, including: clear search protocols, detailed criteria for including or excluding studies (or studies of specific populations), and the ability to analyse research methodology in a repeatable way. The target populations for this study will consist of peer-reviewed journals specifically on stock market microstructure and the sub-categories associated with each including: trading mechanisms and trading regulations. We chose the Scopus database as our main source of data for this project because it allows for the greatest level of coverage of high quality academic publications in the areas of business, finance and economics. Compared to other databases Scopus also has a larger number of journals that are included in the database and has been able to standardise their bibliographic formats, which will allow us to do bibliometric analysis (Patel, 2021).

The search strategy is developed through an iterative process. An initial scoping exercise was conducted to identify frequently used terminology in prominent market microstructure studies, drawing on prior review articles and domain knowledge. This led to the formulation of three core keyword strings: "Stock Market Microstructure," "Trading Mechanism," and "Trading Regulations", combined with "AND" to capture articles addressing the intersection of these topics. The search was conducted across title, abstract, and author keywords fields, ensuring that retrieved articles explicitly engaged with the core concepts rather than only mentioning them tangentially in the full text. The starting year, 1983 allowed the inclusion of early foundational works, while end year was 2024 to incorporate the most recent research developments.

The initial search yielded 1067 records. A multi-stage screening process was then applied. First, all non-English articles were excluded using automated filters in the Biblioshiny package in R, reducing the dataset to 1028 items. Second, non-research items such as books, book chapters, conference papers, editorials, errata, retracted papers, and review articles were removed, leaving 877 journal



Fig. 1. Outlined methodology.

articles. Third, only peer-reviewed articles published in scholarly journals were retained, and duplicate records were eliminated and resulted in a dataset of 867 articles forming the basis for analysis.

The analytical framework combined performance analysis and science mapping techniques. Performance analysis identified the most influential journals, authors, institutions, and countries based on citation counts and publication output. Science mapping was conducted using VOSviewer and Biblioshiny to visualize co-authorship networks, co-citation structures, and thematic clusters. Co-authorship analysis illuminated collaboration patterns among scholars and across institutions. Co-citation and bibliographic coupling analyses revealed intellectual linkages and thematic proximities within the literature. Finally, content analysis was employed to interpret the substantive focus of the most prominent clusters, highlighting prevailing research themes, theoretical underpinnings, and methodological approaches.

By integrating bibliometric mapping with in-depth content interpretation, this methodology not only quantifies scholarly influence but also situates it within the conceptual and methodological evolution of market microstructure research. The process is summarized schematically in Fig. 1, which presents the sequential stages of database selection, keyword formulation, search execution, screening, and analysis.

4. Analysis of the data

Initially, both descriptive indicators and the most published authors or institutions, journals, and countries are displayed to show who has contributed the most within the discipline. Next, the social structure is examined using collaboration networks to visualize the way that researchers in different institutions cooperate and create co-authorship agreements or create formal institutional partnerships for a given period as well as to track the evolution of themes through time. The subsequent analysis looks at the intellectual structure of the discipline using co-citation analysis to display the key research "underpinnings" of the discipline or areas of research. Content analysis is then used to further provide a detailed description of the major concepts and emerging themes discovered, helping to demonstrate what the various areas of research are focusing on. All of these trends, relationships, and clusters of themes are also represented in graphical and tabular form to assist with visualizing the results of the analysis of the data collected.

4.1. Performance analysis (descriptive bibliometrics)

This section examines the quantitative productivity indicators of the research field, including the number of publications, citations, and authorship patterns. It highlights the most prolific authors, institutions, countries, and journals, providing an overview of the scientific output and its distribution over time and the overall growth trajectory of the literature.

4.1.1. Annual scientific production and average citations

Fig. 2 illustrates the evolution of research output and its scholarly impact in the field of stock market microstructure from 1983 to 2024. In the early period (1983–1990), research output was minimal, reflecting the niche status of the field within finance. Low average citations during this phase suggest that foundational work had yet to gain widespread academic attention. From the early 1990s to early 2000s, the number of publications began to rise, coinciding with increased recognition of liquidity, trading mechanisms, and market efficiency as important research areas. This period also saw notable spikes in average citations, possibly linked to innovations in trading technology, the advent of electronic markets, and regulatory changes during the dot-com bubble era.

The mid-2000s onward marked a phase of rapid growth in publication volume, driven by developments such as algorithmic trading, decimalization, HFT, and later, big data analytics. Average citations, however, exhibited more fluctuation, with notable peaks around 2004–2007 and the post-2008 global financial crisis, when market instability and regulatory reforms renewed academic interest in market structures. During the 2010s, the field reached maturity, with consistently high publication rates peaking around 2015 and again in 2022. Research themes expanded to include blockchain, cryptocurrency markets, AI-based trading strategies, and the

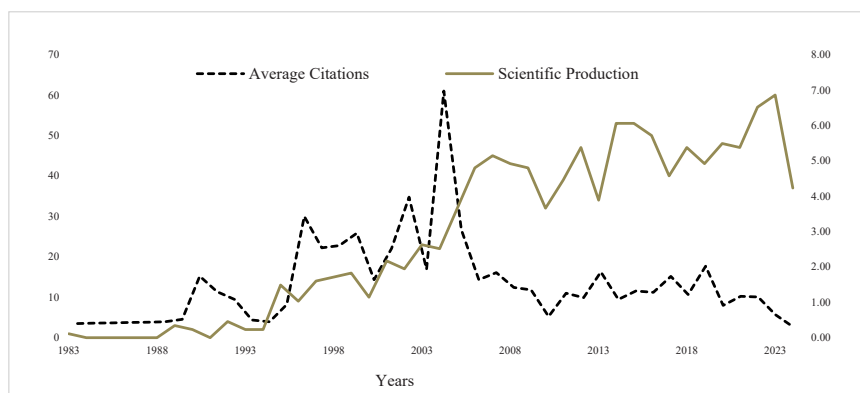


Fig. 2. Annual scientific production and average citations.

implications of dark pools. Despite high production, average citations showed a gradual downward trend, likely due to topic specialization, market stability in certain years, and shifts in attention toward emerging finance subfields like decentralized finance (DeFi) and behavioral finance. The recent decline in publications after 2022 may reflect both saturation in core research questions and broader shifts in finance research priorities. Citation spikes in some years align with major market events, technological shifts, and regulatory milestones, reinforcing the sensitivity of the field to real-world market dynamics.

4.1.2. Most influential countries

Authors throughout the globe contributed to the growing literature on market microstructure. [Table 1](#) ranks the top 30 countries based on their academic influence, measured by citations and Total Link Strength (TLS), which reflects collaborative research networks.

Total Link Strength (TLS) represents the overall intensity of a country's collaborative research connections within the global network, as computed by VOSviewer. The USA dominates all other nations in terms of research, followed by China and Australia. European countries such as England, France, and Germany also feature prominently, though their TLS values vary, suggesting differences in collaborative engagement. Notably, some nations with moderate citation counts, like Sweden exhibit low TLS, indicating weaker research partnerships despite substantial output. The inclusion of countries such as Tunisia, Pakistan, and Vietnam highlight emerging contributions in the field. This table underscores disparities in global research influence, emphasizing the stronghold of Western nations while revealing growing participation from other regions. The data serves as a valuable reference for analyzing trends in scholarly impact and international collaboration.

4.1.3. Country collaboration

In this section we highlight the nature and magnitude of collaboration between researchers from different countries. Such international collaboration is important for sharing research insights, lab expertise and data driven knowledge base. International collaboration is specifically of utmost importance for researchers from emerging markets. The [Fig. 3](#) visually represents international collaborations.

Dark blue countries represent the most influential collaborations (e.g., the USA, some European nations, China, and Australia). Light blue countries have collaborations but may not be as central as the dark blue ones. The brown Connecting lines indicate collaborative relationships between countries: the thicker and denser the lines, the stronger or more frequent the collaborations. The USA and European countries seem to be major hubs, with numerous connections. China also has significant collaborative links. Australia has notable collaborations, possibly related to research, business, or policy agreements.

4.1.4. Most influential journals

To identify the primary outlets shaping the intellectual landscape of market microstructure research, we examined the journals with the highest volume of papers and citation impact. These journals serve as the key platforms through which influential studies have been disseminated, reflecting both the scholarly visibility and academic recognition of the field. [Table 2](#) presents the most influential journals ranked by publication frequency and impact.

To complement the tabulated evidence mentioned above, the study also provides a visual representation of the journals contributing to the field and highlights their relative contributions in a more accessible format.

[Table 2](#) and [Fig. 4](#) investigates the top-ranking journals. For this purpose, we report the number of publications in each journal on the topic. We also report citations received by the journal and citations received by the respective paper on MMS in the journal. In terms of number of publications, the Journal of Banking & Finance and Journal of Financial Economics stand at top. The top ten sources listed in [Table 2](#) represent over half of the empirical and theoretical output. When examining all three matrices, the Journal of Finance emerges as the most influential publication, having published 21 papers that collectively received 6048 citations, averaging 288 citations per paper.

Table 1
Top 30 countries showing the highest/lowest citations with total link strength (TLS)

S.No.	Country	Citations	TLS	S.No.	Country	Citations	TLS
1.	USA	9953	209	16.	Italy	205	14
2.	China	2553	189	17.	Netherlands	196	30
3.	Australia	1040	83	18.	Tunisia	188	11
4.	England	963	91	19.	Pakistan	144	18
5.	Canada	696	19	20.	Romania	138	17
6.	France	599	43	21.	Finland	135	16
7.	Taiwan	554	53	22.	Vietnam	129	27
8.	Spain	489	27	23.	South Korea	113	21
9.	Germany	452	17	24.	UAE	109	13
10.	Malaysia	325	53	25.	South Africa	105	12
11.	Japan	284	42	26.	Greece	89	10
12.	Turkey	263	36	27.	Iran	79	1
13.	New Zealand	245	12	28.	Portugal	77	21
14.	Sweden	244	4	29.	Poland	66	5
15.	India	236	32	30.	Saudi Arabia	54	2

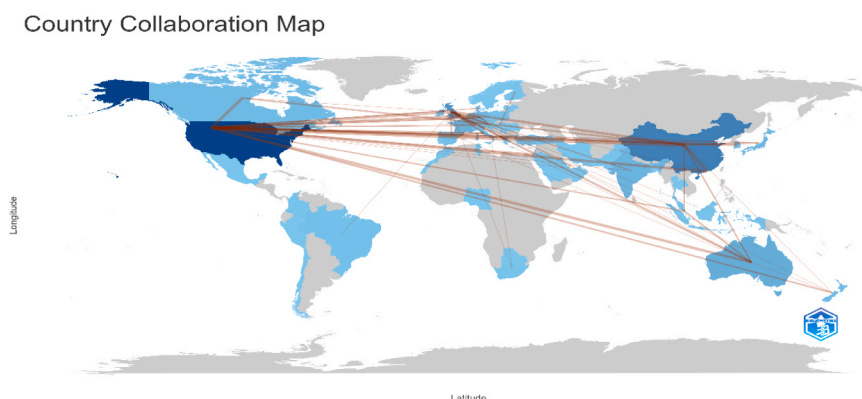


Fig. 3. Country collaboration.

4.1.5. Most influential authors

Understanding the intellectual structure of the field also needs identifying the researchers who have contributed most significantly to its development. By analyzing frequency of paper, citation impact, and average citations, the study highlight the authors whose work has shaped both the theoretical foundations and empirical advancements of the field. Table 3 presents the most influential authors, ranked by their overall scholarly impact.

As highlighted by Van Eck and Waltman (2014), recognizing leading journals and authors can assist readers and researchers in fostering future collaborations. How influential is an author in the field of study? This question is answered by investigating both the quantity and quality of scientific work published by the author. Quantity is evaluated based on the number of publications in the field, while quality is determined by the impact of the work, measured through citation counts and average citations per publication. The analysis resulted in thresholds of four publications, 16 total citations, and an average of four citations per paper. A closer look at the most productive authors reveals some intriguing patterns. Notably, the maximum number of articles by the leading influential figures is relatively low, and the top three authors based on citations are not the most prolific. Specifically, Hu and Prigent (Southwest University, China), in his paper “*Information asymmetry, cluster trading, and market efficiency: Evidence from the Chinese stock market*”, examines how information asymmetry and illiquidity from cluster trading affect market efficiency in China. The study finds that both factors negatively impact efficiency, with information asymmetry dominating during informational periods and illiquidity dominating when trading is less concentrated. Noise trading improves efficiency by reducing illiquidity but does not significantly affect information asymmetry. The research provides insights for investors on trading strategies in markets with varying liquidity and information conditions.

Kim and Ljungqvist (Imperial College, London), in paper “*Information Externalities Among Listed Firms*” the authors examine how private firms going public in the U.S. create positive information externalities for already-listed peers. They find that IPO filings improve peer firms’ trading liquidity by reducing information asymmetry and indirectly stimulate voluntary disclosure and analyst coverage. The study highlights that mandatory disclosure enhances the overall market information environment, while the trend of staying private limits these beneficial spillovers. This research contributes to market microstructure and corporate finance by showing how firm-level disclosure affects peer trading, liquidity, and market-wide informational efficiency. Xiong et al. (Tianjin University, China) study “*Analyzing the Impact on Stock Index Futures Market Volatility of Arbitrage*,” build an agent-based, cross-market simulation platform to model interactions between stock and stock-index-futures markets. Using 5-second HFT data, the study investigates how the number of arbitrageurs affects futures-market volatility. The findings show that both an excessive and an insufficient number of arbitrageurs increase market fluctuations, suggesting that market stability is maximized when arbitrage activity remains at an optimal level. The study emphasizes that regulators should maintain a balanced investor structure and promote diverse trading agents to support efficient price discovery and reduce volatility. These are the most cited work in this field, with each having published only one article related to stock market microstructure. In contrast, when considering all three metrics (number of publications, total citations, and citations per paper) Zhang Wei (University of Wisconsin, USA) emerges as a prominent author, with four papers and a total of 114 citations. The work of the highly cited authors above has mainly focused on machine learning, coding, simulations, and HFT data analysis. This area of research involves analyzing very short time frames and has gained a lot of attention from researchers.

4.2. Conceptual structure (mapping knowledge structure)

This section explores the underlying intellectual and thematic organization of the market microstructure field by identifying major research themes and examining how they have evolved over time. Using techniques such as co-word analysis, thematic mapping, and thematic evolution, the analysis uncovers clusters of related topics, emerging trends, and shifting research priorities. This mapping provides a visual and conceptual understanding of how ideas are interconnected and how the focus of scholarship has developed across different time periods.

Table 2
Influential Journals.

Panel A: Total number of Papers			
Rank	Journal	Issues/year	Papers
1.	Journal of Banking and Finance	12	53
2.	Journal of Financial Economics	06	44
3.	Journal of Financial Markets	05	44
4.	Quantitative Finance	12	35
5.	Pacific-Basin Finance Journal	06	29
6.	Physica A-Statistical Mechanics & its Applications	24	28
7.	Journal of Econometrics	12	26
8.	Journal of Empirical Finance	05	26
9.	Journal of Futures Markets	12	22
10.	Journal of Finance	06	21
11.	Asia-Pacific Journal of Financial Studies	06	19
12.	International Review of Financial Analysis	06	18
13.	Journal of Financial and Quantitative Analysis	08	17
14.	Review of Financial Studies	04	17
15.	Journal of International Financial Markets Institutions & Money	06	14
Panel B: Citations of the Journals			
Rank	Journal	Issues/year	Citations
1.	Journal of Financial Economics	06	6615
2.	Journal of Finance	06	6048
3.	Journal of Financial Markets	05	4941
4.	Journal of Econometrics	12	3335
5.	Review of Financial Studies	04	2274
6.	Journal of Financial and Quantitative Analysis	08	1126
7.	Journal of Banking and Finance	12	984
8.	Quantitative Finance	12	768
9.	Journal of Empirical Finance	05	465
10.	Journal of Futures Markets	12	356
11.	Pacific-Basin Finance Journal	06	255
12.	Physica A-Statistical Mechanics & Its Applications	24	243
13.	Journal of International Financial Markets Institutions and Money	06	133
14.	International Review of Financial Analysis	06	152
15.	Asia-Pacific Journal of Financial Studies	06	108
Panel C: Citations per paper			
Rank	Journal	Issues/year	Citations/paper
1.	Journal of Finance	06	288.00
2.	Journal of Financial Economics	06	150.34
3.	Review of Financial Studies	04	133.76
4.	Journal of Econometrics	12	128.27
5.	Journal of Financial Markets	05	112.30
6.	Journal of Financial and Quantitative Analysis	08	66.24
7.	Quantitative Finance	12	21.94
8.	Journal of Banking and Finance	12	18.57
9.	Journal of Empirical Finance	05	17.88
10.	Journal of Futures Markets	12	16.18
11.	Pacific-Basin Finance Journal	06	8.79
12.	Physica A-Statistical Mechanics and Its Applications	24	8.68
13.	International Review of Financial Analysis	06	8.44
14.	Journal of International Financial Markets Institutions and Money	06	6.86
15.	Asia-Pacific Journal of Financial Studies	06	5.68

4.2.1. Keyword co-occurrence analysis and thematic evolution (research fronts)

Keyword co-occurrence analysis is a powerful bibliometric technique for mapping the intellectual structure of a research field by identifying relationships between terms based on their simultaneous appearance in publications (Van Eck and Waltman, 2014). Using VOSviewer, keywords are clustered through network visualization, where proximity reflects co-occurrence strength, node size indicates keyword frequency (i.e., prominence), and link thickness denotes association intensity. Articles, authors, and journals assigned the same color belong to the same cluster, revealing thematic cohesion and interdisciplinary linkages (Tripathi and Dixit, 2020). This method not only highlights dominant research sub-areas but also traces their interconnections, evolution, and emerging fronts.

Fig. 5 presents the keyword co-occurrence network for market microstructure studies (MMS), comprising 312 nodes (keywords meeting the minimum occurrence threshold of 5) and 8214 links. The network density is 0.067, indicating a moderately inter-connected field with several tightly knit thematic groups. The two largest nodes microstructure (occurrences: 182, total link strength: 1456) and liquidity (occurrences: 165, total link strength: 1389) anchor the map, underscoring their centrality in MMS discourse.

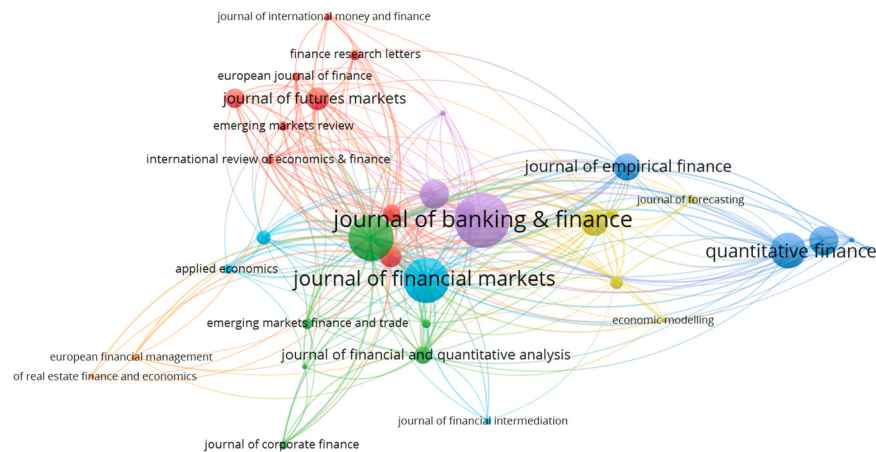


Fig. 4. Shows major contribution by the Journals.

Table 3
Influential Authors.

Panel. A Total number of Papers				
Rank	Author	Hi-Index	Institution	Papers
1.	Wong, Wing-Keung	11	Asia University, Taiwan	8
2.	Xiong, Xiong	3	Tianjin University, China	6
3.	Jawadi, Fredj	0	University of Lille, France	5
4.	Kim, Jae H.	1	Imperial College, London	5
5.	Lim, Kian-Ping	1	University of Malaya, Malaysia	5
6.	Qiao, Zhuo	11	University of Macao, China	5
7.	Hu, Prigent	1	Southwest University, China	4
8.	Ryu, Doojin	0	Sungkyunkwan University, South Korea	4
9.	Tiwari, Aviral Kumar	0	Indian Institute of Management, India	4
10.	Zhang, Wei	5	University of Wisconsin, USA	4
Panel. B Citations of the Journals				
Rank	Author	Hi-Index	Institution	Citations
1.	Wong, Wing-Keung	11	Asia University, Taiwan	139
2.	Xiong, Xiong	3	Tianjin University, China	130
3.	Lim, Kian-Ping	1	University of Malaya, Malaysia	120
4.	Zhang, Wei	5	University of Wisconsin, USA	114
5.	Kim, Jae H.	1	Imperial College, London	99
6.	Qiao, Zhuo	11	University of Macao, China	71
7.	Jawadi, Fredj	0	University of Lille, France	54
8.	Tiwari, Aviral Kumar	0	Indian Institute of Management, India	38
9.	Ryu, Doojin	0	Sungkyunkwan University, South Korea	20
10.	Hu, Yingyi	0	Southwest University, China	16
Panel. C Citations per paper				
Rank	Author	Hi-Index	Institution	Citations/paper
1.	Zhang, Wei	5	University of Wisconsin, USA	28.50
2.	Kim, Jae H.	1	Imperial College, London	24.00
3.	Xiong, Xiong	3	Tianjin University, China	21.67
4.	Hu, Yingyi	0	Southwest University, China	19.80
5.	Wong, Wing-Keung	11	Asia University, Taiwan	17.38
6.	Qiao, Zhuo	11	University of Macao, China	14.20
7.	Lim, Kian-Ping	1	University of Malaya, Malaysia	10.80
8.	Ryu, Doojin	0	Sungkyunkwan University, South Korea	9.50
9.	Tiwari, Aviral Kumar	0	Indian Institute of Management, India	5.00
10.	Jawadi, Fredj	0	University of Lille, France	4.00

4.2.2. Cluster analysis

1. Red Cluster (Empirical Microstructure & Liquidity Dynamics): Centered on liquidity, market liquidity, illiquidity, transaction costs, information asymmetry, and transparency. This cluster (48 items) focuses on core market frictions and price formation

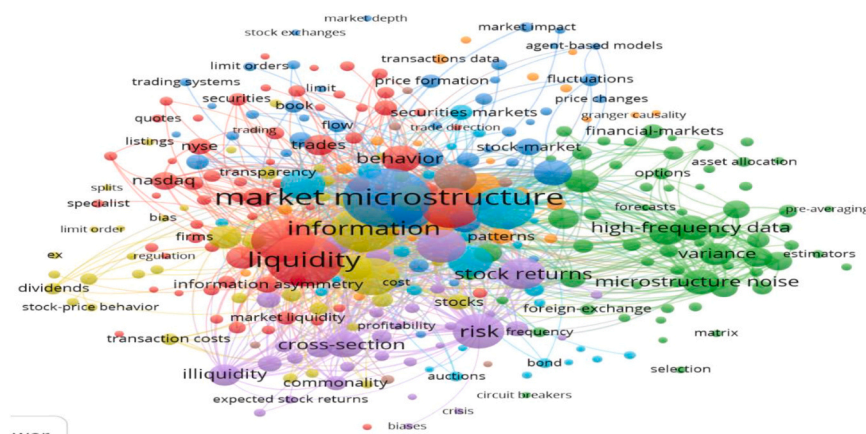


Fig. 5. Shows cartography analysis with a minimum of three occurrences of keywords.

mechanisms. Keywords like bid-ask spread, price impact, and adverse selection highlight investigations into how information revelation and trading costs affect execution quality. The cluster's high internal density (average link strength: 42.3) reflects mature, interconnected scholarship on liquidity provision and measurement.

2. **Green Cluster (HFT & Volatility Modeling):** Led by HFT data, variance, pre-averaging, realized volatility, and microstructure noise. Comprising 42 items, this cluster represents the data-intensive, econometric turn in MMS. Terms such as estimators, matrix, and frequency point to advanced statistical techniques for noise-robust volatility estimation in ultra-short horizons. Its proximity to the red cluster suggests synergy between liquidity risk and high-frequency dynamics.
3. **Blue Cluster (Market Design & Institutional Mechanisms):** Anchored by market microstructure, trading systems, limit orders, NYSE, Nasdaq, and regulation. This 38-item cluster explores exchange architecture, order flow organization, and regulatory impacts. Keywords like circuit breakers, auctions, and cross-sectional profitability indicate studies on market stability, fairness, and design efficiency. The cluster bridges theoretical and policy-oriented research.
4. **Yellow Cluster (Behavioral & Informational Efficiency):** Dominated by information, stock returns, stock-price behavior, and Granger causality. With 35 items, this cluster integrates behavioral finance with microstructure. Terms such as fluctuations, patterns, and forecasts reflect efforts to link trader psychology, informational cascades, and return predictability. Its central position suggests it mediates between empirical and institutional clusters.
5. **Purple Cluster (Asset Pricing & Risk in Microstructure):** Focused on risk, stocks, foreign exchange, options, asset allocation, and expected stock returns. The smallest major cluster (31 items) connects microstructure to broader asset pricing. Keywords like profitability, selection, and crisis highlight risk transmission across asset classes and during stress events.

6. Inter-Cluster Linkages and Research Integration

Strong bridges exist between the red (liquidity) and green (high-frequency) clusters via market depth, price changes, and agent-based models, indicating growing integration of liquidity metrics with high-frequency econometrics. The blue (market design) cluster connects to the yellow (behavioral) cluster through transparency and securities markets, suggesting regulatory responses to behavioral biases. The purple (risk) cluster links peripherally via stock returns and financial markets, signaling an emerging front on systemic risk in fragmented venues.

4.2.3. Thematic evolution (research fronts)

The pre-2010 period (cooler colors) was dominated by foundational themes such as stock returns, bid-ask spreads, stock splits, bonds, quotes, and securities data, reflecting an early emphasis on static market microstructure and cross-sectional return anomalies. Between 2010 and 2018 (neutral tones), the literature evolved with the emergence of high-frequency data, electronic trading, market depth, and regulatory concerns, largely driven by technological disruption and post-crisis reforms. In the post-2018 period (warmer colors), research increasingly focused on pre-averaging, variance estimators, agent-based models, illiquidity, and circuit breakers, indicating a paradigm shift toward real-time risk management, algorithmic liquidity, and market resilience. This evolution traces MMS from descriptive, low-frequency analysis to dynamic, high-dimensional modeling of ultra-fast markets. Emerging fronts include algorithmic liquidity provision, regulatory sandboxes for HFT, and microstructure-aware systemic risk gauges.

4.3. Bibliographic coupling (collaboration by content overlap)

To better understand the intellectual landscape of market microstructure research, we examine author relationships using two complementary bibliometric techniques: bibliographic coupling and co-citation analysis. While the visual layouts of these analyses appear similar, they capture different dimensions of scholarly relatedness.

The bibliographic coupling (Fig. 6) network of market microstructure research, illustrating how documents cluster together based

on shared references. It reflects the extent to which studies draw on common theoretical and methodological foundations, thus revealing the underlying intellectual structure of the field. Three major clusters emerge. The green cluster, anchored by Amihud (2002) and Loughran and Ritter (1995), represents foundational work on liquidity, trading costs, and asset-pricing implications of market frictions. The red cluster, centered around Barclay and Warner (1993), Brennan and Subrahmanyam (1996), and Harris et al. (2002), captures research on order-flow dynamics, information asymmetry, and price discovery mechanisms. The blue cluster, dominated by Ghysels et al. (2007), Hansen and Lunde (2006), Corsi et al. (2010), and Bollerslev et al. (2008), reflects advanced econometric modelling of volatility, high-frequency dynamics, and statistical microstructure. Smaller peripheral clusters represent niche but influential contributions. Overall, the bibliographic coupling map demonstrates that the literature is organized around interconnected yet distinct thematic pillars such as liquidity and market quality, intraday microstructure and information transmission, and volatility modelling, highlighting how diverse methodological approaches collectively shape the evolution of market microstructure research.

4.4. Co-citation analysis

We identify the pioneer and foundational research streams and the theoretical extraction that leads to the development of market microstructure as a unique discipline. Because these clusters represent well-established and influential lines of inquiry, they offer a reliable basis for identifying enduring gaps and future opportunities for research. We also agree that only co-citation clusters may limit the ability to capture emerging or rapidly evolving themes for future research. In order to address this issue, we have clarified the rationale for choosing co-citation analysis and have strengthened the explanation of how its results were used to construct the future research agenda.

This analysis examines how often two authors are cited together by later works. This is a backward-looking measure that reveals how the research community perceives connections between scholars' contributions over time. High co-citation frequency suggests that the paired authors have both contributed significantly to a related body of knowledge. In this network, two dominant clusters emerge: a red cluster centered on David Easley and Yakov Amihud, focusing on liquidity, information asymmetry, and strategic trade models (e.g., the Probability of informed trading and liquidity impact measures), and a green cluster led by Torben Andersen, Robert Engle, and Ole Barndorff-Nielsen, emphasizing volatility modeling, ARCH-type processes, and stochastic volatility frameworks. Additional clusters, such as the blue group including Bouchaud, Lux, and Cont, align with themes in behavioral finance and herd behavior in markets. Presenting these two analyses together allows us to capture both research proximity at the point of publication (bibliographic coupling) and intellectual relatedness as recognized by the scholarly community (co-citation). The former helps identify contemporary thematic alignments, while the latter reveals enduring conceptual linkages and schools of thought within the market microstructure literature.

We also agree that only co-citation clusters may limit the ability to capture emerging or rapidly evolving themes for future research. In order to address this issue, we have clarified the rationale for choosing co-citation analysis and have strengthened the explanation of how its results were used to construct the future research agenda. We explicitly discuss how historical clusters help identify persistent gaps in theory, while more recent analyses (bibliographic coupling, keyword co-occurrence, and trending topics) complement this by revealing current and emerging areas. By integrating insights from these layers, the revised version now presents a more balanced and forward-looking research agenda.

The highest number of collaborations is made by Amihud followed by Loughran, and Ghysels, and lastly, major collaboration is made by Hansen. These authors belong to a diverse set of institutions, domiciled at different regions across the globe. The analysis is based on the number of co-authored documents and citation count. The institutional network comprises around 25 institutions, each with at least one publication.

4.5. Intellectual structure

The intellectual structure reveals the underlying knowledge base of the field by examining citation and co-citation patterns among

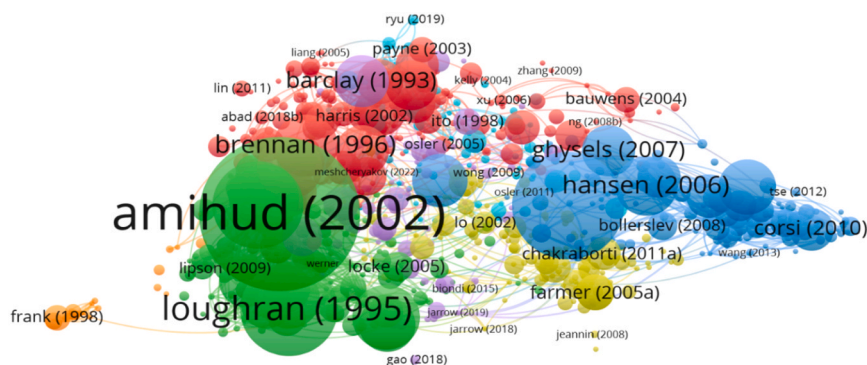


Fig. 6. Bibliographic coupling by documents: The figure displays the co-authorship analysis, which is based on a minimum threshold of one co-authored research paper.

authors, journals, and documents. This analysis identifies seminal works, influential scholars, and foundational theories that have shaped the development of the research area.

Fig. 7 shows the bibliographic coupling of authors that have published on the topic. Dr. Doojin Ryu (Sungkyunkwan University, South Korea) and Andersen Torben (Northwestern University, USA) are the two most productive authors. Most of the work published by these two authors frequently cite research articles, published by Dr. Bart Frijns (Open Universiteit, Nederland), Dr. Avanidhar Subrahmanyam (University of California) and Dr. Tim Bollerslev (Duke University, Denmark).

4.6. Reference co-citation density map

Fig. 8 presents a density map of the co-citation network within the field of market microstructure literature. Unlike the node-link diagrams in previous figures, this visualization uses a density-based approach to highlight the most influential intellectual cores and their overlapping boundaries. The color spectrum, (low to high density), shows the concentration of co-cited references, effectively mapping the foundational pillars of the field of stock market microstructure. This type of visualization was preferred precisely to complement the circle-based network maps by highlighting the impact and cohesion of intellectual clusters instead of their structural connections. It allows for a clearer identification of the central, dominant themes. The following analysis in the text and Table 4 labels the explicit contributors and thematic focus of each cluster identified with the help of this density map.

In more detail, the main intellectual categories of market microstructure research for a more comprehensive qualitative review, based on the direction of the documents, are as follows:

Table 4 synthesizes four clusters identified through co-citation analysis, outlining the works that define each research stream. The clusters are market microstructure and trade classification, liquidity in financial markets, volatility and financial markets, and components of market microstructure.

Cluster. 1 (Red) Market Microstructure and Trade Classification

This cluster mainly includes the studies on different trading behaviors and market microstructure. The most cited article is “Continuous Auctions and Insider Trading” written by Kyle (1985). This study centered on information-based trading, interaction of traders and the impact of asymmetric information on market dynamics. The second most cited study Glosten (1985) led to the development of the Glosten-Milgrom model, which explores the behavior of market makers and the bid-ask spread. Lee and Ready (1991) investigated methods for classifying individual trades as market buy/sell orders using intraday trade and quote data. They addressed challenges related to quote-based trade classification and proposed procedures to improve accuracy. Along with the above studies the research of Admati and Pfleiderer (1988) delved into market liquidity which is one of the main pillars of microstructure and the impact of trading mechanisms on market efficiency. Their work sheds light on how liquidity affects asset prices and trading dynamics. Lastly in this cluster, Easley and O'Hara (1987) explored various aspects of market microstructure, including order flow, market design, and liquidity and has significant implications for understanding trading behavior and optimizing market structures. In summary, these studies significantly contributed to our understanding of market behavior, trading strategies, and the intricate dynamics of financial markets.

Cluster. 2 (Green) Liquidity in Financial Markets

The main themes of these studies are centered around the impact of liquidity on asset pricing and market efficiency. The paper entitled “Illiquidity and stock returns” (Amihud, 2002) published in the ‘Journal of Financial Markets’ has the highest citation. This study introduces a liquidity measure that averages daily ratios of absolute stock returns to dollar volume, highlighting the importance of liquidity in stock returns. Result shows that illiquidity affects small stocks more than large stocks, which might explain changes in the “small firm effect” over time. Considering the impact of market illiquidity on stock excess return, it appears there is an illiquidity premium, which contributes to explaining the equity premium puzzle. The second highly cited piece of work is contributed by Amihud

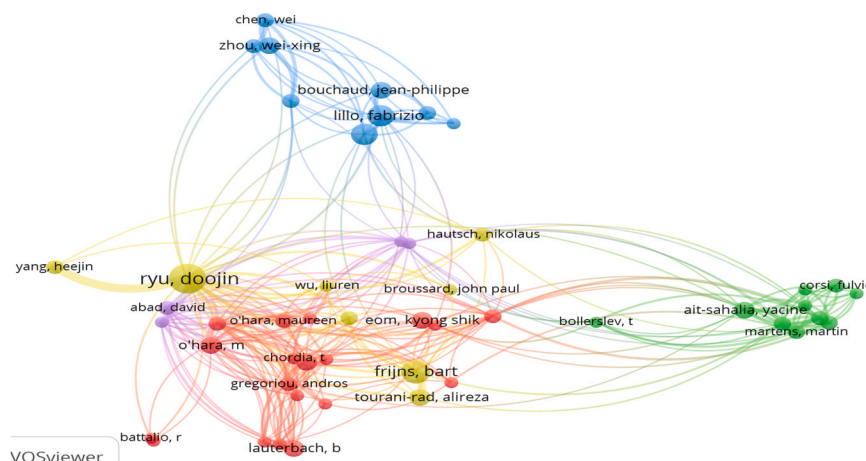


Fig. 7. Bibliographic coupling of authors.

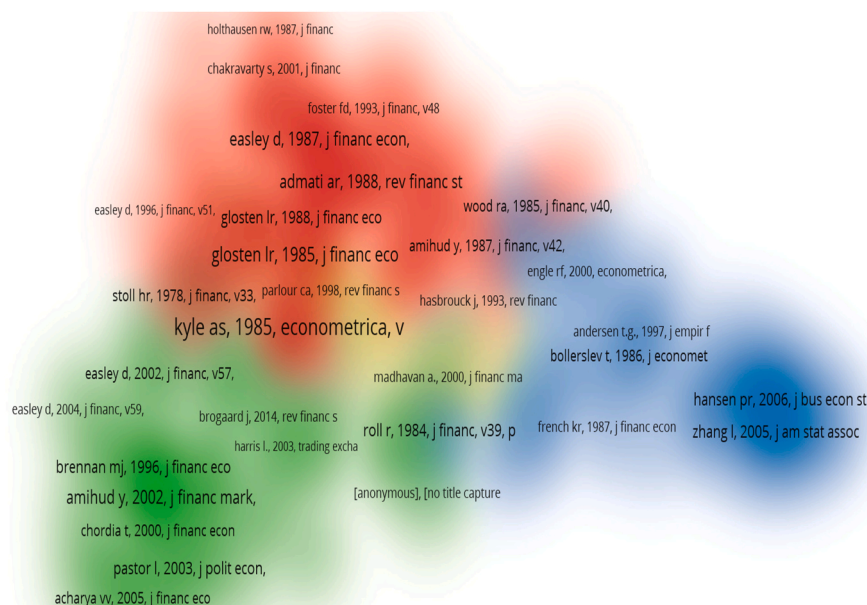


Fig. 8. References co-citation network by density map.

and Mendelson (1986) published in Financial Analyst Journal which made a significant contribution to the field of financial economics by examining the effect of the bid-ask spread on asset pricing, suggesting that expected asset returns increase with the bid-ask spread, reflecting liquidity costs. They introduced a new concept that expected asset returns are higher when the relative bid-ask spread, which measures liquidity, is greater. Results indicate that as the spread increases, the expected return also increases, but at a decreasing rate. The study also proposed further research to explore the interaction between market characteristics, trading organization, liquidity and bridging the time gaps between the arrivals of buy and sell orders.

Brennan and Subrahmanyam (1996) also examine market illiquidity and stock returns, proposing higher expected returns compensate for greater market illiquidity. Illiquidity costs, arising from information asymmetry between privately informed and uninformed investors, should be reflected in higher required rates of return for less liquid securities. The main contributions of this study include establishing an empirical link between monthly returns and measures of illiquidity obtained from intraday data, and demonstrating that required rates of return are significantly related to these measures of illiquidity, even after adjusting for Fama and French risk factors and accounting for stock price levels. The study also opened avenues for future research in developing more precise empirical techniques to measure adverse selection costs, investigating the impact of illiquidity due to information asymmetry on a firm's required rate of return in greater depth, and exploring alternative measures of illiquidity beyond the quoted bid-ask spread, which can be a noisy indicator of true market liquidity.

A significant component of this cluster is the study by Pástor and Stambaugh (2003), which examines whether market-wide liquidity serves as a crucial state variable for asset pricing. Their findings indicate that stock returns are linked to the sensitivities of those returns to changes in aggregate liquidity. Results suggest that assets with higher sensitivities to liquidity risk require higher expected returns to compensate investors for holding them. The measure suggests that order flow induces greater return reversals with low liquidity. From 1966 through 1999, it was observed that the average return on stocks with high sensitivities to liquidity is 7.5 % greater annually than those with low sensitivities, adjusted for exposures to the market return as well as size, value, and momentum factors. This research also specified that a liquidity risk factor accounts for half of the profits to a momentum strategy over the same period. While the study was comprehensive for its time, it raises further questions that subsequent research could address. For example, how might alternative liquidity measures affect the study's conclusions? Does the study hold across diverse global markets, exclusively developing ones? How do the liquidity and stock returns link change with changes in market structure and trading technology? What role does liquidity risk play during a financial crisis, and how does it affect asset pricing?

Chordia et al. (2000) made significant contributions to the understanding of market liquidity and trading activity, where they analyze the predictability of returns from past order flows as an inverse indicator of market efficiency, suggesting that liquidity enhances market efficiency. The study examined the market spreads, depths, and trading activity for U.S. equities over an extended period, revealing that liquidity significantly drops in down markets, and recent market volatility decreases trading activity and spreads. It also identified day-of-the-week effects and highlighted how interest rates affect liquidity. The study suggests future research on the evolution of trading activity and liquidity, comparisons across different markets, other variables influencing trading activity and liquidity, and the influence of regulatory amendments on liquidity and trading activity. These findings collectively contribute to understanding how liquidity affects stock returns and market behavior in financial markets.

Cluster. 3 (Blue) Volatility and Financial Markets

The main themes of the studies centered on financial econometrics, predominantly focusing on the volatility and dynamics of

Table 4

Most effective references in Market Microstructure research by co-citation analysis.

Authors	Title	CI	TLS	Key Contents
<i>Cluster 1: Market Microstructure and Trade Classification</i>				
Kyle (1985)	Continuous Auctions and Insider Trading	231	2656	Brownian motion governs the stock market, with all private information being reflected in prices by the end of the trading day, while market depth remains constant.
Glosten and Milgrom (1985)	Bid, ask and transaction prices in a specialist market with heterogeneously informed traders	147	1812	An improvement in information quality results in a wider spread, whereas an increase in trading volume leads to a reduction in the spread.
Lee and Ready (1991)	Inferring trade direction from intraday data	134	1533	Trades inside spreads cannot readily be classified since quotes can be obtained before trades that trigger them.
Admati and Pfleiderer (1988)	A theory of intraday patterns: Volume and price variability	119	1444	Discretionary liquidity trading is concentrated at equilibrium. Trading is more concentrated near demand realization. Informed traders actively trade during concentrated liquidity trading. More traders become privately informed during concentrated liquidity trading.
Easley and O'hara (1987)	Price, trade size, and information in securities markets	104	1255	Both the size and sequence of trades are important for determining the price-trade size relationship.
<i>Cluster 2: Liquidity in Financial Markets</i>				
Amihud (2002)	Illiquidity and stock returns: cross-section and time-series effects	129	1459	Illiquidity affects more strongly small firms' stocks, suggesting an explanation for the changes "small firm effect" over time.
Amihud and Mendelson (1986)	Asset pricing and the bid-ask spread	113	1342	(i) Market-observed average returns tend to rise with the spread. (ii) after accounting for trading costs, asset returns for holders also increase with the spread. (iii) There is a clientele effect, indicating that stocks with higher spreads are generally held by investors who have longer holding periods. (iv) Due to this clientele effect, returns on higher-spread stocks exhibit reduced sensitivity to changes in the spread, leading to a concave relationship between returns and spread.
Brennan and Subrahmanyam (1996)	Market microstructure and asset pricing: On the compensation for illiquidity in stock returns	86	1192	We observe a notable relationship between required rates of return and these measures, even after adjusting for the Fama and French risk factors and considering the influence of stock price levels.
Pástor and Stambaugh (2003)	Liquidity risk and expected stock returns	82	1184	Suggests that assets with higher sensitivities to liquidity risk require higher expected returns to compensate investors for holding them.
Chordia et al. (2000)	Commonality in liquidity	60	827	It finds that a significant common component influences firm-level liquidity, such as quoted spreads, quoted depth, and effective spreads, which co-move with market and industrywide liquidity.
<i>Cluster 3: Volatility and Financial Markets</i>				
Roll (1984)	A simple implicit measure of the effective bid-ask spread in an efficient market	96	1106	The impact of bid-ask spread on measuring the price response to new information.
Zhang et al. (2005)	A tale of two-time scales: Determining integrated volatility with noisy high-frequency data	79	870	Challenges of estimating volatility in the presence of market microstructure noise
Hansen and Lunde (2006)	Realized variance and market microstructure noise	74	838	Features of microstructure noise and proposes methods for removing microstructure-induced biases from realized variance estimates.
Andersen et al. (2003)	Modeling and forecasting realized volatility	66	709	Provide model-free estimates of daily exchange rate volatility and correlation.
Barndorff-Nielsen and Shephard (2002)	Econometric analysis of realized volatility and its use in estimating stochastic volatility models	52	654	Studied the statistical properties of realized volatility and its use in estimating stochastic volatility models providing both a central limit theory approximation and an exact second-order analysis.
<i>Cluster 4: Components of Market Microstructure</i>				
Biais et al. (1995)	An empirical analysis of the limit order book and the order flow in the Paris Bourse.	53	564	Analyzed the dynamics between investor order strategies and price formation in the Paris Bourse.
Madhavan (2000)	Market microstructure: A survey	43	387	Studied the stock market structure as well as the design of the market.
Glosten (1994)	Is the electronic open limit order book inevitable?	36	444	Studied the nature of quotes, orders, and transactions, and the models that explain liquidity provision.
Biais et al. (2005)	Market microstructure: A survey of microfoundations, empirical results, and policy implications.	29	332	Survey the literature on price formation, trading processes, and the consequences of market organization for price discovery and welfare.
Bessembinder, (2003)	Trade execution costs and market quality after decimalization.	23	201	Highlights the importance of selection biases in cross-market trading cost comparisons and the quality of market centers.

markets. The highly cited study in this cluster is the study of Roll (1984), published in the high-ranked Journal of Finance, which addresses the effect of market microstructure on stock prices, particularly the bid-ask spread and its effect on measuring its response to new pieces of information. As a result of this study, a better understanding of asset pricing and portfolio theory is gained. Roll's significant contribution was the development of Roll's critique, which challenges the testability of the CAPM. A CAPM cannot be empirically tested without knowing the true market portfolio, which is unobservable in practice. As a result of this critique, alternative

asset pricing models have been explored in subsequent research. A future gap has been highlighted by Roll's study as the need for more empirical research into the empirical testing of asset pricing models, considering the difficulties of defining and observing the true market portfolio. This gap suggests that future studies should focus on developing methods to approximate the market portfolio or to find alternative ways to test asset pricing models that do not rely on the exact composition of the market portfolio.

The work of [Zhang et al. \(2005\)](#) deals with the challenges of estimating volatility in the presence of market microstructure noise, proposing a two-scale estimator that is robust to the effects of this noise. Their main contributions are: They proposed a new estimator for integrated volatility that considers the noise inherent in HFT data. Addressing the market microstructure noise that poses challenges to the traditional estimation approach of volatility from the sum of frequently sampled squared returns. Reconciling continuous-time modeling with discrete-time samples provides a theoretical framework that explains why the traditional volatility estimator fails at high frequencies. The study suggests the need for further research on optimal sampling frequency and how it relates to the data's noise level; the exploration of bias-correction methods and their effectiveness in dealing with market microstructure noise suggests an area of volatility estimation using HFT data.

The study of [Hansen and Lunde \(2006\)](#) contributes to the empirical evidence regarding the dynamic features of microstructure noise and proposes methods for removing microstructure-induced biases from realized variance estimates. Identifying the presence of market microstructure noise in HFT data and its complications for volatility estimation, demonstrating that standard estimators, showing that kernel-based estimators can reveal key features of market microstructure noise, providing empirical analysis that market microstructure noise is time-dependent and correlated with increments in the efficient price. The study highlighted the need for developing better estimators that can handle the dynamic nature of market microstructure noise, understanding the time varying properties of noise.

[Andersen et al. \(2003\)](#) focus on the distribution of realized exchange rate volatility using high-frequency data, providing model-free estimates of daily exchange rate volatility and correlation. The paper introduces a framework for incorporating HFT intraday data into volatility and return distribution measurement and forecasting. It demonstrates that long-memory Gaussian vector autoregression provides accurate volatility forecasts. Additionally, it suggests areas for future research, such as model refinement, applying the framework to newer financial instruments and markets, integrating machine learning techniques, and advancing real-time volatility forecasting in HFT trading.

[Barndorff-Nielsen and Shephard \(2002\)](#) research is essential in the econometric analysis of realized volatility and the use in estimating stochastic volatility models. They employ quadratic variation-like measures of activity in financial markets to investigate the stochastic properties of returns. Each of these studies has contributed significantly to the field of financial econometrics by providing insights and methodologies for understanding and modeling the complexities of market volatility and price movements.

Cluster. 4 (Yellow) Components of Market Microstructure

In this last cluster, the highly cited study of [Biais et al. \(1995\)](#) contributed significantly to the understanding of market microstructure. It focuses on the limit order book and the order flow in the Paris Bourse, analyzing the dynamics between investor order strategies and price formation. It explored how thin and thick books affect the placement of orders and trades and how investors can gain price and time priority. The study demonstrated the effects of information on market prices and highlighted high trading costs and liquidity nature. It also opened up avenues for further research on limit orders' strategic placement and impact on asset price dynamics. [Madhavan's \(2000\)](#) survey examines market microstructure literature on price formation, market structure, transparency, and the interconnection between microstructure and other areas of finance. The study analyzes static and dynamic trading issues, such as the association between price formation and trading protocols. It also provides a roadmap for further research on liquidity, security prices, transparency, and market design. The study is relevant for academics, investors, policymakers, and regulators. However, there is still much to understand about how microstructure affects trading.

[Glosten \(1994\)](#) has significantly contributed to the field of financial economics, particularly in market microstructure that studies the price determination in markets, including the nature of quotes, orders, transactions, the models that explain liquidity provision, and the impact of market design. The study provides insights into the electronic open limit order book and its implications for market efficiency, the study inquired into various market frictions such as order-handling costs, inventory costs, and adverse selection, and how these affect transaction prices and market liquidity. Glosten's work opens up avenues for exploring how strategic behavior by market participant's influences price formation and efficiency, with the technological advancement, there's a need for ongoing research into how these changes affect market structure and behavior. [Biais et al. \(2005\)](#) surveys the literature on price formation, trading processes, and the consequences of market organization for price discovery and welfare, offering a united perspective on theoretical, empirical, and experimental approaches. Lastly, [Bessembinder \(2003\)](#) highlights the importance of selection biases in cross-market trading cost comparisons and the quality of market centers. These studies collectively contribute to our understanding of how securities' prices are determined, the role of a number of market participants, and the influence of market structure and regulations on trading costs and efficiency.

5. Conclusion

This study offers the first integrated market microstructure insights through the use of bibliometric and content analysis. This analysis draws upon 867 peer-reviewed papers published between 1983 and 2024 in the Scopus database. By integrating science mapping tools, the current study provides an overall perspective of the intellectual framework, evolutionary themes, and collaborative nature of the field. From a thematic and intellectual perspective, the findings of this research produced five thematic pillars of research on market microstructure: Liquidity and Price Discovery; Information Asymmetries; Trading Mechanisms and Market Design; High-Frequency and Low-Latency Trading; and Market Fragmentation/Execution Quality in addition to a cross-cutting (emerging) theme

on Governance, ESG (Environmental, Social & Governance), and Market Fairness. As the research continues to evolve from models developed during the 1980s focusing primarily on trading costs and efficiency in the 1980s, past crises and subsequent regulatory developments generated a higher frequency of research from the early 2000s up until present-day developments in high-frequency trading, fragmented liquidity, and sustainable finance.

The analysis also shows that the United States is still the center of intellectual activity related to market microstructure research supported by top institutions like Cornell University, New York University, and Monash University and some other contributors also include Australia, China, and a number of European countries. The collaborative network of research, however, is still unequal with developed nations continuing to have a greater contribution to both research strategic networks and the quantity of research. Increased research contributions from developing markets occur; however, they are typically of a lower link strength than those from developed countries. Leading authors in the field include Amihud, Easley, and Subrahmanyam and more recent articles are focusing more on high-frequency econometrics, machine learning and cross-market relationships. Many leading journals, such as the *Journal of Finance*, *Journal of Banking and Finance*, and *Journal of Financial Economics*, are publishing articles that are advancing the above-mentioned discussions.

Although many advances have been made, continuing research opportunities exist. Among these are the relative underrepresentation of emerging and frontier markets, the need to incorporate ESG issues into microstructure research, and the lack of systematic cross-market relationships. All of the above present fertile grounds for future research. In order to fill these gaps; high-frequency econometrics, causal inference, network analysis, and high-quality granular datasets such as intraday trading data and decentralized finance platforms need to be employed as methodologies for further research.

5.1. Future research questions

The co-citation analysis in the paper reveals key intellectual clusters that underpin the stock market microstructure research. The recent advancements in market microstructure shape the efficiency of the market and open ways for future research. It is very important to timely identify the glitches in the system and research gaps so that future researchers can further explore the market dynamics. Based on the extensive review and analysis we present directions for future research in Table 5. In addition to research gaps, we also present core areas of market microstructure which requires attention from academia and practice.

The table discusses several key dimensions of market microstructure that require scholarly attention. In addition to identifying thematic clusters related to the topic, it systematically delineates existing research gaps by specifying the data requirements needed to address existing and emerging issues and recommending appropriate analytical techniques and methodological approaches. As such, the table provides a structured and coherent agenda for future empirical research in the field of stock market microstructure. An extensive research effort is needed to collect, process, and manage large datasets that provide high frequency data associated with these clusters. For example, ESG disclosers and intra-day data of stock markets. In particular, emerging markets need to undertake serious initiatives to develop and sustain comprehensive high-frequency trading databases. The availability of such data would enable future studies to examine the implications and effectiveness of market reforms using advanced econometric methods, thereby facilitating the development of more timely and accurate models for assessing market efficiency and enhancing the smooth functioning of trading mechanisms.

Moreover, clusters focusing on high-frequency trading, market fragmentation, execution quality, and market fairness highlight the

Table 5

Linking thematic pillars to research gaps, data requirements, and suggested methodologies.

Thematic Cluster	Research Gaps	Data Requirements	Suggested Methodologies
Liquidity & Price Discovery	Limited empirical work on liquidity formation in thinly traded or emerging markets; lack of studies integrating liquidity shocks with volatility spillovers.	High-frequency transaction and quote (TAQ) data from emerging exchanges; order book depth records.	Microstructure VAR models; liquidity measures (Amihud, Roll, LOT); event studies for regulatory changes.
Information Asymmetry	Underexplored effects of disclosure regimes, corporate governance quality, and ESG transparency on bid-ask spreads and adverse selection.	Firm-level governance & ESG disclosure datasets; intra-day spreads; analyst coverage data.	Regression discontinuity; difference-in-differences; machine learning for text-based sentiment & disclosure analysis.
Trading Mechanisms & Market Design	Limited cross-market comparative analysis of auction vs. continuous trading; lack of robust evaluation of tick-size and circuit breaker impacts.	Trade & order-level datasets from multiple exchanges; regulatory policy timelines.	Natural experiments; simulation models; market microstructure invariance tests.
High-Frequency Trading (HFT) & Low-Latency Markets	Sparse long-term, multi-market evidence on resilience, price efficiency, and volatility clustering in HFT-dominated venues.	Millisecond-level order book updates; consolidated feed and proprietary exchange feeds.	Autoregressive conditional duration (ACD) models; Hawkes process modeling; network analysis of liquidity provision.
Market Fragmentation & Execution Quality	Insufficient analysis of how order routing, latency arbitrage, and dark pool usage affect retail vs. institutional execution quality.	Order routing datasets; dark pool trade reports; transaction cost analysis data.	Agent-based modeling; execution cost decomposition; matched-order analysis.
Governance, ESG, and Market Fairness	Nascent research on how ESG mandates and fairness regulations shape microstructure dynamics and investor behavior.	ESG score databases; order book transparency metrics; investor order-type classification.	Panel regressions with ESG interaction terms; behavioral microstructure experiments.

need and relevance of advanced econometric techniques for designing models. Future studies may leverage recent VAR models, Hawkes processes, agent-based simulations, and natural experiment frameworks to evaluate multi-facet market concepts and the long-term implications of market reforms, low-latency trading environments, and ESG-related regulations. Integration of machine learning techniques with traditional econometric models can significantly improve the efficiency of forecasting models. Such combination also presents an opportunity to improve the accuracy of predications and understanding of investor behavior and market efficiency. Overall, a comprehensive roadmap for future studies is presented in Table 5 and it will help develop a relatively robust, timely, and policy-relevant models.

CRedit authorship contribution statement

Muhammad Wajid Raza: Writing – original draft, Software, Data curation. **Ahmed Elshahat:** Writing – review & editing, Investigation, Conceptualization. **Marco Ercole Oriani:** Supervision, Resources. **Andrea Paltrinieri:** Writing – review & editing, Investigation. **Bahrawar Said:** Methodology, Formal analysis, Data curation.

Declaration of Competing Interest

The authors declare no competing interests or conflicts of interest that could influence the research presented in this manuscript. No AI is used to refine the writing and coherence in some sections of the paper.

Data availability

Data will be made available on request.

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