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A Bibliometric Analysis of Stock Trading Research: Unveiling Publication Trends and Future Direction

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Abstract

This research aims to comprehensively analyze the landscape of stock trading research. The study seeks to understand the current state of publications, identify emerging trends, recognize key contributors, and explore potential future directions in the field. It also aims to elaborate on descriptive analysis, publication trends, author and institution profiling, collaboration networks, and factorial analysis to provide a multifaceted view of stock trading research. This research uses BiblioMagika and Biblioshiny, a shiny app for the Bibliometrix R package, to perform bibliometric analysis of stock trading studies. The data retrieved from the Scopus database is decoded into multiple visualized formats using the method applied in this study. This study's review of stock trading studies encompasses all relevant papers from 1984 until early 2024, utilizes data from 396 sources, covering 578 documents, and involves 1,118 authors. An appropriate scan and refinement of the article's record was performed.

The study reveals substantial growth in stock trading publications, with notable peaks in recent years. Emerging trends include the increasing influence of technology, machine learning, and a global collaborative effort. The dynamics of stock trading are characterized by a symbiotic relationship between foundational knowledge, advanced analytics, automation, and digitalization. The interplay between these factors reflects the evolving nature of the stock trading ecosystem, where technology plays a pivotal role in shaping investment, trading behaviors, behavioral finance and artificial intelligence integration.

The Scopus online database was the sole place where stock trading studies were examined from multiple perspectives. Other publications published in other databases are not included. Subsequent investigations may examine comparable publications found in other reputable databases.

This research makes a significant contribution to the area by providing a thorough trend of stock trading research, highlighting

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technological breakthroughs, identifying important contributors, considering possible research future directions, and adding to the body of knowledge on stock trading.

Keywords: stock trading, behavioral finance, artificial intelligence, bibliometric analysis

JEL: G12, G14, J51, H54, R53

Introduction

Stock trading refers to the buying and selling of shares or securities in stock markets. Stock investment is one of the commercial activities that has become more accessible due to the expansion of digital technology and innovation (Chong et al., 2021). The stock market can help both novice and seasoned investors grow their wealth (Yang et al., 2021). Since digital technologies are critical to the development of financial institutions in emerging nations, stock trading has flourished. The traditional mechanism used on the stock exchange is where the global stock market starts. The Stock Exchange subsequently put in place a mechanism for trading automation. It started putting into practice a system for remote trading, which enables stock investors to trade from a distance using the Internet and their computing devices or smartphones. These days, anyone with an internet connection can trade stocks digitally from anywhere (Murhadi et al., 2021). The digital transformation of stock trading is being aided by a rise in trading platforms, smartphones, and retail investors (Gupta and Dey, 2023).

Digital transformation has an impact on stock trading systems developed based on the internet or digital. A digital platform utilized for real-time analysis of prices, market news, transaction volume, stock charts, top values, winners, and losers of exchange-traded equities is known as internet or digital stock trading. They can trade with ease using stock sellers, stakeholders, and mobile technologies from their PCs or smartphones. Through digital mobile stock trading, users can swiftly evaluate corporate information, place orders, and carry out technical analysis on a computer or smartphone. Individuals can deal on the online stock market, mainly buying and selling stocks, by using their computers to access the stock exchange (Diakoulakis et al., 2002). According to Nguyen et al., (2020), the primary benefit of online trading over traditional systems is its immunity to alluring fees. When trading and performing other financial processes, investors find that using applications is more convenient (Nair et al., 2023). Profits can be made by investors who purchase shares traded on the stock exchange. Accurate and useful stock price forecasts can bring significant benefits (Suhail et al., 2021). To accurately predict the future behavior of an investor is one of the biggest challenges in the stock trading. Therefore, bibliometric research that can identify research patterns and forecast future investor behavior is required.

The dynamic interaction of financial markets, technological improvements, and changes in investor behavior have resulted in significant improvements in the field of stock trading research. Bibliometric analysis can shed light on research publication patterns, authorship, and citation impact in the field of stock trading, to provide insight into the evolution and development of stock trading today. Most bibliographic research deals with the stock market, which discusses stock market performance (Zulfikar, 2022). There is no bibliographic research that focuses on “stock trading.” Furthermore, there is review research that discusses stock trading only a

little, Alryalat et al. (2007) provide an overview of relevant issues in trading and the impact of the US Securities and Exchange Commission (SEC). Vasconcelos and Martins (2020) examine how competition between institutional investors is important to improve stock price efficiency. Thus, bibliographic research on stock trading needs to be carried out which aims to provide an overview of various data related to publication trends, writing patterns, the impact of quotes, and research themes that can be developed in the future.

In order to offer a thorough review of particular topics, as well as to provide visual analysis and identify the cluster of investigation from the previous study, bibliometric analysis is a suitable method for methodically performing science mapping (Fayad et al., 2023). In contrast to conventional trend analysis, it consists solely of listing and basic analysis using lists of variables and theoretical frameworks (Punj et al., 2023). The cluster area of inquiry in the field can be developed by using bibliometric analysis to enable network analysis of keywords and titles by the researcher. Indeed, the investigator might offer a comprehensive synopsis of the authors, references, and citations of the prior investigation by employing science mapping and network analysis. The purpose of this project is to address the following research questions:

1. What is the current landscape of stock trading research?
2. What are the publication trends in the field of stock trading, and how have they evolved over time?
3. Who are the most prolific authors in the stock trading research?
4. What are the most influential institutions in the field of stock trading, and how have they contributed to the development of the field?
5. What are the most active countries in the field of stock trading, and how does this vary across different regions and time periods?
6. What are the most highly cited documents in the field of stock trading, and what are the key themes and topics that they address?
7. What are the most common keywords and themes in the literature on stock trading, and how have they evolved over time?
8. What is the collaboration network of stock trading, and how do they vary across different regions, institutions, and research topics?
9. What are the key themes and topics that emerge from co-occurrence analyses of author keywords and title/abstract terms in the literature on stock trading?

The structure of the paper is as follows. The next section will discuss the literature review development in the field of the stock trading market in general, followed by a review of stock trading. After that, this paper explains how Biblioshiny was utilized as the bibliometric tool for this research. This section presents a variety of references and flowcharts for conducting bibliometric analysis. After that, the discussion shifts to a detailed analysis aimed at answering the above research questions. This is followed by a discussion of the contribution, limitations, and recommendations for more research in the future.

1. Theoretical framework

The landscape of stock trading research is continually evolving, driven by dynamic shifts in financial markets, technological advancements, and an expanding

understanding of investor behavior. As we embark on a journey through the historical development and recent trends in stock trading research, this literature review aims to provide an updated overview of the current state of research in this domain. The field of stock trading research is currently characterized by a rich tapestry of themes and debates that collectively shape the discourse within the financial domain. From the pervasive influence of algorithmic trading and machine learning techniques to the enduring significance of traditional technical analysis, this literature review encapsulates the breadth of contemporary research endeavors. Recent years have witnessed transformative milestones in stock trading research, driven by the ingenuity of key contributors. Researchers have significantly advanced the field through their groundbreaking work in algorithmic trading (Kuo et al., 2013), predictive modelling (Pholsri and Kantavat, 2023), and behavioral finance (Deng et al., 2023; Thaler, 2005).

The historical development of stock trading research is a tapestry woven with significant milestones and contributors, reflecting the ever-changing dynamics of financial markets. While tracing the origins of the establishment of the Amsterdam Stock Exchange in the 17th century, we now extend our exploration into recent decades, acknowledging the pivotal contributions of luminaries such as Fama (1970), Thaler (1980), and Ng et al. (2001). Building upon foundational concepts such as the Efficient Market Hypothesis (EMH) and embracing emerging technologies, the historical narrative expands to incorporate the rise of algorithmic trading (Chen, 2012; Ma et al., 2021), high-frequency trading (Hsieh et al., 2019), infusion of machine learning (Allen et al., 2012; Lin et al., 2021; Ullah et al., 2023), and artificial intelligence (Alnemer and Al-Sartawi, 2023). More recently, a growing emphasis on environmental, social, and governance (ESG) factors, interdisciplinary approaches, and the integration of alternative data sources has marked the evolution of stock trading research.

In the recent landscape of stock trading research, our focus extends to the forefront of emerging trends, theoretical frameworks, and methodological innovations. As we delve into recent developments, the integration of blockchain technology, artificial intelligence, and machine learning becomes increasingly prevalent (Chang and Wang, 2023). Concepts like decentralized finance (DeFi), non-fungible tokens (NFTs), and the impact of the COVID-19 pandemic on market resilience shape the contemporary discourse. Recent trends in the concepts and constructs studied in stock trading research reflect a paradigm shift towards the integration of emerging technologies and the consideration of ethical and sustainable dimensions. Blockchain and cryptocurrencies, artificial intelligence, robo advisors, and cybersecurity concerns take center stage (Lian et al., 2020; Yoo, 2024). The exploration of stock trading in different contexts, such as healthcare and government, highlights the expanding applications of these concepts beyond traditional financial realms.

The theoretical frameworks, including extensions of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), underscore the efforts to understand the evolving landscape of user acceptance and behavior within stock trading platforms. These frameworks adapt to consider the nuances introduced by robo-advisors, algorithmic trading, and the ethical considerations associated with sustainable investing. Davis (1989) developed TAM, which focuses on

user acceptance of technology. Recent developments in TAM might involve extensions to consider factors specific to stock trading platforms, algorithmic trading, and the user experience in financial technology (FinTech) applications. Researchers may explore how perceived ease of use and usefulness impact the adoption of advanced trading technologies. Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), and Theory of Planned Behavior (TPB) (Ajzen, 1991), respectively, are frameworks that consider attitudes, subjective norms, and perceived behavioral control. In the context of stock trading, recent developments may include exploring how social norms, perceived control, and attitudes toward trading strategies influence investors' decision-making processes. Unified Theory of Acceptance and Use of Technology (UTAUT) is an extension of TAM that integrates multiple factors influencing technology acceptance (Venkatesh, 2003). Recent developments in UTAUT might involve applications in the context of stock trading (Tai and Ku, 2013), exploring how performance expectancy, effort expectancy, social influence, and facilitating conditions influence traders' acceptance and use of advanced technologies. UTAUT2, an extension of UTAUT, incorporates additional constructs such as hedonic motivation, price value, and habit (Venkatesh, 2012). Recent developments may involve applying UTAUT2 to understand user acceptance and adoption of specific features or technologies within stock trading platforms, considering factors like user motivation, perceived value, and habit formation.

The implications of these recent trends in stock trading research are profound, shaping the future trajectory of the field. From a holistic understanding of trading behavior to advancements in predictive modeling and the ethical considerations of sustainable investing, the multidisciplinary nature of research methods heralds a future marked by resilience and adaptability. The implications extend beyond theoretical frameworks to the practical realms of decision-making, risk management, and the sustainable evolution of financial markets. The literature trends suggest a need for heightened attention to the ethical considerations of stock trading. Future research could delve into developing ethical frameworks for algorithmic trading and contribute to the formulation of effective regulatory policies (Lv et al., 2023). The pervasive use of technology in stock trading calls for research that is adaptable to technological changes. Future studies should be designed with the flexibility to incorporate emerging technologies and methodologies (Trang and Tho, 2017). Given the global nature of financial markets, future research could explore the impact of geopolitical events, market integration, and cross-border trading on stock market dynamics (Vismayaa et al., 2020). Encouraging multidisciplinary collaboration amongst experts in finance, computer science, psychology, and ethics to address the multifaceted nature of stock trading.

2. Methodology and data

The methodology used in each study must be explained in detail. Rehn et al. (2007) state that bibliometrics is frequently used to evaluate scientific research by means of quantitative analyses of research publications. The foundation of bibliometric analyses is the presumption that the majority of scientific findings and research findings are eventually published in internationally recognised scientific journals, where other researchers can read and quote them. According to

Pritchard (1969), bibliometrics is the study of books and other communication media via the use of statistical and mathematical techniques. A bibliometric analysis is typically employed to assess the volume and calibre of published literature in order to identify patterns or trends within a particular field of study (Sweileh et al., 2017). One method that is becoming more and more common for reporting research trend and impact is bibliometric analysis. The classification of publications, citations, authorship, publication impact, and country are the most frequently noticed indicators when using bibliometrics study (Ahmi and Mohamad, 2019).

Scopus provides the flexibility in terms of search across many bibliographic categories (Hassan and Ahmi, 2022). Scopus is one of the biggest and most complete abstract and citation databases of peer-reviewed literature, it was chosen as a strategic methodological choice. The range of fields covered by Scopus includes social, scientific, technical, and medical sciences, all of which are extremely important to our investigation of stock trading. Its thorough coverage of business and management studies, engineering, environmental sciences, and other fields guarantees a comprehensive and accurate dataset. In addition, Scopus provides extensive geographic coverage and strict quality controls, making it a suitable option for a careful bibliometric examination. Its selection as our primary data source for this investigation was further supported by its capacity to provide a wide range of metadata, including citation data and author affiliations (Burnham, 2006; Chadegani et al., 2013). The information gathered covered a wide range of topics, such as the type of document, the source type, languages, subject areas, publication trends, the number of authors per document, institutional contributions to publications, the distribution of publications by country, and frequently used keywords.

2.1. Search strategy and data collection

The online Scopus database is used in this study to gather a set of papers for examination. Because it is regarded as the largest database of quotes and abstracts in the domains of technology, social sciences, business, and management, including stock trading, the online database Scopus was used for this study. The data used in this study were taken from the Scopus database as of January 16, 2024. This study used the data from the Scopus database as of January 16, 2024. The following keywords have been used to search relevant articles which is related to stock trading, such as “stock trading” OR “stock trade”, contained in the title of the article. This study focuses on the article titles since they convey the pertinent subject that is important to the aim of the study and the research area. Chen (2010) explains that as the title is the first thing readers would notice, it should include information that could be used to attract their attention. The precise procedures for the search strategy used in this study and for carrying out the bibliometric analysis are shown in Figure 1. From the keywords entered in the Scopus database, 580 documents were obtained with Search Field: Article Title, Time Frame: All, Language: English, Source Type: All, Document Type: All. Then all these documents are language restricted, that is, only documents in English will be analysed. So that the number of documents analysed in this paper amounted to 578. Furthermore, the data is exported in the form of comma separated values and included in the bibliomagika. BiblioMagika

was used to ensure the reliability and validity of the data in these studies.

2.2. Data cleaning and harmonisation

The process of repairing or eliminating inaccurate, corrupted, improperly formatted, duplicate, or incomplete data from a dataset is known as data cleaning. It also involves making sure the data is accurate, consistent, and useful. The majority of the bibliographical information is inconsistent. Therefore, cleaning is required before moving on to the bibliometric analysis (Ahmi, 2023a). This study uses BiblioMagika and OpenRefine in the cleaning and harmonizing process. In the first stage, the data obtained from Scopus is entered into BiblioMagika for the cleaning process. Comprehensive bibliometric measurements, including Total Publications (TP), Number of Cited Publications (NCP), Number of Contributing Authors (NCA), Citations per Cited Paper (C/CP), Total Citations (TC), Citations per Paper (C/PCitations per Author (C/A), Citations per Year (C/Y), Authors per Paper (A/P), Citable Year, g-index, h-index, and m-index, as well as Citation Sum within h-Core for year, source titles, authors, institutions, and nation were all carried out in the meantime using BiblioMagika.

Moreover, BiblioMagika made it easier to find any missing data, which allowed us to manually complete the cleaning and harmonization process and fill in the gaps. All filtered and modified keywords were thoroughly reviewed for accuracy following the first cleaning. The data consistency was preserved by joining multivalued cells and re-entering the separators that were initially used during the splitting operation. Eventually, the data was cleaned and harmonized, and exported back into its original format, prepared for additional examination. Then in the second stage, data from bibliomagika is entered into OpenRefine. OpenRefine as an approachable tool for cleaning and harmonizing bibliographical data (Ahmi, 2023b). Author, Affiliation, Authors Keyword, and Reference data are harmonized in OpenRefine, so that a clean dataset is ready for further analysis in Biblioshiny.

2.3. Data analysis and measures

The framework of the data analysis was designed to address the study questions mentioned in the introduction. Documenting the current state of stock trading research in terms of subject areas, languages, document types, sources, and citation metrics as part of our methodology. The findings are arranged in a way that highlights important contributors and prevailing trends in the area. These criteria include the number of papers published annually, publications by the most productive authors, institutions, nations, and source titles. The impact and relevance of the identified publications were comprehensively assessed using bibliometric measurements, including total publications, number of cited papers, total citations, citations per paper, citations per cited papers, h-index, g-index, m-index, and citation sum within h-core. Additionally, we used factorial analysis, thematic mapping, and co-occurrence network analysis to visualize the author's keywords in order to shed light on important themes and concepts in the field. With the use of these visualizations, we were able to spot linked topic clusters, find hidden patterns, and learn more about the links between different study subdomains.

2.4. Tools

This study used a range of instruments to do an extensive bibliometric analysis. The initial data structure and cleaning was done

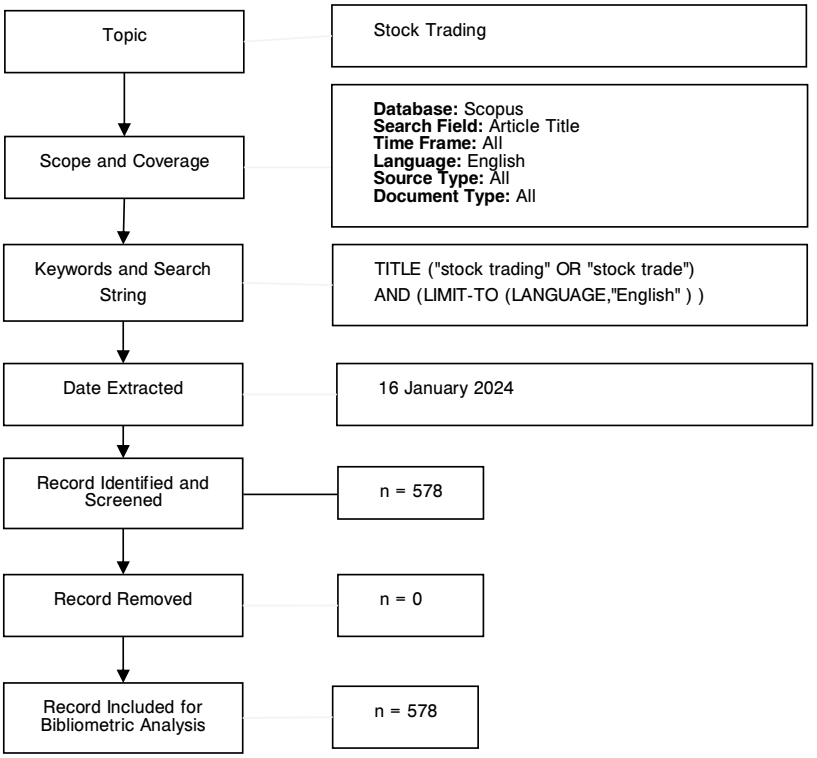

Figure 1. Flow diagram of the search strategy
Source: Zakaria et al. (2021), Moher et al. (2009)

using Microsoft Excel, and the process of cleaning, harmonising, and standardising author, affiliation, and country data was streamlined using BiblioMagika. The author's keyword data was cleaned and harmonised using OpenRefine. After the data was ready, we created illuminating visual representations of our findings using Biblioshiny. Aria and Cuccurullo (2017) developed this software, primarily focusing on science mapping analysis, Biblioshiny is a shiny app for the Bibliometrix R package, to answer the research questions set in this study and to reach the research objective. The integration of these instruments and methodologies enabled a comprehensive and resilient analysis of stock trading.

3. Results

3.1. Descriptive analysis

This section discusses the research profile of stock trading, including publication sources from 1984 to 2024. This section includes all information regarding the current state of publications, research trends, highly cited papers, prolific authors, countries and institutions, publication sources, and terms author's key. To address the first research question, which seeks to understand the current landscape of stock trading research, we will analyse the main information regarding selected articles. Additionally, we will discuss the overall citation metrics for publications within the stock trading domain to gain insight

Table 1. Main information regarding selected articles

Description	Results
Main information about data	
Timespan	1984:2024
Sources (Journals, Books, etc)	396
Documents	578
Annual Growth Rate %	2.78
Document Average Age	9.94
Average citations per doc	15.69
References	15730
Document contents	
Keywords Plus (ID)	2473
Author's Keywords (DE)	872
Authors	
Authors	1118
Authors of single-authored docs	64
Authors Collaboration	
Single-authored docs	68
Co-Authors per Doc	2.84
International co-authorships %	13.15
Document Types	
Article	312
Book chapter	11
Conference paper	246
Erratum	1
Note	3
Review	5

into their impact and relevance. The earliest paper discussing stock trading appeared in the Scopus database in 1984. The number of publications shows substantial growth at an annual rate of 2.78%. Table 1 presents the information on all articles published in stock trading from 1984 to 2024, covering specific information on average years from publication, average citation per document, average citation per year, document types, document contents, authors' details, and author's collaboration.

The research covers the period from 1984 to 2024, providing a comprehensive view over several decades. The data is derived from 396 sources (Journals, Books, etc), indicating a wide range of references, potentially contributing to a diverse and robust dataset. There are 578 documents in total, suggesting a substantial amount of information for analysis. The average annual growth rate is 2.78%, indicating a moderate increase in the number of documents over the years. The average age of the documents is 9.94 years, giving an insight into the recency of the literature being analysed. Each document, on average, has been cited 15.69 times, suggesting a relatively high level of impact or influence within the research community. There are 15,730 references in total, highlighting the

extensive use of external sources and a robust foundation for the research.

There are 2,473 additional keywords, providing a rich set of terms that can enhance the understanding of the topics covered. There are 872 author-specified keywords, providing insights into the specific focus areas of the research. The research involves 1,118 authors, showcasing a collaborative effort and potentially diverse perspectives. 64 documents were authored by a single individual, emphasizing individual contributions. Collaboration is evident with 68 single-authored documents and an average of 2.84 co-authors per document. Approximately 13.15% of the collaboration involves international co-authorships, indicating a global perspective. The document types include 312 articles, 11 book chapters, 246 conference papers, 1 erratum, 3 notes, and 5 reviews, offering a diverse range of content.

3.2. Publication trends

Addressing our second research question, "What emerging trends can be observed in stock trading publications?" we chart the growth trajectory of this burgeoning field. From its inception in 1984, stock trading research has seen a momentous rise, particularly from the turn of the century, with a peak of 59 publications in 2023, a testament to the burgeoning interest in this field (Fig. 2 and Table 2). Fig. 2 illustrates this remarkable growth story by presenting the trend of total publications and citations over time. The bar chart depicts an accelerating trend of publications, with a few notable leaps in recent years. Parallelly, the line graph underscores the increasing total citations, demonstrating the rising influence of this body of research.

The total number of publications on stock trading over the years is 578, providing a comprehensive dataset for analysis. The total number of publications has shown a general upward trend over the years, with a significant increase from the 1990s onward. The Normalized Citation Per Paper (NCP) metric gives an average number of citations per paper. It varies over the years, with the highest NCP in 1991 (842.00) and the lowest in 2024 (0.00). The cumulative total citations over the years indicate the overall impact of the research, reaching 9,070. The total citations increased steadily, reflecting the growing impact of stock trading research. However, the average citations per paper (C/P) have shown fluctuations. The citations Per Paper (C/P) metric gives an average number of citations each paper received. It peaked in 1984 with 255.00 citations per paper. The Citations Per Cited Paper (C/CP) considers only the cited papers, providing an average number of citations each cited paper received. It peaked in 1991 with 842.00 citations per cited paper. On the other hand, the H-index and G-index provide insights into the impact of the most cited papers, with the H-index peaking in 2013. The h-index is a measure of the impact of the most cited papers. It reached 13 in 2013, suggesting that 13 papers each have at least 13 citations. And the g-index in 2013 reach 22.

Table 2. Year of Publication

Year	TP	NCP	TC	C/P	C/CP	h	g
1984	1	1	255	255.00	255.00	1	1
1986	2	2	153	76.50	76.50	2	2
1987	3	3	11	3.67	3.67	2	3
1988	2	2	12	6.00	6.00	2	2
1989	1	1	170	170.00	170.00	1	1
1991	1	1	842	842.00	842.00	1	1
1993	2	1	18	9.00	18.00	1	2
1994	1	0	0	0.00	0.00	0	0
1996	1	1	26	26.00	26.00	1	1
1997	6	5	18	3.00	3.60	3	4
1998	4	3	40	10.00	13.33	3	4
1999	1	0	0	0.00	0.00	0	0
2000	2	2	106	53.00	53.00	2	2
2001	6	4	252	42.00	63.00	3	6
2002	10	9	445	44.50	49.44	7	10
2003	11	8	77	7.00	9.63	4	8
2004	17	15	216	12.71	14.40	8	14
2005	13	11	142	10.92	12.91	6	11
2006	12	10	516	43.00	51.60	6	12
2007	8	8	223	27.88	27.88	6	8
2008	20	17	318	15.90	18.71	8	17
2009	18	15	645	35.83	43.00	9	18
2010	22	21	468	21.27	22.29	11	21
2011	27	22	471	17.44	21.41	10	21
2012	20	18	387	19.35	21.50	9	19
2013	33	28	509	15.42	18.18	13	22
2014	25	22	358	14.32	16.27	9	18
2015	22	19	331	15.05	17.42	9	18
2016	25	21	420	16.80	20.00	9	20
2017	27	23	343	12.70	14.91	10	18
2018	31	27	343	11.06	12.70	9	17
2019	20	17	155	7.75	9.12	6	12
2020	39	33	421	10.79	12.76	10	19
2021	36	30	229	6.36	7.63	10	13
2022	47	32	124	2.64	3.88	6	8
2023	59	15	26	0.44	1.73	2	3
2024	3	0	0	0.00	0.00	0	0
Total	**578**	**441**	**9070**	**15.69**	**20.29**		

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; and g=g-index.

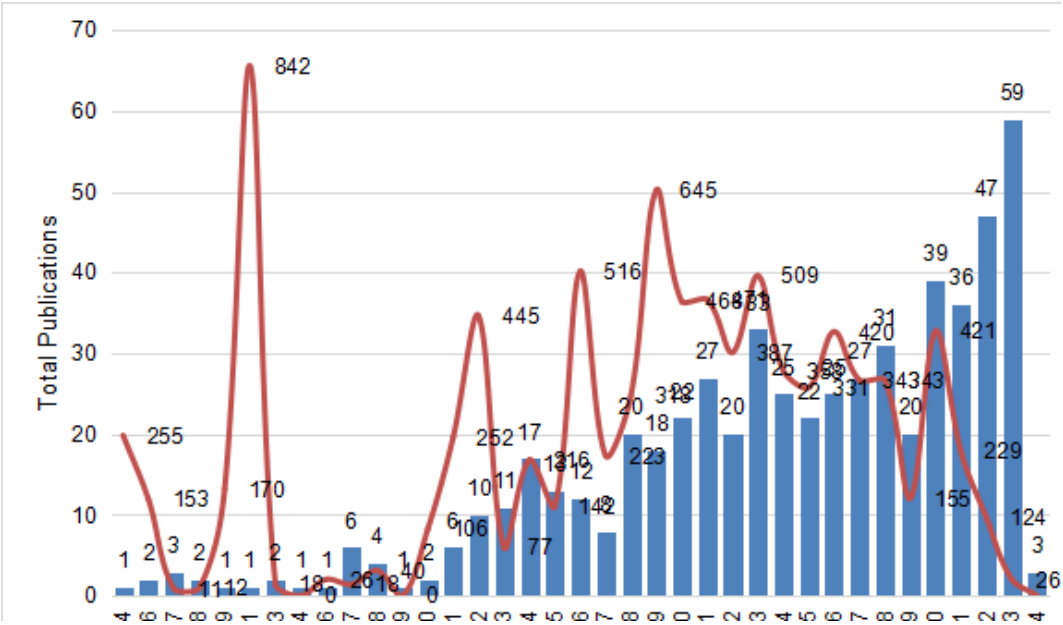

Figure 2. Total Publications and Citations by Year

3.3. Publications by authors

To answer the third research question, "Which key players - authors are driving progress in stock trading research?" we will investigate the most influential authors in the field by examining their contributions, number of citations, and overall impact on the stock trading research landscape. The most productive authors come from diverse institutions and countries, showcasing the global nature of stock trading research. Table 3 shows five productive authors in stock trading research, demonstrated by their total number of publications, number of papers cited, total citations, h index, and g index. As presented in Table 3, Barmish from the University of Wisconsin-Madison leads in productivity with a total number of articles produced being 19. While Chang from Yuan Ze University stands out for the highest average citations per paper (C/P). Authors from Waseda University, Japan, demonstrate consistent productivity and impact, with Mabu and Hirasawa both having a notable presence. Authors from Taiwan, such as Chang, Kuo, and Chou, contribute significantly with impactful research. The h-index and g-index provide insights into the impact and concentration of citations within each author's body of work.

3.4. Publications by Institutions

In Table 4, research productivity is presented at the institutional level, focusing on the institutions that have produced a minimum of 6 publications in the field of stock trading. The University of Wisconsin-Madison tops the chart with a TP of 17, asserting its strong position in this research field. It holds a h-index of 9, reflecting the substantial impact and quality of its research output. The high TC of 257 further reinforces its influence in the academic community. Waseda University has a solid record in fraud detection studies, with

Table 3. Productive Authors that Published more than ten Document

Author's Name	Affiliation	Country	TP	NCP	TC	C/P	C/CP	h	g
Barmish, B. Ross	University of Wisconsin-Madison	United States	19	19	269	14.16	14.16	10	0
Mabu, Shingo	Waseda University	Japan	16	15	191	11.94	12.73	7	2
Hirasawa, Kotaro	Waseda University	Japan	15	14	160	10.67	11.43	6	2
Chen, Yan	Shanghai University of Finance and Economics	China	11	10	137	12.45	13.70	5	2
Chang, Pei-Chann	Yuan Ze University	Taiwan	10	10	433	43.30	43.30	7	1

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; and g=g-index.

Table 4. Most productive institutions with minimum of six publications

Affiliation	TP	TC	NCP	C/P	C/CP	h	g
University of Wisconsin-Madison	17	257	17	15.12	15.12	9	0
Waseda University	15	160	14	10.67	11.43	6	2
Yuan Ze University	10	433	10	43.30	43.30	7	1
Sungshin Women's University	10	191	10	19.10	19.10	6	1
Nanyang Technological University	10	233	8	23.30	29.13	6	1
Tongji University	9	154	8	17.11	19.25	7	1
Tsinghua University	9	212	8	23.56	26.50	4	2
National Chi Nan University	7	94	6	13.43	15.67	6	1
Shandong University of Science and Technology	7	25	5	3.57	5.00	3	2
Politecnico di Torino	6	20	6	3.33	3.33	3	1
Vilnius University	6	43	5	7.17	8.60	3	1
Sun Yat-sen University	6	96	4	16.00	24.00	4	1
Seoul National University	6	176	6	29.33	29.33	6	0

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; and g=g-index.

a good number of publications and citations. The h-index is 6, indicating that there are 15 papers with at least 6 citations each, and the g-index is 2. The University of Wisconsin-Madison, Yuan Ze University, and Nanyang Technological University stand out with high average citations per paper (C/P), indicating the impact of their research. Waseda University, Tongji University, and Tsinghua University show a good balance between the number of publications and citations. Institutions like Shandong University of Science and Technology and Politecnico di Torino have a lower impact, but the g-index suggests that a few top papers contribute significantly to their citation counts. These institutions have made

significant contributions to the field of stock trading studies, with varying degrees of impact and productivity. This information is not only essential for understanding the landscape of current research productivity but also provides valuable insights for future institutional collaborations and strategic planning in the research sector. Researchers and institutions can benchmark their contributions against these influential institutions to identify areas of strength and potential collaboration. The focus on quality metrics (C/P, C/CP) indicates a commitment to producing research with a lasting impact. The data provides insights into how different institutions have shaped the field of stock trading through their research output.

3.5. Publications by countries

Table 5 illustrates the research productivity of various countries in the field of stock trading, considering those that have produced a minimum of 10 publications. The United States and China are the leading contributors to stock trading research, with high productivity, citations, and impactful publications. Leading the list, the United States has the highest productivity with a TP of 120. It also boasts an impressive h-index of 22, indicating the significant impact and quality of the research contributions. The high TC of 3013 further attests to the strong influence of the United States' research in the global scientific community. Close behind, China presents a TP of 116, proving its substantial contributions to the field. While the h-index is at 21. Taiwan, India, and South Korea also have a significant presence in the field, with notable average citations per paper (C/P) and per cited paper (C/CP). European countries like the United Kingdom, Germany, Italy, and Poland, as well as Asian countries like Singapore, Hong Kong, and Malaysia, contribute to the global landscape of stock trading studies. Each country's h-index and g-index provide insights into the impact and influence of their research output, with some countries having a more concentrated impact from top-cited papers. Researchers and institutions can identify key contributors and collaborative opportunities in different regions. The trends suggest the evolving landscape of stock trading research, with certain countries experiencing rapid growth in publications. Recognizing the regional variations helps in understanding the global distribution of expertise and knowledge in stock trading.

3.6. Publications by source titles

The top-cited documents cover a wide range of stock trading topics, including information content, optimal trading, decision support systems, and the impact of financial crises. Hasbrouck's work on measuring the information content of stock trades is exceptionally influential. Hasbrouck's (1991) document with the title Measuring the Information Content of Stock Trades has the highest total citations, namely 842 and Citations per year of 24.76. Table 6 shows that there are 20 documents that have the highest citations in the field of stock trading. Older publications, such as Constantinides' 1984 paper, continue to have a lasting impact, emphasizing the enduring value of foundational research. The C/Y ratio helps assess the ongoing relevance of each document, with higher ratios indicating sustained interest over time. These highly cited documents cover a broad spectrum of topics within the

Table 5. Countries that contributed 10 or more publications

Country	TP	TC	NCP	C/P	C/CP	h	g	m	CSwHC
United States	120	3013	101	25.11	29.83	22	8	0.537	2488
China	116	1393	80	12.01	17.41	21	8	0.656	1008
Taiwan	60	1378	54	22.97	25.52	18	5	0.563	1193
India	45	379	29	8.42	13.07	11	5	0.500	323
South Korea	35	398	24	11.37	16.58	10	4	0.417	343
Japan	26	249	24	9.58	10.38	8	3	0.364	195
Canada	18	118	15	6.56	7.87	7	3	0.250	102
Thailand	16	88	12	5.50	7.33	4	3	0.235	69
United Kingdom	15	224	11	14.93	20.36	6	2	0.250	210
Singapore	15	298	12	19.87	24.83	8	2	0.296	282
Hong Kong	13	187	10	14.38	18.70	6	2	0.300	178
Germany	13	70	10	5.38	7.00	5	2	0.132	60
Indonesia	13	36	8	2.77	4.50	4	3	0.400	31
Australia	13	197	9	15.15	21.89	4	3	0.160	185
Malaysia	13	241	10	18.54	24.10	6	2	0.375	229
Poland	12	351	12	29.25	29.25	8	1	0.400	336
Italy	12	152	12	12.67	12.67	4	2	0.267	133
Iran	11	280	8	25.45	35.00	3	2	0.158	268

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; and g=g-index; m = index; CSwHC = citation sum within h-core.

field of stock trading, including measurement techniques, decision support systems, optimal trading strategies, the role of taxes, and the impact of financial crises. Researchers can explore these documents for foundational insights and a comprehensive understanding of the themes shaping stock trading research.

3.7. Top keywords

The researcher performed a similar analysis for the most frequent analysis for this bibliometric study on stock trading. Table 7 below shows the most commonly used words in this analysis and the list of keywords, The top authors' keywords and indexed keywords that occur more than ten times.

Table 6. Top 20 highly cited documents

No.	Author(s)	Title	TC	C/Y
1	Hasbrouck (1991)	Measuring the Information Content of Stock Trades	842	24.76
2	Constantinides (1984)	Optimal stock trading with personal taxes. Implications for prices and the abnormal January returns	255	6.22
3	Kuo et al. (2001)	An intelligent stock trading decision support system through integration of genetic algorithm based fuzzy neural network and artificial neural network	240	10.00
4	Albadvi et al. (2007)	Decision making in stock trading: An application of PROMETHEE	230	12.11
5	Zhang (2001)	Stock trading: An optimal selling rule	229	9.96
6	Ben-David et al. (2012)	Hedge fund stock trading in the financial crisis of 2007-2009	192	14.77
7	Ramayah et al. (2009)	A decomposed theory of reasoned action to explain intention to use Internet stock trading among Malaysian investors	171	10.69
8	Jarrell and Poulsen (1989)	Stock trading before the announcement of tender offers: Insider trading or market anticipation?	170	4.72
9	Lakonishok and Smidt (1986)	Volume for Winners and Losers: Taxation and Other Motives for Stock Trading	149	3.82
10	Dash and Dash (2016)	A hybrid stock trading framework integrating technical analysis with machine learning techniques	130	14.44
11	Chang et al. (2009)	A neural network with a case based dynamic window for stock trading prediction	120	7.50
12	Teixeira and De Oliveira (2010)	A method for automatic stock trading combining technical analysis and nearest neighbor classification	118	7.87
13	Ivashina and Sun (2011)	Institutional stock trading on loan market information	116	8.29
14	Wu et al. (2020)	Adaptive stock trading strategies with deep reinforcement learning methods	114	22.80
15	Chang et al. (2009)	Integrating a piecewise linear representation method and a neural network model for stock trading points prediction	107	6.69
16	Ang and Quek (2006)	Stock trading using RSPOP: A novel rough set-based neuro-fuzzy approach	93	4.89
17	Wu et al. (2006)	An effective application of decision tree to stock trading	92	4.84
18	Naughton and Naughton (2000)	Religion, ethics and stock trading: The case of an Islamic equities market	90	3.60
19	Luo et al. (2002)	A multi-agent decision support system for stock trading	89	3.87
20	Chavarnakul and Enke (2008)	Intelligent technical analysis based equivolume charting for stock trading using neural networks	88	5.18

Note(s): TC: Total Citations; C/Y: Citations per year

Table 7. Top author's keywords

Author Keyword	Frequency
stock trading	127
stock market	67
technical analysis	51
reinforcement learning	43
internet stock trading	34
trading strategy	28
deep q-learning	26
machine learning	24
stock prediction	19
information	18
neural networks	18
genetic algorithm	17
algorithmic trading	16
financial forecasting	16
genetic network programming	16
trading behavior	15
investor behavior	14
data mining	13
investment	13

Figures 3 show the word cloud of the keywords on stock trading research. Among the top word clouds found from this analysis are stock trading, stock market, technical analysis, reinforcement learning, internet stock trading, trading strategy, deep q-learning, machine learning, stock prediction, information, neural networks, genetic algorithm, algorithmic trading, financial forecasting, genetic network programming, trading behavior, investor behavior, data mining, and investment. These keywords collectively reveal a diverse landscape of stock trading research, incorporating traditional technical analysis, cutting-edge machine learning methods, and a focus on specific aspects such as internet-based trading and trading strategies. Researchers in this field are exploring the intersection of technology, data, and market dynamics to gain insights into effective stock trading practices.

Figure 3. Word cloud of the author keywords

Source: BiblioShiny

3.8. Collaboration network

3.8.1. Collaboration network by author

In order to answer research question eight, an analysis of the collaboration between authors, institutions, and countries was conducted utilizing 50 nodes for clarity. The related authors are shown in Figure 4 with the following indication: the intensity of the authors' relationships is reflected in the color, text size, circle size, and thickness of the connecting lines. More precisely, authors that are associated are shown in the same group and color. Chen Y, Mabu S, Hirasawa K, Li X, and Hu J closely cooperated and carried out research, as shown in Figure 4. Figure 5 displays institutional collaboration, and Figure 6 shows a network map of the affiliations of the various countries.

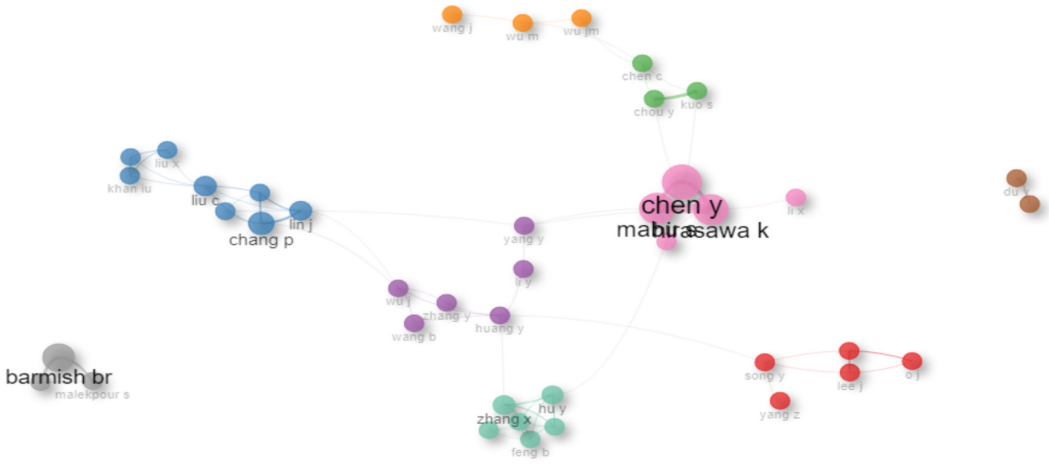

Figure 4. Network visualisation map of the co-authorship by authors

Source: BiblioShiny

3.8.2. Collaboration network by institutions

Collaboration network institution measures the importance of an institution in facilitating communication between other institutions. Higher betweenness centrality values suggest that an institution plays a crucial role in connecting different parts of the network. Closeness centrality measures how quickly an institution can reach other institutions in the network. Higher closeness centrality values indicate institutions that are closer to others and potentially more influential in the network. These institutions in this cluster (e.g., Waseda University, University of Wiconsin-Madison) exhibit high closeness centrality and PageRank, suggesting significant collaboration and influence. The clusters in the collaboration network highlight groups of institutions with varying degrees of centrality, collaboration intensity, and influence in the field of stock trading. Institutions with higher betweenness centrality, closeness centrality, and PageRank play pivotal roles in connecting the network, facilitating collaboration, and potentially influencing the overall dynamics of research in the field.

Figure 5. Network visualisation map of the co-authorship by organizations
Source: BiblioShiny

3.8.3. Collaboration network by countries

The clusters in the collaboration network highlight groups of countries with varying degrees of centrality, collaboration intensity, and influence in the field of stock trading. Countries with higher betweenness centrality, closeness centrality, and PageRank play pivotal roles in connecting the network, facilitating collaboration, and potentially influencing the overall dynamics of research in the field. These Cluster Countries in China, USA, United Kingdom, Italy, Germany, Thailand, Canada, Poland, Hong Kong, Bangladesh, France, Netherlands, Pakistan, Norway, Portugal, Switzerland, and Iceland, exhibit moderate to high betweenness centrality, closeness centrality, and PageRank, indicating significant collaboration and influence within the network. China and the USA have particularly high betweenness centrality and PageRank, suggesting their central roles in connecting and influencing the network.

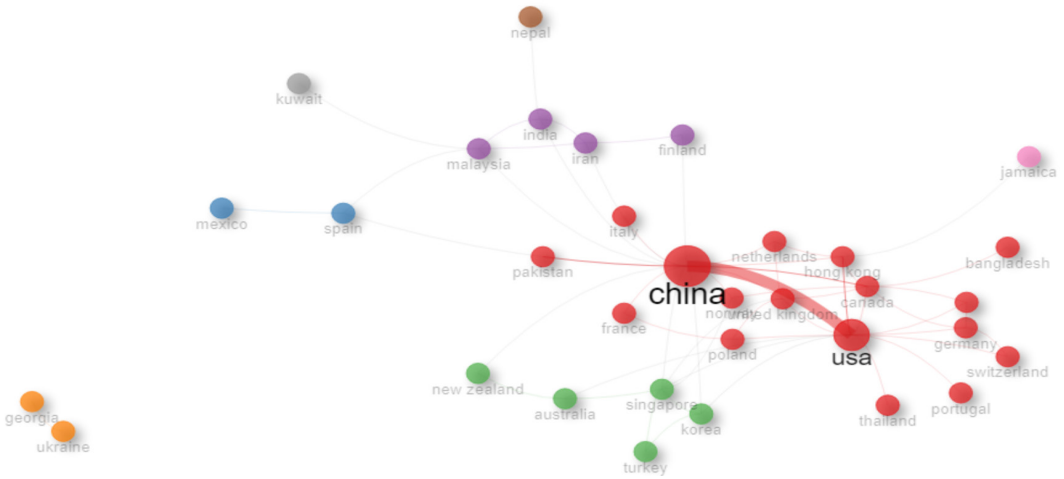

Figure 6. Network visualisation map of the co-authorship by countries

Geographic distribution of stock trading research is brought up by this discovery. Research concentration in specific areas implies that the causes and effects of stock trading may differ in various markets. This suggests the stock trading research must incorporate a wider range of nations in order to fully capture the subtleties and contextual elements that influence stock trading practices around the world. Subsequent investigations may delve deeper into the causes of the discrepancy and promote heightened involvement from marginalised areas.

3.9. Factorial analysis

The purpose of this study is to find the underlying correlations, in a lower dimensional space, between different terms in stock trading research. To examine categorical data, like keyword co-occurrence data, we employed the multiple correspondence analysis (MCA) method, a form of factorial analysis that is frequently utilised. To find the underlying factors, statisticians employ factor analysis. The association between different phrases in stock trading research is visualised visually in this instance through a word map generated by MCA (see Figure 7). The word maps generated by multiple correspondence analysis (MCA) can be further interpreted on the basis of this study. These are some salient observations: The primary cluster, Cluster 1, highlights fundamental ideas and strategies associated with stock trading and symbolises a variety of perspectives in stock trading research. Key terms in this cluster include "stock.trading", "stock.market", "internet.stock.trading", "trading.strategy", "stock.prediction", "information", "investment", "share", "investor.behavior", "financial data", "support.vector.engine", "financial markets", "fuzzy.model", "trade.volume", "individual. investor", " quantitative.stock trading", "sentiment.analysis", "stock price". These factors appear to cover a wide spectrum of terms related to general aspects of stock trading, financial markets, investor behavior, and data-related components. It signifies a comprehensive factor that covers various aspects of the stock trading domain.

Cluster 2 concentrates on the practical aspects of stock trading implementation, paying particular attention to "technical.

analysis", "neural networks", "genetic algorithm", "algorithmic.trading", "finance. forecasting", "genetic.network.programming", "data.mining", "artificial neural network", "evolutionary computing", "fuzzy.logic", "intelligent.stock.trading", "decision-making", "moving.average", "decision.support. system", "decision.tree", "prediction.model". These factors appear to represent terms relating to advanced analytical techniques and technologies used in stock trading. It includes technical analysis, machine learning, evolutionary computing, and various predictive models. These factors suggest a focus on advanced methods and technology in stock trading research. Cluster 3 is distinguished by terms associated with particular technology and cutting-edge methods in stock trading research, like "reinforcement.learning", "deep learning.q", "machine learning", "long term memory.short", "convolutional. neural.network", "automatic stock trading", "sentiment.analysis", "artificial intelligence", "transformer". This factor highlights terms related to advanced machine learning techniques, artificial intelligence, and automation in stock trading. This suggests a focus on advanced technologies and approaches to automated decision-making and analysis. Cluster 4 comprises keywords associated with particular techniques in stock trading research, like "piecemeal. linear representation", "trading.turning.points". These factors appear to represent terms relating to specific techniques or methods such as piecewise linear representation and trading turning points. This may signal a different methodological or conceptual focus in stock trading research.

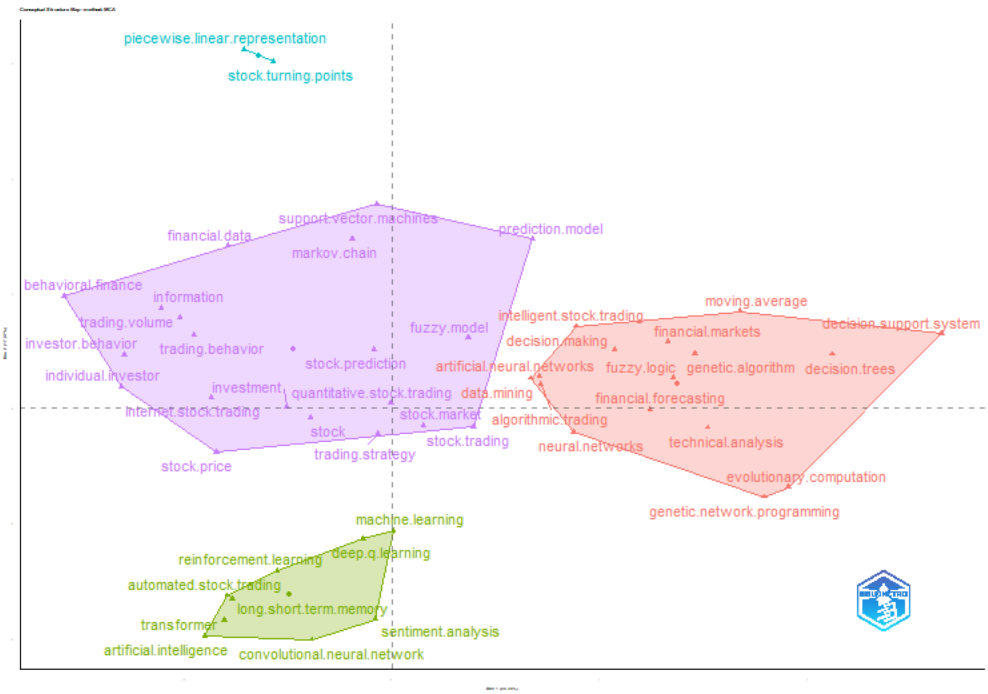

Figure 7. Word map of the author's keywords in stock trading research

The findings of the factor analysis indicate that phrases associated with stock trading can be classified into multiple unique factors, each of which corresponds to a distinct component of the research subject. Cluster 1 comprises of generic terminology, Cluster 2 is about advanced analysis techniques, Cluster 3 is about automation and machine learning, and Cluster 4 is about specific concepts. Cluster analysis is a useful tool for identifying term clusters that share similar properties. These clusters and determinants shed light on the different elements that affect research in the stock trading domain as well as its underlying structure. The factors or clusters collectively reveal that stock trading research is a multidimensional field covering foundational aspects, advanced analytical techniques, automation, and specific methodologies or concepts. Researchers and practitioners in the field may explore a diverse set of topics, ranging from general market dynamics to sophisticated technologies and specific trading strategies.

A symbiotic relationship between foundational knowledge, advanced analytics, automation, and digitalization characterizes the dynamics of stock trading. Investors and traders navigating this landscape are likely to benefit from a holistic approach that integrates both traditional market understanding and cutting-edge technologies. The interplay between these factors reflects the evolving nature of the stock trading ecosystem, where technology plays a pivotal role in shaping investment and trading behaviors. Understanding and adapting to these relationships can empower investors and traders to navigate the complexities of the modern stock trading environment. Strategies to increase investor engagement and tailor technology for stock trading users should be dynamic, accommodating various user preferences and technological advancements. Balancing educational initiatives, advanced features, and user-centric design can contribute to a more engaging and inclusive trading environment.

4. Discussion

This analysis uncovered foundational works that support the body of research on stock trading. Notably, the articles with the highest number of citations were “Measuring the Information Content of Stock Trades” by Hasbrouck (1991). These publications function as fundamental sources, influencing the conversation in the subject. The research identified recurring themes and ideas that dominated the field of citations. There was a lot of interest in subjects like market microstructure, behavioral finance, and algorithmic trading. Several authors have left an indelible mark on the field through their prolific contributions. Barmish BR stands out as a key figure. Their work has not only garnered numerous citations but has also influenced subsequent research trajectories. The analysis unveiled collaborative networks among authors, highlighting clusters of researchers with shared interests. Chen Y, Mabu S, Hirasawa K, Li X, and Hu J were identified as central figures within these networks, indicating their collaborative influence on the evolving landscape of stock trading research.

The analysis traced the temporal evolution of research trends in stock trading. While early works focused on foundational theories, recent years witnessed a surge in studies related to behavior trading, reflecting the dynamic nature of the field. The institutions such as Waseda University and Yamaguchi University, have high PageRank, proximity

centrality, and indications of substantial influence and collaboration. China and the USA have especially high PageRank and Betweenness Centrality, indicating their crucial roles in influencing and linking the network. The interdependent nature of sophisticated analytics, automation, digitization, and basic knowledge characterizes the dynamics of stock trading. An all-encompassing strategy that incorporates cutting-edge technologies and conventional market knowledge is probably going to be beneficial for traders and investors traversing this terrain. The way these elements interact demonstrates how the environment of stock trading is always changing, with technology having a major influence on trading behavior and investing.

The applicability of academic findings to real-world scenarios often depends on the nature of the research, these findings could influence industry practices, policy-making, and practical settings such as algorithmic trading strategies, insights into successful algorithms could enhance trading practices and potentially improve market efficiency. Research on risk assessment and decision-making in stock trading might integrate these findings into decision-support systems to mitigate risks associated with market volatility. Technology Adoption and Innovation focuses on technological advancements and leads to developing innovative trading platforms, analytics tools, or other technological solutions to streamline processes and gain a competitive edge. Insights into investor behavior can be applied in designing educational materials for investors, and understanding how psychological factors influence decision-making could lead to more informed and rational investment practices. International collaborations from institutions and professionals in different countries might collaborate to address common challenges in stock trading. Interdisciplinary research between finance and other disciplines results in more comprehensive models that account for economic, social, and technological factors influencing stock trading. Research focusing on sustainable or ethical trading practices could contribute to advocacy for responsible investment. This may influence industry norms and encourage sustainable approaches to stock trading.

Methodological considerations in stock trading research often involve adopting a mixed-methods approach that integrates qualitative and quantitative techniques to obtain a comprehensive understanding of the multifaceted nature of stock trading behavior. Interdisciplinary Collaboration encourages collaboration across disciplines such as finance, computer science, psychology, and ethics to address the diverse aspects of stock trading. Conduct longitudinal studies to track the evolution of stock trading practices, technologies, and market dynamics over time. Utilize real-time market data and advanced analytics to assess the immediate impact of technological changes and market events on stock trading. Case studies and scenario analysis are used to delve into specific instances, providing in-depth insights into the intricacies of emerging trends and challenges. Involving key stakeholders, including traders, regulators and technology developers is essential in the research process through interviews, surveys and focus groups. In order to ensure a comprehensive understanding of the complex interplay of behaviour, technology, and market dynamics, researchers can contribute to the continued evolution of stock trading practices by addressing these prospective study objectives and utilising a variety of research approaches.

The limitation of this study on stock trading was only reviewed from multiple perspectives in the Scopus online collection. This has not been included in papers from other databases. Similar papers from other reliable databases might be examined in later studies. The study primarily focuses on finance-related aspects, with less exploration of interdisciplinary intersections, such as the intersection of technology, ethics, and finance. Foster interdisciplinary collaboration to address emerging challenges at the crossroads of finance, technology, and ethics in stock trading. The opportunities for future research are behavioral finance and artificial intelligence integration, cybersecurity resilience in trading platforms, human-machine collaboration in trading, blockchain technology and cryptocurrencies, explainability and Interpretability in Algorithmic Trading, impact of ESG (environmental, social, and governance) factors on stock trading, regulatory frameworks and technological innovation, market microstructure in digital age, global financial inclusion and stock trading, market sentiment and social media. Future studies in stock trading can add to a more thorough and forward-looking understanding of the industry by addressing this potential and seeing its limitations. Investigating these fields can yield novel insights that close knowledge gaps and guide useful applications in the rapidly evolving landscape of stock trading.

5. Conclusion

This bibliometric study aimed to comprehensively analyse the landscape of stock trading research, spanning from 1984 to 2024. The objectives included understanding the current state of publications, identifying emerging trends, recognizing key contributors, and exploring potential future directions. The insights derived from this study contribute to the broader understanding of stock trading dynamics and offer valuable implications for academia, industry, and policy-makers. The study provided a detailed snapshot of the current stock trading research landscape, indicating substantial growth in publications with a moderate annual increase. Emerging trends were identified through publication trends, citation metrics, and factorial analysis, highlighting the increasing influence of technology, and global collaboration. The main trends in this study focus on research on shaping investment, trading behaviors, behavioral finance, and artificial intelligence integration. Barmish BR has made a great contribution to stock trading research with the largest number of influential paper publications on technology issues in stock trading strategies. Waseda University and the University of Wisconsin-Madison are the two institutions that produce the most research, playing a major role in providing trend research on stock trading. Related to Barmish BR, who comes from the University of Wisconsin-Madison, the university contributes greatly to the issue of stock trading. Research focuses on stock trading from 1984 to 2024 that researchers have underdeveloped is machine learning, because this is still a topic that is not strategic in the development of stock trading. The researchers are mostly discussing topics about behavior and integration with artificial intelligence, and robo-advisors that will play a role in the advancement of stock trading technology.

While these findings contribute significantly to the understanding of stock trading, it's essential to acknowledge the study's limitations. The source of database, and interdisciplinary intersections are factors that should be considered in interpreting the

results. The insights gained from this study have lasting implications for the field of stock trading. The identified gaps and opportunities pave the way for future research endeavors: behavioral finance and artificial intelligence integration, cybersecurity resilience in trading platforms, human-machine collaboration in trading, blockchain technology and cryptocurrencies, Algorithmic Trading, impact of ESG factors, regulatory frameworks and technological innovation, market microstructure in digital age, global financial inclusion and stock trading, market sentiment and social media. These directions represent a roadmap for researchers, practitioners, and policymakers to navigate the ever-evolving landscape of stock trading. By addressing these gaps and embracing interdisciplinary approaches, the field can continue to advance, contributing to informed decision-making and sustainable practices in stock trading. This study serves as a foundational piece, and its enduring impact lies in inspiring further research that aligns with the dynamic nature of the stock trading domain.

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