International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Research Trends on Artificial Intelligence Led Investors' Behaviour in Gold Bullion Market: Bibliometric Analysis Using R Studio and VOSviewer

Sirisha Charugulla[1], Shaiku Shahida Saheb*[2]

Submitted:12/03/2024 **Revised**: 27/04/2024 **Accepted**: 04/05/2024

Abstract: The study conducted a bibliometric examination of investors' behaviour using AI in gold bullion market research publications published between 1994 and 2024 using the Scopus database. The study performed the analysis of science mapping and performance on paper from the last three decades of publications. The study makes use of bibliometrics, science mapping, and performance analysis on 548 publications from the Scopus database. This study looked at Thematic mapping, co-citations, co-occurrence of keywords, productive authors, cooperation between writers and nations, citable documents, most pertinent institutions, and cited countries, and scientific output of papers. Bibliometric-Biblioshiny, R package and Vosviewer were the instruments utilized in the study to conduct the science mapping analysis and performance analysis. There were 50 citations for each document or 22.62 citations per year for each document. China, USA, India, and France are the most fruitful nations related to total citations and international partnerships. Resources Policy, International Review of Financial Analysis, Energy The leading journals for investor behaviour utilizing AI in gold market research.

Keywords: *Artificial Intelligence, Bibliometric analysis, Biblioshiny, Gold Bullion Market, R Package, VOSviewer.*

1. Introduction

To study and analyse the citations of scholarly publications, numerous frameworks are combined in bibliometric analysis, tools, and techniques. As a result, various metrics have been developed to provide insight to evaluate the relative significance of scientific publications, projects, and researchers, as well as the intellectual framework of a broad range of academic disciplines [1]. The availability of databases like Scopus, which are essential for searching journals, papers, and citations, has made it easier to perform empirical evaluations of knowledge management research. Researchers can identify growing trends in articles, journal performance, highly productive authors, and collaboration patterns with the aid of bibliometric analysis results.

Two commonly utilized markers of an influential contribution in these evaluations are the publication of scientific articles and highly referenced documents [1]. Due to evidence that mining operations, particularly those involving gold, have a discernible negative influence depending on the geographical environment, climate, and population's socioeconomic status, various activities are still controversial worldwide, particularly in developing countries. One of the primary factors contributing to the deterioration of environmental health is mining operations and the ways used to dispose of the waste they produce [2] [3].

[1]VIT-AP University – VIT-AP School of Business, Amaravati, AP, India. ORCID ID: 0009-0001-1319-1526
[2]VIT-AP University – VIT-AP School of Business Amaravati, AP, India. ORCID ID: 0000-0001-6406-3746
* Corresponding Author: Email-ID: shahid.sk@vitap.ac.in

Due to evidence that mining operations, particularly those involving gold, have a discernible negative influence depending on the geographical environment, climate, and population's socioeconomic status, various activities are still controversial worldwide, particularly in developing countries. One of the primary factors contributing to the deterioration of environmental health is mining operations and the ways used to dispose of the waste they produce [2][3]. The study on GMIs scientometric examination of relevant articles from 1990 to 2018 to examine the immediate environment and its possible effects on human health and also found that the majority of studies on GMIs were from industrialized countries with very few from transitional states like South Africa [3]. There are many different ways to invest in gold, which is confusing investors in the current highly volatile and dynamic market environment. Numerous studies indicate that 16,000 tons of gold are mostly kept in Indian households as jewellery. Investors still favour gold coins, jewellery, and bullion bars as investment vehicles, but they also prefer to invest in ETFs, futures, and options, which offer higher returns and are simpler to use [4]. The potential consequences of price discontinuities on investors in gold, silver, and US stocks were examined by the researchers using a bootstrap approach. They discovered that by taking advantage of co-jump asymmetry with the gold market, bondholders at the short end of the yield curve can optimize their portfolios' hedging effectiveness. After controlling for microstructure noise, the researchers extracted leaps and co-jumps from the one-minute price data using wavelet decomposition of stochastic processes [5].

To find out about the multiplicity of publications and scientific output in a certain field of study and gauge the amount of effort that has been done in that area, researchers have conducted a range of reviews. “Bibliometric analysis” is a popular and effective way to locate and examine large volumes of scientific material. It allows us to explore the boundaries of a field and analyse its very detailed evolutionary aspects [6]. Bibliometric analysis measures citations of scholarly publications to understand the intellectual structure of a discipline [1] [7]. Bibliometric analysis can be used by researchers to find patterns in the production of articles, journal performance, most prolific authors, and collaboration patterns, [1] [7]. The bibliometric measures used in the performance study include the h-index, citations, and productivity [7] [8]. Thematic mapping, collaboration networks, co-citation visualization, and keyword mapping are examples of scientific mapping of bibliographic databases, [7] [9]. The availability of databases like Google Scholar, Scopus, Dimensions, and Web of Science has made empirical evaluations of gold bullion more practical. These databases are essential for performing citation, journal, and publication searches. With the launch of Scopus, Elsevier simplified large-scale bibliometric analysis and popularized it as a tool for analysing publications, authors, countries and document sources. Elsevier’s abstract and citation database, Scopus indexes articles from a variety of academic disciplines, such as the biological, physical, health, and social sciences [7].

Fig 1. Represents Scopus content of publishers and different countries

Source:

“(https://www.elsevier.com/__data/assets/pdf_file/0007/69451/Scopus_ContentCoverage_Guide_WEB.pdf)”

As per the website of Elsevier (www.elsevier.com) Over 40 different languages are covered globally. It has 8,439 active journals in Physical Sciences, Health Sciences has 7,129 active journals, Social Sciences has 10,464 and Life Sciences has 4,890 active journals in Scopus. And it has various Journals, Conferences and Books to be published worldwide. Access to excellent research in developing countries is made possible by Scopus, which also offers better coverage of emerging markets. Users can set up alerts to get notified when new content is released and updated regularly. This database is what we chose for our investigation. Since it is the largest database, it can meet the requirements of bibliometric analyses. We used data from 1983 to 2024 three decades for this investigation. Nonetheless, there is disagreement over the methodologies and metrics employed in these investigations. In order to close this gap, the current study uses artificial intelligence (AI) to do a performance and science mapping analysis of investor behaviour in gold market research during the previous three decades. The research aims to respond to the following questions:

Research Questions

1. What are the primary investing behaviours in gold market journals utilizing AI?
2. Which writers and works have been mentioned the most?
3. Which investor behaviours employing AI in the gold market themes are most common?
4. How many articles about investors' behaviour utilizing AI in the gold market have been published overall?
5. In terms of investor behaviour utilizing AI in the gold market, which publication is the most productive?
6. Which nations and associations are frequently mentioned?

Scope and significance of the study

Developing this paper usually entails gathering and evaluating information about scientific publications, including statistics about citations, journal metrics, and authorship. The Scopus database's publishing statistics related to the investors behaviour using AI in gold bullion market were the main focus of the investigation. The study used bibliometric metrics, such as citation counts, h-indices, and co-citation analyses, to assess the output of research papers as well as the influence of authors, journals, and institutions. Research output is assessed for significance, new research trends are monitored, and notable authors and papers are found through the application of bibliometric analysis. This research paper looks at the patterns and trends found in scholarly works that are pertinent to a certain field of study. It analysed information from multiple bibliographic databases, such as the Scopus database, to ascertain whether publications, writers, magazines, etc. organizations were most frequently cited. The results shed light on current research directions, areas of knowledge deficiency, and potential field partnerships. Additionally, the research sheds light on how research themes and trends have evolved throughout the previous three decades, i.e., from 1993 to 2024, and clarifies the current situation of the field of study. Future researchers in this subject are anticipated to profit from the findings of this work.

2. Literature Review of the Study

The study results show that six self-regulating companies may be differentiated by utilizing ICA from the price of gold. In the meantime, the impact of the gold price on ICs is examined using contrastive analysis and fundamental statistics. The authors predict that long-term trends (stock market fluctuations), cyclic recurrent elements (inflation, resident consumption level), and stochastic factors (historical events, financial crises, etc.) will all have an effect on the price of gold, and the suggested model beats the ARIMA, RBFNN, ISTM, ICA-ISTM and GRUNN models in terms of gold price prediction. Its advantages include quick convergence, low computation and accuracy [10], it was found that a retail investor is motivated to buy gold as an investment by factors such as profitability, tax aversion, prospects, time value of money, etc. [11], wherein the price direction prediction accuracy of gold and silver is compared across many tree-based classifiers; in particular, RFs, decision tree bagging, and tree (stochastic gradient) boosting are employed to anticipate the price direction of gold and silver ETFs over a 20-period forecast horizon, it is found that machine learning methods are more accurate at forecasting gold prices than econometric methods. There are thirteen commonly used technical indicators in the feature space. [12], revealed that gold prices, stock market volatility and the impact of COVID-19 on small retail investors' investment behaviour are all covered in this research paper, it also reveals that as a result of lower household income, the stock market crash and investor preferences shifting toward safer investment options like bank deposits, there has been a decline in SIP investments during the COVID-19 outbreak. For short-term investors [13], Time-Frequency of the Multi-Betas Model measurement of market sensitivity is not substantially different from the Standard Multi-Betas Model and the CAPM, in fact, employing the CAPM can be sufficient to make investment decisions based on the βm, can consider the Multi-Betas Model and the sensitivity to gold and oil to modify its decisions [14], the study identified key factors influencing gold prices in India, such as variations in the price of crude oil, shifts in the BSE Sensex, exchange rates, inflation trends, and repo rates, and apparent correlation between crude oil and gold prices highlighted the close linkages between these two economic commodities. [15], explored the factors which influence investor behaviour (security, traditional value and high returns) towards Gold as an attractive investment avenue [16] and in addition to being a solid portfolio diversifier and providing financial protection against macroeconomic and geopolitical risk, gold is a resource i.e., simple to invest in and yields good profits. It offers a safeguard against inflation as well [17], and examines the behaviour of investors in the gold bullion coin market by determining whether feedback traders are active in the secondary market for the Krugerrand. They demonstrate that the Krugerrand involved significant positive feedback trading, which was directionally asymmetric and significantly impacted by several variables, including the volume of the Krugerrand, gold returns the South African Rand's exchange rate with the US dollar the returns of the JSE All Share index and geopolitical risk.

Bibliometric analysis has developed into a well-liked and trustworthy technique for analysing and assessing scientific datasets in large volumes, allowing researchers to explore the intricacies of evolution and uncover new fields of inquiry. [6]. The word "bibliometrics" which Pritchard first used in 1969 to describe the use of statistical and mathematical methods to evaluate bibliographic content [18], [19]. Bibliometrics uses statistical and mathematical methods to investigate publication patterns [18]. Bibliometrics is a crucial instrument for assessing and scrutinizing scientific fields, gathering information, and executing specific stages of science mapping analysis using software tools [20]. A knowledge system called bibliometrics combines philology, mathematics, statistics, and quantification. Applications at both the micro and macro levels include the creation of more effective intelligence networks and systems, raising the efficacy of intelligence processing, identifying weaknesses and errors in document services, predicting publication trends, and developing and enhancing basic intelligence theories [21]. Bibliometric techniques are becoming more and more significant in the assessment of research and university rankings[22]. Research components, collaboration patterns, and trends in the performance of publications and journals are all revealed by bibliometric analysis [23]. Bibliometric analysis is the quantitative analysis of bibliographic data, including impact factor, co-citation analysis, citation analysis and H-index. Measures of publications, authors, journals, and study fields are determined by statistical and mathematical methods.

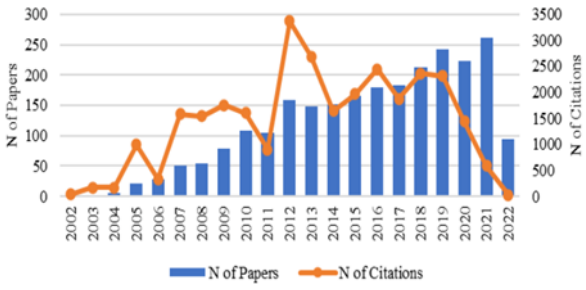

Fig 2. No. of articles published and citations year-wise on bibliometric study

Figure 2 - The above graph drawn from [24], claims that many articles published annually from 2002 to 2022 on bibliometric have increased recently but in the year 2020 drastically declined due to the COVID-19 impact.

2.1. Table 1. An overview of prior research reviews on investors behaviour using AI in gold bullion market research

Title of the Article with citation	Methodology/Database used/software tools used	Findings
Bibliometric Analysis of Gold Open Access in India [25]	Bibliometric analysis of 2006-2015 articles, Web of Science database.	Examined the differences among general research and gold open access production for papers written by Indian scholars, with a focus on research output in OA journals.
Exchange-traded funds and the future of passive investments: a bibliometric review and future research agenda [26]	Bibliometric analysis articles from 1973 to the present that are linked to the Scopus database throughout the past 50 years. And abstract database from Elsevier. R and Gephi for bibliometric analysis.	Three steps were involved in the study: sensing, substantiating, and scanning. The results show that the US is the country that contributes more to ETF research with China, the United Kingdom, Canada, and Spain following. China is the only developing market economy that makes a significant contribution to the ETF research.

Title of the Article with citation	Methodology/ Database used/software tools used	Findings
Bibliometric Analysis of Gold Open Access in India [25]	Bibliometric analysis of 2006-2015 articles, Web of Science database.	Examined the differences among general research and gold open access production for papers written by Indian scholars, with a focus on research output in OA journals.
Exchange-traded funds and the future of passive investments: a bibliometric review and future research agenda [26]	Bibliometric analysis articles from 1973 to the present that are linked to the Scopus database throughout the past 50 years. And abstract database from Elsevier. R and Gephi for bibliometric analysis.	Three steps were involved in the study: sensing, substantiating, and scanning. The results show that the US is the country that contributes more to ETF research with China, the United Kingdom, Canada, and Spain following. China is the only developing market economy that makes a significant contribution to the ETF research.
Exchange-traded funds and the future of passive investments: a bibliometric review and future research agenda [26]	Bibliometric analysis articles from 1973 to the present that are linked to the Scopus database throughout the past 50 years. And abstract database from Elsevier. R and Gephi for bibliometric analysis.	Three steps were involved in the study: sensing, substantiating, and scanning. The results show that the US is the country that contributes more to ETF research with China, the United Kingdom, Canada, and Spain following. China is the only developing market economy that makes a significant contribution to the ETF research.

Artificial Intelligence and Behavioural Economics: A Bibliographic Analysis of Research Field [14]	Bibliometric analysis of papers about behavioural economics and artificial intelligence of Web of Science database that were published between 2012 and 2022. The R package Bibliometric and VOSviewer.	Identified important writers, publications, organizations, and nations in the field. According to the data, throughout the previous ten years, there has been an increased number of publications on behavioural economics and artificial intelligence.
Bibliometric Review on Gold Currency and The Islamic Perspective [27]	Scopus database indexed 917 articles published in journals, books, book chapters, conference papers and review papers between the rate of 1989 to 2021 bibliometric	It offered numerical data regarding the evolution of writings about gold currency. and included a summary of multiple research that go over the benefits of using gold coins. offered an Islamic viewpoint on gold coinage as well.

	analysis itself. Vosviewer and Excel software were used to analyse the data.	
A bibliometric analysis of behavioural finance with mapping analysis tools [28]	Bibliometric analysis of 1987-2017 articles, Scopus and Web of Science.	13 themes (investor sentiment, mutual funds, speciality themes, etc.) were identified using bibliometric analysis as the various themes that form this research area.

The use of bibliometric analysis has increased. Still, very little research has been done on the investors' behaviour using AI in the gold bullion market. The studies looked at the impact of journals, institutions, and researchers on their research output. Still, they might not have provided a comprehensive analysis of the research scene across three decades, instead focusing solely on a small window of time or a single bibliometric indication. Biblioshiny R studio and VOSviewer software have not been used collaboratively in any of the earlier research conducted by more of these investigations. As a result, the current research report makes considerable use of both the software programs VOS-viewer and Biblioshiny – Bibliometrics R packages to shed light on this study's unexplored topic area through data visualization and graphic representation that will provide future researchers with a solid basis.

3. Methodology

Bibliometric analysis is the quantitative study of scholarly publications to produce metrics of research output and scientific activity using statistical and mathematical models [29]. "Compared to PubMed and Web-of-Science, Scopus offers a wider range of journals, and its citation analysis is quicker and contains a larger number of articles" [30]. Various widespread databases like Scopus, Web of Science and Google Scholar are utilized in bibliometric analysis; nevertheless, when it comes to journal coverage and citation analysis, Scopus outperforms Web of Science and Google Scholar [30], [29]. The bibliometric study requires information from several bibliographic databases such as Web of Science, Scopus and Google Scholar [31]. Because Scopus was created for bibliographic searches and citation analysis, it can carry out the same search functions as Web-of-Science, making it a useful substitute for Web-of-Science [8]. Therefore, in order to extract the metadata relevant to investor behaviour utilizing AI in gold market research, the study leverages Scopus. The data was extracted from Scopus using keywords such as "Gold Market," "Gold Exchange Traded Funds," and "Gold Price" under the major keywords "Investors Behaviour" and "Artificial Intelligence." Using the article, title and keywords research was done. Keywords were combined in a search using boolean operators like AND and OR to narrow the search to the most relevant results. TITLE-ABS-KEY: “Gold Price” OR “Gold Market” OR “Gold Exchange Traded Funds”. After executing the search query in this way, 8,584 records were found.

Language, source type, document type, publication state, source title and keyword were the only parameters included in the search when the filter was applied. Only papers published between 1993 and 2024 were included in the search, which was done in April and May of 2024. It is noted that 8,402 representing 98.16% articles have been published in the English language, 63 representing 0.74% articles have been published in the Chinese language, 32 representing 0.38% articles have been published in the Russian language, 31 representing 0.36% articles have been published in the Spanish language. Most of the articles 3,958 representing 46.39% have been published in the area of Economics, Econometrics and Finance, 1,760 representing 20.91% documents published in the area of Computer Science, 1,667 representing 19.50% documents published in the area of Business Management and Accounting. However, focused on investors' behaviour using AI in the gold bullion market in the areas of “Business, Management, and Accounting”, “Economics, Econometrics and Finance”, and “Social Sciences”.

Using investor behaviour, the data set was narrowed down from 8,584 records to 1,469 articles after the refinement search process. By removing the articles from further references like book series (31), reviews (32), conferences (48), book chapters (31), and others (779), the search was further narrowed. 548 articles from the final data set were ultimately employed in the study.

3.1. The use of bibliometric analysis in research

Utilizing the bibliometric analysis, organise and analyse the studies in the investors' behaviour using AI in gold bullion market research. Science mapping analysis and performance analysis are two of the primary methodologies that are combined in the bibliometrics study. Another bibliometric technique is science mapping analysis which offers a geographic representation of the connections among different scientific participants [8]. Performance analysis, on the other hand, looks at how research components contribute to a particular subject [6]. Bibliometric techniques are playing a bigger role in the assessment of research and university rankings [22]. Few studies have focused on science mapping [9] and some studies have done both science mapping and performance analysis in

bibliometric analysis [8]. The majority of reviews even those that do not use scientific mapping include performance analysis since it is customary for analyses to display the results of various study indicators like authors, institutions, nations, and publications [6]. Conversely, co-citation analysis, coupling map, co-authorship analysis, theme mapping, and co-occurrence of keywords are all included in scientific mapping.

3.2. Data Analysis

The growth of the newest tools of data analysis like VOSviewer [32], CitNet Explorer [33], SciMat [34], Bibexcel [35], and CiteSpace [36], is responsible for the bibliometric analysis's growing popularity in management research. The bibliometric data has been extracted from the Scopus database and analysed, and visualized in the study using R-studio. Bibliometricians can utilize a variety of software tools to analyse and visualize data, but the tool they choose will depend on the sort of study that is needed [37]. One such tool that bibliometricians utilise as bibliometric, which is written in R and quickly updated as well as integrated with other statistical R-packages [20]. Bibliometric facilitates loading and data frame conversion to R. Furthermore, bibliometric links to the Scopus API to automatically gather metadata about the entire list of scholarly publications [20] [37].

4. Results and Discussion

4.1. Performance analysis

4.1.1. Annual total citations per year

Table 2. Annual total citations per year

Year	Mean TC Per Art	N	Mean TC per Year	Citable Years
1993	50	1	1.56	32
1997	123.5	2	4.41	28
2002	52	2	2.26	23
2005	42	1	2.1	20
2006	27.5	4	1.45	19
2007	74	2	4.11	18
2008	45.33	3	2.67	17
2009	23	2	1.44	16
2010	97.25	4	6.48	15
2011	6.5	4	0.46	14
2012	45.83	6	3.53	13
2013	16.6	5	1.38	12
2014	21.43	14	1.95	11
2015	72.8	15	7.28	10
2016	21.83	12	2.43	9
2017	78.69	16	9.84	8
2018	32.42	24	4.63	7
2019	34.43	30	5.74	6
2020	34.02	46	6.8	5
2021	28.83	63	7.21	4
2022	15.24	123	5.08	3
2023	6.05	120	3.02	2
2024	0.73	49	0.73	1

Notes: Mean TC per Art = average total citations per article, Mean TC per year = average total citations per year, N = number of publications

There was one paper published in 1993 about investors' behaviour utilizing artificial intelligence in the gold bullion market, and it received 50 citations. The average annual number of citations was 1.56. When it comes to the number of papers published, or the number of 1 and 2 articles, the years 1997, 2002, 2005, 2007, and 2009 were also the least productive. On the other hand, from 50 average citations per article in 1993 to 123.50 average citations per piece in 1997 there was a notable increase in the average number of citations. In 1993 there were 1.56 citations on average each year; by 1997, that figure had improved to 4.41. It is noteworthy that as Table 1 illustrates, 1997 was the most productive year in terms of average citations per document and average number of citations annually. Regarding the mean quantity of citations for each document, the years 2002–2012 were more fruitful than the first, with 2010 (97.25), 2007 (74), 2002 (52) and 2008 (48.33) contributing the citation of articles. As Figure 3 illustrates, there was a noticeable change in the frequency of documents over the third decade, 2013–2024, with 2015 having the highest frequency (72.80). The yearly average of citations has greatly increased, with 2016 recording the highest productivity in the previous ten years with 9.84 citations.

4.1.2. Scientific production

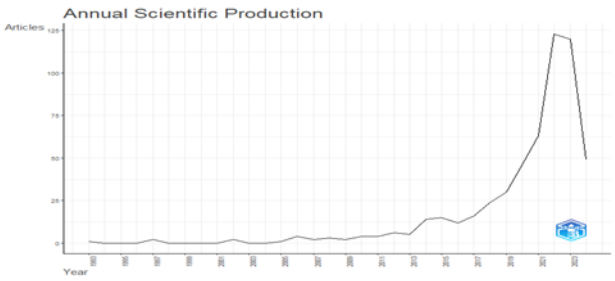

Fig 3. Scientific Production of articles – Biblioshiny (Bibilometrix – R packages

Most of the articles published in the year 2022 (123) followed by 2023 (120) related to investors' behaviour using artificial intelligence in the gold bullion market and only one article was published in 1993 and 2005.

Table 3. General information about the data - Biblioshiny (Bibliometrix – R packages)

Title (*Main data)*	**Period (1992-2024)**
Documents	
Sources (Journals, Books, etc.)	548
Author(s) keywords	170
Years	1552
Average citations per document	32
Keywords Plus	22.62
Annual Growth Rate (%)	1073
Document Average Age	13.38
Co-authors per document	3.8
International co-authorships (%)	2
Single-authored documents	38.87
Article	0
	548

Table 3 displays the scientific article production calculated from 1993 to 2024. The 548 papers on investor behaviour using AI in the gold bullion market were published between 1993 and 2024. There were 22.62 citations on average per document. published articles were gathered from 170 sources, 1552 Author(s) keywords were used from 1993-2024, Annual growth rate (13.38%) was contributed. International co-authorships (38.87%) are contributed at the international level.

4.2. The publication statistics about the authors

4.2.1. Analysis of the authors production

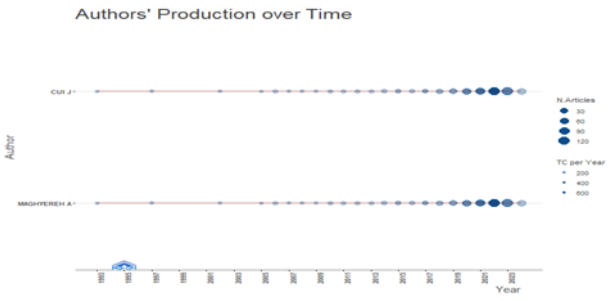

Fig 4. Top authors production over time-Biblioshiny

(Biblimetrix – R package)

The writers' scientific output was calculated based on the number of articles they each published as indicated in Figure 3, the authors' contributions to science were influenced by the bubble size, colour intensity and author timeline. The line displays the chronological order of the author and the size of the bubble changes with the number of papers. According to Figure 3 colour intensity, the authors who published the most frequently between 1993 and 2024 were CUI J & Meghyereh A. But in 2023, the author or authors with the most citations were CUI J (287.200) and Maghyereh A (363.000). On the other hand, Table 4 indicates that both authors were prolific regarding the overall number of citations obtained. The amount of colour intensity corresponds to the annual total of citations.

4.2.2. Analysis of the Lokta's Law

Table 4. Lokta's Law Authors' Production

Documents written	**No. of authors**	**Proportion of authors**
548	2	1.000

The study describes Lokta's law authors' publication regarding investors' behaviour using AI in the gold bullion market. As per Lokta's law there is an inverse relationship between the quantity of articles and the frequency with which authors produce them [38]. As Table 4 illustrates, the findings of Lokta's law demonstrate that 1% of authors provide 548 articles, with 548 of those articles focusing on how investors use AI in the gold bullion market.

4.3. Statistics about the documents

4.3.1. Most cited document analysis

Table 5. Most Global Cited documents

Paper	**Total Citations**	**TC per Year**	**NTC**
SHAHZAD SJH, 2019, INT REV FINANC ANAL	398	66.33	11.56
LI X, 2017, DECIS SUPPORT SYST	317	39.63	4.03
HUSSAIN SHAHZAD SJ, 2020, ECON MODEL	293	58.60	8.61
BECKMANN J, 2015, ECON MODEL	273	27.30	3.75

BATTEN JA, 2010, RESOUR POLICY	265	17.67	2.72
URQUHART A, 2017, ECON LETT	247	30.88	3.14
ADEKOYA OB, 2021, RESOUR POLICY	241	60.25	8.36
BOURI E, 2019, FINAN RES LETT	209	34.83	6.07
KHALFAOUI R, 2015, ENERGY ECON	209	20.90	2.87
BALCILAR M, 2018, ECON SYST	191	27.29	5.89

Table 5 Analysis of performance results indicates that Shahzad SJH (2019) was the most prolific article, receiving 398 citations, followed by 317 citations from Li X (2017) as shown in Figure 6, Table 5. Hussain Shahzad SJ (2020) has 293 citations, Beckmann J (2015) has 273 total citations and 27.3 citations per year, Batten JA (2010) has 265 total citations with 17.66 citations per year, Urquhart A (2017) has 247 total citations with 30.875 citations per year. Adekoya OB (2021) had 241 total citations and 60.25 citations per year, Bouri E (2019) had 209 total citations with 34.83 total citations per year, Khalfaoui R (2015) had 209 total citations with 20.9 citations per year and Balcilar M (2018) has 191 total citations with 27.28 citations per year.

4.4. Publication Statistics about Journals and Most Cited Journals

4.4.1. Source dynamics and Bradford's distribution

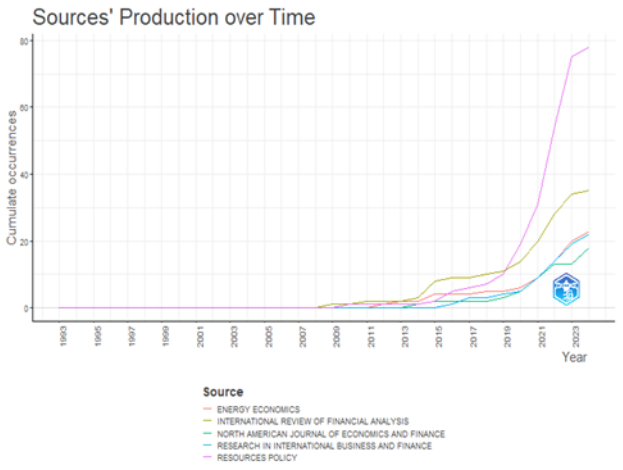

Fig 5. Source dynamics of production - Biblioshiny--Bibliometrix R packages

The total number of publications from different scholarly journals from 1980 to 2020 is displayed in Figure 5 "Sources' Production over Time". Before 2000, there is very little activity and then it gradually increases. There was a significant upsurge around 2010, particularly for the source shown by the magenta line. It suggests an increase in interest and research production in these areas, which is probably brought on by changes in the financial and economic environment, global difficulties, or technological breakthroughs. Scholarly publications have grown significantly overall, with a notable upsurge in the past ten years.

The distribution of journal titles in a certain location is explained by the study using Bradford's rule. As per [39], there are declining returns when the body of literature is published completely, supporting their claim that the law operates based on centric productivity zones. The regulation states that periodicals can be separated into various zones based on how many articles they include Bradford's legislation of scattering indicates that the Resources Policy, International Review of Financial Analysis, Energy Economics, Research in International Business and Finance and North American Journal of Economics and Finance, as shown in Figure 6. The three zones are as follows like Zone 1 has six journals, Zone 2 has thirty and Zone 3 has thirteen, Bradford's law of scattering predicts that journal output will increase from one zone to the next [40].

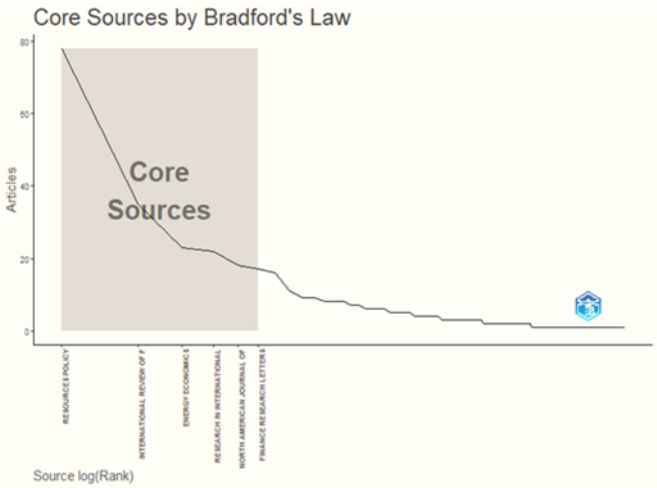

Fig 6. Graphical representation of Main Contributing Journals by Bradford's law {Biblioshiny--Bibliometrix R packages}

4.4.2. Most Relevant Source

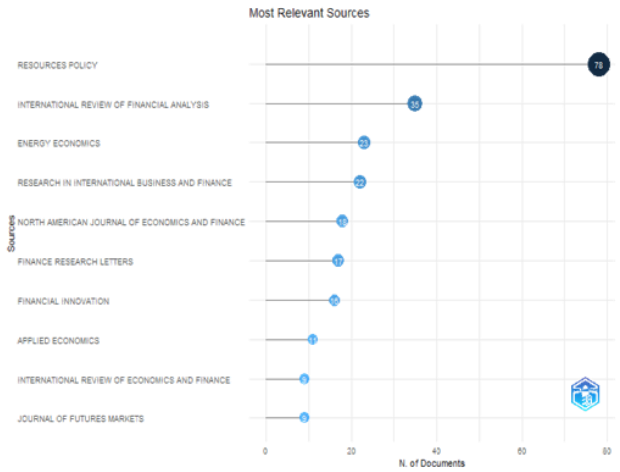

Fig 7. Represents most relevant scholarly journals {Biblioshiny--Bibliometrix R packages}

The top academic journals in the study of investors behaviour using AI in gold bullion market over the past three decades ae shown in Figure 9. Also, it has been found that the top ten journals regarding publications. The maximum paper published by the "Resources Policy" 78, "International Review of Financial Analysis" has 35, "Energy Economics" has 23, "Research in International Business and Finance" has 22, "North American Journal of Economics and Finance" has 18, "Finance Research Letters" has 17, "Financial Innovation" has 16, "Applied Economics" has 11, "International Review of Economics and Finance" and "Journal of Future Market" both have 9 articles**.**

4.4.3. Most Local Cited Relevant Journals

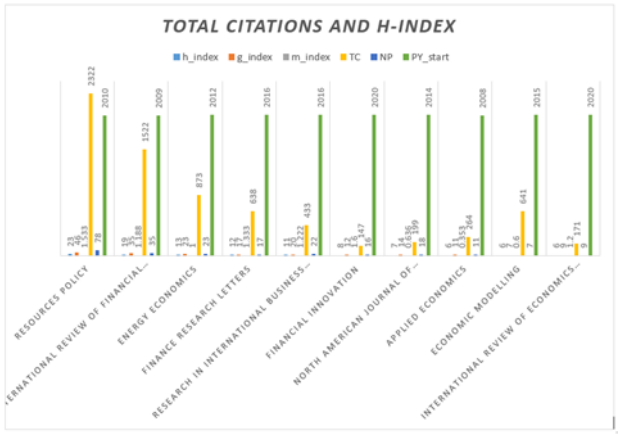

Fig 8. Journal productivity measured by h-index and total citations

Note: TC stands for total citations; NP for total publications; and PY start for the year that the publication began.

Figure 8 shows that the International Review of Financial Analysis had 35 documents and 1,522 citations, whereas the Resources Policy produced 78 papers with 2,322 references along with 23 documents that received at least 23 citations. Despite publishing fewer publications, Energy Economics, Finance Research Letters, and Economic Modelling garnered over 500 citations. Nonetheless, the International Review of Financial Analysis was surpassed by Resources Policy of Investor Behaviour using AI in Gold Market Research, which had the greatest h-index, g-index, and m-index.

4.5. Publication statistics about the Country's scientific production

4.5.1. Most Relevant Nations and Corresponding Authors

Fig 9. The most relevant nations and corresponding Authors - Biblioshiny (Bibliometrix – R packages)

The number of papers written by authors from various nations is displayed in the "Corresponding Authors' Countries" Figure 9 which is divided into two categories like single-country publications (SCP) and multiple-country publications (MCP). The largest number of publications, primarily SCP, are found in China followed by a balanced combination of SCP and MCP in India and the USA. Significant contributions have also been made by Australia, the UK, France and Turkey. The graph 9 shows different levels of international cooperation the USA and several European nations are more involved in international partnerships while China and India concentrate more on domestic research.

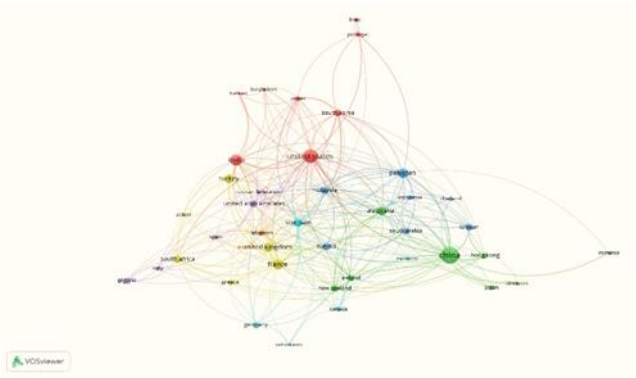

Fig 10. Co-Authors corresponding countries over the three decades by using VOSviewer

Figure 10 indicates that Indian authors correspond with China, USA, Australia, France and other countries. USA authors corresponding with India, Turkey, Pakistan, China and China authors corresponding with USA, India, South Korea, Australia, Pakistan and other countries. Other countries authors correspond with which countries as shown in Figure 11.

4.5.2. Distribution of the Scientific Production of the Nations

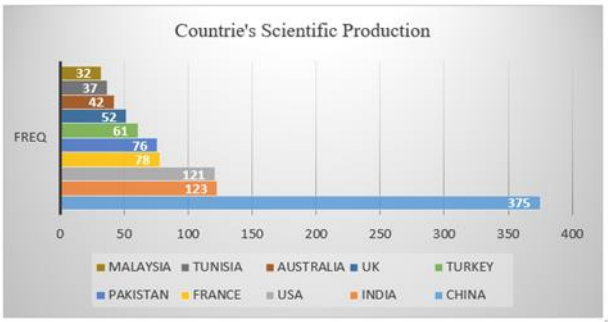

Fig 11. Graphical representation of the distribution of scientific production of the nations over the three decades by using Ms-Excel

Figure 11 indicates that the publications on investors' behaviour using AI in the gold bullion market have been published in different nations all over the globe over the last three decades. China is a leading country, published 375 articles. India, the second most prolific publication country, published 123 papers on this topic. USA is the third country, publishing 121 articles. UK, Turkey, Australia, France, Tunisia, Malaysia and Pakistan are among the top ten countries in terms of publications; however, they have published less than 100 articles.

4.5.3. Most cited countries

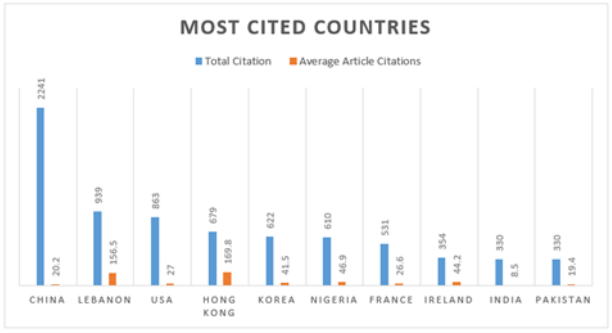

Fig 12. Graphical representation of the Most cited countries over the three decades by using MS Excel

Figure 12 demonstrates the findings of Biblioshiny reveal that China was the most referenced nation, with over 2,241 citations in the behaviour of investors employing AI in gold market research. Over 800 citations were contributed by nations including the USA and Lebanon, whose average article citations from 1992 to 2024 were 156.60 and 27.00, respectively. But in terms of average article citations, Hong Kong led the pack, with 46.90 average citations, followed by Nigeria, with less than 500 citations from the other countries in the study of investor behaviour utilizing AI in the gold market. These are helpful indicators for determining a country's average influence on publications.

4.5.4. Most Relevant Affiliations

Table 6. Tabular representation of most relevant affiliations over three decades

Affiliation	Articles
CENTRAL SOUTH UNIVERSITY	38
QINGDAO UNIVERSITY	24
UNIVERSITY OF PRETORIA	23
UNIVERSITY OF WAIKATO	17
UNIVERSITY OF IBADAN	16
UNITED ARAB EMIRATES UNIVERSITY	15
HUNAN UNIVERSITY	13
IQRA UNIVERSITY	12
UNIVERSITY OF ECONOMICS HO CHI MINH CITY	12
MONTPELLIER BUSINESS SCHOOL	11

Universities have proven to be the most reliable venues for supporting and advancing research. According to the frequency of publications, Central South University was the most productive, followed by Qingdao University and the University of Waikato (Figure 14). and Table 6. IQRA University and the University of Economics Ho Chi Minh City contributed 12 articles from 1992-2024. University of Waikato, United Arab Emirates University and the University of Ibadan contributed more than 15 articles in the area of investors' behaviour using AI in the gold bullion market. Montpellier Business School was the less contributed articles over the three decades.

4.5.5. Countries Collaboration

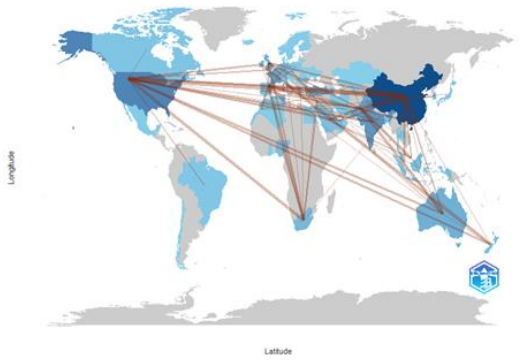

Fig 13. Countries Collaboration World Map over the three decades computed with Biblioshiny – Bibliometrix R package

International research collaborations are depicted on the global map where partnerships are indicated by lines connecting different countries. The two most notable centres with many international partnerships are the US and China. North America, Europe and Asia are strongly connected, indicating robust worldwide research networks. The countries with heavier blue shading are those with higher levels of cooperation involvement; this highlights the fact that scientific research is a worldwide endeavour with major countries serving as central hubs.

4.6. Publication statistics about usage of Keywords

4.6.1. Analysis of keywords

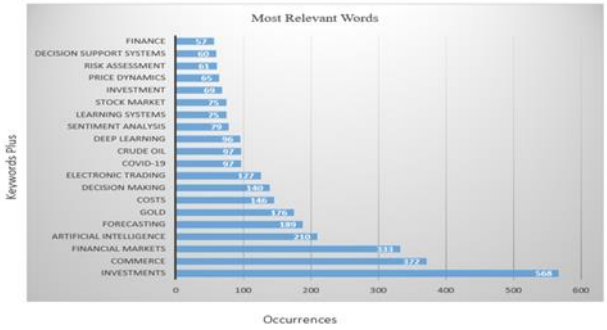

Fig 14. Most frequent keywords in investors' behaviour using AI in the gold bullion market by using MS-Excel

As seen in Figure 14, the bibliometrics data show that the keyword "investment" was most commonly used, with 568 occurrences. This was followed by the terms "commerce" and "financial markets," with 372 and 333 occurrences, respectively. To determine the frequently used keywords in investors' behaviour when utilizing AI in the gold bullion market, the study employed frequency in the sense of occurrence metric. From 1992 to 2024, the terms artificial intelligence, forecasts, gold, and costs were used 210, 189, 176, and 146 times, respectively. With 140, 127, 97, 97, and 96 occurrences, respectively, decision-making, electronic trading, COVID-19, crude oil, deep learning, and statement analysis are among the other frequently used keywords in the investor behaviour studied by AI in the gold market research. However, as demonstrated based on how thick the term is in Figure 14, the findings of the word cloud (minimum 50 key words) show that the most discussed keywords were price dynamics, stock market, investment, financial markets, crude oil, and risk assessment. According to Figure 19, the tree map's results indicate that 13% of the total keywords are related to investing, with the other keywords being commerce (9%), financial markets 8%, artificial intelligence (5%), forecasts and gold (4%), expenses, decision-making, and electronic trading (3%).

Fig 15. Tree map of keywords in the investors' behaviour using AI in gold bullion market (Biblioshiny – Bibliometrix R packages)

The study also looks at the most popular themes related to investors' use of artificial intelligence in the gold bullion market. As Figure 18 illustrates, from 2016 to 2022, investors' use of AI in the gold market was the most talked-about topic. Gold was one of the most popular themes from 2020 to 2022, and from 2021 to 2022, commerce took over. The financial markets (2020–2021) and expenses from 2016–2021 are other hot subjects. AI is being used in gold bullion market research to study investor behaviour.

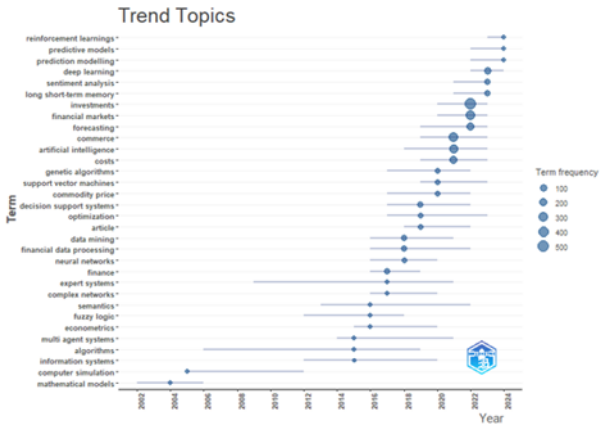

Fig 16. Trended topics in investors behaviour using AI in gold bullion market (Biblioshiny – Bibliometrix R packages)

Science mapping analysis

4.6.2. Keyword occurrence

According to [41], keywords are frequently employed as techniques to determine the study material, primary themes, and methodology/technology employed in a certain field. We employed co-occurrence networks to find and examine the distribution of keywords in the investors' behaviour using AI in gold bullion market research. The statistical link between various terms that occur in the same document is

known as co-occurrence. There, a network map representing the co-occurrence of the keyword network illustrates the connection in between these terms [41]. The co-occurrence network is based on several characteristics including the field network architecture, normalization and clustering technique. The optimal layout for graph readability is selected automatically [42]. Similarity metrics, such as Salton's Cosine, Jaccard's index, equivalency index, and association strength, can be used to normalize co-occurrence [43].

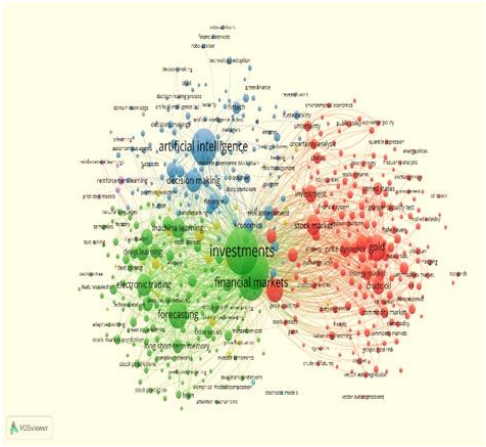

Fig 17. Co-occurrence of keywords over three decades by using VOSviewer

Several keywords, including gold, price dynamics, commerce, financial markets, investments, crude oil, artificial intelligence, decision making and the stock market, are indicated by the vertex size as being at the centre of the network by the co-occurrence network results. The size of a vertex in a network is directly proportional to the occurrence of an item or term it represents. The degree of correlation between the terms is shown by the edge size. The citation link between two keywords is indicated by the width of the line that separates them. The edge's thickness demonstrates that gold was thoroughly examined with financial markets, stock markets, crude oil, price dynamics, investments, etc., as shown in Figure 17.

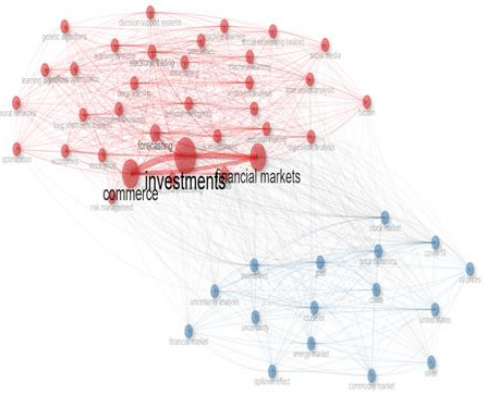

Fig 18. Co-occurrence of network between the keywords over the three decades (Biblioshiny – Bibliometrix R package)

The measurements of the co-occurrence of keywords in the investors' behaviour using AI in gold bullion market research are closeness centrality and betweenness centrality, respectively, according to the study. The connections among nodes in a network of scientific collaboration are used to generate the centrality metrics [44]. The keywords such as financial markets, crude oil, investments, artificial intelligence, machine learning and commerce possess the highest centrality betweenness. To put it another way, as Figure 18 illustrates, the keywords are situated closest to one another.

Thematic map

The thematic amp includes major themes and patterns as well as a word occurrence analysis to explain what science says in an area [45]. The process of thematic mapping divides the body of knowledge on a topic into four categories [39] [45]. The top right quadrant contains themes that are highly central and dense and are crucial to the field. The low density and strong centrality of the motifs in the upper left quadrant have led to their classification as niche themes. The lower left quadrant's motifs are considered to be either developing or declining themes because of their low density and low centrality. Because of their great centrality and low density, the motifs in the lower right quadrant are thought to constitute basic themes.

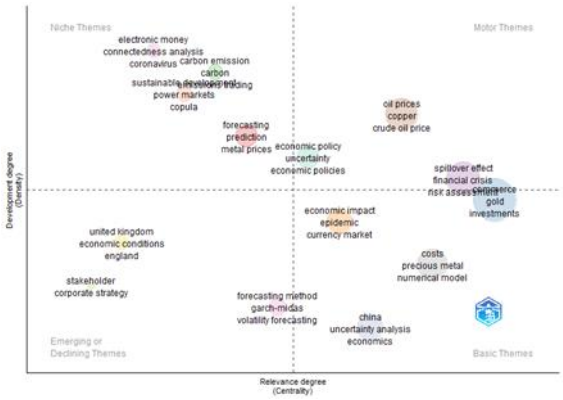

Fig 19. Thematic mapping of investors behaviour using AI in gold

bullion market studies over the three decades (Biblioshiny - Bibliometrix R package)

The magnitude of the node suggests that the subjects of "economic policy," "risk assessment," "uncertainty," and "economic policies" constitute a fundamental and significant area of research in the field of investor behaviour utilizing AI in the gold market. In addition to "economic policy" and "risk assessment," the lower right quadrant contains three more themes: "precious metal," "investment," and "costs." These themes are significant to the field of investor behaviour utilizing AI in the gold market, although they are less developed than "costs" and "precious metal," as seen by their low density and high centrality. The size of the node in Figure 19 illustrates how the final four

specialized themes on the upper left and right quadrants are, in order, "oil prices," "copper," "crude oil price," "forecasting," "metal prices," and "sustainable development."

Results

To obtain a better understanding of investor behaviour in the context of artificial intelligence in the gold bullion market, we performed a bibliometric analysis in this study. Using the R bibliometric tool, we examined 548 documents that were indexed in Scopus between 1992 and 2024. Our investigation of the scientific production of papers, prolific authors, most cited documents, most cited nations, co-occurrence authors countries, most relevant keywords, and most relevant author keywords was made possible by performance analysis. Additionally, the co-occurrences of places, concepts, documents, and authors were illustrated by the scientific mapping analysis. It was discovered that, with an average of 13.38% tears from publishing, the output of scientific publications has expanded dramatically over the past ten years. There were 50 citations for every document or 22.62 citations per year for each document. Over three decades, the analysis discovered that authors had utilized 1073+ keywords, with author keywords accounting for 1552. The cooperation index results showed that each document in the investors' behaviour utilizing AI in gold market research had two authors working together and that the percentage of foreign co-authorships (%) was 38.87. According to the survey, the document's average age is 3.8.

Bradford's law of dispersal states that the major journals that published the most articles about investors' behaviour using artificial intelligence (AI) in the gold bullion market are Resources Policy, International Review of Financial Analysis, Energy Economics, Research in International Business and Finance, North American Journal of Economics and Finance and Finance Research Letters. These journals also received the most total citations and had the highest h-index.

The performance analysis demonstrates a sharp rise in publications, which has fuelled the expansion of gold bullion research as a whole. Based on the overall number of citations obtained, the data show that China was the most productive nation, followed by the USA and India. According to the global cooperation map, the nations that are actively collaborating are France, Nigeria, Hong Kong, Australia, Pakistan, Singapore, Lebanon, Korea, and Ireland. Australia and India are the next most collaborative countries in terms of investor behaviour using AI in the gold market, behind China and France.

The study lists several keywords that are relevant to a fundamental and significant area of research in the field of gold bullion, including "financial markets," "investments," "artificial intelligence," "price dynamics," "crude oil," and commerce. In addition, the terms "risk assessment," "financial crisis," "spillover effect," "costs," "precious metals," "economic effect," "economic policies," "forecasting," and "metal prices" suggest how sophisticated and significant these subjects are about the gold bullion market. The terms "sustainable development," "stakeholder," "corporate strategy," and "electronic money" refer to underdeveloped but developing themes in investor behaviour that are being used in the gold market and other domains. Although they are well-developed, the other specialist themes—such as "gold investments," "financial crisis," "crude oil prices," and "commerce"—have no bearing on how investors behave in the gold market when utilizing artificial intelligence. Five important keywords—gold investments, risk assessment, spillover impact, crude oil prices, and precious metal—that are crucial to investor behaviour utilizing artificial intelligence in the gold market have been determined based on the study of the research's keywords.

Discussion and conclusion

The most relevant top journals, most relevant keywords, co-occurrence of authors' collaboration with other nations in the investors' behaviour using AI in the gold bullion market, research subjects and trends, and significant authors were all identified in this study using bibliometric tools. This 30-year (1993–2024) bibliometric analysis of the Scopus database illuminates the patterns and trends in scholarly study. It highlights important study disciplines and theme areas that have expanded dramatically, as well as the leading authors, journals, and countries that have made major contributions to the state of research. Our results can be used to set goals for scholarly study and outline future directions. The most important elements of the literature on the investors' behaviour using AI in the gold bullion market have been identified by this bibliometric analysis. The three decades (1993–2024) of scientific production on the topic of investors' behaviour using AI in the gold bullion market were discussed. Six areas made up the organization of the research. The study's initial portion addressed the performance analysis of publications on a global scale. The study covered author statistics in the second section, document statistics in the third, journal and cited journal statistics in the fourth, country-specific scientific production statistics in the fifth, and usage of most relevant keywords in the study's final section.

The most often occurring words on this theme are "gold", "investments", "commerce", "financial markets", "crude oil" and "price dynamics", "artificial intelligence, "electronic money" is a new evolving keywords in the studies relevant to investors behaviour using AI in the gold bullion market. This study also provides information on the bibliographic coupling of articles, journals, authors, nations and keywords through network visualization. A similar

study was conducted to analyse the research on investors' behaviour using AI in the gold bullion market using a Scopus database [27]. The study's findings reveal that in 2022, the most publications were made. Based on national evaluations, China is the only country with more than 100 publications, followed by India and USA.

For academics looking to profit from the advantages of analysing investor behaviour in the gold market through artificial intelligence, the research offers multiple opportunities. Apart from offering a methodology that enables scholars in different domains to comprehend and utilize bibliometric analysis in their fields, the study adds a great deal to the topic of gold bullion and goes beyond existing evaluations. It provides an analysis of the numerous studies published over the 32 years of investor behaviour utilising artificial intelligence (AI), in addition to incorporating additional papers and research fields covering gold bullion studies. Additionally, it displays the most popular publications, prolific authors highly cited documents, developing themes, keyword co-occurrences and author and nation collaboration networks. The study makes use of the R-Studio to conduct bibliometric analysis and generate data matrices for co-occurrence of keywords, coupling map, co-citation, collaboration and theme analysis. This could make it easier for scholars researching how AI-powered investors behave in the gold market to comprehend how the sector has evolved. This technique helps to produce visualisations and helps the authors to understand the data more fully and efficiently. The study is more understood in terms of performance and science mapping analysis since the authors have thoroughly looked at each participant and parameter involved in analysing the scientific output of the field.

The report provides academics and researchers with several recommendations and consequences. Initially, the data can be utilized by the researchers to comprehend the issues that arise from gold investments and how these issues have been addressed. Second, the study might assist researchers in identifying recent advancements in the investors' behaviour using AI in the gold bullion market and how these advancements contribute significantly to the market's performance. Third, this study can serve as a reference for academicians seeking to learn how to assess academic outcomes through the use of different indicators. Fourth, the study can help scholars and researchers studying the investors' behaviour using AI in the gold bullion market comprehend the topics, trends, and patterns that are emerging in this field. Fifth, the study examines the cooperation between writers and nations in the field of investors' behaviour using AI in the gold bullion market. The researchers can utilize this information to work with the most successful authors and nations in particular.

It is necessary to address the bibliometric study limitations firstly Scopus provided the original data used in the study and the Social Science Citation Index (SSCI) and impact factor statistics are not included in Scopus, even though it is the largest abstract and citation database containing papers from various industries. Moreover, only 548 publications concerning the activities of investors using artificial intelligence in the gold bullion market were included in the analysis. To incorporate the significant publications required for an assessment, future research should collect the bibliometric metadata from Web of Science and Scopus. Second, Biblioshiny was the software tool used in the study to do science mapping and performance analysis of gold bullion literature, rather than relying on other programs such as CitNet Explorer and SciMat to provide better data visualizations. Third, as the bibliometric analysis was conducted from 1993 to 2024, there's a chance that article productivity changed throughout that time. Finally, the research was limited to terms like "gold," "commerce," and "investments." Other terms that can affect search results but were omitted include "gold investments," "artificial intelligence," "investor behaviour," and "gold price prediction." Thus, future studies ought to incorporate these keywords.

References

[1] P. Akhavan, N. A. Ebrahim, M. A. Fetrati, and A. Pezeshkan, "Major trends in knowledge management research: a bibliometric study," *Scientometrics*, vol. 107, no. 3, pp. 1249–1264, Jun. 2016, doi: 10.1007/s11192-016-1938-x.

[2] S. J. Spiegel *et al.*, "Phasing Out Mercury? Ecological Economics and Indonesia's Small-Scale Gold Mining Sector," *Ecol. Econ.*, vol. 144, pp. 1–11, Feb. 2018, doi: 10.1016/j.ecolecon.2017.07.025.

[3] R. Orimoloye and O. O. Ololade, "Potential implications of gold-mining activities on some environmental components: A global assessment (1990 to 2018)," J. King Saud Univ. - Sci., vol. 32, no. 4, pp. 2432–2438, Jun. 2020, doi: 10.1016/j.jksus.2020.03.033.

[4] N. Nawaz and S. V. R., "A Study on Various Forms of Gold Investment," *SSRN Electron. J.*, Feb. 2020, doi: 10.2139/ssrn.3525301.

[5] Semeyutin and G. Downing, "Co-jumps in the U.S. interest rates and precious metals markets and their implications for investors," Int. Rev. Financ. Anal., vol. 81, May 2022, doi: 10.1016/j.irfa.2022.102078.

[6] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *J. Bus. Res.*, vol. 133, pp. 285–296, Sep. 2021, doi: 10.1016/j.jbusres.2021.04.070.

[7] R. Farooq, "A review of knowledge management research in the past three decades: a bibliometric analysis," *VINE J. Inf. Knowl. Manag. Syst.*, vol. 54,

no. 2, pp. 339–378, 2024, doi: 10.1108/VJIKMS-08-2021-0169.

[8] M. Gaviria-Marin, J. M. Merigó, and H. Baier-Fuentes, "Knowledge management: A global examination based on bibliometric analysis," *Technol. Forecast. Soc. Change*, vol. 140, pp. 194–220, Mar. 2019, doi: 10.1016/j.techfore.2018.07.006.

[9] P. Hallinger and J. Kovačević, "Science mapping the knowledge base in educational leadership and management: A longitudinal bibliometric analysis, 1960 to 2018," *Educ. Manag. Adm. Leadersh.*, vol. 49, no. 1, pp. 5–30, Jan. 2021, doi: 10.1177/1741143219859002.

[10] B. S. Hundal, S. Grover, and J. Kaur Bhatia, "Herd Behaviour and Gold Investment: A Perceptual Study of Retail Investors." [Online]. Available: www.iosrjournals.org

[11] P. Sadorsky, "Risk and Financial Management Predicting Gold and Silver Price Direction Using Tree-Based Classifiers," 2021, doi: 10.3390/jrfm.

[12] Gurbaxani and R. Gupte, "A study on the impact of covid-19 on investor behaviour of individuals in a small town in the state of Madhya Pradesh, India," Australas. Accounting, Bus. Financ. J., vol. 15, no. 1 Special Issue, pp. 70–92, 2021, doi: 10.14453/aabfj.v15i1.6.

[13] R. Mestre, "A wavelet approach of investing behaviors and their effects on risk exposures," *Financ. Innov.*, vol. 7, no. 1, Dec. 2021, doi: 10.1186/s40854-021-00239-z.

[14] N. Marisetty, "A STUDY ON VARIOUS FACTORS IMPACT ON THE GOLD PRICE IN INDIA." [Online]. Available: https://ssrn.com/abstract=4587897

[15] S. Garg, "A study of factors influencing investor behaviour towards gold as an investment avenue with factor analysis," in *Materials Today: Proceedings*, Elsevier Ltd, 2020, pp. 2587–2590. doi: 10.1016/j.matpr.2020.08.503.

[16] J. E, J. Ye, and H. Jin, "A novel hybrid model on the prediction of time series and its application for the gold price analysis and forecasting," *Phys. A Stat. Mech. its Appl.*, vol. 527, Aug. 2019, doi: 10.1016/j.physa.2019.121454.

[17] [17] A. Charteris and V. Kallinterakis, "Feedback trading in retail-dominated assets: Evidence from the gold bullion coin market," *Int. Rev. Financ. Anal.*, vol. 75, May 2021, doi: 10.1016/j.irfa.2021.101727.

[18] F. Abbas et al., "BIBLIOMETRIC ANALYSIS OF GLOBAL RESEARCH TRENDS ON ELECTRONIC WORD OF MOUTH USING SCOPUS DATABASE JOURNAL OF CRITICAL REVIEWS BIBLIOMETRIC ANALYSIS OF GLOBAL RESEARCH TRENDS ON ELECTRONIC WORD OF MOUTH USING SCOPUS DATABASE." [Online]. Available: https://www.researchgate.net/publication/343814001

[19] "TOWARD A DEFINITION OF 'BIBLIOMETRICS,'" 1987.

[20] M. Aria and C. Cuccurullo, "bibliometrix: An R-tool for comprehensive science mapping analysis," *J. Informetr.*, vol. 11, no. 4, pp. 959–975, Nov. 2017, doi: 10.1016/j.joi.2017.08.007.

[21] As-Salafiyah, Aam, and L. Marlina, "Mapping Research on Islamic Fintech Using Biblioshiny-R," J. Islam. Econ. Lit., vol. 3, no. 2, Nov. 2022, doi: 10.58968/jiel.v3i2.108.

[22] O. Ellegaard and J. A. Wallin, "The bibliometric analysis of scholarly production: How great is the impact?," *Scientometrics*, vol. 105, no. 3, pp. 1809–1831, Dec. 2015, doi: 10.1007/s11192-015-1645-z.

[23] N. Donthu, S. Kumar, and D. Pattnaik, "Forty-five years of Journal of Business Research: A bibliometric analysis," *J. Bus. Res.*, vol. 109, pp. 1–14, Mar. 2020, doi: 10.1016/j.jbusres.2019.10.039.

[24] Irwanto, A. D. Saputro, W. Widiyanti, and S. D. Laksana, "Global Trends on Mobile Learning in Higher Education: A Bibliometric Analysis (2002–2022)," Int. J. Inf. Educ. Technol., vol. 13, no. 2, pp. 373–383, Feb. 2023, doi: 10.18178/ijiet.2023.13.2.1816.

[25] M. Nazim, "Bibliometric Analysis of Gold Open Access in India," *Int. Inf. Libr. Rev.*, vol. 50, no. 1, pp. 13–23, Jan. 2018, doi: 10.1080/10572317.2017.1326246.

[26] G. Joshi and R. K. Dash, "Exchange-traded funds and the future of passive investments: a bibliometric review and future research agenda," *Futur. Bus. J.*, vol. 10, no. 1, Feb. 2024, doi: 10.1186/s43093-024-00306-8.

[27] M. S. Antonio, A. S. Rusydiana, M. S. Bahri, and A. A. Nasution, "Bibliometric Review on Gold Currency and The Islamic Perspective," *Libr. Philos. Pract.*, vol. 2021, 2021.

[28] J. Paule-Vianez, R. Gómez-Martínez, and C. Prado-Román, "A bibliometric analysis of behavioural finance with mapping analysis tools," *Eur. Res. Manag. Bus. Econ.*, vol. 26, no. 2, pp. 71–77, May 2020, doi: 10.1016/j.iedeen.2020.01.001.

[29] S. H. Zyoud, S. W. Al-Jabi, W. M. Sweileh, and W. S. Waring, "Scientific research related to calcium channel blockers poisoning," *Hum. Exp. Toxicol.*, vol. 34, no. 11, pp. 1162–1170, Nov. 2015, doi: 10.1177/0960327115571768.

[30] M. E. Falagas, E. I. Pitsouni, G. A. Malietzis, and G. Pappas, "Comparison of PubMed, Scopus, Web of Science, and Google Scholar: strengths and weaknesses," *FASEB J.*, vol. 22, no. 2, pp. 338–342, Feb. 2008, doi: 10.1096/fj.07-9492lsf.

[31] E. M. Murgado-Armenteros, M. Gutiérrez-Salcedo, F. J. Torres-Ruiz, and M. J. Cobo, "Analysing the conceptual evolution of qualitative marketing research through science mapping analysis," *Scientometrics*, vol. 102, no. 1, pp. 519–557, Jan. 2015, doi: 10.1007/s11192-014-1443-z.

[32] N. J. van Eck and L. Waltman, "Software survey: VOSviewer, a computer program for bibliometric mapping," *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010, doi: 10.1007/s11192-009-0146-3.

[33] N. J. van Eck and L. Waltman, "Citation-based clustering of publications using CitNetExplorer and VOSviewer," *Scientometrics*, vol. 111, no. 2, pp. 1053–1070, May 2017, doi: 10.1007/s11192-017-2300-7.

[34] M. J. Cobo, A. G. Lõpez-Herrera, E. Herrera-Viedma, and F. Herrera, "SciMAT: A new science mapping analysis software tool," *J. Am. Soc. Inf. Sci. Technol.*, vol. 63, no. 8, pp. 1609–1630, Aug. 2012, doi: 10.1002/asi.22688.

[35] R. Danell and J. W. Schneider, "How to use Bibexcel for various types of bibliometric analysis # FN KF LJ < @ 9 < O : < C = FI M8I @ FLJ KPG < J F = 9 @ 9C @ FD < KI @: 8E8CPJ @ J," no. January 2009, 2017.

[36] C. Chen, "CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature," *J. Am. Soc. Inf. Sci. Technol.*, vol. 57, no. 3, pp. 359–377, Mar. 2006, doi: 10.1002/asi.20317.

[37] H. Dervis, "Bibliometric analysis using bibliometrix an R package," *J. Scientometr. Res.*, vol. 8, no. 3, pp. 156–160, Dec. 2019, doi: 10.5530/JSCIRES.8.3.32.

[38] Anand, H. Himani, and S. Modi, "Science Mapping Analysis Of Intellectual Capital To Comprehend The Future Agenda And Dimensions: Bibliometric Analysis," 2024. [Online]. Available: www.ijcrt.org

[39] N. Singh, S. Handa, D. Kumar, and G. Singh, "Mapping of breast cancer research in India: a bibliometric analysis," 2016.

[40] C. Swain, D. K. Swain, and B. Rautaray, "Bibliometric analysis of Library Review from 2007 to 2011," *Libr. Rev.*, vol. 62, no. 8, pp. 602–618, 2013, doi: 10.1108/LR-02-2013-0012.

[41] C. Huang, C. Yang, S. Wang, W. Wu, J. Su, and C. Liang, "Evolution of topics in education research: a systematic review using bibliometric analysis," *Educ. Rev.*, vol. 72, no. 3, pp. 281–297, May 2020, doi: 10.1080/00131911.2019.1566212.

[42] D. Holten and J. J. Van Wijk, "Force-Directed Edge Bundling for Graph Visualization," 2009.

[43] N. J. Van Eck and L. Waltman, "How to normalize cooccurrence data? An analysis of some well-known similarity measures," *J. Am. Soc. Inf. Sci. Technol.*, vol. 60, no. 8, pp. 1635–1651, Aug. 2009, doi: 10.1002/asi.21075.

[44] S. Gholampour, A. Noruzi, B. Gholampour, and A. Elahi, "Research trends and bibliometric analysis of a journal: Sport management review," *Webology*, vol. 16, no. 2, pp. 223–241, 2019, doi: 10.14704/web/v16i2/a200.

[45] J. Jain, N. Walia, S. Singh, and E. Jain, "Mapping the field of behavioural biases: a literature review using bibliometric analysis," *Manag. Rev. Q.*, vol. 72, no. 3, pp. 823–855, Sep. 2022, doi: 10.1007/s11301-021-00215-y.

[46] J. Caust and M. Vecco, "Is UNESCO World Heritage recognition a blessing or burden? Evidence from developing Asian countries," *J. Cult. Herit.*, vol. 27, pp. 1–9, Oct. 2017, doi: 10.1016/j.culher.2017.02.004