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Impact of Artificial Intelligence on Bangladesh Stock Market: Bibliometric Approach

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Abstract

The study shows the importance of the concept of artificial intelligence's impact on stock markets in economics, with implications for other disciplines as well. The research emphasizes the importance of this concept via a bibliometric analysis, and promotes more interdisciplinary collaboration among experts. Analyzed using several performance criteria, the quantitative attributes and importance of academic contributions from worldwide sources were evaluated. VosViewer software was used for Science Mapping, which revealed the vast network of ideas. Future researchers may profit from the favorable research trajectory and major relevance of published works, as they anticipate additional breakthroughs in the subject.

Keywords: artificial intelligence; stock market; bibliometric analysis

JEL: G10

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1. Introduction

The modern era of Artificial Intelligence (AI) began in 1956. AI applications include Internet searches, service recommender systems, picture and recognition of voices, sensor devices, robotic machines, forecasting, and cognitive decision support systems have all been made feasible by machine learning (ML) and the utilisation of large data (Howard, 2019). In contrast, the stock market exhibits notable attributes such as elevated volatility, nonlinearity, and fluctuations in both its internal and external environments. The utilisation of artificial intelligence (AI) methodologies can be employed to identify and analyse non-linear patterns, leading to significantly enhanced forecasts of outcomes (Chopra & Sharma, 2021). Artificial intelligence has enabled the creation of cutting-edge financial services like intelligent consulting, lending, tracking, warnings, and cunning customer service, transforming the entire financial industry (Xie, 2019). A variety of machine learning algorithms were put into use to forecast the stock market. They suggested that two primary, technical and fundamental studies can be employed to model stock market prediction (Mokhtari et al., 2021). The technical assessment technique uses regression algorithms that use machine learning (ML) to forecast the price of a stock trend at the conclusion of a company's day utilising past price information. On the other hand, in the basic analysis, machine learning algorithms constructed from headlines and social networking sites are used to categorise public opinion (Mokhtari et al., 2021). They applied nine different ML algorithms to find the best model to predict the stock market using fundamental analysis. These models include Logistic Regression, Gaussian, Bernoulli, Decision Tree, Random Forest, K-Neighbors, SVC, XGBoost, and Artificial Neural Network. We tested those algorithms using Apple and Twitter datasets. Support Vector Machine performed the best among these models with 76% average accuracy. They used MAPE, RMSE and MAE functions to evaluate the models. For technical analysis, they used Linear Regression and LTSM. The "Yahoo Finance" Dataset was used to train and predict the technical analysis model. The Linear Regression model performed well for this analysis than LTSM. The summary table of artificial intelligence on the stock market is given below:

Table 1: Article Summary

Features	Details
Algorithms	For Fundamental Analysis: ANN, DT, SVM, LR, GNB, BNB, RF, KNN, XGB For Technical Analysis: Linear Regression, LSTM
Dataset & Source	Technical Analysis: Yahoo Finance Fundamental Analysis: Twitter, Apple
Methodology	Dataset Generation ➔ Fundametal/Technical Data ➔ Data Cleaning ➔ Data Reduction ➔ Feature Selection ➔ Data Transformation ➔ ML Model ➔ Model Evaluation ➔ Stock Market Prediction ➔ Buy/Sell/Hold
Result	Technical: Linear Regressing performs best (LR/LTSM) Fundamental: SVM performs with 76% accuracy (All)

Source: Summary of the research of (Mokhtari et al., 2021)

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Their research concluded that AI models are not yet powerful enough to make precise (Guresen et al., 2011). An artificial neural network stock market forecasting model. Their research examined MLP, DAN2, and hybrid neural networks that use generalised autoregressive conditional heteroscedasticity (GARCH) to generate new input variables. As an experiment dataset, they compared these models using MSE and MAD on NASDAQ Stock Exchange. Training used 146 days and testing 36 days. Their experiment trained the NASDAQ dataset on MLP, DAN2, GRACH and hybrid models GARCH-DAN2 and GARCH-MLP. After this process, they compared the models, and after comparing those models, the best result was concluded. Of those models, they found that MLP performed the best with a MAD score of 2.324 and the hybrid model performed the worst with a MAD score of 7.361. They came to the conclusion that MLP is an extremely effective and useful instrument for predicting stock volatility.

Table 2: Article Summary

Features	Details
Algorithms	MLP, DAN2, GARCH
Dataset & Source	NASDAQ Stock Exchange Training data: 146 days Testing data: 36 days
Methodology	Load Data set of NASDAQ ➔ Train Using MLP/DAN2/GARCH/GARCH-MLP/GARCH-DAN2 ➔ Performance Validation using MSE/ MAD ➔ Compare the models ➔ Declares the best model
Result	**MLP: 2.324(MAD) Test: 2.516(MAD)** GARCH-MLP: 2.456(MAD) Test: 2.775(MAD) DAN2: 2.409(MAD) Test: 2.768(MAD) GARCH-DAN2: 7.361 (MAD) Test: 6.487(MAD) Best Model: MLP with 2.324(MAD)

Source: Summary of the research of (Guresen et al., 2011)

Sharma et al. (2016) adopted a novel strategy to include AI for stock market forecasting. To conduct the projection, the researchers utilised two prominent stock market indices in the United States, namely DOW30 and NASDAQ100. They proposed a compelling methodology that integrates an Artificial Neural Network (ANN) with a Genetic Algorithm (GA) to provide intelligent predictions. The name of their hybrid model was GANN, and they compared the model with another model, which is called Back Propagation Artificial Neural Network (BPANN). In their experiment, first, the data was processed and partitioned in train, testing and validation. Then the data was passed through the ANN model, and then the model's output was passed into a Genetic Algorithm; after that, the GA model generated an output. After that error was calculated using MAPE, MSE and RMSE methods, the best model was declared. After experimenting with the problem, they found that the BPANN is stuck at the local optima, where GANN can jump from the local optima to the global optima, so it has an advantage over BPANN. This process was applied on NASDAQ100 and DOW30 for training and prediction

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on GANN and BPANN models. Out of those two, GANN models topped with an outstanding accuracy of 97.66%. From the result, they concluded that ANN connected with GA performs best. The summary table of this research has given below:

Table 3: Article Summary

Features	Details
Algorithms	GANN (GA+ANN), BPANN
Dataset & Source	NASDAQ100, DOW30 Samples: 910 Training: 80-90% Testing: 10-20%
Methodology	Gather Data ➔ Data Partition ➔ ANN ➔ GA ➔ Error Calculation: MAPE/MSE/RMSE ➔ Find out the best model
Result	**For NASDAQ100:** GANN performed better than BPANN in both training and prediction (97.16% Accuracy) **For DOW30:** GANN performed better than BPANN in both training and prediction (97.75% Accuracy) GANN performed better for global optimization

Source: Summary of the study of (Sharma et al., 2016)

Mingyue et al. (2016) forecasted Japanese stock market returns using AI. The researchers employed an artificial neural network (ANN) to forecast the future performance of the Japanese Nikkei 225 index. This ANN possesses the capability to accurately model nonlinear functions without relying on any predetermined assumptions. To achieve the best possible results, a combination of genetic algorithm (GA) and simulated annealing (SA) techniques were integrated with the ANN to optimise the search for the global optima. In their experiment, 71 input variables were selected, and after implementing the optimal variable selection method, only 18 were chosen for final training. The Nikkei 225 index has 237 months of observation, and the data was divided into 70:30 for training and testing. After that, those parameters were trained on BP, and to reduce the error, it was combined with GA and SA. After that, the result was tested on accuracy. For BP training, they tested 900 combinations, and from that best model was selected, and an average level of parameters was set. After the experiment, they concluded that a hybrid model created combining GA and BP performed the best.

Table 4: Article Summary

Features	Details
Algorithms	GA & BP, SA & BP

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Dataset & Source	Nikkie 255 index Samples: 237 Months of data Training: 70% Testing: 30%
Methodology	Gather Data ➔ Data Partition ➔ Variable Selection➔ Input in Back Propagation (BP) ➔ Passed through GA and SA for improvement ➔ Find the best experiment result
Result	GA with BP (GABPNN) achieved the best result with MSE of 0.0090 but in CPU time, SABPNN holds the best result which is 28s.

Source: Summary of the research of (Mingyue et al., 2016)

To sum up, the aforementioned articles underscore the efficacy of AI methodologies, specifically Artificial Neural Networks, in forecasting stock market patterns. Two methods can be used to predict the market using ANN, which is technical and fundamental analysis, where fundamental analysis considers the most essential parameters, such as public and social media sentiment, alongside the numerical data of day-to-day exchanges. Different algorithms of AI models can be used; hybrid models that combine AI algorithms with optimization techniques such as Genetic Algorithm and GARCH show promising results. However, models' specific performance and accuracy may vary depending on the dataset and evaluation metrics used. Further research and experiments are needed to explore the robustness and generalizability of these AI-based approaches in stock market prediction. Until now, many AI algorithms have exhibited a bias towards specific datasets and parameters. No single model has demonstrated the ability to accurately predict the stock market outcomes across diverse datasets, preventing us from confidently asserting that AI can surpass the stock market.

2. Methodology

In the last decade, comprehensive literature reviews and bibliometric studies have aided academics in better understanding the research patterns within a given field of study and in identifying potential directions for potential studies in areas like models for businesses (Coombes & Nicholson, 2013), international business (Rialp et al., 2019), economics (Bonilla et al., 2015), entrepreneurial spirit (Valenzuela-Fernandez et al., 2019), industrial marketing (Valenzuela-Fernandez et al., 2019), operations and management research (Merigó & Yang, 2017), and politics (Amiguet et al., 2017). To assess productivity and its impact, this study primarily considers the overall number of documents and citations (Merigó & Yang, 2017). Table 5 lists the measures that we used to conduct our bibliometric analysis.

Table 5: Metrics and their measures

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Name of Metrics	Measures
Cite Score at Scopus (5 years window) (Scopus,2023)	Citation received in a five-year window ÷ Published documents in a five-year window Here, Five years window = the 2023 cite score count the citations received in 2019-2023.
Field Weighted Citation Impact (FWCI) (Scopus2023)	The Field Weighted Citation Impact (FWCI) reveals how frequently it has been cited within similar documents. A number greater than 1.00 indicates that the document has received more citations than would typically be expected.
Productivity per active year of publication (PAY)	Total publication (TP) ÷Number of active years of publication (NAY)
Average Citation (AC)	Total Citation ÷Number of years
Collaboration index (CI)	(NCA ÷ TP) ÷ TP Here, NCA=Number of Contributing authors
Collaboration Coefficient (CC)	1 - (TP ÷ NCA)
Proportion of Cited Publications (PCP)	NCP ÷ TP Here, NCP=Number of Cited Publications

Findings of Bibliometric analysis

Performance analysis

When this study was conducted, 418 papers were written on the effect of artificial intelligence on the stock market, that were accessible on Scopus. Only final and complete articles were selected. These filters reduced the number of Artificial Intelligence documents from 2019 to 2023, as shown in Figure 1.

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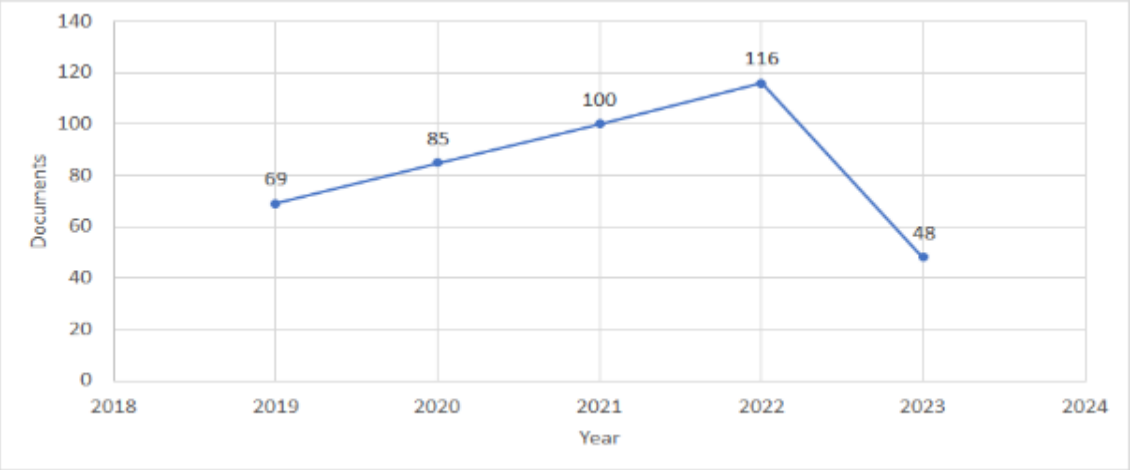
Figure 1: documents added to the scopus database in accordance with the year



Source: Database of Scopus

Figure 2 displays the authors' affiliations in artificial intelligence and stock market research papers found in Scopus. Sunyani Technical University and the University of Energy and Natural Resources rank first with three documents, followed by all other universities with two documents.

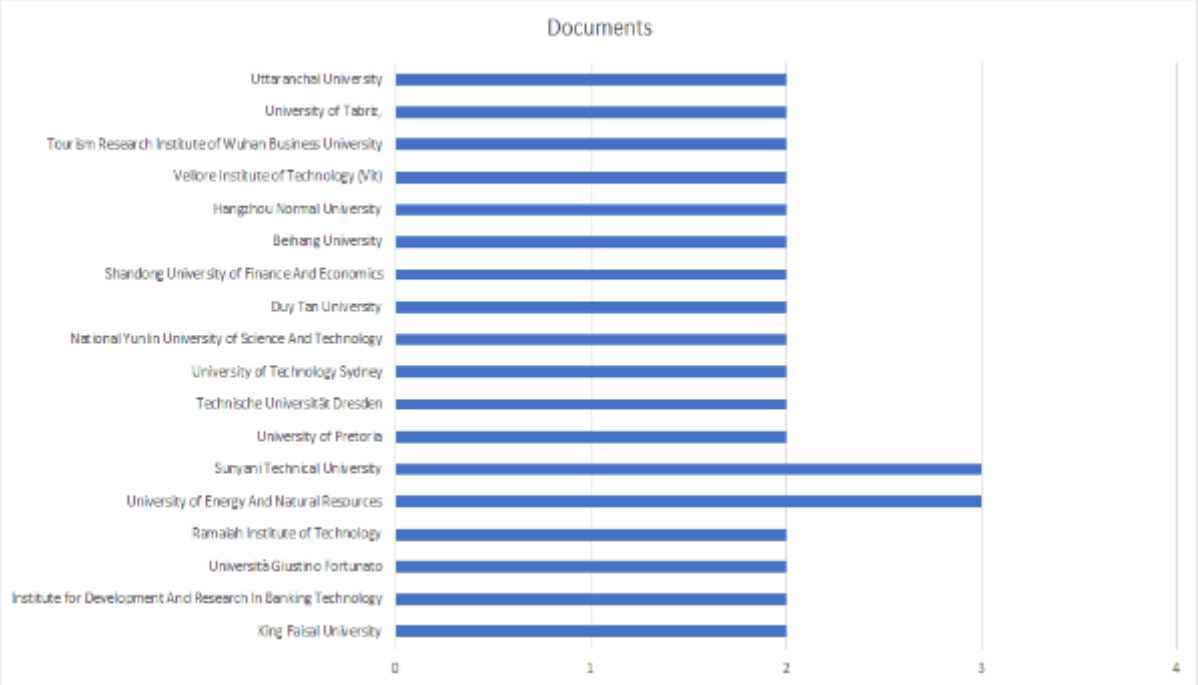


Figure 2: documents by affiliation

Source: Representation of Authors

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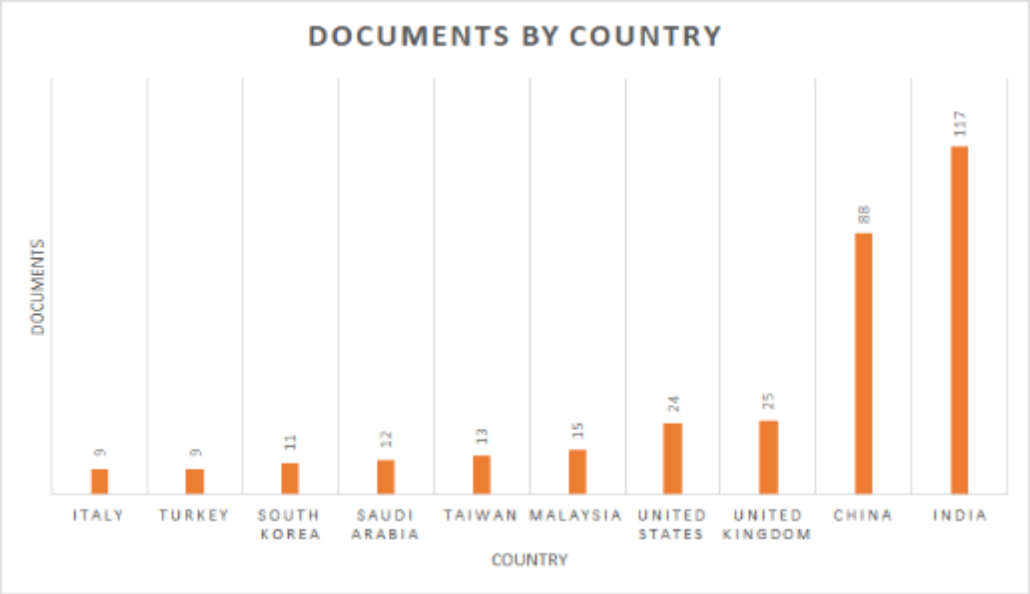
Figure 3 displays the documents by country on Artificial Intelligence. India has the highest number of documents, with 117 documents. The second highest-ranked country is China, with 88 documents, followed by the United Kingdom (25 documents), the United States (24



documents) and Malaysia (15 documents). The lowest-ranked country is Italy and Turkey, with nine documents.

Figure 3: Documents by Country

Source: Representation of Authors

The most cited document, "Stock Closing Price Prediction using Machine Learning Techniques," was published in 2020 and cited 117 times. The second most cited document, "Decision-making for financial trading: A fusion approach of machine learning and portfolio selection," was published in 2019 and cited 101 times. The third most cited document, "A systematic review of fundamental and technical analysis of stock market predictions," was published in 2020 and cited 85 times.

Scientific mapping

Analysis of co-word

According to (Donthu et al., 2021; Baker et al., 2020), the co-word scanning is frequently generated from the "author keywords," but if this information is unavailable, remarkable keywords may be collected from "article titles," "abstracts," and "full manuscripts." In the context of co-word analysis, we looked at the material presented in the impact of Artificial Intelligence on stock market publications. When doing the keyword analysis, it was decided that the number 10 was the threshold for significance. Out of 2657 keywords, 64 keywords meet the threshold. The most dominant keyword was financial markets which occurred 207 times. The second dominant keyword was commerce which occurred 203 times. The third

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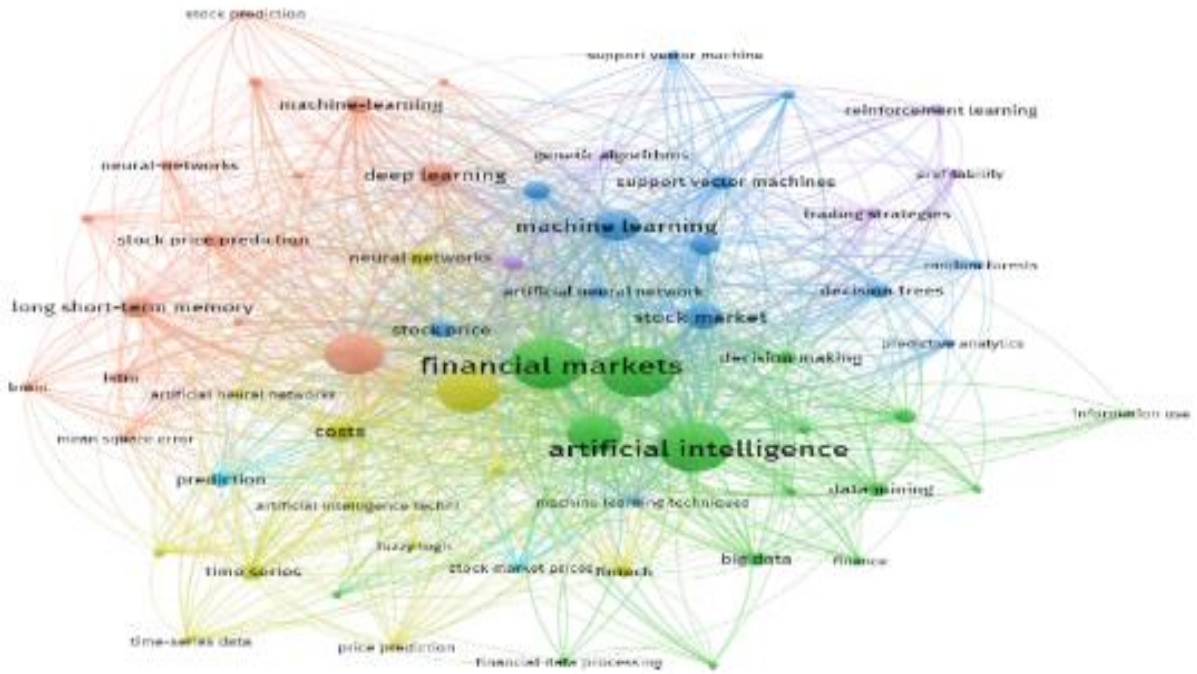
dominant keyword was artificial intelligence which occurred 200 times, followed by electronic



trading (152 occurrences), forecasting (141 occurrences) and investments (128 occurrences).

Figure 4: Co-word Analysis

Citation Analysis by Authors

According to (Donthu et al., 2021), citation analysis depends on the notion that it indicates

links between articles in artificial intelligence and that these ties are generated when one source references another. Only 32 of the 1110 writers who have contributed at lowest of two documents and 15 citations were considered. Figure 5 illustrates the three writers who have had the most significant impact and the connections between their various bodies of study.

Figure 5: Citation analysis by authors

Source: Developed by authors

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Citation analysis by source

A total of 418 documents have 256 sources for analyzing documents by source. The study was limited to 16 sources after applying the filters of taking into account at least 2 papers from each source and a minimum of 15 citations from each source. The following 3 sources were linked together from these sources (figure 6).

Figure 6: Citation analysis by source

Source: Developed by authors

Citation Analysis by Country

The study was limited to 29 out of 72 countries after applying the filters of taking into account at least 2 papers from each country and a minimum of 15 citations from each country. India has the highest number, with 117 documents and 486 citations (figure 7). China has 88 documents with 427 citations. South Korea has 11 documents with 303 citations.

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Figure 7: Citation analysis by country

Source: Developed by authors

Co-citation analysis by cited references

When two articles appear together in the references section of a different publication, they are linked in a co-citation network according to artificial intelligence, and co-citation analysis only focuses on publications that get a lot of citations (Donthu et al., 2021). Co-citation analysis enables not only to identify the most seminal works on this subject but also to identify thematic clusters associated with this topic. Out of 12,354 cited references, 13 meet the threshold with a lowest of 5 citations of a cited reference. Figure 8 shows that the research paper "A Comparative Analysis" has the highest 10 citations.

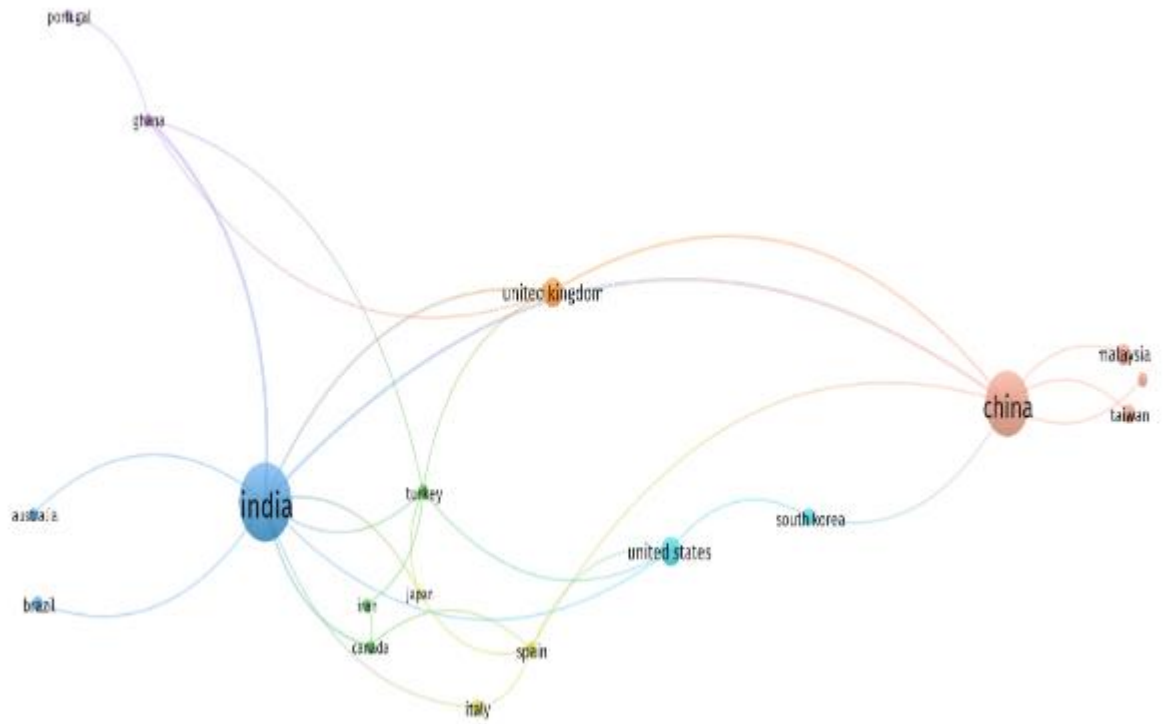

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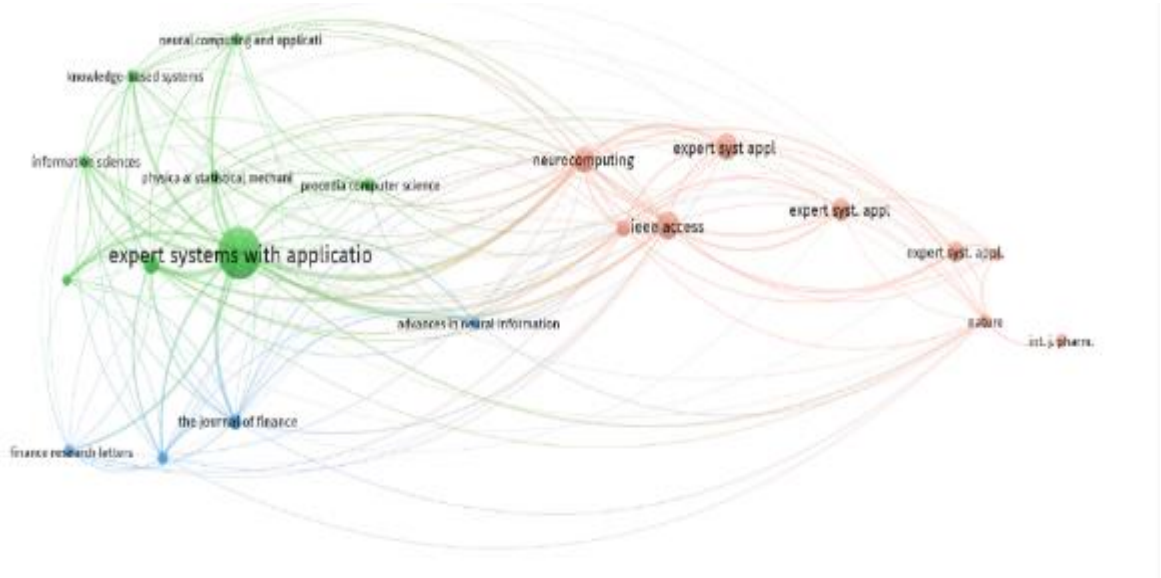
Figure 8: Analysis of citations using the referenced sources

Source: Developed by authors

Analysis of citations from cited sources

Regarding co-cited sources of cited sources, the study considered 21 sources with 30 or more co-



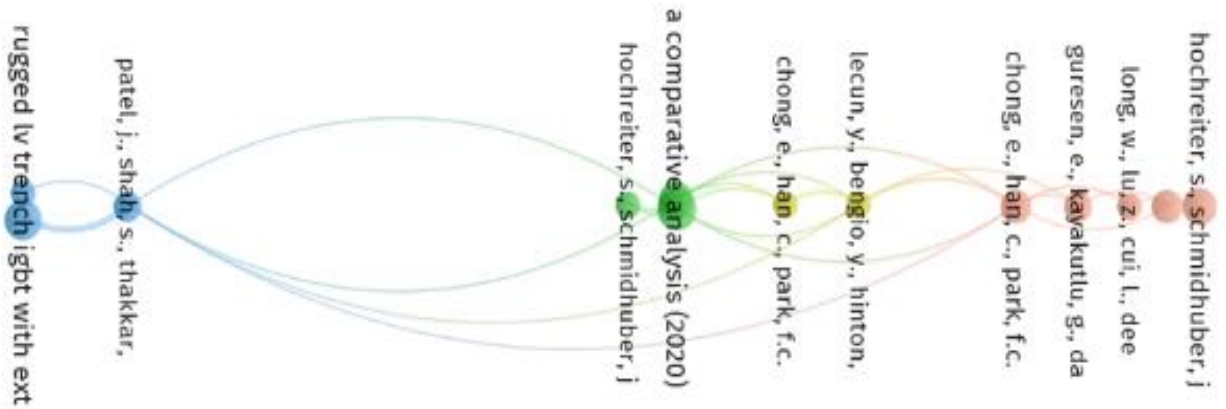
citations (figure 9). "Expert Systems with Applicatio" was the primary source that was also mentioned by other reputable sources the most.

Figure 9: Analysis of citations from cited sources

Source: Developed by authors

Bibliographic coupling

Assuming two works with comparable references have similarities in substance, the bibliographic



coupling is an additional analysis of scientific mapping (Donthu et al., 2021). Bibliographic coupling on documents was performed on a network of 419 papers that all referenced each other at least 10 times,

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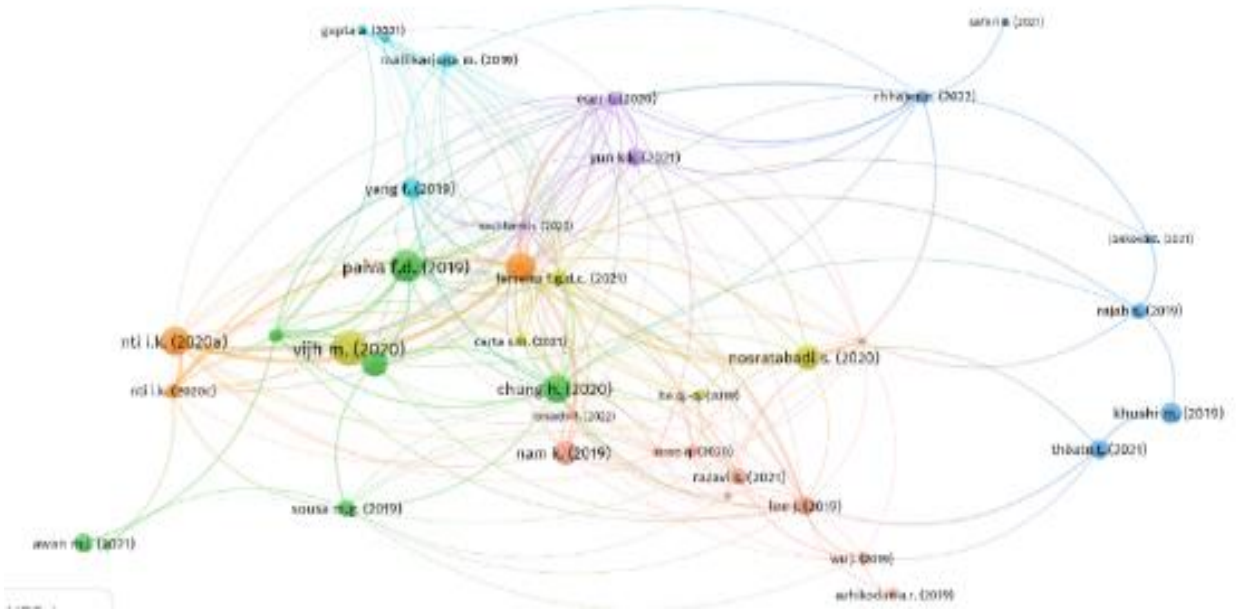
and 53 met the threshold (figure 10). The green cluster was significant among the six groups, spearheaded by (Vijh et al., 2020).'s paper (117 citations).

Figure 10: Bibliographic coupling based on documents

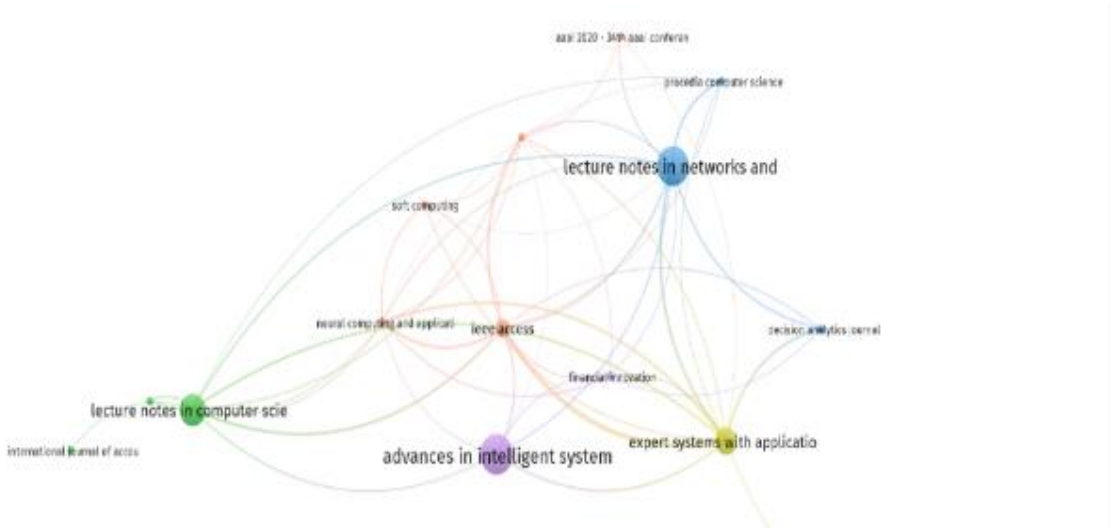
Source: Developed by authors



Bibliographic coupling on sources was performed on a network of 256 sources with a lowest number of documents per source of 2 and a lowest number of citations per source of 2, and 53 meet the threshold (figure 11). Significant among the sources were "Advances in Intelligent Systems."

Figure 11: Source-based bibliographic coupling

Source: Developed by authors



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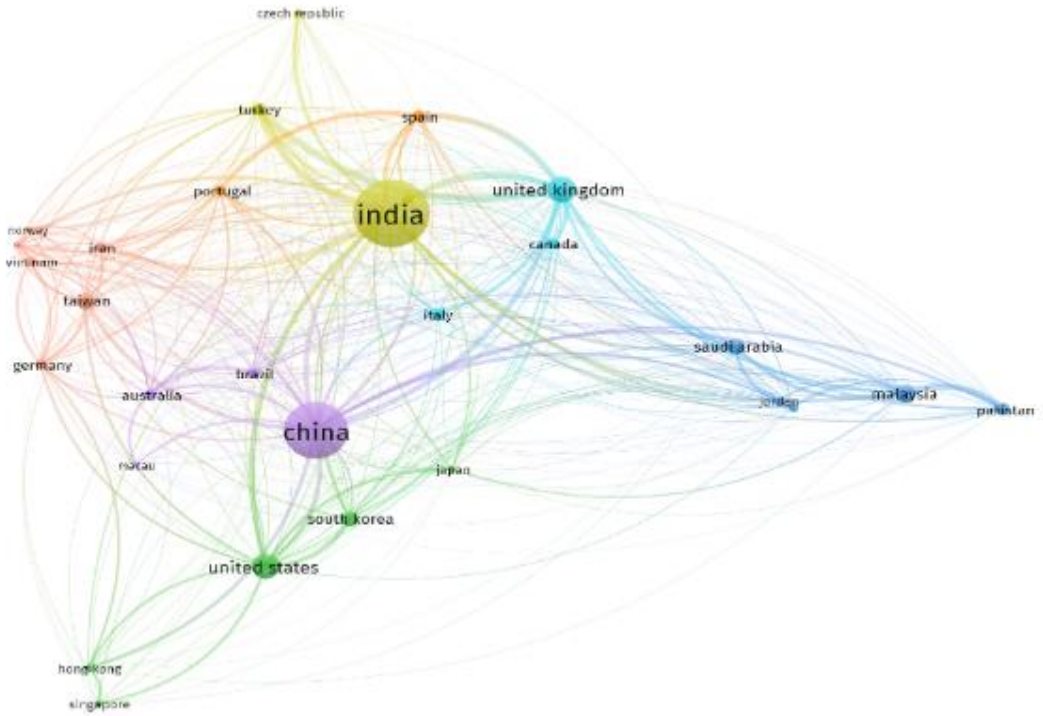
Bibliographic coupling on countries was limited to 29 out of 72 countries after applying the filters of taking into account not less than 2 documents from each country and at least 15 citations from each country. India has the highest number, with 486 citations (figure 12). China has 428 citations, and South Korea has 303 citations.

Figure 12: Country-based bibliographic coupling

Source: Developed by authors



Co-authorship analysis based on authors

In artificial intelligence, the formal method of intellectual cooperation among academics is co-authorship analysis. The purpose of this method is to get an understanding of how scholars communicate with one another (Donthu et al., 2021). The research looked at a minimum of two documents and fifteen citations; out of them, there were 32 authors that fulfilled the requirements to be included in co-authorship analysis (figure 13). All 32 writers worked on various research projects, contributing to the theory's overall significance.

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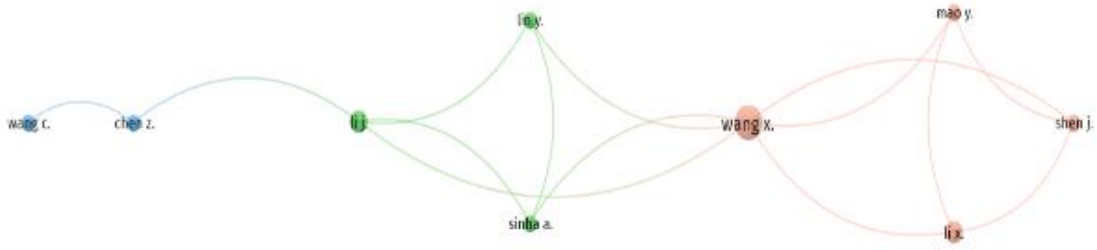
Figure 13: Authors co-authorship analysis



Source: Developed by authors

4. Discussion on Findings

The success of utilizing AI or machine learning techniques for stock market prediction hinges on numerous parameters. Due to the intricate interplay of various factors, achieving precise predictions is a formidable challenge. After an extensive review of research papers, it becomes apparent that the predominant factors encompass historical price and volume data, technical indicators, fundamental data, market sentiment, social media and news analysis, market volatility, macroeconomic indicators, company-specific information, sector and industry trends, external events, adept feature engineering, as well as vigilant consideration of regulatory constraints. There, have been several approaches and models created for predicting the stock market, with LSTM and ANN emerging as the most prominent alternatives in recent years. When it comes to forecasting the stock market, both LSTM and ANN have shown decent performance, with accuracy rates that are higher than 90%. However, other models like SMA, SARIMA, and GARCH have been explored but have not delivered the most promising results. Some research endeavours have also explored hybrid models, such as UMAP-LSTM and ISOMAP-GBR; however, these hybrid models have not surpassed the predictive capabilities of LSTM and ANN.

Although LSTM and ANN can be utilized for stock market forecasting, it's crucial to recognize the presence of various limitations that challenge the assumption of their flawless performance in this context. Across many studies, these common limitations come to the forefront:

- Narrow Focus: Often, the models concentrate solely on a single stock market.
- Limited Parameter Exploration: Experiments frequently involve a restricted set of parameters.
- Limited Data Sources: Historical data from only a handful of companies is commonly employed.
- Neglect of Sentiment Analysis: The influence of media and public sentiment is often overlooked.
- Short Historical Data: Researchers typically use historical data from a constrained time frame.
- Incomplete Variable Tracking: Comprehensive tracking of all relevant variables is often lacking.
- Black Swan Events: The financial markets are susceptible to being significantly influenced by unexpected and infrequent occurrences, sometimes known as "black swan" events. Because

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of the nature of these occurrences, it is impossible to accurately anticipate them using only past data.

Predicting the stock market using conventional AI and ML techniques faces formidable hurdles due to the intricacies of financial markets. These markets are inherently non-linear, noisy, and influenced by a multitude of unpredictable factors, including human emotion and sentiment. The high dimensionality of data, data quality issues, and the non-stationary nature of financial time series further complicate the task. While some models may demonstrate short-term predictive accuracy, consistently forecasting long-term market movements remains elusive. The presence of "black swan" events, regulatory changes, and the challenge of incorporating market sentiment and emotion underscore the limitations of conventional techniques. Successful stock market prediction often requires a multi-faceted approach, combining AI/ML models with expert judgment and robust risk management strategies, while acknowledging the inherent uncertainties and risks associated with financial markets. Ultimately, the feasibility of stock market prediction using trending algorithms like ANN and LSTM is contingent upon simplifying the analysis to a select few factors. In reality, stock market fluctuations are influenced by a vast array of variables, often intertwined with human sentiment. This complexity, compounded by the need for substantial time and resources, renders the accurate prediction of the global stock market impractical at present. Global regulatory constraints and ethical considerations further complicate the matter. Consequently, our analysis asserts that forecasting the stock market comprehensively, considering real-time parameters, is a challenging and currently unfeasible task. However, there is optimism for the future, as the advancing capabilities of AI may open doors to enhanced predictability in time.

By bringing together the several subfields that make up artificial intelligence's effect on the stock market in a unified area, a bibliometric study contributes to the overall image of AI's multidisciplinary character. This report has discovered and described key authors, research materials, published sources, and contributed nations in artificial intelligence through a comprehensive evaluation of the performance and scientific mapping. The importance of this concept in the research was shown by these analyses. Only complete and final research documents were covered in the bibliometric analysis, reducing the comprehensive number of papers to 418. In addition, the study displayed performance analysis and scientific mapping based on most-cited research publications. In addition, it only examined papers that were included in the Scopus database. More opportunities for cross-disciplinary research may be created by using bibliometric analysis. A bibliometric comparison between scopus database papers and those discovered in additional sources (like the Web of Science, Google Scholar, etc.) provides an avenue for further study.

5. Conclusion

The research indicates that the hypothesis of artificial intelligence's effects on the stock market is essential in economics and has far-reaching ramifications for various fields of study. This bibliometric study demonstrates the relevance of this hypothesis, which should encourage academics to conduct more interdisciplinary research. Scholarly works from around the globe were analyzed using a variety

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of analytic performance measures to determine their quantitative characteristics and significance. Through networks of papers, authors, organizations, and nations, scientific mapping clearly illustrates the immensity of this idea. A promising outlook emerges from this research, as it reveals a positive trend in the quantity and significance of published works on this hypothesis. This trend implies that the field is evolving and expanding, offering fertile ground for future researchers to explore. Anticipating further advancements in the domain, scholars can look forward to contributing to an ever-growing body of knowledge that addresses the intricate relationship between AI and the stock market. Future researchers may expect to see further progress in the field as a result of the positive trend in research and the enormous relevance of the works that have been published. The research presented in this study underscores the fundamental nature of the hypothesis concerning the impact of artificial intelligence (AI) on the stock market. Beyond its relevance to economics, this hypothesis carries profound implications for an array of academic disciplines. Through a comprehensive bibliometric analysis, this study illuminates the pivotal role played by this hypothesis in shaping contemporary research landscapes. One of the notable outcomes of this analysis is the compelling call for interdisciplinary exploration that arises from the hypothesis's multidisciplinary nature. Employing a diverse range of analytical performance measures, this research unveils the quantitative attributes and scholarly significance of works spanning the globe. The examination of these characteristics provides valuable insights into the depth and breadth of this research domain, underscoring its far-reaching impact on academic discourse. Furthermore, the adoption of VosViewer software for the Science Mapping section of the study yielded a plethora of results that underscore the multifaceted dimensions of the concepts encompassed within this hypothesis. These findings shed light on the diverse aspects and expansive scope of AI's influence on the stock market, enriching our understanding of this intricate subject.

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