

SYSTEMATIC LITERATURE REVIEW: FORECASTING THE RELATIONSHIP BETWEEN STOCK MARKET AND MACROECONOMIC VARIABLES

Ahmad Fazli¹, Mohd Hakim Jamil^{2*}, Mohd Nazrul Mohd Amin³ and Sumarni Abu Bakar⁴

College of Computing, Informatics and Mathematics, Universiti Teknologi MARA, 40450
Shah Alam, Selangor, Malaysia

^{1*}ahmadfazli5829@gmail.com, ²mohdhakim@uitm.edu.my, ³nazrul840@uitm.edu.my,

⁴sumarni164@uitm.edu.my

(* indicates the corresponding author)

ABSTRACT

Investing in the stock market is a significant and well-liked kind of investment worldwide while considering macroeconomic factors might have an impact on innovators' investment decisions and shock share returns. This study was applying PRISMA model in Systematic Literature Review (SLR) by locating numerous pertinent and acceptable forms of literature to establish the connection between macroeconomic variables and stock market future value. As SLR performed searches on articles collected from these databases, data search was conducted using criteria established by studies from several search platforms, including Google Scholar, Science Direct, Springer Link, Research Gate, and others. A total of 91 publications were found, 37 of which were relevant to the goal of this work. Only 17 of the 37 papers were pertinent to this investigation. Moreover, a qualitative method to data analysis was used to describe the research findings. The aim of study, types of data and methodology were identified to be the three key research themes, according to the findings. Roughly, the study of these papers' findings revealed that there are two methodologies, Auto Regressive Integrated Moving Average (ARIMA) and Back Propagation Neural Network (BPNN) were often utilised techniques but not directly compared for accuracy to forecast stock market and macroeconomic factors, gross domestic product (GDP), unemployment rate and money supply specifically. The results of SLR gave understanding into the field's main contributions, opportunities, and gaps, which sparked a discussion regarding crucial study areas in the future.

Keywords: Auto Regressive Integrated Moving Average, Back Propagation Neural Network, Granger Causality, Macroeconomic Variables, Stock Market.

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1. Introduction

The objectives of this paper are to review, examine and categorise the existing literature study which is linked to forecasting and analysing the relationship between stock market and macroeconomic factors. In this systematic literature review (SLR), research patterns are



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investigated together with comparable aim of studies, types of data, theoretical and conceptual framework, and methodologies used. The topics of this study are displayed in Table 1.

Table 1. Themes of this study

No.	Themes of the study
1	Aim of the study
2	Types of data
3	Methodology

The stock market and the macroeconomic indicators of a country's economic growth, which include factors like the GDP, unemployment rate, money supply, and others, are similar in that both are essential and significant to the advancement of the country. It is crucial to determine whether a macroeconomic variable can explain the stock market pattern or whether the relationship is reversed (Lai et al., 2019). Thus, several studies were conducted to identify whether there is a relationship between macroeconomic factors and the stock market (Zulkarnain and Sofian, 2012).

2. Literature Review

Due to stock prices are the discounted present value of anticipated future cash flows, stock prices should theoretically be closely related to the macroeconomic variables of the nation. (Zulkarnain and Sofian, 2012). Also, Khumalo, J. (2013) emphasized investors typically think that monetary policy and macroeconomic developments have a significant impact on the volatility of the stock market according to anecdotal data from the financial press. This suggests that macroeconomic factors could shock share returns and affect investors' decisions.

Additionally, a company's shares are issued and exchanged on the open market at the stock market. This is a way for companies to finance their operations while also indirectly boosting a country's economy and elevating society's standard of living. Since the major rise in inflation and the devaluation of local currency versus foreign currencies, investors have entered the stock market in an effort to improve profits and protect their money. However, since stock market trading is unpredictable and the market frequently reacts to changes in macroeconomic variables as well as occasionally for some inexplicable reasons, investors frequently do not receive the profits they had hoped for from their investments (Murthy, U., Anthony, P., & Vighnesvaran, R., 2017).

One type of literature review approach is systematic literature review (SLR). In academic research, a critical aspect is building upon existing knowledge. To advance knowledge, it is essential to be aware of the existing frontiers. This is achieved through reviewing relevant literature, which helps in grasping the scope and depth of previous work and identify areas that require further exploration. By summarizing, analysing, and synthesizing related literature, the specific hypotheses or develop fresh theories can be tested. Additionally, the credibility and quality of existing work against specific criteria, uncovering weaknesses, inconsistencies, and contradictions can be assessed (Paré et al., 2015).

3. Research Methodology

The objective of this study's Systematic Literature Review (SLR) technique was used. It was to accumulate, determine, analyse, and synthesise numerous research on the forecasting and analysing the relationship between future value of stock market and macroeconomic variables. As stated by Peter et al., (2019) on recommended reporting materials for systematic reviews and meta-analysis, or PRISMA, this study makes use of various steps. Identification, screening, adequacy, and insertion are these steps. The methodological process used to

respond to this research topic is depicted in Figure 1 below. Additionally, 17 articles were further examined depending on the outcomes of the data analysis as shown in the chart above. Table 2 provides a summary of the papers' descriptions.

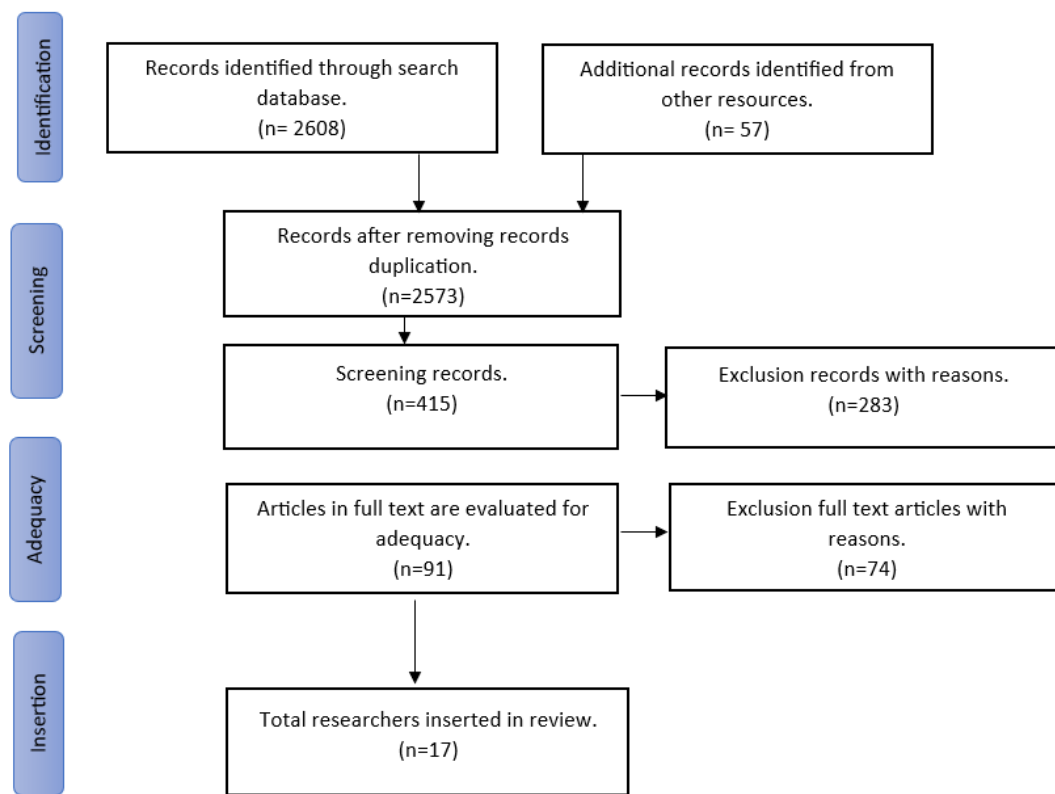


Figure 1. Selection Flow & Research Data Search

Table 2. Identity of the articles to be analyzed further

No	Article Title	Year	Author's Name	Journal Name/Proceedings Papers
1	Investment in Malaysia: forecasting stock market using time series analysis	2021	Abdul Rahman, N., Chen, Y. K., Pang, K., Shaik Abdullah, F. Z., & Izani, N. S.	e-Proceedings of the 5th International Conference on Computing, Mathematics and Statistics (iCMS 2021).
2	Analysing and Forecasting Share Price Index in Malaysia.	2019	Mohamed Hafiz, N. A., Ishak, N., & Nurullah Rasedee, A. F.	Journal of Computational and Theoretical Nanoscience.
3	Back propagation neural network based big data analytics for a stock market challenge.	2019	Ramesh, V. P., Baskaran, P., Krishnamoorthy, A., Damodaran, D., & Sadasivam, P.	Communications in Statistics-Theory and Methods.

4	Stock Price Prediction Using Back Propagation Neural Network Based on Gradient Descent with Momentum and Adaptive Learning Rate	2017	Utomo, S. D.	The Journal of Internet Banking and Commerce.
5	Forecasting Egyptian GDP using ARIMA models.	2019	Abonazel, M. R., & Abd-Elftah, A. I.	Reports on Economics and Finance.
6	Forecasting GDP and CPI of the Malaysian Economy Using ARIMA Models.	2022	Radzi, H. M., & Bakar, A. S. A.	International Journal of Advanced Management and Business Intelligence.
7	Back-Propagation Neural Network and ARIMA Algorithm for GDP Trend Analysis.	2022	Hua, S.	Wireless Communications and Mobile Computing.
8	Genetic Algorithm Neural Network Model vs Backpropagation Neural Network Model for GDP Forecasting.	2016	Gjylapi, D., Proko, E., & Shehu, A.	International Conference on Recent Trends and Applications in Computer Science and Information Technology (RTA-CSIT).
9	Estimation of the unemployment rate in Turkey: A comparison of the ARIMA and machine learning models including Covid-19 pandemic periods.	2023	Yamacli, D. S., & Yamacli, S.	Heliyon, 9(1).
10	Prediction of the unemployment rate in Malaysia.	2018	Ramli, S. F., Firdaus, M., Uzair, H., Khairi, M., & Zharif, A.	International Journal of Modern Trends in Social Sciences.
11	Prediction model of the unemployment rate for Nanyang in Henan province based on BP neural network.	2017	Cheng, Y., Hai, T., Zheng, Y., & Li, B.	13th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC-FSKD 2017).
12	Comparative Analysis of Different Univariate Forecasting Methods in Modelling and Predicting the Romanian Unemployment Rate for the Period 2021–2022.	2021	Davidescu, A. A., Apostu, S. A., & Paul, A.	Entropy, 23(3)
13	Application of SARIMA to modelling and forecasting money circulation in Nigeria.	2017	Adubisi, O. D., Eleke, C. C., Mom, T. T., & Adubisi, C.	Asian Research Journal of Mathematics
14	Estimating the macroeconomic indicators using ARIMA and ANFIS methods.	2022	Kuzu, Y., & Selçuk, A. L. P.	Recent Advances in Science and Engineering, 2(1).

15	Determination of the Optimal Model on Money Supply Data in Indonesia Using Backpropagation Neural Networks.	2022	Amani, N., Permana, D., Syafriandi, S., & Zilrahmi, Z.	Probilitas, 1(02).
16	A comparative analysis of macroeconomic variables and stock market performances in Africa (2000-2015).	2017	Worlu, C. N., & Omodero, C. O.	International Journal of Academic Research in Accounting, Finance and Management Sciences.
17	US stock market and macroeconomic factors.	2016	Jareño Cebrián, F., & Negrut, L.	Journal of Applied Business Research.

4. Data Collection and Analysis

Several internet resources, including Google Scholar, Research Gate, Science Direct, Springer Link, and others, were used to obtain data sources for this study. In data searches, a number of terms are searched for, including forecasting technique, stock market, GDP, unemployment rate, money supply, ARIMA, BPNN, and Granger causality. Additionally, the researchers employed several criteria for examining the data. Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA), which are used to choose criteria, were used in the SLR model equation. The chosen articles have been released by respected scientific publications. The data gathered from the papers included in this investigation are displayed in Table 3.

Table 3. Data collected from the articles

No	Article Title	Aim of the Studies	Types of Data	Methodology
1	Investment in Malaysia: forecasting stock market using time series analysis.	This study aims to investigate the performance of the Kuala Lumpur Composite Index (KLCI) from 1997 to 2018, to forecast the value of KLCI stock market for the coming three years and to investigate whether investment in stock market is the best in terms of profit for the coming three years.	KLCI data from January 1997 until December 2018 with a total duration of 22 years.	All the analysis of time series ARIMA will be conducted with the aid of SPSS, EViews and Minitab software.
2	Analysing and Forecasting Share Price Index in Malaysia.	In this paper, the Wilkie share price model was applying to Malaysia data in analyzing and forecasting FTSE Bursa Malaysia KLCI share price index for 36 months ahead from November 2015 to October 2018.	Monthly historical KLCI data from January 1996 to October 2015.	This study used Wilkie share price model in forecasting share prices in Malaysia and modelling a time series based on Box-Jenkins methodology.
3	Back propagation neural	In this article, the authors are	The training data of	Using back

	network based big data analytics for a stock market challenge.	presenting their methodology on solving a stock market challenge on predicting the intraday stock returns. The validation of the approach is also presented demonstrating the effectiveness of back propagation neural network-based model on predicting the stock returns.	intraday stock returns had information on 40,000 arbitrary stocks and 211 different pieces of information were given for all these 40,000 stocks. Also, the test file was comprised of 1,20,000 arbitrary stocks.	propagation neural network algorithm, namely the choice of activation function, learning rate and the number of neurons in the hidden layer to solve a stock market challenge on predicting the intraday stock return.
4	Stock Price Prediction Using Back Propagation Neural Network Based on Gradient Descent with Momentum and Adaptive Learning Rate.	This thesis proposes a gradient-based back propagation neural network approach to improve optimization in stock price predictions. The use of gradient descent in BPNN method aims to determine the parameter of learning rate, training cycle adaptively so as to get the best value in the process of stock data training in order to obtain accuracy in prediction.	The data to be tested for prediction is data from private bank stocks from 2010 to 2016.	A gradient-based back propagation neural network approach is applied to improve optimization in stock price predictions.
5	Forecasting Egyptian GDP using ARIMA models.	In this paper, the Box-Jenkins approach has been used to build the appropriate Autoregressive-Integrated Moving-Average (ARIMA) model for the Egyptian GDP data.	Egypt's annual GDP data obtained from the World-Bank for the years 1965 to 2016.	Statistical techniques in time series analysis to estimate and predict the Egyptian GDP. The proposed Egyptian GDP model has been presented based on Box-Jenkins approach.
6	Forecasting GDP and CPI of the Malaysian Economy Using ARIMA Models.	The implication of this study is crucial for academic reference of the future study which related to the usage of the same model approach as well as the economic indicators used.	Data of Malaysia GDP and CPI from the year of 1960 until 2021.	This study also followed the Box-Jenkins methodology that includes stages of analysis, which is model identification, estimation, diagnostic and finally

				forecasting.
7	Back-Propagation Neural Network and ARIMA Algorithm for GDP Trend Analysis.	This paper develops a fusion model by combining the advantages and disadvantages of the ARIMA and BPNN models and develops a new improved fusion model.	China GDP data from 2010 to 2014 as the training sample, and the GDP data from 2011 to 2020 as the test sample, and different evaluation criteria are used to evaluate the model test results.	The time series ARIMA and the BPNN model are combined to create the ARIMA-BPNN fusion prediction model. The predicted values of the two models were then weighted averaged to obtain the predicted values of the linear part of the improved fusion model.
8	Genetic Algorithm Neural Network Model vs Backpropagation Neural Network Model for GDP Forecasting.	This paper evaluates the usefulness of neural networks in GDP forecasting. It is focused on comparing a neural network model trained with genetic algorithm (GANN) to a backpropagation neural network model, both used to forecast the GDP of Albania.	The data used to forecast GDP are quarterly data from quarter 2 of 2002 until quarter 1 in 2016.	The GDP forecast by using the neural network trained with the Backpropagation method and Genetic Algorithm Neural Network Model
9	Estimation of the unemployment rate in Turkey: A comparison of the ARIMA and machine learning models including Covid-19 pandemic periods.	The article examines the accuracy of the Auto Regressive Integrated Moving Average (ARIMA) and Artificial Neural Networks (ANN) approaches for estimating the unemployment rate.	Unemployment rate monthly data in Turkey with 176 data samples for the period of 01.01.2008-31.08.2022	The method used in this study is ARIMA and ANN to forecast unemployment rate and another macroeconomic variable such as oil price, interest rate and exchange rate.

10	Prediction of the unemployment rate in Malaysia.	The three subsequent portions of this paper's purpose, which is to identify the important elements influencing Malaysia's unemployment rate, to identify the most accurate models for predicting Malaysia's unemployment rate and use the best model to predict the future value of Malaysia's unemployment rate	Data on Malaysia's unemployment rate from 1982 to 2016 were used to predict the country's 10-year unemployment rate.	The significance level is assessed to analyse the variables, and the ARIMA and Holt's exponential smoothing techniques are used to anticipate the unemployment rate.
11	Prediction model of the unemployment rate for Nanyang in Henan province based on BP neural network.	This paper focuses on BP (Back Propagation) neural network-based prediction model for Nanyang, Henan Province's unemployment rate.	The indicators data and unemployment rate of Nanyang in Henan province (2001-2014) are applied, and the training samples are from the data in Nanyang statistical yearbook.	The method used, BPNN in forecasting unemployment rate has been simulated by the MATLAB software.
12	Comparative Analysis of Different Univariate Forecasting Methods in Modelling and Predicting the Romanian Unemployment Rate for the Period 2021–2022.	The aim of this paper is implementing future forecasting of unemployment rate by applying a few univariate time series methods and analyzes the performance of forecast.	The sample data for model identification is starting from 2000 – 2017. For model estimation is from 2018-2020 and forecast data for next two years, 2021-2022.	Several forecasting methods such as seasonal model autoregressive integrated moving average (SARIMA), self-exciting threshold autoregressive (SETAR), Holt–Winters, ETS (error, trend, seasonal), and NNAR (neural network autoregression) has been performed.
13	Application of SARIMA to modelling and forecasting money circulation in Nigeria.	This article explains Nigeria's currency circulation trend and pattern. Its importance stems from the possibility that it may help in tracking the extent of money movement in the economy.	From January 2000 to December 2016, data on monthly records of currency in circulation were examined using the central bank of Nigeria's online database.	The method used in this paper is Box-Jenkins (ARIMA) methodology.

14	Estimating the macroeconomic indicators using ARIMA and ANFIS methods.	This article focuses on money supply, currency rates, and interest rates were among the variables considered in the ANFIS model to predict inflation rate using Adaptive Neuro Fuzzy Inference System (ANFIS) and ARIMA.	The 202 months of data between January 2005 and October 2021 were used, and the data were collected monthly from Central Bank of Turkey.	Adaptive Neuro Fuzzy Inference System (ANFIS) and Auto Regressive Integrated Moving Average (ARIMA) were applied in this paper.
15	Determination of the Optimal Model on Money Supply Data in Indonesia Using Backpropagation Neural Networks.	This paper focuses on utilizing a backpropagation neural network model to forecast the amount of money, determine the model's degree of accuracy, and forecast future money supply.	Monthly data on the amount of money circulation in Indonesia from January 2010 to June 2022.	The backpropagation neural network's application yielded ANN BP (12,6,1) as the best model of the money supply.
16	A comparative analysis of macroeconomic variables and stock market performances in Africa (2000-2015).	The study aimed at evaluating the impact of macroeconomic variables on stock market performance in Africa from the period of 2000 to 2015.	Selected macroeconomic variables such as GDP, inflation and exchange rate in the selected countries representing Africa like Nigeria, Ghana, South Africa, and Kenya for the period of 2000-2015.	The research design adopted in this study is a cross sectional survey which involves a survey of existing data and through convenient sampling, Ghana, Kenya, South Africa and Nigeria were selected. The time series data employed were analyzed using SPSS software to find out how the variables collectively and individually affect share price index.

17	US stock market and macroeconomic factors.	This paper analyzes the relationship between the US stock market and some relevant US macroeconomic factors, such as gross domestic product, the consumer price index, the industrial production index, the unemployment rate and long-term interest rates.	Quarterly GDP, Consumer Price Index (CPI), Industrial Production Index (IPI), interest rate, unemployment rate and Dow Jones Stock Market data for the 2008-2014 period.	Student's t distribution and the associated probabilities (p-value) are used to confirm whether the relationships found are statistically significant.
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5. Results and Discussion

5.1 Aim of the studies

The table 3 shows the selected articles aimed to forecast both stock market variables and specific macroeconomic factors such as GDP, money supply, and unemployment rate. The methods used, time series analysis or neural network analysis, are common approaches in financial and economic forecasting.

There is a relationship and connection between these macroeconomic factors (GDP, money supply, and unemployment) and the stock market. This is indeed an area of interest for researchers and analysts, as changes in macroeconomic indicators can have significant implications for stock market performance. For example, a strong GDP growth rate may be associated with increased corporate profits and higher stock market returns. Similarly, changes in money supply or interest rates can impact market liquidity and investor sentiment, which can in turn affect stock prices. Unemployment rates can also influence consumer spending patterns and overall economic stability, which can have indirect effects on the stock market.

In addition, further research must be performed to analyse these relationships and look at potential effects on the stock market of changing macroeconomic factor values. Researchers may learn about possible market trends and improve their investment decisions by analysing the prediction ability of future macroeconomic indicators.

5.2 Types of Data

Table 4. Types of data in the study

Types of Data	Selected Countries									
	Malaysia	Nigeria	Indonesia	China	Turkey	Egypt	Albania	Romania	US	India
Stock Market	n=2 (1996-2018)		n=1 (2010-2016)							n=1 (n.d)
GDP	n=1 (1960-2021)			n=1 (2010-2020)		n=1 (1965-2016)	n=1 (2022-2016)			
Unemployment Rate	n=1 (1982-2016)			n=1 (2001-2014)	n=1 (2008-2022)			n=1 (2000-2020)		

Money Supply		n=1 (2000-2016)	n=1 (2010-2022)		n=1 (2005-2021)					
Relationship between Stock Market and Macroeconomic Factors		n=1 (2000-2015)							n=1 (2008-2014)	
Total	17 Articles									

Based on the table 4 above, the most recent data may be used to capture the most recent market conditions and trends, which can result in more precise predictions. A large data period might also be advantageous since it enables a more thorough investigation of past patterns and trends. The ability to comprehend market dynamics and maybe spot long-term trends that could affect future estimates improves with longer data periods.

Depending on the author's objective and the data's accessibility, the choice of data while forecasting macroeconomic issues might change. Different priorities or particular factors may be important to different researchers or analysts. To utilise macroeconomic indicators that are known to influence the stock market, such as GDP growth, inflation rates, interest rates, employment statistics, and others are typically advised. Although the availability and calibre of these data points can differ among nations and historical times, efforts should be taken to ensure that the data selected are trustworthy and indicative of the economic conditions under consideration.

Overall, the reliability and precision of stock market forecasting and macroeconomic research may be improved by combining the most recent available data and making use of a wide variety of macroeconomic parameters.

5.3 Methodology

Table 5. Research methodology in this study

	Methodology	ARIMA	Holt's Winter	SARIMA	BPNN	ANN	NNAR	Student's t distribution
Forecasting Method	Statistical Method Analysis	n=6	n=1	n=1				
	Neural Network Analysis				n=6	n=1	n=1	
Variables Relationship	Stochastic Process							n=1
Total	17 Articles							

The table 5 above indicates that the preceding articles tried to forecast macroeconomic variables like GDP, money supply, and unemployment rate as well as stock market indicators.

ARIMA and BPNN were two often utilised techniques. These models were not directly compared for accuracy. The effectiveness of various forecasting techniques should be compared in future study, including with accuracy testing. Granger Causality has been recommended as a method for examining the relationship between macroeconomic variables and stock market indices (such as the KLCI). Researchers may learn more about the positive aspects of various models and raise predicting accuracy by implementing Granger causality and comparing the accuracy results.

6. Conclusion

This study conducted a systematic literature analysis on predicting and evaluated at the way the stock market and macroeconomic issues relate in 17 studies that were published between 2016 and 2023. Study aims, types of data used, and methodology were the three primary elements of the review. In addition to identifying the goals of each study, the data sources used, and the forecasting techniques used, the study gave a thorough summary of the research in this area. A drawback of this study is that it only looked at a small number of papers, which might not accurately reflect the range of research that is currently being conducted in the field.

Future researchers should aim for broader scope, encompassing a bigger and more diverse selection of publications, to improve the effectiveness of literature reviews. A greater comprehension of forecasting methods and the connections between stock markets and macroeconomic factors might be possible with a more thorough synthesis of the research. Researchers can get important insights and improve the validity of their literature review papers by incorporating a greater variety of studies.

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9. Conflict of Interest

The authors have no conflicts of interest to declare.

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