AN ANALYSIS OF CORRELATION BETWEEN STOCKS AND ITS IMPACT ON INVESTMENT RISK

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ABSTRACT
The research paper investigates the correlation between stocks and volatility dynamics within the Indian stock markets and their implications for investment strategies. Utilizing historical data spanning multiple sectors and market indices, this research conducts a comprehensive analysis of correlation coefficients among various stocks and asset classes. Through statistical techniques, including correlation matrices and time-series analysis, this research identifies the degree of interdependence among different stocks and sectors. Moreover, this study also examines the stability of correlations over different market conditions and time periods. The analysis encompasses a nuanced examination of correlation coefficients, shedding light on the degree and nature of interdependence among different segments of the Indian equity market. The study scrutinizes the stability of correlations and time horizons. Furthermore, this research analyses the standard deviation of returns as a measure of volatility and explores its determinants, including macroeconomic indicators, investor sentiment and global market trends. This research investigates how changes in volatility impact investment decisions and risk management strategies for market participants. Based on the findings, this research provides practical insights and recommendations for investors, portfolio managers, and policymakers to navigate the challenges posed by volatility and correlations in the Indian stock market effectively. This research emphasizes the importance of dynamic asset allocation, active risk monitoring and the integration of alternative investment strategies to achieve optimal risk-adjusted returns in a volatile market environment.

Keywords: Stock Market, Equity Shares, Weightage of the stocks, Standard Deviation of Security Returns, Stock volatility, Correlation between stocks, Markowitz Model, Diversification.

INTRODUCTION
The stock market was introduced to India in 1875 when the Bombay Stock Exchange (BSE) was established. Commodity markets are the places where commodities are bought and sold, similarly Stock markets are the place to buy and sell stocks. The stock market determines the price of stocks on a given day through a bid and offer process. At a specific price, a stock is offered for purchase or sale. In the stock market, buyers compete with other buyers leading to increase in the stock prices in the market, similarly, stock sellers compete with each other leading to fall in the price of stock. When the best offer and the best offer match, the deal is done. In an automated exchange, a high-speed computer does all the work.

The shares of various companies are listed at the stock exchange. Currently India has 23 stock Exchanges. Bombay Stock Exchange (BSE) and National Stock Exchange (NSE) are the 2 national level stock exchanges and rest 21 are Regional Stock Exchanges (RSEs) in state capitals and other major cities. eg: Calcutta Stock Exchange (CSE). The two widely used indices in the Indian market are Nifty and Sensex. All activities in Indian stock market are regulated and controlled by SEBI.

Harry Markowitz created portfolio theory in the 1950s as a formal attempt to quantify portfolio risk and develop a framework for calculating the optimal portfolio. Prior to this hypothesis, investors used the terms return and risk loosely. Harry Markowitz was the first to demonstrate statistically that diversity minimizes risks. Portfolio theory shows how investors can create the best possible portfolio through efficient diversification wherein risk is minimised for any given expected return.

Preferences of Investors in the Stock Market:
Most investors seek both safe and secure investment returns, as well as maximum rewards. Pure debt investments are less liquid than equity investments, but they provide reasonable returns. Therefore, in quest of higher returns (taking risk factors into account), investors shift towards equity investments. Recent investment trends like FII entry and performance of the Indian stock market shows that in India, it is obvious that stock market investment is increasing.

India is a growth engine due to its enormous population and booming economy. Its stock market capitalization first overtook Hong Kong's on January 22, 2024. Bloomberg data shows that the value of shares listed on Indian exchanges was $4.33 trillion, while Hong Kong's value was $4.29 trillion.

Foreign Investment in India's Stock Market:

In the 1990s, India opened up to outside investment. Foreign investments are divided into two types: Foreign Direct Investment (FDI) and Foreign Portfolio Investment. All investments in which an investor participates in the company's day-to-day management and operations are considered FDI, whereas investments in shares that have no control over management and operations are considered FPIs.

Being a foreign institutional investor (FII) or holding a sub-account of a registered FIIS is a requirement for making portfolio investments in India. The market regulator, SEBI, has authorized both registrations. The majority of foreign institutional investors are found in insurance companies, banks, sovereign wealth funds, mutual funds, pension funds, and asset management organizations. FIIs can also invest in unlisted securities outside of stock exchanges, as long as the Reserve Bank of India approves the price.

Equity Shares:

Equity capital is the ownership capital. The corporation is jointly owned by its equity owners. They bear the risks and reap the benefits of ownership. Equity shares appear to be the most romantic type of security. While fixed income investments may be more important to most investors, equity shares appear to pique their curiosity the most. Equity shares are an interesting, even exciting, proposition because of the possible benefits and penalties.

The market value of an equity share is the price at which it is traded on the market. This price is easily determined as for a company that trades privately. A credible market quotation is difficult to establish for a company listed on the stock exchange but traded infrequently. For a corporation that is not publicly traded, one can only speculate on its market price if it were traded.

LITERATURE REVIEW:

Gupta (1972) investigated the operation of stock markets in India and made several recommendations to improve their operation. The study emphasizes the importance of regulating speculation volume in order to meet liquidity and price continuity needs. It suggests listing company shares on more than one stock market at the same time to boost liquidity. The research also seeks to keep the cost of offerings low in order to protect small investors.

Panda (1980) investigated the role of stock exchanges in India prior to and during independence. According to the survey, listed stocks accounted for four-fifths of joint stock businesses. Investment in securities was no longer restricted to a certain class or group of individuals. It drew the attention of many low- and middle-income people. It was discovered that a considerable part of savings were initially spent on the acquisition of already issued stocks.

Mukherjee and Tiwari (2022) analyzed the trading behavior of foreign institutional investors (FIIs) and its impact on the Indian stock market. They found that FIIs' trading activities significantly affect stock prices and market volatility. This study underscores the importance of monitoring institutional investors' actions to manage investment risk effectively (SpringerLink).

Rahman and Shamsuddin (2019) studied the relationship between economic indicators such as the price-to-earnings (P/E) ratio and market sentiment. Their findings revealed that higher P/E ratios, often driven by optimistic investor sentiment, lead to increased market volatility. This suggests that economic indicators can serve as proxies for understanding and predicting stock market behavior (SpringerOpen).

Gupta (1981) believes in his long study titled 'Return on New Equity issuance' that the investment performance of new equity share issuance, particularly those of emerging enterprises, warrants distinct examination. The 'set price' at which new issues are issued has a substantial impact on the rate of return to initial buyers. Dividends and capital appreciation are both included in the return on equity. This study provides credible estimates of equities' rates of return and investigates their variability across time.

Jawahar Lal (1992) provides an overview of Indian investors and examines their investing selections. He made an attempt to investigate their familiarity and grasp of financial information, as well as the extent to which they apply it. The information provided by the companies generally fails to meet the needs of a wide range of individual investors, and it is widely assumed that the company's Annual Report and other statements are poorly received by them.

L.C.Gupta (1992) reported the conclusions of his investigation, which found that there is rampant speculation in the Indian stock market. The Indian stock market's over-speculative nature is evident in the exceptionally high concentration of market activity in a few shares at the expense of the remaining shares, as well as the extremely high trading velocities of the speculative counters. He believed that excessive short-term speculation could result in "artificial prices." An artificial price is one that is not justified by future earnings, dividends, financial strength, or assets, or is created by speculators through rumours, manipulations, and so on. He concluded that such fake values were sure to crash at some point, as history has repeatedly demonstrated.

Nabhi Kumar Jain (1992) provided specific advice for both purchasing and selling stocks. He recommended investors to buy stock in a rising company in a booming industry. Purchase stock by investing in a number of growth companies operating in a separate but similarly fast-growing segment of the economy. He proposed selling the shares once the company had reached or was about to reach its pinnacle of growth. Also, sell the shares as soon as you understand you made a mistake in your initial stock decision. The only way to decide when to acquire and sell high-priced stocks is to assess the individual merits or demerits of each share in the portfolio and make a decision.

Pyare Lal Singh (1993) in his paper "Indian Capital Market - A Functional Analysis," presents the primary market as a consistent source of fund supply. It mobilises savings from many sectors of the economy, including households, the public and private corporate sectors. The number of investors grew from 20 lakhs in 1980 to 150 lakhs in 1990 (7.5 times). The contribution of securities to the financing of company project costs has increased from 35.01% in 1981 to 52.94% in 1989, using various financing methods. Debentures and bonds have contributed significantly to the overall number of securities issued in recent years, rising from 16.21% to 30.14%.

Sunil Damodar (1993) examined 'Derivatives', particularly 'Futures', as a tool for short-term risk management. He believes that derivatives have become a vital instrument for finance managers, whose primary goal is to manage or reduce the risk in their portfolios. He stated that the overarching aspect of 'financial futures' in risk management is that these instruments are most beneficial when risk control is required in the short term, i.e., for a year or less. They are typically the cheapest and most readily available options for protecting against or benefiting from short-term price fluctuations. Their cheap execution costs make them ideal for frequent and short-term trading, allowing for more effective risk management.

Gupta (2019) investigated the impact of investor sentiment on stock market volatility in India. The study found that fund managers' sentiments are a stronger predictor of market volatility compared to actual returns. This highlights the role of psychological factors in influencing market behavior, contradicting the Efficient Market Hypothesis (EMH) which assumes that all investors act rationally based on available information (SpringerOpen).

R. Venkataramani (1994) discussed the uses and risks of derivatives. If the entire implications of derivative products are not well grasped, we may find ourselves in a perilous situation. Because derivative products are off balance sheet, they are traded more than cash market items, which suffer greatly due to their sensitivity. He brought to the attention of investors the 'Over the counter product' (OTC), which is exchanged across a bank's counters. OTC products (for example, options and futures) are tailored to a customer's specific needs and act as an ideal hedge. He stressed the use of futures as a hedge because they are inexpensive.

OBJECTIVES OF THE STUDY:
Every study has well defined objectives. Objectives determine the overall structure of any investigation. The primary goal of this research is to identify the trends, activities, and movements of the Indian stock market. The present study is based on the following objectives:

- Develop a comprehensive understanding of the stocks mentioned.

- Understanding previous and current trends in the Indian stock market.

- Analysing the movement of selected stocks in different sectors.

- Calculating the correlation, standard deviation and efficient frontier of security returns for selected stocks.

- Application of Markowitz Model of Portfolio for Calculation of Risk and Return.

RESEARCH METHODOLOGY

The study is majorly based on the secondary data available on websites of stock exchanges. Standard deviation is used to analyse the risk associated with the stock. To study whether the two selected stock move in tandem, correlation is checked. To analyse the optimal portfolio, Markowitz model is used to determine the "efficient frontier", a curve displaying the ideal portfolios with the highest projected return for a given amount of risk.

Security Returns

The return on a security is the profit or loss made on an investment over a given time period. This might come from a variety of sources. Capital appreciation is defined as an increase in the price of a security. Income production can be achieved through bond interest payments or equity dividends.

Risk and Return Relationship:

The relationship between risk and reward is an important concept. In general, greater-risk equities have the potential to provide bigger returns, and vice versa. Stocks of tiny, rising companies, for example, may have considerable return potential but are also more volatile in price. Government bonds, on the other hand, often provide lower returns while being regarded as safer investments.

Standard Deviation of Security Returns:

The standard deviation of securities return is a statistical metric used in finance to evaluate the volatility of an investment's returns. In layman's words, it indicates how much the investment's return deviates from its average return (usually calculated over a particular period). Higher standard deviation indicates a more volatile security. Returns will fluctuate more considerably around the average return, increasing the likelihood of experiencing both higher gains and larger losses. Lower standard deviation indicates a less volatile security. The returns will be closer to the average, indicating a more steady investment.

Investors use standard deviation to determine the risk level associated with a security. It enables people to comprehend the potential range of returns and make informed investing decisions. The Standard Deviation is derived using historical data. While it offers useful insights, it cannot forecast future performance with accuracy. A higher expected return typically corresponds to a bigger standard deviation. In other words, investors must often endure more volatility in order to potentially make larger rewards. When analysing standard deviation, it is useful to evaluate it in conjunction with expected return to gain a complete view of the risk-reward trade-off for a certain security.

CORRELATION COEFFICIENT BETWEEN SECURITIES RETURNS:

The correlation coefficient is another key statistic used in finance to measure the relationship between the returns of two securities. It tells us how much the returns tend to move together over time.

Positive correlation (coefficient closer to 1): Securities move in the same direction. When one security's return goes up, the other security's return also tends to go up, and vice versa.

Negative correlation (coefficient closer to -1): Securities move in opposite directions. If one security's return increases, the other security's return usually decreases.

Zero correlation (coefficient close to 0): There's no linear relationship between the returns. The movements of one security don't provide any indication of what the other security's return will be.

MARKOWITZ MODEL OF PORTFOLIO FOR CALCULATION OF RISK AND RETURN

The Markowitz model, commonly known as Modern Portfolio Theory (MPT), is a framework for designing portfolios that balance risk and reward. It assists investors in maximizing their returns for a particular level of risk tolerance.

MPT focuses on a portfolio's total risk and return rather than the characteristics of each individual investment. Diversification is critical: The model emphasizes the significance of diversification. Investors can spread their risk and potentially lower total portfolio volatility by including assets with low correlations (those whose returns do not move in lockstep).

The Efficient Frontier: The Markowitz model aids in determining the "efficient frontier", a curve displaying the ideal portfolios with the highest projected return for a given amount of risk. Investors can select a portfolio on this frontier that is appropriate for their risk tolerance.

The model performs computations based on predicted returns, standard deviations, and correlations among various assets. By analysing these criteria, investors can create portfolios that offer the best risk-adjusted return based on their personal tastes. MPT does not completely remove risk, but it can give investors with a useful tool

for making informed decisions and creating portfolios that balance prospective rewards with acceptable levels of risk.

Efficient Frontier

The efficient frontier is a pillar of Modern Portfolio Theory (MPT) and an important idea for investors looking to optimize their portfolios. Consider it as a curved line on a graph, with the x-axis representing risk (usually quantified by standard deviation) and the y-axis representing anticipated return. This frontier displays the portfolios that provide the highest predicted return for a certain level of risk or the lowest risk for a specific level of return. Portfolios that are below the frontier are deemed inefficient because they provide lower returns for the same level of risk or higher risk for the same expected return.

Diversification is the key to the efficient frontier's appeal. Investors can develop portfolios on or near the frontier by mixing assets with low correlations, which means their returns do not always move in the same direction. This allows them to obtain larger expected returns while minimizing risk. The optimal location of an investor's portfolio on the efficient frontier is determined by their risk tolerance. Risk-averse investors mays select portfolios on the left side of the frontier, which prioritize reduced risk with potentially lower returns. Risk-seeking investors, on the other hand, may lean toward the right side, hoping for potentially larger profits despite taking on more risk. The efficient frontier cannot guarantee precise outcomes, but it can serve as a helpful guide for investors. Understanding this notion allows them to make informed asset allocation decisions and create portfolios that match their risk tolerance and return expectations.

DATA ANALYSIS AND INTERPRETATION

Case 1 – Stocks having Positive Correlation

Particulars	WIPRO	INFOSYS
Periodic Returns	2.0027%	0.3654%
Standard Deviation	5.85%	6.09%
Correlation Coefficient	$r = 0.4603441$	

| Weightage of Investment in WIPRO	Weightage of Investment in INFOSYS	Return of Portfolio	Standard Deviation of Portfolio
0%	100%	0.36536%	6.09%
10.0%	90%	0.52909%	5.78%
20.0%	80%	0.69282%	5.51%
30.0%	70%	0.85655%	5.31%
40.0%	60%	1.02028%	5.17%
50.0%	50%	1.18401%	5.10% (MVP)
60.0%	40%	1.34774%	5.11%
70.0%	30%	1.51148%	5.20%
80.0%	20%	1.67521%	5.35%
90.0%;	10%	1.83894%	5.57%
100.0%	0%	2.00267%	5.85%

Efficient Frontier
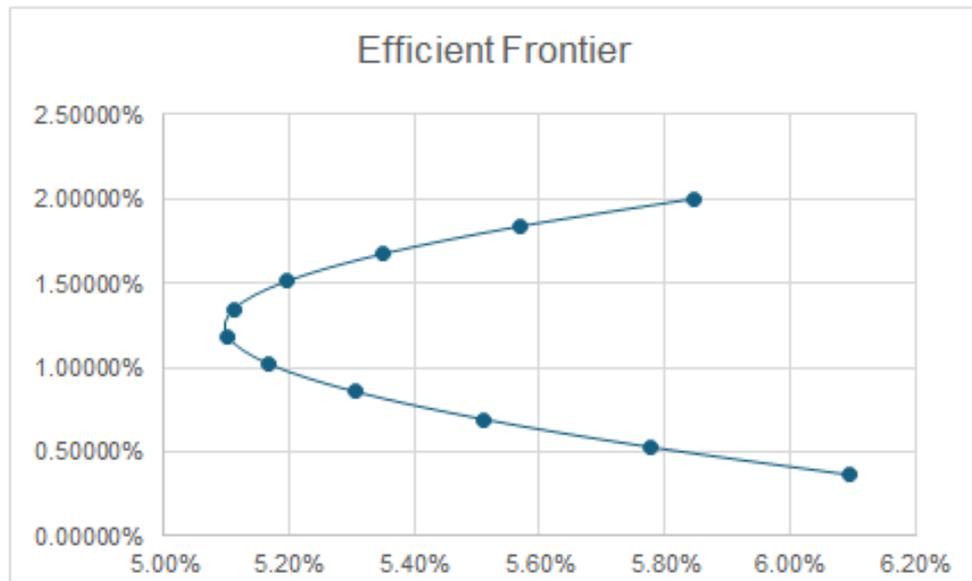
Interpretation: In the analysis of portfolios based on their returns and standard deviations relative to the Minimum Variance Portfolio (MVP), investment considerations are required to prioritize portfolios exhibiting higher returns and greater standard deviations. Portfolios demonstrating these characteristics are deemed favorable for investment. Conversely, those portfolios positioned beyond the MVP on the efficient frontier, which exhibit a backward bending pattern in the diagram, should be excluded from consideration.

Case 2

- Stocks having Close to Zero / Zero Correlation

Particulars	AMD	IRCTC
Periodic Returns	1.6933%	3.7409%
Standard Deviation	15.06%	7.43%
Correlation Coefficient	$r = 0.1363865$	

| Weightage of Investment in AMD	Weightage of Investment in IRCTC	Return of Portfolio	Standard Deviation of Portfolio
0%	100%	3.74090%	7.4317%
10.0%	90%	3.53614%	7.0535%
20.0%	80%	3.33138%	7.0214% (MVP)
30.0%	70%	3.12662%	7.3402%
40.0%	60%	2.92186%	7.9677%
50.0%	50%	2.71710%	8.8385%
60.0%	40%	2.51234%	9.8885%
70.0%	30%	2.30758%	11.0668%
80.0%	20%	2.10282%	12.3367%
90.0%	10%	1.89806%	13.6727%
100.0%	0%	1.69330%	15.0572%
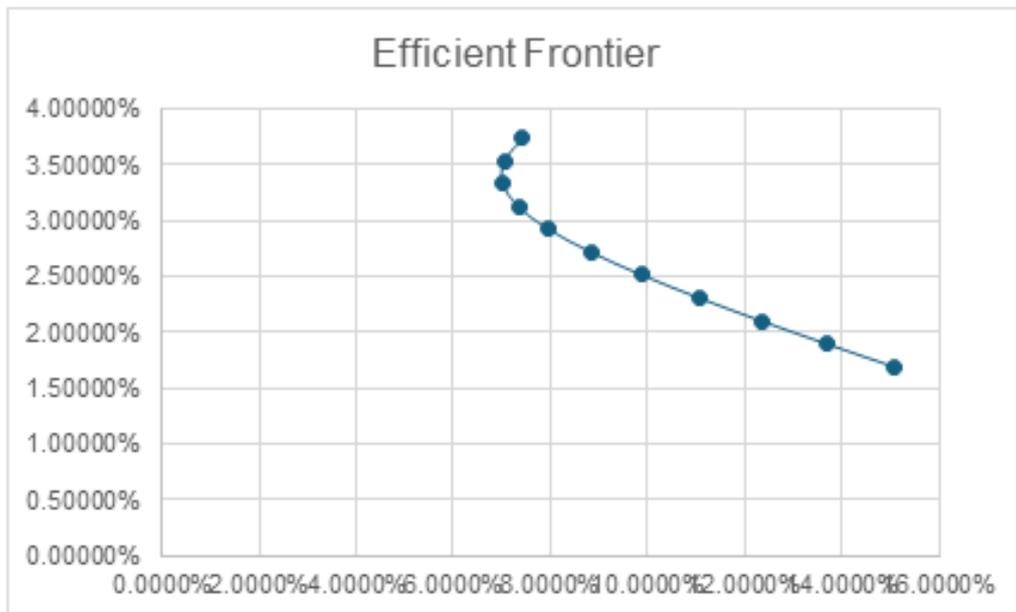
Interpretation: In the analysis of portfolios based on returns and standard deviations relative to the Minimum Variance Portfolio (MVP), investment consideration are required to be given to those portfolios exhibiting higher returns and greater standard deviations. Portfolios that fall below this criterion, particularly those situated before the MVP on the efficient frontier and displaying a backward bending pattern in the diagram, should be excluded from consideration.

Case 3 - Stocks having Negative Correlation

Particulars	ONGC	MAHENDRA
Periodic Returns	4.7641%	4.1074%
Standard Deviation	6.58%	6.37%
Correlation Coefficient	$r = -0.3170043$	

Weightage of Investment in ONGC	Weightage of Investment in Mahendra	Return of Portfolio	Standard Deviation of Portfolio
0%	100%	4.10736%	6.3720%
10.0%	90%	4.17304%	5.5615%
20.0%	80%	4.23871%	4.8441%
30.0%	70%	4.30439%	4.2671%
40.0%	60%	4.37007%	3.8936%
50.0%	50%	4.43574%	3.7842% (MVP)
60.0%	40%	4.50142%	3.9609%
70.0%	30%	4.56710%	4.3892%
80.0%	20%	4.63277%	5.0050%
90.0%	10%	4.69845%	5.7484%
100.0%	0%	4.76412%	6.5761%
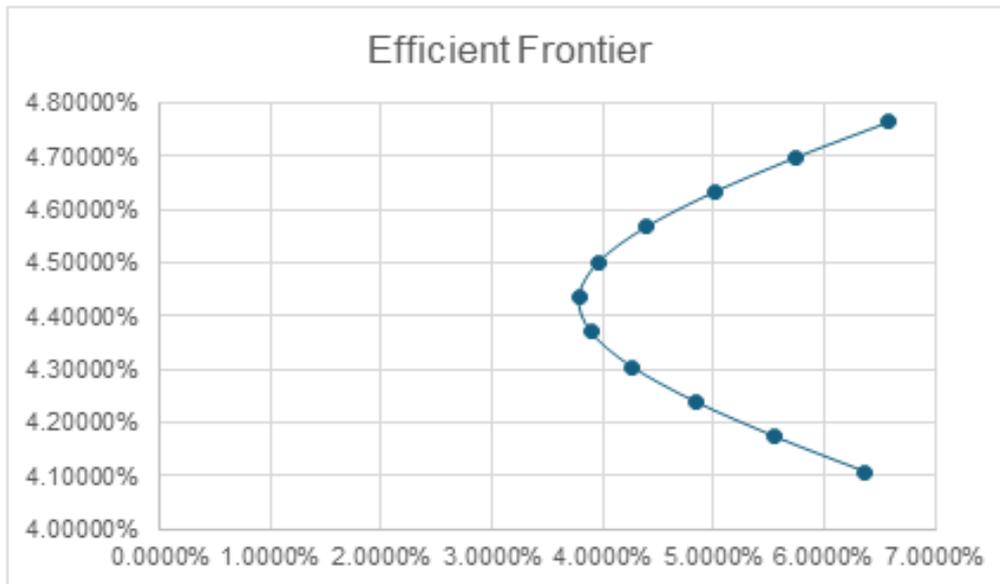
Interpretation: In the comparative analysis of portfolios based on returns and standard deviations relative to the Minimum Variance Portfolio (MVP), preference are required to be given to those portfolios that exhibit higher returns and greater standard deviations. Portfolios that do not meet these criteria should be excluded from investment consideration. Specifically, portfolios that are positioned after the MVP on the efficient frontier and demonstrate a backward bending pattern in the diagram should be rejected.

CONCLUSION

In concluding this research paper on the correlation of stocks in the Indian stock market, the movement of stocks, and the utilization of historical data, several key findings emerge that collectively advance our understanding of the dynamics of Indian financial markets. The study synthesizes various analytical perspectives and methodologies that point towards nuanced insights into stock market behaviours, efficiency, and predictive capabilities.

While the Indian stock market presents complex, multifaceted phenomena influenced by a range of local and global factors, through meticulous analysis of patterns, sentiment, and historical data, stakeholders can better navigate and benefit from its opportunities. Future studies may expand upon these insights by incorporating more granular data, longer time horizons, and advanced computational techniques to continually refine the predictive accuracy and practical relevance of financial market analysis.

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