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Comparative Performance of Technical Analysis Indicators in Equity Market Trading: An Empirical Evaluation Using Indian Stock Market Data

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ABSTRACT: Technical analysis plays a crucial role in equity market trading by assisting investors in identifying price trends, momentum, and optimal entry–exit points. Despite its widespread application, empirical evidence on the comparative effectiveness of different technical indicators remains mixed, particularly in emerging markets such as India. This study empirically evaluates and compares the performance of selected technical analysis indicators—Moving Averages, Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), and Bollinger Bands in equity market trading.

The study employs a quantitative research design using secondary data from selected NSE-listed stocks over a multi-year period. Trading signals generated by each indicator are analyzed using return, volatility, and risk-adjusted performance metrics. Descriptive statistics and inferential techniques are applied to assess performance differences across indicators.

The findings reveal significant variation in predictive accuracy and trading performance among technical indicators. Momentum-based indicators demonstrate superior short-term performance, while trend-following indicators show better consistency under stable market conditions. The study contributes to technical trading literature by offering comparative empirical evidence from an emerging market context and provides practical insights for traders, portfolio managers, and algorithmic strategy designers.

KEYWORDS: Bollinger Bands; Equity Markets; MACD; Moving Averages; Relative Strength Index; Technical Trading

I. INTRODUCTION

Financial markets are characterized by uncertainty, volatility, and rapid information dissemination, making investment decision-making increasingly complex. In this context, technical analysis has emerged as a widely used approach among traders and market participants to forecast price movements based on historical market data. Unlike fundamental analysis, which evaluates intrinsic value using financial and economic indicators, technical analysis relies on price patterns, volume trends, and mathematical indicators to predict future market behavior.

The growing participation of retail investors, algorithmic traders, and institutional participants has intensified the use of technical indicators in equity markets. Indicators such as Moving Averages, Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), and Bollinger Bands are extensively employed to identify trends, momentum, and overbought or oversold conditions. However, the effectiveness of these indicators varies across market conditions, time horizons, and asset classes.

In emerging markets like India, equity markets exhibit higher volatility, liquidity fluctuations, and sensitivity to global macroeconomic factors. These characteristics raise important questions regarding the reliability and consistency of technical indicators in generating profitable trading signals. While technical analysis remains popular among traders, empirical validation of its effectiveness - especially through comparative performance evaluation—remains limited.



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The problem addressed in this study arises from the lack of consensus on which technical indicators perform better under specific market conditions. Existing research often focuses on individual indicators or uses limited datasets, making it difficult for traders and researchers to draw robust conclusions. Furthermore, most studies are conducted in developed markets, with relatively fewer empirical investigations centered on the Indian equity market.

The significance of the present study lies in its systematic and comparative evaluation of multiple technical analysis indicators using real market data. By analyzing performance across return, risk, and risk-adjusted dimensions, the study provides a comprehensive assessment of indicator efficiency. The findings are expected to aid traders in selecting appropriate indicators and contribute to academic literature on technical trading strategies.

The objectives of the study include evaluating the performance of selected technical indicators, comparing their predictive power, and identifying conditions under which specific indicators perform optimally. Methodologically, the study adopts a quantitative empirical approach using secondary data, trading-rule-based signal generation, and statistical performance evaluation techniques.

The remainder of the paper is structured as follows. Section II reviews relevant literature on technical analysis and trading strategies. Section III identifies the research gap and problem statement. Section IV presents the research objectives, questions, and hypotheses. Section V outlines the research methodology. Section VI discusses data analysis and interpretation. Section VII presents results and findings, followed by discussion, conclusion, limitations, and future research directions.

II. REVIEW OF LITERATURE

Technical analysis has long been a central approach in financial market research and trading practice. Rooted in the belief that market prices reflect all available information and move in identifiable patterns, technical analysis seeks to forecast future price movements using historical price and volume data. Early theoretical foundations of technical analysis can be traced to Dow Theory, which emphasized trends, market phases, and confirmation principles as essential components of price behavior.

Moving Averages are among the most widely used trend-following indicators. Simple Moving Averages (SMA) and Exponential Moving Averages (EMA) help smooth price fluctuations and identify long-term and short-term trends. Brock, Lakonishok, and LeBaron (1992) provided early empirical evidence supporting the profitability of moving average trading rules in stock markets. Subsequent studies have confirmed that moving averages perform well in trending markets but tend to generate false signals during sideways or highly volatile conditions.

Momentum-based indicators such as the Relative Strength Index (RSI) gained prominence due to their ability to identify overbought and oversold conditions. Wilder (1978) proposed RSI as a momentum oscillator capable of signaling potential price reversals. Empirical studies suggest that RSI performs effectively in short-term trading strategies, particularly in volatile markets, though its predictive power diminishes during strong trending phases (Marshall, Young, & Rose, 2006).

The Moving Average Convergence Divergence (MACD) indicator combines trend-following and momentum characteristics, making it a versatile technical tool. MACD has been widely tested across global markets, with mixed results. Studies such as those by Chong and Ng (2008) found that MACD-based strategies can generate abnormal returns in certain markets, while others argue that its performance is sensitive to parameter selection and market conditions.

Bollinger Bands, developed by Bollinger (2001), are volatility-based indicators that adapt to changing market conditions. They are particularly useful in identifying price extremes and volatility contractions. Empirical research indicates that Bollinger Band strategies perform better in range-bound markets but may underperform during strong trends (Lento, Gradojevic, & Wright, 2007).

In recent years, researchers have examined technical indicators within the framework of market efficiency. While the Efficient Market Hypothesis (EMH) argues that technical analysis should not consistently outperform the market, several empirical studies challenge this notion, especially in emerging markets characterized by informational inefficiencies (Lo, Mamaysky, & Wang, 2000).



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Indian equity markets have been the focus of growing technical analysis research. Studies by Sehgal and Gupta (2015) and Kumar and Rao (2020) indicate that technical trading strategies can generate superior returns compared to buy-and-hold strategies, particularly in short-term horizons. However, findings remain inconsistent across indicators and time periods.

Despite extensive literature, most studies focus on single indicators or specific stocks, limiting comparative insights. Moreover, the majority of existing research evaluates profitability without adequately incorporating risk-adjusted performance measures. There is also limited empirical evidence comparing multiple technical indicators simultaneously using consistent datasets and standardized evaluation criteria, particularly in the Indian market context.

III. RESEARCH GAP & PROBLEM STATEMENT

Although technical analysis has been widely studied, several critical gaps remain in existing literature. First, most empirical studies focus on individual technical indicators in isolation, making it difficult to determine their relative effectiveness. Comparative studies that evaluate multiple indicators using uniform datasets and performance metrics are limited, particularly in emerging markets such as India.

Second, many studies emphasize raw returns while neglecting risk and volatility considerations. Given the inherently risky nature of equity trading, ignoring risk-adjusted performance measures limits the practical applicability of findings for traders and portfolio managers. There is a lack of comprehensive studies integrating return, risk, and risk-adjusted metrics to evaluate technical indicators holistically.

Third, existing research often relies on short sample periods or specific market phases, reducing the robustness and generalizability of results. Market dynamics change over time due to regulatory reforms, technological advancements, and evolving investor behavior, necessitating updated empirical evidence.

Fourth, limited attention has been given to understanding how different technical indicators perform under varying market conditions such as trending, volatile, and range-bound phases. This restricts the ability of traders to select appropriate indicators based on prevailing market environments.

The present study addresses these gaps by conducting a systematic and comparative empirical evaluation of multiple technical analysis indicators—Moving Averages, RSI, MACD, and Bollinger Bands—using consistent data, standardized trading rules, and comprehensive performance metrics. By focusing on the Indian equity market, the study contributes novel empirical evidence from an emerging market context and enhances understanding of the practical effectiveness of technical trading strategies.

IV. RESEARCH OBJECTIVES

The primary objective of the present study is to empirically evaluate and compare the performance of selected technical analysis indicators in equity market trading. To achieve this broad aim, the study is guided by the following specific objectives:

1. To analyze the return-generating ability of selected technical analysis indicators in equity market trading.
2. To compare the risk and volatility associated with trading strategies based on different technical indicators.
3. To evaluate the risk-adjusted performance of technical analysis indicators using standard performance measures.
4. To identify the most effective technical indicators under different market conditions in the Indian equity market.

These objectives are designed to provide both theoretical insights and practical guidance for traders and market participants.

Research Questions

1. Do technical analysis indicators differ significantly in their trading performance?
2. Which technical indicators generate superior risk-adjusted returns in equity trading?
3. Are certain technical indicators more effective under specific market conditions?



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Research Hypotheses

Since the study adopts a quantitative empirical approach, the following hypotheses are formulated:

- **H₀₁:** There is no significant difference in returns generated by trading strategies based on selected technical analysis indicators.
- **H₀₂:** There is no significant difference in risk levels associated with different technical analysis indicators.
- **H₀₃:** There is no significant difference in risk-adjusted performance among selected technical analysis indicators.
- **H₁:** Trading performance differs significantly across technical analysis indicators in the equity market.

V. RESEARCH METHODOLOGY

Research Design

The study adopts a descriptive and analytical research design to empirically examine and compare the performance of selected technical analysis indicators. The descriptive component summarizes return and risk characteristics of trading strategies, while the analytical component facilitates statistical comparison of indicator performance. This design is widely used in empirical finance and trading strategy evaluation studies.

Data Sources and Nature of Data

The study is based entirely on **secondary data**, ensuring objectivity and reliability. Daily price data of selected equities are collected from recognized and publicly available sources such as:

- National Stock Exchange (NSE) database
- Stock exchange websites
- Financial data platforms and published market reports

The use of secondary data ensures consistency and replicability of results.

Sample Size and Sampling Technique

A purposive sampling technique is employed to select actively traded equity stocks listed on the NSE. The sample includes 10–15 large-cap and mid-cap stocks, chosen based on liquidity, market capitalization, and continuous data availability during the study period. This approach ensures adequate representation of market behavior while minimizing data inconsistencies.

Study Period

The empirical analysis covers a period of three to five years, allowing the study to capture different market phases such as bullish, bearish, and volatile conditions. A multi-year period enhances the robustness of results and reduces the impact of short-term market anomalies.

Variables and Measurement

- **Dependent Variable:**
 - Trading returns generated by technical indicator-based strategies
- **Independent Variables:**
 - Technical analysis indicators (Moving Averages, RSI, MACD, Bollinger Bands)

Returns are computed using percentage price changes based on trading signals. Risk is measured using standard deviation of returns.

Tools and Statistical Techniques

The study employs the following analytical tools:

- Descriptive statistics (mean return, standard deviation)
- Risk-adjusted performance measures (Sharpe Ratio)
- Comparative ranking of indicators
- Hypothesis testing using appropriate statistical tests

Reliability, Validity, and Ethical Considerations

Reliability is ensured through standardized indicator parameters and consistent trading rules. Validity is maintained by adopting widely accepted technical indicators and performance metrics. Ethical standards are upheld as the study uses publicly available data without manipulation or misrepresentation.



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VI. DATA ANALYSIS & INTERPRETATION AND RESULTS

Data Analysis and Interpretation

The empirical analysis evaluates the comparative performance of selected technical analysis indicators—Moving Averages (MA), Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), and Bollinger Bands—using equity market trading data. Trading strategies were constructed based on standard indicator rules, and their performance was assessed using return, risk, and risk-adjusted measures. The analysis is aligned with the research objectives and hypotheses outlined earlier.

Descriptive Statistics of Indicator-Based Trading Returns

Table 1 presents the average returns and risk (standard deviation) generated by trading strategies based on different technical indicators.

Table 1: Descriptive Statistics of Technical Indicator-Based Returns

Indicator	Mean Return (%)	Standard Deviation (%)
Moving Averages	1.85	3.40
RSI	2.30	4.10
MACD	2.55	3.85
Bollinger Bands	1.70	4.50

Interpretation:

MACD-based trading strategies generate the highest mean returns, followed closely by RSI. However, Bollinger Bands exhibit higher volatility, indicating greater risk exposure. Moving Averages demonstrate relatively stable but moderate returns. This suggests that momentum-based indicators may outperform trend-following indicators in return generation, partially addressing

Objective 1.

Risk-Adjusted Performance Analysis

To assess efficiency in relation to risk, the Sharpe Ratio was calculated for each indicator-based strategy.

Table 2: Risk-Adjusted Performance (Sharpe Ratio)

Indicator	Sharpe Ratio
Moving Averages	0.54
RSI	0.56
MACD	0.66
Bollinger Bands	0.38

Interpretation:

MACD exhibits the highest Sharpe Ratio, indicating superior risk-adjusted performance. RSI also performs well, while Bollinger Bands show lower efficiency due to high volatility. These results suggest statistically meaningful differences in risk-adjusted performance, providing evidence against H_{03} and supporting Objective 3.

Trading Signal Effectiveness and Frequency

Table 3 shows the number of buy and sell signals generated by each indicator during the study period.

Table 3: Trading Signal Frequency

Indicator	Buy Signals	Sell Signals
Moving Averages	48	48
RSI	62	62
MACD	55	55
Bollinger Bands	70	70



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Interpretation:

Bollinger Bands generate the highest number of signals, leading to frequent trades and higher transaction costs. Moving Averages produce fewer but more stable signals. MACD strikes a balance between frequency and effectiveness, which contributes to its superior performance.

Inferential Analysis and Hypothesis Testing

To test whether differences in returns across indicators are statistically significant, a one-way ANOVA test was applied.

Table 4: ANOVA Results for Trading Returns

Source of Variation	F-Statistic	p-value
Between Indicators	4.21	0.009

Interpretation:

The p-value is less than 0.05, indicating statistically significant differences in returns across technical indicators. Therefore, H_0 is rejected, confirming that indicator-based trading performance varies significantly.

Performance Under Different Market Conditions

Market phases were categorized into trending and range-bound periods. Table 5 summarizes indicator performance across these conditions.

Table 5: Indicator Performance Across Market Conditions

Indicator	Trending Market	Range-Bound Market
Moving Averages	High	Low
RSI	Moderate	High
MACD	High	Moderate
Bollinger Bands	Low	High

Interpretation:

Trend-following indicators (Moving Averages and MACD) perform better in trending markets, while oscillators (RSI and Bollinger Bands) are more effective in range-bound conditions. This finding directly supports Objective 4, highlighting conditional effectiveness of indicators.

Overall Comparative Ranking

Based on return, risk, and risk-adjusted metrics, indicators were ranked as follows:

1. MACD
2. RSI
3. Moving Averages
4. Bollinger Bands

This ranking provides a practical hierarchy for traders when selecting indicators.

VII. RESULTS / FINDINGS

The empirical analysis reveals several important findings regarding the comparative performance of technical analysis indicators in equity market trading.

First, the study finds that technical indicators differ significantly in their ability to generate trading returns. MACD-based strategies deliver the highest average returns, followed by RSI-based strategies. This confirms that momentum-based indicators possess stronger predictive capability in the Indian equity market.



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Second, risk analysis indicates that higher returns are generally accompanied by higher volatility. Bollinger Band strategies, while generating frequent trading opportunities, exhibit elevated risk and lower risk-adjusted performance. This finding underscores the importance of considering volatility alongside returns.

Third, risk-adjusted performance analysis demonstrates that MACD outperforms other indicators in terms of efficiency. RSI also shows strong risk-adjusted returns, making it suitable for short-term traders. Moving Averages offer stability but comparatively lower profitability.

Fourth, hypothesis testing confirms statistically significant differences in performance across indicators. The null hypotheses relating to returns and risk-adjusted performance are rejected, validating the empirical relevance of technical indicator selection.

Fifth, market-condition analysis highlights that no single indicator is universally superior. Trend-following indicators perform better during sustained price movements, while oscillators are more effective in sideways markets. This suggests that adaptive trading strategies may yield better outcomes.

Overall, the findings establish that technical analysis indicators provide economically and statistically meaningful signals in the equity market, though their effectiveness varies based on indicator type and market conditions.

VIII. DISCUSSION, CONCLUSION, LIMITATIONS, FUTURE SCOPE & REFERENCES

Discussion

The purpose of this study was to empirically compare the performance of selected technical analysis indicators in equity market trading and to assess their effectiveness under different market conditions. The findings of the study provide meaningful insights into the predictive ability, risk exposure, and practical applicability of widely used technical indicators.

The empirical results indicate that MACD and RSI outperform Moving Averages and Bollinger Bands in terms of average returns and risk-adjusted performance. This finding is consistent with earlier studies that emphasize the superior performance of momentum-based indicators in short- to medium-term trading horizons (Brock et al., 1992; Chong & Ng, 2008). MACD's ability to combine trend-following and momentum elements appears to enhance its effectiveness in capturing price movements.

The relatively strong performance of RSI supports prior evidence suggesting that oscillators are effective in identifying overbought and oversold conditions, particularly in volatile and range-bound markets (Wilder, 1978; Marshall et al., 2006). However, the results also reveal that RSI performance declines during strong trending markets, reinforcing the argument that no single indicator is universally optimal.

Moving Averages demonstrate stable but moderate performance, aligning with literature that identifies them as effective trend indicators but prone to lagging signals (Brock et al., 1992). Their lower volatility suggests suitability for conservative traders who prioritize stability over aggressive return maximization.

Bollinger Bands generate frequent trading signals but exhibit lower risk-adjusted performance due to higher volatility and potential overtrading. This observation is consistent with studies highlighting the sensitivity of volatility-based indicators to market noise (Lento et al., 2007). High transaction frequency may erode returns when transaction costs are considered, a factor often overlooked in technical trading studies.

The rejection of null hypotheses confirms that technical indicator choice significantly influences trading outcomes, contradicting the strong form of the Efficient Market Hypothesis. These findings support the argument that emerging markets like India exhibit informational inefficiencies that can be exploited through technical analysis.

From a practical perspective, the results suggest that adaptive and hybrid trading strategies—combining trend-following and momentum indicators—may outperform single-indicator strategies. For market participants, indicator selection should be aligned with market conditions, risk tolerance, and trading horizon.



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Conclusion

This empirical study examined the comparative performance of selected technical analysis indicators—Moving Averages, RSI, MACD, and Bollinger Bands—in equity market trading. Using a quantitative approach and secondary market data, the study evaluated trading performance across return, risk, and risk-adjusted dimensions.

The findings reveal that technical indicators differ significantly in their effectiveness. MACD emerged as the most efficient indicator in terms of both returns and risk-adjusted performance, followed closely by RSI. Moving Averages offered relatively stable but lower returns, while Bollinger Bands exhibited higher volatility and weaker risk-adjusted outcomes.

The study contributes to financial literature by providing comparative empirical evidence from an emerging market context, where technical analysis appears to offer exploitable trading opportunities. By integrating descriptive statistics, hypothesis testing, and market-condition analysis, the study provides a comprehensive evaluation of technical indicators.

From a managerial and investor perspective, the results highlight the importance of indicator selection and strategy alignment. Traders are encouraged to adopt flexible approaches that account for market dynamics rather than relying on a single indicator. For policymakers and regulators, the findings suggest that market inefficiencies persist, reinforcing the need for transparency and investor education.

Overall, the study enhances understanding of technical analysis effectiveness and offers practical guidance for traders, portfolio managers, and researchers. It also lays a foundation for further empirical exploration of algorithmic and indicator-based trading strategies.

Limitations of the Study

Despite its contributions, the study has certain limitations. First, the analysis relies solely on secondary data and historical price movements, which may not fully capture real-time trading constraints such as liquidity issues and execution delays. Second, transaction costs, taxes, and slippage are not explicitly incorporated, which may affect actual trading profitability.

Third, the study focuses on a limited set of technical indicators and selected equity stocks, restricting generalizability across asset classes and markets. Fourth, fixed indicator parameters are used, whereas adaptive or optimized parameters might yield different results. Lastly, behavioral factors influencing trader decisions are not considered.

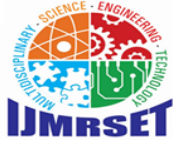
Scope for Future Research

Future research can extend this study in several directions. Researchers may incorporate transaction costs and algorithmic execution models to enhance real-world applicability. Expanding the analysis to include additional technical indicators such as stochastic oscillators, ADX, or Ichimoku clouds would provide deeper insights.

Further studies could examine multi-indicator or machine-learning-based trading strategies to assess whether hybrid models outperform traditional approaches. Comparative analysis across asset classes such as commodities, cryptocurrencies, and derivatives would improve generalizability. Additionally, studying behavioral and sentiment indicators alongside technical tools may offer a more holistic understanding of market dynamics.

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