INVESTIGATING THE EFFICACY OF RSI IN THE NIFTY 50 INDEX

by

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Dedication

To all those who are facing the challenges of incurable genetic disorders, this work is dedicated to you. Your courage, strength, and resilience in the face of adversity have been a constant source of inspiration for me. You have shown that no matter what obstacles we may face in life, it is possible to keep going and pursue our dreams.

This doctoral degree is a personal testament to the power of perseverance and determination. I hope that it serves as a symbol of hope and motivation for those who are struggling with similar difficulties. May it encourage you to reclaim your confidence, self-esteem, and empower you to make a difference in the world.

I dedicate this work to all of you, and to the memories of those who may have lost their fight. May your courage and spirit live on and continue to inspire future generations."

Acknowledgements

I am deeply grateful to the following individuals who have helped me along my academic journey, especially in the face of my incurable genetic disorder, Retinitis Pigmentosa.

First and foremost, I want to express my sincere gratitude to my mother, Mrs. Jyoti Bansal, who was my rock and motivator during this difficult time. Her unwavering support and encouragement were invaluable in helping me transition to a new career in finance. I am also grateful to my brother, Mr. Jai Bansal, for being a wonderful sibling and taking on additional responsibilities after my diagnosis. I thank my father, Mr. Sant Kumar Bansal, who taught me the importance of resilience and survival, which have been crucial in helping me overcome this challenge. I also want to extend a heartfelt thank you to my friends Kusum, Rahul, Sahil, Vishal and Yogiraj for their laughter, support, and unwavering positivity, which have helped keep me mentally intact.

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Thank you all for being a part of my journey and helping me achieve this monumental accomplishment.

ABSTRACT

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By

SAGAR BANSAL,
2023

Dissertation Chair: <Chair's Name>
Co-Chair: <If applicable. Co-Chair's Name>

This dissertation evaluates the effectiveness of the Relative Strength Index (RSI) in the NIFTY 50 index in the Indian stock market. The study compares RSI's performance to a Buy and Hold strategy using historical data analysis, simulation, and statistical analysis on data from 2000 to 2021. Results show that RSI can identify potential trading opportunities but its success depends on specific settings. 33 RSI strategies were analyzed with positive returns seen when used for buy decisions in divergence scenarios. The RSI outperformed a Buy and Hold strategy in average return, maximum potential, and stability, but the choice of settings such as the period and RSI threshold levels are crucial. The industry's popular RSI(14,30/70) strategy resulted in negative returns. The study has limitations in terms of data and methodology and its results may not be generalizable to other assets. The study highlights the importance of appropriate settings

and risk management techniques in using RSI as a trading signal. Future research opportunities include expanding the data set and considering transaction costs.

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INTRODUCTION

Chapter 1 provides an overview of the Indian stock market and the increasing interest among traders and investors. It also highlights the need for financial analysis and outlines the problems with the practice of technical analysis in the Indian context. Finally, the chapter provides an overview of the research problem and the objectives along with the significance of the study.

1.1 Overview

With a population of over 1.41 billion people (World Bank, 2021), India offers vast opportunities for investors. “In a world that is currently starved of growth, the opportunity set in India must be on global investors’ radar,” (Ahya, 2022).

India attracted the highest Foreign Direct Investment (FDI) inflow of $83.57 bn during the financial year 2021-22 (Invest India, 2021) and it’s economy is projected to grow at 6.6% in 2023 (World Bank, 2022). India will surpass Japan and Germany by 2027 and become the third-largest stock market in the world by the end of 2030 (Desai, 2022)

Currently there are 7 active exchanges in India (Securities and Exchange Board of India, 2022)

Sr. No.	Exchange	Recognition Valid Upto	Segments Permitted

1	BSE Ltd.	PERMANENT	a. Equity b. Equity Derivatives c. Currency Derivatives (including Interest Rate Derivatives) d. Commodity Derivatives e. Debt
2	Calcutta Stock Exchange Ltd.	PERMANENT	-
3	Metropolitan Stock Exchange of India Ltd.	Sep 15, 2023	a. Equity b. Equity Derivatives c. Currency Derivatives (including Interest Rate Futures) d. Debt
4	Multi Commodity Exchange of India Ltd.	PERMANENT	a. Commodity Derivatives
5	National Commodity & Derivatives Exchange Ltd.	PERMANENT	a. Commodity Derivatives
6	Indian Commodity Exchange Limited	PERMANENT	-
7	National Stock Exchange of India Ltd.	PERMANENT	a. Equity b. Equity Derivatives c. Currency Derivatives (including Interest Rate Derivatives) d. Commodity Derivatives e. Debt

Table 1.1a: List of active exchanges in India As of 2023 (Source: Securities and Exchange Board of India, 2022)

The National Stock Exchange of India (NSE) is the biggest stock exchange in India and was ranked Number 9 in Aug 2021 and Number 8 in Sep 2022 in the world for it's Market Capitalization (refer table 1.1b and 1.1c).

Rank	Stock Exchange	Region	Market Cap (Aug 2021)	%age Change (Aug 2020 to Aug 2021)
1	NYSE	Americas	26,636,745.85	35.20%
2	Nasdaq - US	Americas	23,464,726.09	36.00%
3	Shanghai Stock Exchange	APAC	7,633,201.37	20.60%
4	Euronext	EMEA	7,327,740.72	59.10%

5	Japan Exchange Group	APAC	6,789,752.83	13.50%
6	Hong Kong Exchanges and Clearing	APAC	6,016,055.08	9.10%
7	Shenzhen Stock Exchange	APAC	5,736,569.14	20.40%
8	LSE Group London Stock Exchange	EMEA	3,834,675.78	10.50%
9	National Stock Exchange of India	APAC	3,403,404.75	63.70%

Table 1.1b: Top 9 Stock Exchanges By Market Capitalization as of Aug 2021 (Source: The World Federation of Exchanges, 2021)

Rank	Stock Exchange	Region	Market Cap (Sep 2022)	%age Change (Sep 2021 to Sep 2022)
1	NYSE	Americas	23,752,490.91	-8.70%
2	Nasdaq - US	Americas	16,591,116.86	-25.70%
3	Shanghai Stock Exchange	APAC	6,328,080.59	-18.40%
4	Euronext	EMEA	5,075,791.59	-27.80%
5	Japan Exchange Group	APAC	4,756,464.29	-31.40%
6	Shenzhen Stock Exchange	APAC	4,352,863.16	-23.50%
7	Hong Kong Exchanges and Clearing	APAC	3,927,028.26	-30.80%
8	National Stock Exchange of India	APAC	3,309,714.63	-4.90%

Table 1.1c: Top 8 Stock Exchanges By Market Capitalization as of Sep 2022 (Source: The World Federation of Exchanges, 2022)

Aug 2021, NSE recorded a yearly percentage change of 63.70% which was the highest in all top 9 stock exchanges (refer to table 1.1a). In Sep 2022, NSE recorded a yearly percentage change of (-4.90%) which was the lowest in all top 8 stock exchanges (refer to table 1.2b). This shows that NSE is the best-performing stock exchange in the last two years.

Rank	Derivative Exchange	Region	Volume (Nov 2022)
1	National Stock Exchange of India	APAC	3,666,015,197
2	B3	Americas	728,213,200
3	Zhengzhou Commodity Exchange	APAC	262,764,666
4	Chicago Mercantile Exchange	Americas	255,190,400
5	Borsa Istanbul	EMEA	252,975,992

Table 1.1d: Top 5 Derivative Exchanges By Volume as of Nov 2022 (Source: Futures Industry Association, 2022)

NSE is also the world's biggest derivative exchange with the trade volume more than five times of the second-ranked exchange - B3 (refer table 1.1d)

The NIFTY 50 is the flagship index on the National Stock Exchange of India Ltd. and it accounts for 50 Key Stocks from 14 sectors of the Indian economy. It is used for various purposes such as benchmarking fund portfolios, index-based derivatives, and index funds. (NSE India, 2022)

1.2 Research Problem

In recent years, retail investors are more attracted to the stock market as it requires small capital and has easy access (Talwar, Shah & Shah 2019). The market capitalization of NIFTY 50 has shown drastic growth since its existence. Especially the recovery after the COVID-19 crash is significant (refer Figure 1.2a)

Figure 1.2a: Growth of NIFTY 50 Index from 1996 to 2022 (Source: NSE India, 2022)

The volume snapshot of NIFTY 50 when studied along with the market price movement clearly shows the growing interest of people in recent years. Nifty grew from 7610 on March 2020 to 18477 in October 2021 which is a 143% growth. The peak volume in this period was as high as 1.8 Billion as recorded in March 2020 (refer Figure 1.2b)

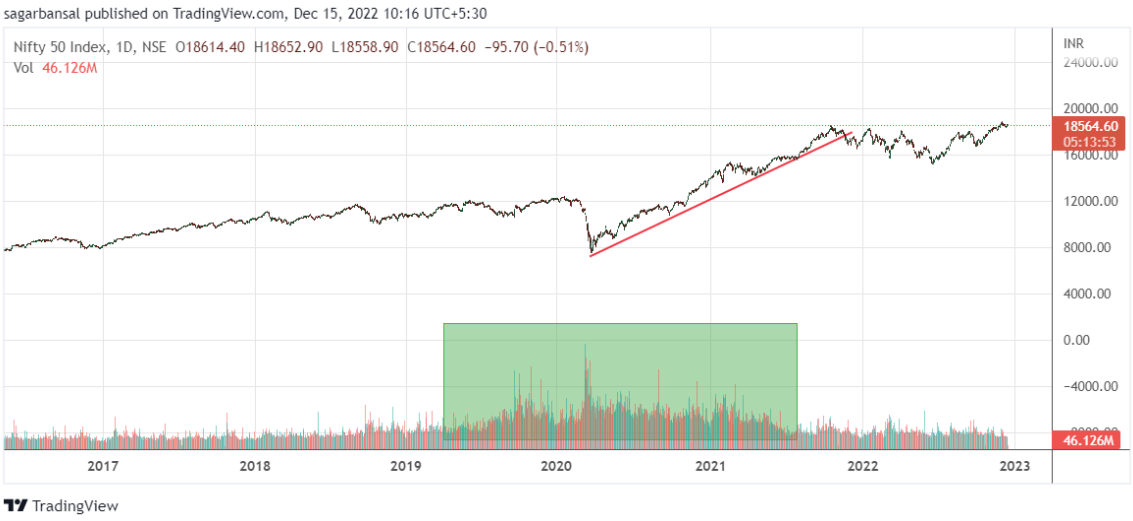

Figure 1.2b: Increased Volume on NIFTY 50 Index from 2019 to 2022 (Source: Analysis by the Author using the TradingView Charting Platform)

Similar results can be seen in the searches done by people on search engines like google as Google Trends reported the interest index as 11 out of 100 in April 2019 compared to 61 out of 100 in April 2022 (refer Figure 1.2c)

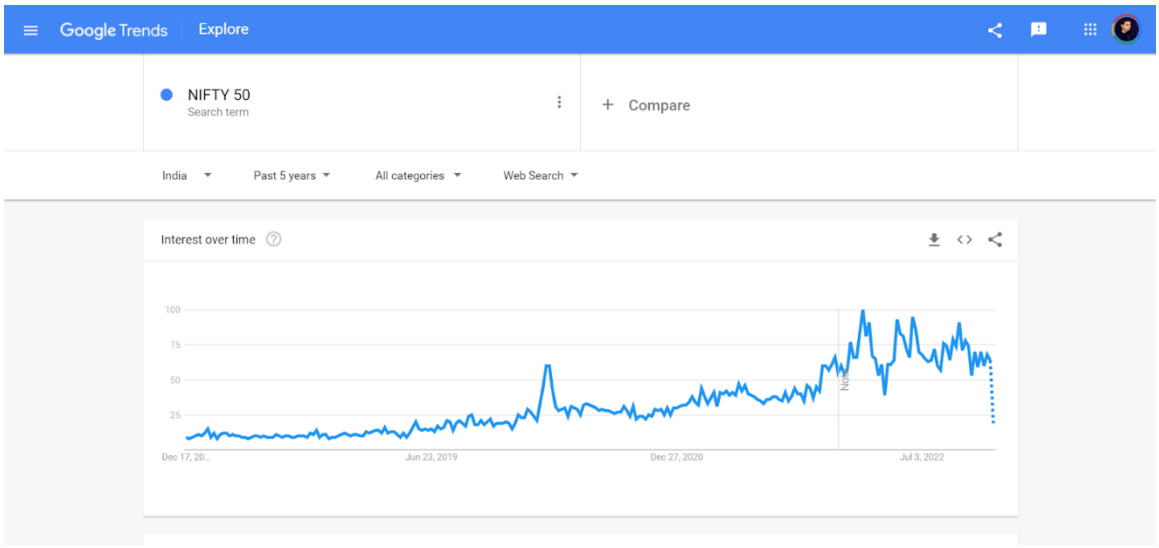

Figure 1.2c: Increased Interest Index for Search Term "NIFTY 50" from 2019 to 2022. (Source: Observation by Author using Google Trends)

The stock market remains volatile and choosing the right stocks at the right time can be challenging for investors (Gumparthi, 2017). This is why fundamental and technical analysis can be useful for evaluating the intrinsic value of a stock (Petrusheva and Jordanoski, 2016) and predicting future trends (Chen, 2010). However, the lack of knowledge in these areas can lead to losses for small Indian investors (Mahajan, 2015), making financial asset management critical for successful investing

It has been observed that some tools and indicators are pretty accurate for certain stocks whereas they are quite ineffective for others. That's why it is essential to identify which indicator works best for a particular stock (Talwar, Shah & Shah, 2019).

In developing markets like India, the use of technical analysis by investors is limited to the use of standard MACD and other indicators developed by respective technicians (Mahajan, 2015)

The Relative Strength Index (RSI) is a popular indicator that measures the relative strength of a security's price and oscillates on a scale of 0 to 100 (Chong & Ng, 2008) but It has been rarely used by Indian investors (Gumparthi, 2017).

RSI has been used widely in stock markets around the world such as the Asian Market by Wong, Manzur & Chew (2003), European Market by Chong & Ng (2008), OECD Markets by Chong, Ng & Liew (2014), and the Australian Stock Market by Mohd Nor and Wickremasinghe (2014) but has always been neglected in the Indian stock market (Dixit, 2020). One of the prominent reasons is the lack of knowledge on how to use the RSI indicator (Gumparthi, 2017).

The existing studies on the use of RSI in the Indian market (Jain, 2014; Mahajan, 2015; Gumparthi, 2017; Talwar, Shah & Shah, 2019; Kishori & Divya, 2020) suffer from limitations such as small sample sizes, limited time periods, and lack of statistical evidence. Moreover, the studies provide mixed results on the reliability and consistency of RSI in predicting stock price movements.

This highlights the need for in-depth research on the use of RSI in the Indian market that addresses these limitations and provides a comprehensive understanding of its effectiveness in the Indian stock market

1.3 Research Question and It's Objectives

The research is focused on answering the question: How does RSI as a trading signal perform in NIFTY 50 Index agianst a Buy and Hold strategy?

Hence the goal of this study is to evaluate the performance of the Relative Strength Index (RSI) for the NIFTY 50 index, compared to a Buy and Hold strategy.

In order to achieve this goal, the study will focus on three objectives:

1. To analyze the price movement of the NIFTY 50 index and establish a reliable baseline for future comparisons through a Buy and Hold return calculation.
2. To gather performance data by reapplying technical analysis strategies based on RSI from past studies and collecting statistical results.
3. To offer valuable insights and recommendations for traders and investors in regards to using RSI as an indicator for the NIFTY 50 index.

1.4 Significance of the Study

This research is crucial in addressing the lack of information on the use of RSI in the Indian stock market. It examines the efficacy of the RSI on the NIFTY 50 index, yielding a thorough understanding of its relevance in India.

By gauging the performance of the NIFTY 50 Index, the study establishes a robust benchmark return for the Buy and Hold strategy, beneficial for financial decision-making and statistical comparisons.

The research also re-evaluates previous studies on RSI and assesses their results for the NIFTY 50 index, providing insights into the usefulness of RSI in trading and investing.

The study offers valuable insights into the utilization of RSI for NIFTY 50, including the performance of various RSI strategies and their related risks and limitations. This can potentially lead to enhanced market returns and financial success for traders and investors

1.5 Chapter Summary

The stock market of India presents a vast opportunity for investors, with the economy projected to grow at 6.6% and attract a high Foreign Direct Investment (FDI) inflow. The NIFTY 50 index is the flagship index on the National Stock Exchange of India and it accounts for 50 key stocks. Retail investors are attracted to the stock market, but it can be challenging to choose the right stocks due to their volatility. Fundamental and technical analysis can be useful, but a lack of knowledge can lead to losses.

The use of technical analysis by Indian investors is limited and the RSI indicator is rarely used. Although the RSI has been used worldwide and provided positive results, the existing studies on its use in the Indian market are limited. This highlights the need for in-depth research on the use of RSI in the Indian market to provide a comprehensive understanding of its effectiveness.

The purpose of this study is to evaluate the performance of the RSI for the NIFTY 50 index compared to a Buy and Hold strategy. The study aims to analyze the price movement of the NIFTY 50 index, gather performance data by reapplying technical

analysis strategies based on RSI, and compare the results to a Buy and Hold strategy to determine the effectiveness of RSI in the Indian stock market.

CHAPTER II:

REVIEW OF LITERATURE

Chapter 2 provides a comprehensive literature review on the topic of Technical Analysis in the field of finance. It starts with a general introduction to the concept of technical analysis and its underlying theories and assumptions. The chapter then moves on to explore the implications and applications of technical analysis, along with the criteria and metrics used to evaluate its effectiveness. The profitability of technical analysis is also analyzed, including a discussion of the criticisms and debates surrounding its use. The second part of the chapter focuses on the Relative Strength Index (RSI), a widely used indicator in technical analysis. This section covers the calculation of the RSI, strategies for using it, and its performance in different global and Indian markets. Finally, the chapter concludes with a summary of the literature review.

2.1 Literature Review on Technical Analysis

This section will provide an overview of the theories and assumptions of technical analysis and explore its implications and applications. Additionally, the section will examine the criteria and metrics for evaluating technical analysis and discuss its profitability. Finally, the section touch upon the criticisms and debates surrounding the use of technical analysis in the financial markets

2.1.1 Introduction To Technical Analysis

Technical analysis is a widely used method for predicting and trading financial assets, such as stocks, bonds, currencies, or commodities (Abu-Mostafa & Atiya, 1996). It is based on the assumption that the price movements of financial assets are not random, but are determined by market conditions, trends, patterns, or psychological factors. Technical

analysis uses a variety of tools, such as charts, indicators, or oscillators, to identify and analyze these price movements, and to generate trading signals or strategies (Kirkpatrick II & Dahlquist, 2010).

Technical analysis has several principles or characteristics that distinguish it from other methods of analysis, such as fundamental analysis or behavioral finance. These principles include:

Technical analysis is a data-driven and evidence-based method, that relies on the collection, analysis, and interpretation of empirical data, such as price, volume, or volatility, to generate trading signals or strategies (Cooper & Graziano, 2000).

Technical analysis is a statistical and probabilistic method, that uses statistical and mathematical techniques, such as regression, correlation, or time series analysis, to model, forecast, or test the price movements of financial assets (Lo, Mamaysky & Wang, 2000).

Technical analysis is a historical and comparative method, that uses the past and current data of financial assets, to identify and compare patterns, trends, or indicators that may be relevant or predictive for the future (Chen, 2010).

Technical analysis is a technical and objective method, that relies on the use of objective and standardized tools, such as charts, indicators, or oscillators, to generate trading signals or strategies, without the influence of personal or psychological biases (Wilder Jr., 1978).

Technical analysis is a dynamic and adaptive method, that adjusts to changing market conditions, and adapts to new data, trends, or patterns, to generate trading signals or strategies that are relevant and profitable for the current market conditions (Pan, 2003).

2.1.2 Theories and Assumptions of Technical Analysis

Technical analysis is based on several theories and assumptions that provide the foundation and rationale for the principles and methods of technical analysis. These theories and assumptions include

The Efficient Market Hypothesis (EMH) states that financial markets are efficient and that the prices of assets reflect all available information. This means that the prices of assets reflect their true value or "fair value," and that it is impossible to consistently earn above-average returns by trading on information that is already reflected in prices (Fama, 1970). Technical analysis challenges the EMH, by assuming that the prices of financial assets may not be efficient, and may be influenced by other factors, such as market conditions, trends, patterns, or psychological factors, that can be identified and analyzed by technical analysis (Murphy, 1999; Nison, 1994).

The Random Walk Hypothesis (RWH) states that the past movement or direction of a stock's price has no bearing on its future movement or direction. In other words, the hypothesis suggests that stock prices move randomly and are not predictable. (Bachelier, 1900; Malkiel, 1973). Technical analysis challenges the RWH, by the Non-Random Walk Hypothesis which states that stock prices exhibit patterns and trends that can be predicted to some extent. (Lo & MacKinlay, 1988; Lo & MacKinlay, 1999).

The Dow Theory, states that the price movements of financial assets can be classified into three types: trends, corrections, or ranges (Dow, 1897). Technical analysis assumes that the Dow theory is valid and that the price movements of financial assets can be identified and analyzed by technical analysis, based on the type of movement, the duration, the amplitude, or the direction of the price (Wilder Jr., 1978; Pan, 2003).

The Behavioral Finance Theory, states that the behavior and decisions of traders and investors may be influenced by cognitive biases, such as overconfidence, herd behavior, or loss aversion, that may affect the prices of financial assets (Kahneman & Tversky, 1979; Thaler, 1985). Technical analysis assumes that behavioral finance is valid and that the psychological factors that may affect the prices of financial assets can be identified and analyzed by technical analysis, using indicators, such as sentiment, volume, or volatility, that measure the psychological factors of traders and investors (Steenbarger, 2002).

The Fractal Geometry Theory, states that the price movements of financial assets may be self-similar or fractal, and may exhibit patterns or structures that repeat over different scales or time frames (Mandelbrot & Mandelbrot, 1982). Technical analysis assumes that the fractal geometry theory is valid and that the patterns or structures of the price movements of financial assets can be identified and analyzed by technical analysis, using tools, such as Fibonacci retracements, Elliott waves, or Gann angles, that are based on fractal geometry (Chen, 2010).

The Chaos Theory, states that the price movements of financial assets may be chaotic or nonlinear, and may exhibit complex, nonlinear, and unpredictable behaviors (Lorenz,

1963). Technical analysis assumes that the chaos theory is valid and that the complexity, nonlinearity, and unpredictability of the price movements of financial assets can be identified and analyzed by technical analysis, using tools, such as the Hurst exponent, the Hurst channel, or the fractal dimension, that are based on chaos theory (Murphy, 1999).

2.1.3 Implications and Applications of Technical Analysis

Technical analysis has several implications and applications for the financial markets, the traders and investors, and the regulators and policymakers, such as:

Technical analysis provides a practical and comprehensive method for predicting and trading financial assets, that can be used by traders and investors to generate profitable trades, to avoid losses, to capture market trends, or to adapt to changing market conditions (Murphy, 1999; Wilder Jr., 1978).

Technical analysis provides a transparent and objective method for evaluating and comparing the performance of financial assets, that can be used by traders and investors to compare the performance of different assets, strategies, or indicators, and to select the assets, strategies, or indicators that are most appropriate for their needs and preferences (Cooper & Graziano, 2000; Nison, 1994).

Technical analysis provides a flexible and adaptable method for trading financial assets, that can be used by traders and investors to adjust to changing market conditions, and to adapt to new data, trends, or patterns, in order to generate trading signals or strategies that are relevant and profitable for the current market conditions (Wilder Jr., 1978; Pan, 2003).

Technical analysis provides a valuable and complementary method for analyzing financial assets, that can be used by traders and investors to complement or supplement other methods of analysis, such as fundamental analysis or behavioral finance, and to provide a more comprehensive and balanced analysis of financial assets (Pan, 2003; Chong, Ng & Liew, 2014).

Technical analysis provides a valuable and practical method for educating and training traders and investors, that can be used by educators and trainers to teach traders and investors the principles and methods of technical analysis, and to help them apply technical analysis to real-world trading and investing scenarios (Kirkpatrick II & Dahlquist, 2010; Steenbarger, 2002).

2.1.4 Criteria and Metrics for Evaluating Technical Analysis

The evaluation of technical analysis is a crucial and challenging step in the research because it involves defining the criteria, the assumptions, or the metrics that will be used to assess the performance or the predictability of technical analysis. The criteria and metrics for evaluating technical analysis should be selected based on the objectives, the scope, or the limitations of the research, and should be appropriate, relevant, and robust, to provide a valid and reliable evaluation of technical analysis. Some of the criteria and metrics for evaluating technical analysis include

The performance criteria, which measure the profitability, the risk-return, or the consistency of the trading signals or strategies generated by technical analysis, and which compare the performance of technical analysis with a benchmark, such as a buy-and-hold strategy, or another technical indicator or trading strategy (Schwager, 1995). The

performance criteria can include metrics such as the return, the Sharpe ratio, the drawdown, the maximum drawdown, or the trade duration, that capture the profitability, the risk, or the stability of the trading signals or strategies generated by technical analysis (Park & Irwin, 2007; Lento, 2008)

The predictability criteria, which measure the accuracy, reliability, or sensitivity of the trading signals or strategies generated by technical analysis, and compare the predictability of technical analysis with a benchmark, such as random signals, or another technical indicator or trading strategy (Fang and Xu, 2003). The predictability criteria can include metrics such as the hit rate, accuracy, precision, recall, or f1-score, that capture the accuracy, reliability, or sensitivity of the trading signals or strategies generated by technical analysis (Lo, 2002; Hansen & Lunde, 2005).

The robustness criteria, which measure the stability, the sensitivity, or the generalizability of the trading signals or strategies generated by technical analysis, and which evaluate the robustness of technical analysis to different conditions, such as different financial assets, markets, or time frames, or different parameters, rules, or methods (Bel Hadj Ayed, Loeper & Abergel , 2016). The robustness criteria can include metrics such as the stability test, the sensitivity test, or the out-of-sample test, that capture the stability, the sensitivity, or the generalizability of the trading signals or strategies generated by technical analysis (Chong, Ng & Liew, 2014; Nor & Wickremasinghe, 2014).

The integration criteria, measure the complementarity, the synergy, or the interaction of technical analysis with other methods of analysis, and evaluate the value-added or the potential benefits of integrating technical analysis with other methods (Bettman, Sault &

Schultz, 2009). The integration criteria can include metrics such as the information ratio, the diversification ratio, or the alpha-beta ratio, that capture the value-added or the potential benefits of integrating technical analysis with other methods (DeMark, 1994; Schwager, 1995).

The reliability criteria, which measure the consistency, the reliability, or the reproducibility of the results obtained from technical analysis, and which evaluate the robustness or the reliability of the methods, the data, or the assumptions used in technical analysis (Park & Irwin, 2007). The reliability criteria can include metrics such as the p-value, the t-test, the F-test, or the chi-squared test, that capture the statistical significance, the reliability, or the reproducibility of the results obtained from technical analysis (Lo, 2002; Brock, Lakonishok & LeBaron, 1992).

Overall, these criteria and metrics can provide a comprehensive and rigorous evaluation of technical analysis, and can help to assess the performance, the predictability, and the robustness of technical analysis in different contexts. The selection and application of these criteria and metrics should be carefully considered and documented, to ensure the validity and reliability of the evaluation of technical analysis.

2.1.5 Profitability of Technical Analysis

The profitability of technical analysis has been the subject of many studies and debates, with some researchers arguing that technical analysis can provide valuable insights into the behavior or the trends of financial markets, while others argue that technical analysis is based on unreliable or untested assumptions. In this section, we will review some of

the research on the profitability of technical analysis, and discuss the implications of these findings for the use of technical analysis in practice.

Park & Irwin (2007) provides insights about the empirical literature being categorized into two major groups namely “early” and “modern” based on the period of study. Early studies suggest that technical analysis strategies are profitable in forex and futures markets whereas Modern studies suggest that technical analysis strategies generate profit in a variety of speculative markets. Among a total of 95 modern studies, 56 studies find positive results regarding technical trading strategies, 20 studies obtain negative results, and 19 studies indicate mixed results.

Levich & Thomas III (1993) present one example of research on the application of technical analysis to the forex and futures market. The study found that simple technical trading rules can generate highly unusual profits. The study split the entire sample in three equal subsamples and found that the profitability of the trading rules declined in the latest period yet on average remained positive and significant in many cases.

Hsu & Kuan (2005) is another example of research on the profitability of technical analysis in the equity markets. The study found out that significantly profitable simple rules do exist but it mostly in the “young” markets like NASDAQ Composite and Russell 2000. More “mature” markets like Dow Jones Industrial Average and S&P 500 are not profitable. The study also took account of the transaction costs and yet found that the technical trading rules in the “young” markets beat the buy-and-hold strategy in most in- and out-of-sample periods. The study also provides insights that more complex trading

strategies improve profits over simple trading rules and may even generate significant profits from unprofitable simple rules.

Furthermore, Bessembinder & Chan (1995) found that buy signals exceed means on days that the rules emit sell signals by 0.095% per day, or about 26.8% on an annualized basis when simple trading rules are applied. The study also found that less developed markets like Malaysia, Thailand and Taiwan have less explanatory power when compared to more developed markets such as Hong Kong and Japan.

Additionally, the use of technical analysis can also provide other potential benefits for traders or investors. For example, technical analysis can help to improve the risk-return profile of trading strategies, by providing signals or rules that can help to maximize the returns or to minimize the losses of a portfolio (Murphy, 1999; Schwager, 1995). Technical analysis can also help to diversify trading strategies, by providing signals or rules that can be applied to different financial assets, markets, or time frames, and that can be combined with other methods, such as fundamental analysis, to provide a more comprehensive or balanced view of the performance or the predictability of the market (Bettman, Sault & Schultz, 2009; DeMark, 1994).

Overall, the evidence from these and other studies suggests that technical analysis can be a valuable tool for forecasting future performance or predictability of financial assets. While there may be limitations or challenges to using technical analysis in practice, the results of these studies indicate that technical analysis can provide profitable trading signals or strategies, and can provide valuable insights into the behavior or trends of financial markets.

2.1.6 Criticisms and debates of technical analysis

Technical analysis has been criticized and debated by several researchers, practitioners, or regulators, who have questioned the validity, reliability, or usefulness of technical analysis, and have challenged its assumptions, methods, or performance. These criticisms and debates include:

The backtesting bias (De Bondt & Thaler, 1985), which states that the performance of technical analysis may be overfitted or biased, when it is tested on the same data that was used to develop or optimize the trading rules or strategies. The backtesting bias challenges the reliability of technical analysis, by assuming that the performance of technical analysis may be inflated or misleading, when it is tested on the same data that was used to generate the trading signals or strategies.

The data-mining bias (Fama & French, 1992), which states that the performance of technical analysis may be overfitted or biased, when it is tested on a large number of indicators, rules, or metrics, and when only the best-performing rules or strategies are selected or reported. The data-mining bias challenges the usefulness of technical analysis, by assuming that the performance of technical analysis may be inflated or misleading, when it is tested on a large number of rules or strategies, and when only the best-performing rules or strategies are selected or reported.

The survivorship bias (Marshall, Qian and Young, 2009), which states that the performance of technical analysis may be overfitted or biased, when it is tested on a survivorship sample of financial assets, and when the performance of the assets that have failed or delisted is not considered. The survivorship bias challenges the generalizability

of technical analysis, by assuming that the performance of technical analysis may be inflated or misleading, when it is tested on a survivorship sample of assets, and when the performance of the assets that have failed or delisted is not considered.

The regulation bias (Grossman & Stiglitz, 1980), which states that the performance of technical analysis may be overfitted or biased, when it is tested on a regulated sample of financial assets, and when the performance of the assets that are not regulated is not considered. The regulation bias challenges the fairness of technical analysis, by assuming that the performance of technical analysis may be inflated or misleading, when it is tested on a regulated sample of assets, and when the performance of the assets that are notlated is not considered.

The look-forward bias (Lo & MacKinlay, 1990), which states that the performance of technical analysis may be overfitted or biased, when it is tested on data that was not available at the time the strategy was applied, and when the strategy is optimized or selected based on this data. The look-forward bias challenges the reliability of the technical analysis, by assuming that the performance of technical analysis may be inflated or misleading when it is tested on data that was not available at the time the strategy was applied, and when the strategy is optimized or selected based on this data

2.2 Literature Review on Relative Strength Index (RSI)

This section will delve into the Relative Strength Index (RSI) - a commonly used technical analysis indicator. It will first provide an overview of common indicators in technical analysis, followed by an in-depth look at the RSI indicator. This section will

also discuss common strategies and rules for using the RSI and provide a summary of key studies on its performance, including its use in the Indian markets.

2.2.1 Common Indicators in Technical Analysis

One of the key tools used in technical analysis is indicators. Indicators are mathematical calculations based on the price and/or volume of an asset. They provide information about an asset's strength, momentum, volatility, and trend, among other things.

One of the most commonly used technical analysis indicators is the moving average, which shows the average price of a security over a specified time period (Hunter, 1986). For example, a 50-day moving average shows the average price of a security over the past 50 days. Moving averages can help traders identify trends and make decisions about buying and selling (Chen, 2010).

Figure 2.2.1a: Technical Analysis of NIFTY 50 Index Using 50 SMA (Source: Analysis by the Author using the TradingView Charting Platform)

Another popular technical analysis indicator is the relative strength index (RSI), which is a momentum indicator that measures the magnitude of recent price changes to determine overbought or oversold conditions (Wilder Jr., 1978). The RSI is calculated using a formula that compares the average of up closing prices to the average of down-closing prices over a specified time period. A reading above 70 is considered overbought, while a reading below 30 is considered oversold (Chong, Ng & Liew, 2014).

Figure 2.1.1b: Technical Analysis of NIFTY 50 Index Using 14 RSI (Source: Analysis by the Author using the TradingView Charting Platform)

Bollinger Bands created by Bollinger (1992) is another popular choice. It consists of three lines plotted on a security's chart. The middle line is a simple moving average, and the upper and lower lines are plotted a certain number of standard deviations above and below the moving average. Bollinger Bands can help traders identify potential entry and exit points by showing when a security is overbought or oversold (Bollinger, 2002).

Figure 2.2.1c: Technical Analysis of NIFTY 50 Index Using 2 Std. Bollinger Bands (Source: Analysis by the Author using the TradingView Charting Platform)

The moving average convergence divergence (MACD) is also a top choice among technical analysts (Appel, 2005). This is a momentum indicator that shows the relationship between two moving averages of a security's price. The MACD is calculated by subtracting a 26-day exponential moving average from a 12-day exponential moving average. The resulting line is then plotted on a chart, along with a 9-day exponential moving average of the MACD line, which is called the "signal line." Traders can use the MACD to identify potential entry and exit points, as well as to spot divergences between the MACD and the security's price (Chong & Ng, 2008).

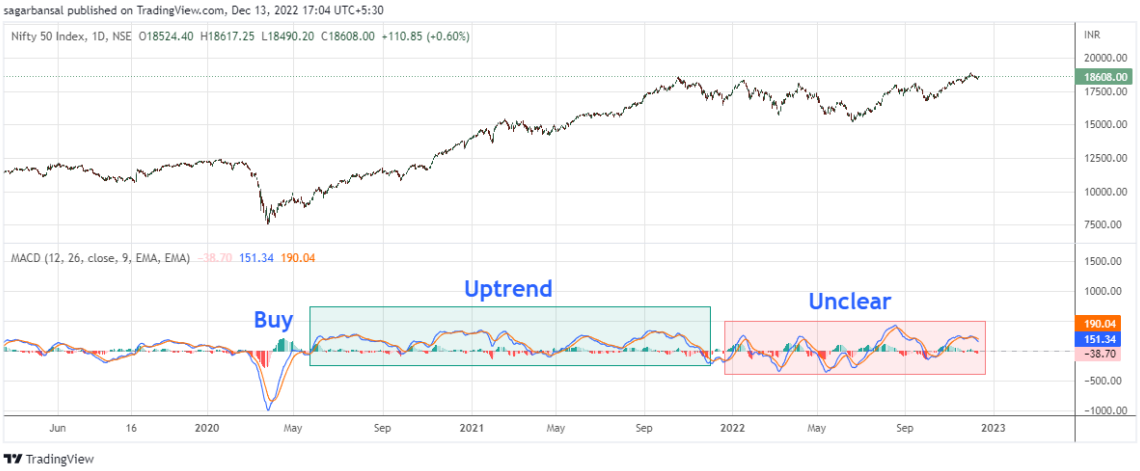

Figure 2.2.1d: Technical Analysis of NIFTY 50 Index Using MACD (Source: Analysis by the Author using the TradingView Charting Platform)

In addition, there are many other technical analysis indicators that traders and investors can use. Some of the other popular indicators include Stochastic Oscillator, Gann Angles, Elliot Waves (Chen, 2010) and the Parabolic SAR (Wilder Jr., 1978). Some traders may prefer to use a combination of several indicators like ATX with RSI (Wong, Manzur & Chew, 2003), while others may focus on just one.

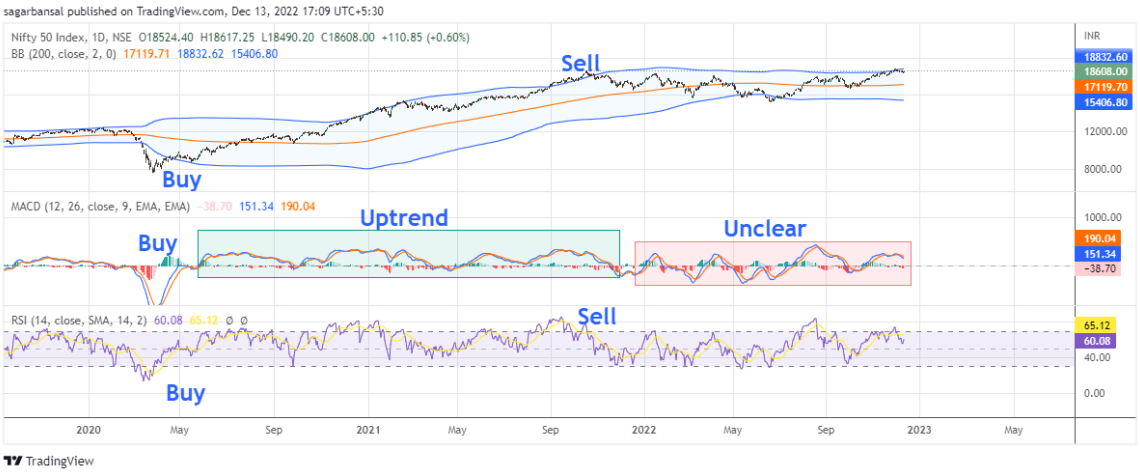

Figure 2.2.1e: Technical Analysis of NIFTY 50 Index Using MACD & RSI (Source: Analysis by the Author using the TradingView Charting Platform)

2.2.2 Calculating The Relative Strength Index

Developed by Wilder Jr. (1978), the RSI is calculated using a formula that compares the magnitude of recent gains and losses in the price of a stock or other asset. It is typically plotted on a scale from 0 to 100, with values below 30 indicating an oversold condition and values above 70 indicating an overbought condition.

There are two stages for calculating the RSI: the first stage involves calculating the Initial RSI. It is done by calculating the average gain and average loss over a chosen number of periods and then using these values to calculate the relative strength (RS) and the RSI. The formula used in the first stage is as follows:

Average gain = Sum of gains over the chosen number of periods/number of periods
Average loss = Sum of losses over the chosen number of periods/number of periods
RS = Average gain / Average loss
RSI = 100 - (100 / (1 + RS))

B	D	E	F	G	H	I	J
Date	Close	UP	DOWN	UP AVG	DOWN AVG	RS	RSI
11/1/1999	1270.00						
11/2/1999	1332.20	62.20	0				
11/3/1999	1326.40	0	5.8				
11/4/1999	1336.80	10.40	0				
11/5/1999	1364.50	27.70	0				
11/7/1999	1369.60	5.10	0				
11/9/1999	1371.20	1.60	0				
11/10/1999	1389.10	17.90	0				
11/11/1999	1389.60	0.50	0				
11/12/1999	1373.50	0	16.1				
11/15/1999	1362.70	0	10.8				
11/16/1999	1357.70	0	5				
11/17/1999	1352.20	0	5.5				
11/18/1999	1364.20	12.00	0				
11/19/1999	1361.80	0	2.4				
11/22/1999	1375.20	13.40	0	9.81	3.26	3.01	75.08196721
11/24/1999	1394.90	19.70	0	10.52	3.02	3.48	77.67063432
11/25/1999	1408.60	13.70	0	10.75	2.81	3.83	79.28253436
11/26/1999	1399.60	0	9	9.98	3.25	3.07	75.43028752
11/29/1999	1384.60	0	15	9.27	4.09	2.27	69.37963738
11/30/1999	1376.10	0	8.5	8.61	4.40	1.95	66.14187388
12/1/1999	1388.70	12.60	0	8.89	4.09	2.17	68.48937807
12/2/1999	1408.80	20.10	0	9.69	3.80	2.55	71.84317894

Figure 2.2.2: RSI Calculations On NIFTY 50 Index (Source: Calculated by Author Using Google Sheets & NIFTY 50 Historical Price Data)

Once the Initial RSI has been calculated, the second stage starts and the calculation of all upcoming RSI values involves a more complex calculation that uses a smoothing factor to reduce the volatility of the RSI over time. The formula for this is as follows:

Average gain = [(previous average gain) x 13 + current gain] / 14

Average loss = [(previous average loss) x 13 + current loss] / 14

RS = Average gain / Average loss

RSI = 100 - (100 / (1 + RS))

2.2.3 Strategies and Rules for Using RSI

There are various strategies and rules for using the relative strength index (RSI). Some of the most common strategies and rules include

Oversold / Overbought Reversal: The most common use of the RSI is to identify Tops and Bottoms. It is believed that the RSI will usually top out (overbought) or bottom out (oversold) before the actual market top or bottom is observed. This represents a potential reversal or at least a significant reaction. The rule is commonly written as RSI(14,30/70) where 14 is the number of periods on which RSI is calculated and 30/70 is the oversold/overbought levels (Chong, Ng & Liew, 2014).

Figure 2.2.3a: Technical Analysis of NIFTY 50 Index Using RSI Oversold / Overbought Reversal (Source: Analysis by the Author using the TradingView Charting Platform)

Centerline Crossover: Since RSI 50 level is the centerline of the indicator's range, Many traders use RSI(14,50) rule for their entry and exit signals. Whenever the price crosses above 50, the price is considered to be in an uptrend and whenever the price crosses below 50, the price is considered to be in a downtrend (Chong & Ng, 2008).

Figure 2.2.3b: Technical Analysis of NIFTY 50 Index Using RSI Centerline Crossover (Source: Analysis by the Author using the TradingView Charting Platform)

OS/OB Reversal - Opposite Levels: This trading strategy is exactly the opposite of the classic interpretation of Oversold / Overbought Reversal. When a security's price is overbought or oversold, there might be strong buy move or a sell move. This can lead to an extended continuation of the existing trend (Adrian, 2011). Hence the strategy has opposite levels meaning that instead of RSI(14,30/70), The strategy would use RSI(14,70/30).

Figure 2.2.3b: Technical Analysis of NIFTY 50 Index Using RSI OS/OB Opposite Levels (Source: Analysis by the Author using the TradingView Charting Platform)

Failure swings: A failure swing is a pattern that occurs when the RSI moves into overbought or oversold territory, then reverses and moves back in the opposite direction, and then reverses again and moves back into the overbought or oversold territory but fails to break the previous swing. This pattern can be a sign that the security's price is about to reverse direction (Krage, 2021).

Figure 2.2.3d: Technical Analysis of NIFTY 50 Index Using RSI Failure Swings (Source: Analysis by the Author using the TradingView Charting Platform)

Chart Patterns: Common patterns, such as the double top and double bottom, can be identified on the RSI when they might or might not be visible on the price chart (Dixit, 2020).

Figure 2.2.3e: Technical Analysis of NIFTY 50 Index Using RSI Chart Patterns (Source: Analysis by the Author using the TradingView Charting Platform)

Divergences: A divergence occurs when the RSI and price move in opposite directions. When the RSI rises while the security's price falls, a Bullish Divergence is observed. This can be a sign that the security is gaining strength and may be ready to move higher. When the RSI falls while the security's price rises, a Bearish Divergence is observed. This can be a sign that the security is losing strength and may be ready to move lower (Bansal & Bansal, 2019).

Figure 2.2.3f: Technical Analysis of NIFTY 50 Index Using RSI Divergence (Source: Analysis by the Author using the TradingView Charting Platform)

2.2.4 Performance of RSI Around The World

There are various studies on the topic of RSI performance across multiple stock exchanges around the world.

One of the key studies on the RSI was conducted by Wong, Manzur & Chew, (2003), where the study provided evidence of how RSI can generate substantial profits in the Singapore stock market. The data used in this study was the daily close of the Singapore STII for the period of 21 years. The data was divided into 3 equal sub-samples of 7 years each. The study found that RSI(6,50) generated impressive results significant at 1% and 5% significance levels. The study had a few limitations as the author did not have access to the ADX data which helps in the determination of a trending vs range-bound market hence all the tests were done on all the data including both trending as well as range-bound periods. The study mentions that this is a potential reason for getting mixed results for the "touch". "peak", and "retracement" methods, and hence the author didn't publish those results. However, the "crossover" method was effective even in this situation; hence, this study only discusses those results.

Chong & Ng (2008) tested the predictive power of the RSI(14,50) rule on the London Stock Exchange. The study used 60 years of data from the FT30 Index and divided the data into three subsamples. The study found that the RSI can generate better returns than a buy-and-hold strategy in most cases. The majority of the sample size of the study is from a period before RSI was even invented hence the study suffers from look-ahead bias as explained by Mohd Nor and Wickremasinghe (2014)

Chong, Ng & Liew (2014) extended the previous research of Chong & Ng (2008) to cover five other OECD countries with additional RSI rules. The data used in this study was the daily closing prices of the Milan Comit General, S&P/TSX Composite, DAX 30, Dow Jones Industrials, and Nikkei 225 for a period of 27 years. The study found that RSI(21,50) consistently generated abnormal returns in Milan Comit General and the S&P/TSX Composite Index. The study also found RSI(14,30/70) rule to be profitable in the Dow Jones Industrials Index. The rule RSI(7, 30/70) rule generated a significant negative return in Milan Comit General whereas RSI(21,50) generated abnormally positive returns. The same pattern can be seen in other rules as well. The author justifies this with the statement - "it is advisable for traders and practitioners to at least ascertain the profitability of these rules in their markets using historical data." A classic example of data-mining bias (2.19).

Australian market was covered by Mohd Nor and Wickremasinghe (2014) where the study found mixed results. The data used in this study was the daily close of the Australian All Ordinaries Index (XOA) for the period of 23 years. The sample was divided into 4 non-overlapping equal sub-samples. The study found that RSI(14,30,70) rule works well in some periods (but performs poorly in others). The study concluded with the idea of constantly revising existing trading strategies and optimizing the parameters of the trading rules in order to exploit market inefficiency. The study also has limitations of the geographical market.

An adjusted form of RSI (Adrian, 2011) was compared with the Classical RSI (2.6) using the rules RSIM(14,37.5,62.5) and RSI(14,30,70) respectively. The data used in this study was the daily closing price and volume of the S&P 500 (Standard and Poor's 500) index

over the period of 6 years. The study found that both the RSI rules gave a negative return on the selected dataset and concluded that the classic interpretation of overbought and oversold levels is useless while the reversed interpretation gives positive results for both forms of RSI. When reversed, the adjusted RSI performs better than the classical RSI. The study had a limitation of a small sample size

2.2.5 Performance of RSI In the Indian Market

According to Gumparthi (2017), the RSI is not widely utilized by Indian investors due to a lack of understanding of its proper use. Dixit (2020) considers RSI as a disregarded tool in the stock market and emphasizes the need for individuals to develop their own methods of utilizing it effectively. Some of the preliminary studies conducted using RSI in the Indian market are:

Jain (2014) tested the laws of demand and supply by using the RSI centerline as the equilibrium point. The data used in this study was the historical prices of 30 Indian companies for a 6-month period starting 26th September 2014. The study found that the majority of RSI values for actively traded stocks were between 50.00 and 60.00, indicating market stability with equal demand and supply. The study suffers from the limitations of small sample size as it only coves 30 companies for a period of 6 months

Mahajan (2015) presented a comparison study by optimizing MACD and RSI indicators against the standard MACD and RSI indicators as wel as the buy and hold return. The data used in this study was the historical prices of 30 stocks from 5 sectors of the Indian equity market for a 3-year period. The study showed that optimized MACD and RSI generated more profit than a buy and hold strategy, but standard MACD and RSI

generated less return. The sample size was limited, only covering 30 companies, and results may not be generalizable to the entire market. The 3-year time period may not cover significant market events.

Gumparthi (2017) tested the validity of RSI in short- and long-term investment, The data used in this study was the historical prices of 20 companies over a period of 2011 to 2013. The study found RSI can be used in portfolio construction for short- and long-term investments The study lacked statistical evidence and had a small sample size.

Talwar, Shah & Shah (2019) evaluated the reliability and consistency of a combination of top 4 technical indicators, including RSI, in predicting stock price movements. The data used in this study was the historical price data of 20 leading Indian companies over 2012 to 2017. The study concluded that stock market participants can rely on indicators with 4 and 5 ratings based on a 5-point rating scale presents in the results section of the study, but RSI showed mixed performance with mostly 3 ratings. The sample size was limited, only covering 20 companies and 5 years, and results may not be generalizable to all stocks or the entire market. The study only covers medium and long-term investments and does not applies to short term.

Kishori & Divya (2020) used RSI to assess stock price changes over time The data used in this study was the historical prices of 13 Indian companies for a period of 1-year starting 1st January 2017. The study found high volatility in RSI values, ranging from 35 to 60, and showed a buying signal when close to 0. The study had a small sample size and limited generalizability, only covering 12 companies.

2.3 Chapter Summary

The literature reviewed in this chapter provides a detailed and comprehensive understanding of technical analysis and its various aspects.

Technical analysis is a widely used method for predicting and trading financial assets and is based on the assumption that the price movements of these assets are not random, but are determined by market conditions, trends, patterns, or psychological factors (Abu-Mostafa & Atiya, 1996). Technical analysis uses a variety of tools, such as charts, indicators, or oscillators, to identify and analyze these price movements, and to generate trading signals or strategies (Kirkpatrick II & Dahlquist, 2010).

The chapter discussed the principles and characteristics of technical analysis, which include its data-driven and evidence-based approach (Cooper & Graziano, 2000), its statistical and probabilistic methods (Lo, Mamaysky & Wang, 2000), its historical and comparative perspective (Chen, 2010), its technical and objective tools (Wilder Jr., 1978), and its dynamic and adaptive nature (Pan, 2003). These principles and characteristics provide the foundation and rationale for the methods and applications of technical analysis.

The chapter also examined the theories and assumptions underlying technical analysis, such as the Efficient Market Hypothesis (Fama, 1970), the Random Walk Hypothesis (Bachelier, 1900; Malkiel, 1973), the Dow Theory (Dow, 1897), the Behavioral Finance Theory (Kahneman & Tversky, 1979; Thaler, 1985)., the Fractal Geometry Theory (Mandelbrot & Mandelbrot, 1982), and the Chaos Theory (Lorenz, 1963). These theories

and assumptions provide the theoretical and conceptual framework for technical analysis and help to explain its underlying logic and assumptions.

The literature review suggested that technical analysis can provide valuable insights and strategies for financial market participants (Murphy, 1999; Wilder Jr., 1978), by identifying and analyzing the price movements of financial assets (Cooper & Graziano, 2000; Nison, 1994), and by generating trading signals or strategies that are relevant and profitable for the current market conditions (Wilder Jr., 1978; Pan, 2003). The literature also highlights the importance of technical analysis in the broader context of financial market analysis and decision-making (Pan, 2003; Chong, Ng & Liew, 2014), and its potential to complement or supplement other methods, such as fundamental analysis or behavioral finance (Kirkpatrick II & Dahlquist, 2010; Steenbarger, 2002).

The literature review identified evaluation criteria, such as the performance criteria (Schwager, 1995), the predictability criteria (Fang and Xu, 2003), the robustness criteria (Bel Hadj Ayed, Loeper & Abergel, 2016), the integration criteria (Bettman, Sault & Schultz, 2009), and the reliability (Park & Irwin, 2007) criteria. These criteria can be measured and quantified using various metrics, such as hit rates, win rates, profit factors, or risk-reward ratios, which provide objective and standardized measures of the performance of the technical analysis.

The chapter explored the profitability of technical analysis and the criticisms and debate surrounding it. It suggests that technical analysis can be a profitable and effective method for trading financial assets (Park & Irwin, 2007), by identifying and analyzing the price movements of these assets (Levich & Thomas III, 1993; DeMark, 1994; Hsu & Kuan,

2005; Bettman, Sault & Schultz, 2009), and by generating trading signals or strategies that are relevant and profitable for the current market conditions (Schwager, 1995; Bessembinder & Chan, 1995; Murphy, 1999). However, the literature also highlights the limitations and criticisms of technical analysis, such as its lack of consensus and reliability, or its potential to generate false or misleading signals through the backtesting bias (De Bondt & Thaler, 1985), the data-mining bias (Fama & French, 1992), the survivorship bias (Marshall, Qian and Young, 2009), the regulation bias (Grossman & Stiglitz, 1980), and the look-forward bias (Lo & MacKinlay, 1990).

The chapter discussed various indicators used in technical analysis and the relative strength index (RSI) in particular. In conclusion, By using one or more technical analysis indicators such as Moving Average, RSI, Bolliger Band or MACD traders and investors can gain a better understanding of market trends and conditions, and make more informed decisions about buying and selling securities. (Chen, 2010; Wilder Jr., 1978; Bollinger, 1992; Chong & Ng, 2008)

The chapter delved into Relative Strength Index (RSI) which is a technical indicator used to measure the strength of an asset's price action. The calculation involves two stages, the Initial RSI and the ongoing RSI, each with its own formula. By plotting the RSI on a scale of 0 to 100, traders can assess overbought and oversold conditions in the market. Understanding and applying the RSI calculation can aid traders in making informed investment decisions (Wilder Jr., 1978)

The literature explored various strategies of using RSI. One strategy involves identifying oversold and overbought levels for potential market reversals (Chong, Ng & Liew, 2014).

The centerline crossover at RSI 50 is also used as entry and exit signals in trading (Chong & Ng, 2008). Another strategy, OS/OB Reversal - Opposite Levels, takes the uses opposite interpretation of classical OS/OB Reversal (Adrian, 2011). Failure swings and chart patterns, such as double tops and double bottoms, can also be identified on the RSI (Krage, 2021; Dixit, 2020). Lastly, divergences, where the RSI and price move in opposite directions, can indicate a potential reversal in the security's price direction (Bansal & Bansal, 2019).

The literature has shown that the performance of RSI varies across stock exchanges around the world. A key study in Singapore by Wong, Manzur & Chew (2003) found that RSI(6,50) generated substantial profits in the Singapore stock market, while Chong & Ng (2008) found that the RSI(14,50) rule generated better returns than a buy-and-hold strategy on the London Stock Exchange. Chong, Ng & Liew (2014) found that different RSI rules generated abnormal returns in different markets, including the S&P/TSX Composite and the Dow Jones Industrials Index. The Australian market showed mixed results (Mohd Nor and Wickremasinghe, 2014) and an adjusted form of RSI (Adrian, 2011) was found to perform better than the classical RSI when interpreted in a reversed manner.

The literature specific to the Indian context suggests that the RSI is not widely used in the Indian market and is often disregarded. However, some preliminary studies have been conducted which shows that RSI might be useful in Indian market. The findings of these studies are limited by their small sample sizes and lack of statistical evidence hence an indepth research study is required.

In conclusion, this literature review comprehensively covers technical analysis, including principles, theories, profitability, criticisms, evaluation criteria, and the RSI indicator. Findings show the RSI is valuable for identifying market trends and potential trades, but performance varies on different stock exchanges. Limited use of RSI in the Indian market suggests potential usefulness, but further research is required. In sum, the RSI is a versatile and valuable tool for informed investment decision

CHAPTER III:

METHODOLOGY

Chapter 3 provides a comprehensive overview of the research design and methodology applied to address the research problem and the objectives of the research outlined in Chapter 1. This chapter starts with a summary of the research problem and the research purpose and questions. It then delves into the research design. The chapter then highlights the limitations of the research design and a concludes with a summary the chapter.

3.1 Overview of the Research Problem

The Indian stock market offers a great opportunity for investors due to its growing economy, which is expected to expand at 6.7% and attract high foreign direct investment. The NIFTY 50 index on the National Stock Exchange of India comprises of 50 key stocks and is a popular choice for retail investors. However, choosing the right stocks can be challenging because of their volatility, and fundamental and technical analysis can be helpful but lack of knowledge can result in losses.

Indian investors have limited exposure to technical analysis and the use of the Relative Strength Index (RSI) is not common. Although the RSI has shown positive results globally, research on its use in the Indian market is limited. This highlights the need for extensive research to gain a comprehensive understanding of its effectiveness in the Indian stock market.

The literature review on the utilization of the Technical Analysis and Relative Strength Index (RSI) has revealed various studies that have been conducted with varying scopes and limitations.

Study	Objective	Gaps
Wong, Manzur & Chew (2003)	Evidence of how RSI can generate substantial profits in the Singapore stock market	Lack of access to ADX data, mixed results for "touch", "peak", and "retracement" methods, only "crossover" method discussed
Chong & Ng (2008)	Tested the predictive power of the RSI(14,50) rule on the London Stock Exchange	Look-ahead bias, majority of sample size from period before RSI was invented
Chong, Ng & Liew (2014)	Extended previous research to cover five other OECD countries with additional RSI rules	Data-mining bias, results may not be applicable to all markets
Mohd Nor and Wickremasinghe (2014)	Mixed results in the Australian stock market	Limitations of geographical market
Adrian (2011)	Compared adjusted form of RSI with classical RSI	Small sample size
Jain (2014)	Tested the laws of demand and supply using the RSI centerline as the equilibrium point	Small sample size, only covers 30 companies for 6 months
Mahajan (2015)	Compared MACD and RSI indicators with the standard indicators and buy and hold return	Limited sample size, only covers 30 companies, results may not be generalizable to the entire market
Gumparthi (2017)	Tested the validity of RSI in short and long-term investments	Lack of statistical evidence, small sample size
Talwar, Shah & Shah (2019)	Evaluated the reliability and consistency of top 4 technical indicators, including RSI, in predicting stock price movements	Limited sample size, only covers 20 companies and 5 years, results may not be generalizable to all stocks or the entire market
Kishori & Divya (2020)	Used RSI to assess stock price changes over time	Small sample size, limited generalizability, only covers 13 companies

Table 3.1 Summary of Objectives & Gaps in Key RSI Research Studies

As presented by the data in Table 3.1, Despite the availability of information on the topic, there remain gaps in research done so far with respect to the understanding of the performance and usefulness of the RSI especially in the Indian market.

3.2 Research Question

The research is focused on answering the question: How does RSI as a trading signal perform in NIFTY 50 Index agianst a Buy and Hold strategy?

Hence the goal of this study is to evaluate the performance of the Relative Strength Index (RSI) for the NIFTY 50 index, compared to a Buy and Hold strategy.

In order to achieve this goal, the study will focus on three objectives:

1. To analyze the price movement of the NIFTY 50 index and establish a reliable baseline for future comparisons through a Buy and Hold return calculation.
2. To gather performance data by reapplying technical analysis strategies based on RSI from past studies and collecting statistical results.
3. To offer valuable insights and recommendations for traders and investors in regards to using RSI as an indicator for the NIFTY 50 index.

3.3 Research Design

The research design uses a mixed methodology approach which is a a combination of historical data analysis, simulation, and statistical analysis to arrive at meaningful conclusions and recommendations for traders and investors. The study was conducted in four stages, including Dataset pre-processing, Buy and Hold return calculation, performance analysis of RSI strategies and interpretation of results.

3.3.1 Dataset Pre-Processing

Secondary data was collected through National Stock Exchange (NSE) website, to gather historical daily close as well as open prices for the NIFTY 50 index for the period of 01-12-1999 to 31-12-2020.

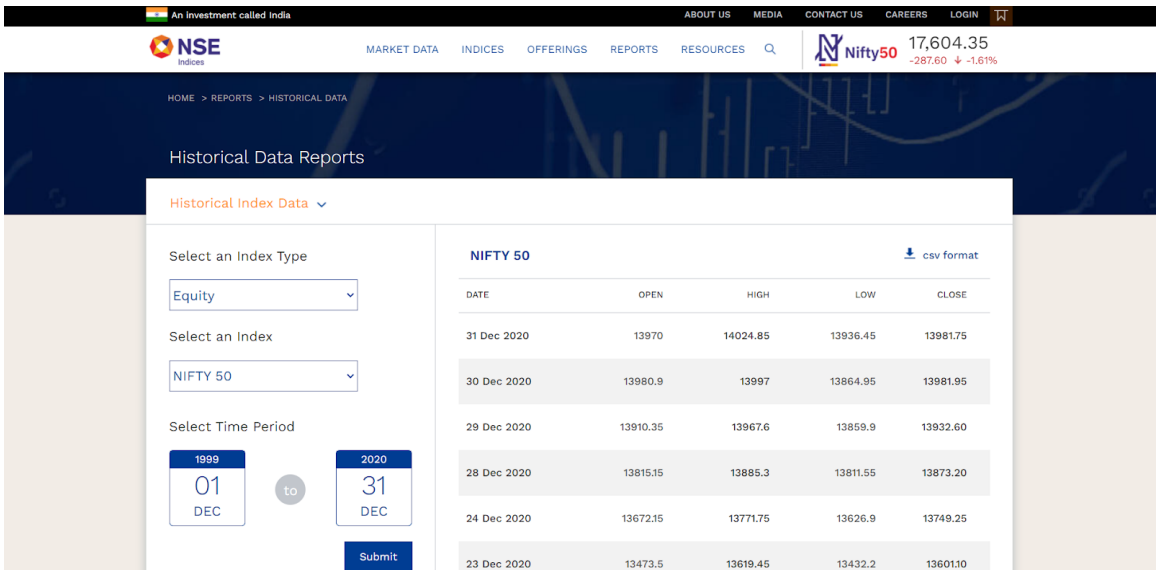

Figure 3.3.1: Historical Price Data of NIFTY 50 Index (01-12-1999 - 31-12-2020) (Source: NSE India)

The 31 days additional data from the month of December 1999 is essential to calculate the Relative Strength Index at various lengths of 7,14 and 21 which shall be used later in this research.

The data from NSE India (refer Figure 3.1) was saved to a CSV file and was pre-processed using a python script (refer Appendix A)

Date	Open	Close	RSI
03-01-2000	1482.15	1592.2	77.15231946
04-01-2000	1594.4	1638.7	80.36199277
05-01-2000	1634.55	1595.8	70.51926422

-	-	-	-
-	-	-	-
-	-	-	-
29-12-2020	13910.35	13932.6	71.4020267
30-12-2020	13980.9	13981.95	72.38849471
31-12-2020	13970	13981.75	72.3775984

Table 3.3.1: First Three & Last Three Rows of Data After Pre-Processing

As presented by the data in Table 3.3.1, The Python Script calculated the RSI at desired length which was 14 in this case and exported the data in the CSV which had the columns as Date, Open, Close and RSI. Similarly RSI at a length of 7 and 21 was also calculated.

3.3.2 Buy & Hold Return Calculation

In order to achieve the first objective of the study: To analyze the price movement of the NIFTY 50 index and establish a reliable baseline for future comparisons through a Buy and Hold return calculation.

A trading account was simulated using python scripts. The simulation used historical data of the NIFTY 50 index and placed long positions every ten days using the Open Prices. The trades were held for 10 days and were closed on the next day Open Price of the market. All the trades were then exported and further processed to calculate the non-overlapping 10-day log returns (Brock, Lakonishok & LeBaron, 1992)

After calculating the log returns, various statistics were calculated such as the number of trades, mean log return, standard deviation of log returns, minimum log return, maximum log return, skewness of log return and kurtosis of log returns.

Following the general industry practice, NIFTY 50 index was further analyzed by dividing the whole period of 2000-2021 into three equal subsamples: Subsample 1 (2000-2007), Subsample 2 (2007-2014), and Subsample 3 (2014-2021). Afterward, the 10-day log return for each subsample was calculated using the same method as before.

In order to access the stability of the 10-day log return of the NIFTY 50 Index, a statistical analysis was performed to compare the 10-day log return of the whole period (2000-2021) to the 10-day log return of each subsample (2000-2007, 2007-2014, 2014-2021).

The null hypothesis for this analysis was that the subsample return is the same as the whole period return. The alternative hypothesis for this analysis was that the subsample return is not the same as the whole period return.

$H0: \mu s = \mu w$

$H1: \mu s \neq \mu w$

To test this hypothesis, multiple statistical tests including the Two-Tailed-T-Statistics test, Wilcoxon-Mann-Whitney test, and Kruskal-Wallis test were performed. Apart from this, Confidence intervals were calculated as well as the power analysis was done at common significance levels.

The results were then interpreted to find the actual 10-day log return of NIFTY 50 Index that can be used as a benchmark for further comparisons.

3.3.3 Performance Analysis of RSI Strategies

In order to achieve the second objective of the study: To gather performance data by reapplying technical analysis strategies based on RSI from past studies and collecting statistical results.

Various strategies (refer Table 3.3.3) were simulated using Python Scripts to generate a list of trades with Trade Opening and Closing prices.

Strategy	Rules
Buy & Hold	Buy on day N and Sell on day N+10
RSI (7,50)	Buy when RSI (Length 7) crosses above 50 Sell when RSI (Length 7) crosses below 50
RSI (14,50)	Buy when RSI (Length 14) crosses above 50 Sell when RSI (Length 14) crosses below 50
RSI (21,50)	Buy when RSI (Length 21) crosses above 50 Sell when RSI (Length 21) crosses below 50
RSI (7,20/80)	Buy when RSI (Length 7) goes oversold and crosses above 20 Sell when RSI (Length 7) goes overbought and crosses below 80
RSI (14,30/70)	Buy when RSI (Length 14) goes oversold and crosses above 30 Sell when RSI (Length 14) goes overbought and crosses below 70
RSI (21,40/60)	Buy when RSI (Length 21) goes oversold and crosses above 40 Sell when RSI (Length 21) goes overbought and crosses below 60
RSI (14,36/63)	Buy when RSI (Length 14) goes oversold and crosses above 36 Sell when RSI (Length 14) goes overbought and crosses below 63
RSI (14,70/30)	Buy when RSI (Length 14) crosses above 70 Sell when RSI (Length 14) crosses below 30
RSI (7,D)	Buy when price makes lower lows but RSI Length 7) makes higher lows Sell when price makes higher highs but RSI (Length 7) makes lower highs

RSI (14,D)	Buy when price makes lower lows but RSI Length 14) makes higher lows Sell when price makes higher highs but RSI (Length 14) makes lower highs
RSI (21,D)	Buy when price makes lower lows but RSI Length 21) makes higher lows Sell when price makes higher highs but RSI (Length 21) makes lower highs

Table 3.3.3: List of Strategies for Proposed Research

Again, a holding period of 10 days was used to calculate the log returns and once a trade has been opened, all other signals were ignored while in the holding period. Due to this, Combined scenarios resulted in less number of trades as compared to Buy trades + Sell trades. Hence all of these scenarios were considered as individual strategies brining the total number of strategies to 34 which included 1 Buy and Hold strategy and 33 RSI strategies

After calculating the log returns, similars statistics were calculated as the first objective to allow a comparitive analysis for future research.

3.3.4 Interpretation of the Results

In order to achieve the third objective of the study: To offer valuable insights and recommendations for traders and investors in regards to using RSI as an indicator for the NIFTY 50 index.

The results from the second objective were clubbed together into Strategy Groups based on meaningful common characteristics. Additionally, Color Codes and Chart Identifiers were assigned to the Groups and Strategies for ease of readability and better interpretation.

The data presented in Table 3.3.4 provides a summary of all the trading strategies studied in this research, clubbed together into 6 strategy groups. Each strategy group has a set of strategies associated with it, as well as a color code and chart identifiers.

Strategy Group	Strategies	Color Code	Chart Identifiers
Buy & Hold	Buy & Hold	Black	bnh
Centerline Crossover	Buy RSI (7,50) Sell RSI (7,50) Combined RSI (7,50) Buy RSI (14,50) Sell RSI (14,50) Combined RSI (14,50) Buy RSI (21,50) Sell SI (21,50) Combined RSI (21,50)	Marigold	1-9
OS/OB Reversal - Common Levels	Buy RSI (7,20/80) Sell RSI (7,20/80) Combined RSI (7,20/80) Buy RSI (14,30/70) Sell RSI (14,30/70) Combined RSI (14,30/70) Buy RSI (21,40/60) Sell RSI (21,40/60) Combined RSI (21,40/60)	Burgundy	10-18
OS/OB Reversal - Random Levels	Buy RSI (14,36/63) Sell RSI (14,36/63) Combined RSI (14,36/63)	Navy Blue	19-21
OS/OB Reversal - Opposite Levels	Buy RSI (14,70/30) Sell RSI (14,70/30) Combined RSI (14,70/30)	Dark Green	22-24
Divergence	Buy RSI (7, D) Sell RSI (7, D) Combined RSI (7, D) Buy RSI (14, D) Sell RSI (14, D) Combined RSI (14, D) Buy RSI (21, D) Sell RSI (21, D) Combined RSI (21, D)	Red	25-33

Table 3.3.4: Strategy Groups with Color Codes and Chart Idenfiers

The "Buy & Hold" strategy group is represented by the color black, and has the chart identifier "bnh". This strategy involves buying an asset and holding onto it for a period of 10 days rather than actively buying and selling.

The "Centerline Crossover" strategy group is represented by the color marigold, and has chart identifiers "1-9". This strategy group consists of strategies that generate buy and sell signals when the RSI crosses the centerline which is the 50 level of the RSI.

The "OS/OB Reversal - Common Levels" strategy group is represented by the color burgundy, and has chart identifiers "10-18". This strategy group consists of strategies that use RSI to generate buy and sell signals, but use overbought (OB) and oversold (OS) levels. The levels are common values of 20/80, 30/70, and 40/60 depending on the RSI length (7, 14, or 21).

The "OS/OB Reversal - Random Levels" strategy group is represented by the color navy blue, and has chart identifiers "19-21". This strategy group is similar to the "OS/OB Reversal - Common Levels" group but consists of strategies that use randomly overbought and oversold levels of 36/63 using 14 RSI length.

The "OS/OB Reversal - Opposite Levels" strategy group is represented by the color dark green, and has chart identifiers "22-24". This strategy group consists of strategies that generate buy and sell signals with opposite overbought and oversold levels of 70/30 using 14 RSI length.

The "Divergence" strategy group is represented by the color red, and has chart identifiers "25-33". This strategy group consists of strategies that use RSI to detect divergences between the direction of the RSI and the direction of the underlying asset and generates buy and sell signals accordingly.

After this, various bargraphs were created and the data was interpretated to generate useful insights for traders and investors on the use of RSI in the NIFTY 50 index.

3.4 Research Design Limitations

It is important to note that the reseach design for this study has certain limitations that must be taken into consideration when interpreting the findings.

The data used for the study is limited to the NIFTY 50 Index historical prices from the period 2000 to 2021. Though It is the is flagship index for the National Stock Exchange of India, The results of this study may not be consistent when tested on individual stocks.

The research design attempts to eliminate the look-forward bias by using the open prices of the following day instead of the close prices commonly used by other researchers. However, the results may vary when applied in real-life situations due to issues such as delays in market order execution, network problems, system processing issues, and others, as it may not always be possible to obtain the exact open price.

The research desgin uses a 10-day holding period was used in the research to ensure consistency with other studies in the field. However, it is important to keep in mind that different holding periods may result in different findings.

3.9 Chapter Summary

The chapter provided an overview of the research problem in the Indian stock market, where the use of technical analysis and the Relative Strength Index (RSI) is not common among Indian investors and there is limited research on its effectiveness in the Indian market. The purpose of this study is to evaluate the performance of RSI for the NIFTY 50 index compared to a Buy and Hold strategy and to offer valuable insights for traders and investors.

The chapter reiterated the objectives of the study which were analyzing the price movement, gathering performance data through reapplying technical analysis, and offering recommendations for using RSI as an indicator.

The chapter introduced the research design for this study which is devided into four stages. In the first stage, the historical daily close and open prices for the NIFTY 50 index from 1999 to 2020 were collected from National Stock Exchange (NSE) and pre-processed using Python scripts. The second stage involved the Buy and Hold return calculation by simulating a trading account using the historical data and calculating the non-overlapping 10-day log returns. The results were divided into three subsamples and analyzed for stability through multiple statistical tests. The the third stage, the performance of various RSI strategies was analyzed and simulated using Python Scripts and the log returns were calculated. In the fourth stage, the results were grouped into strategy groups and color-coded for ease of interpretation.

The chapter also disccused the research design limitations. The data is limited to NIFTY 50 Index prices from 2000 to 2021 and may not be consistent with individual stocks. The study eliminates look-forward bias by using open prices, but the results may vary due to real-life issues such as market execution delays. The 10-day holding period used in the research is consistent with other studies, but different holding periods may lead to different results.

CHAPTER IV:

RESULTS

Chapter 4 provides the major findings of this research. It starts by accessing the price movements of NIFTY 50 index and finding a reliable measure of the Buy and Hold return that can be used for further comparisons. Finally, the chapter will provide a descriptive analysis for the results of various RSI strategies that were described in the previous chapters.

4.1 Buy & Hold Return of NIFTY 50 Index

This section will take a closer look at the buy and hold return of the NIFTY 50 Index, analyzing the 10-day log return, exploring subsample returns, and evaluating the stability of the 10-day log return. These analyses provide valuable insights into the overall performance of the NIFTY 50 Index and will act as a benchmark return for further comparisons

4.1.1 Descriptive Analysis of the 10-Day Log Return of the NIFTY 50 Index

Table 4.1.1 reports the results of the buy and hold strategy statistical performance. The descriptive analysis shows that the NIFTY 50 index had a total of 522 trades during the period of 2000-2021. The mean log return was found to be 0.004116596604, which indicates that on average, the NIFTY 50 index had a positive return of 0.004116596604 over a 10-day period.

Period	2000-2021	2000-2007	2007-2014	2014-2021
N	522	175	173	172
Mean	0.004116596604	0.005011020077	0.002503425839	0.004542660014

Std	0.0480219062	0.0479107889	0.05441379538	0.03494169186
Max	0.1649565623	0.1142689832	0.1919443752	0.1203969274
Min	-0.3243596344	-0.1626800493	-0.1762152543	-0.204059816
Skewness	-1.524121922	-0.7902516905	-0.2470410421	-1.112798873
Kurtosis	8.657950863	0.8185024258	1.756311178	7.261807736

Table 4.1.1 Performance of Buy & Hold Strategy on NIFTY 50 Index

The standard deviation of the log returns was found to be 0.0480219062, which indicates that the data is relatively dispersed. The maximum log return was 0.1649565623, and the minimum log return was -0.3243596344, which shows that the NIFTY 50 index had a significant range of returns over a 10-day period.

The skewness of the log returns was found to be -1.524121922, which indicates that the data is negatively skewed. This means that the tail on the left side of the distribution is longer or fatter than the tail on the right side. The kurtosis of the log returns was found to be 8.657950863, which indicates that the data is leptokurtic, meaning the peak of the distribution is much taller and sharper than a normal distribution.

4.1.2 Descriptive Analysis of the 10-Day Log Return of the NIFTY 50 Index

The results for Subsample 1 showed that the NIFTY 50 index had 175 trades with a mean log return of 0.005011020077 and a standard deviation of 0.0479107889. The maximum log return was 0.1142689832, while the minimum log return was -0.1626800493. The log returns were negatively skewed with a skewness of -0.7902516905 and a kurtosis of 0.8185024258.

The results for Subsample 2 showed that the NIFTY 50 index had 173 trades with a mean log return of 0.002503425839 and a standard deviation of 0.05441379538. The maximum

log return was 0.1919443752, while the minimum log return was -0.1762152543. The log returns were negatively skewed with a skewness of -0.2470410421 and a kurtosis of 1.756311178.

The results for Subsample 3 showed that the NIFTY 50 index had 172 trades with a mean log return of 0.004542660014 and a standard deviation of 0.03494169186. The maximum log return was 0.1203969274, while the minimum log return was -0.204059816. The log returns were negatively skewed with a skewness of -1.112798873 and a kurtosis of 7.261807736.

In summary, the analysis of the 10-day log return of the NIFTY 50 index by dividing it into three subsamples revealed some interesting insights. The mean log return of the Subsample 1 was relatively higher than Subsample 2 and 3, and the standard deviation of the returns of subsample 2 was relatively higher than subsample 1 and 3. The skewness of the log returns for all subsamples was found to be negative, indicating that the tail on the left side of the distribution is longer than the tail on the right side. The kurtosis of the log returns for Subsample 1 and 2 were found to be relatively low, indicating that the peak of the distribution is less tall and less sharp than a normal distribution, but the kurtosis of the log returns for Subsample 3 was found to be relatively high, indicating that the peak of the distribution is much taller and sharper than a normal distribution.

4.1.3 Evaluating the Stability of 10-Day Log Return

Table 4.1.3 provides the result of statistical testing of the log returns of subsamples compared to the whole period.

Particulars	Subsample 1	Subsample 2	Subsample 3
Two-Tailed-T-Statistics p-value	0.8310067902	0.7283838171	0.9001506831
Wilcoxon-Mann-Whitney p-value	0.3917985911	0.5871949927	0.5247197573
Kruskal-Wallis p-value	0.3916786595	0.5870445716	0.5245768615
Confidence interval	[-0.009115970396414583, 0.007327123449929726]	[-0.007497613432575268, 0.010723954962181804]	[-0.0070889596832722215, 0.006236832862688506]
Power at Significance level 0.1	0.1153041562	0.1494851283	0.1034790541
Power at Significance level 0.05	0.06041604649	0.08430189613	0.05235247623
Power at Significance level 0.01	0.01345291677	0.02188770379	0.01076751609
Power at Significance level 0.001	0.001557963963	0.003050348687	0.001121120567

Table 4.1.3 Results of Statistical Testing of Buy & Hold Strategy on NIFTY 50 Index

The results of the statistical analysis for the comparison of the whole period vs subsample 1 showed that the p-value from the Two-Tailed-T-Statistics test for the comparison of the whole period vs subsample 1 was 0.8310067901543738, indicating that there is no significant difference between the whole period and subsample 1 returns.

Wilcoxon-Mann-Whitney test and Kruskal-Wallis test were 0.3917985910926197 and 0.39167865952400305 respectively, which also indicate that there is no significant difference between the returns. The confidence interval for this comparison was found to

be [-0.009115970396414583, 0.007327123449929726]. The power of the test at different significance levels (0.1, 0.05, 0.01, and 0.001) was found to be 0.1153041562384515, 0.06041604648701432, 0.013452916765124357, and 0.0015579639626690307 respectively.

The results of the statistical analysis for the comparison of the whole period vs subsample 2 showed that the p-value from the Two-Tailed-T-Statistics test was 0.7283838170943551, indicating that there is no significant difference between the whole period and subsample 2 returns. Similarly, the p-value from the Wilcoxon-Mann-Whitney test and Kruskal-Wallis test were 0.5871949927110465 and 0.5870445716367011 respectively, which also indicates that there is no significant difference between the returns. The confidence interval for this comparison was found to be [-0.007497613432575268, 0.010723954962181804]. The power of the test at different significance levels (0.1, 0.05, 0.01, and 0.001) was found to be 0.1494851283478323, 0.08430189613499968, 0.02188770379056603, and 0.00305034868712284 respectively.

Finally, the results of the statistical analysis for the comparison of the whole period vs subsample 3 showed that the p-value from the Two-Tailed-T-Statistics test was 0.9001506830653732, indicating that there is no significant difference between the whole period and subsample 3 returns. Similarly, the p-value from the Wilcoxon-Mann-Whitney test and Kruskal-Wallis test were 0.5247197572612393 and 0.52457686150975 respectively, which also indicates that there is no significant difference between the returns. The confidence interval for this comparison was found to be [-0.0070889596832722215, 0.006236832862688506]. The power of the test at different significance levels (0.1, 0.05, 0.01, and 0.001) was found to be 0.10347905410137673,

0.052352476229614434, 0.010767516086997865, and 0.0011211205671148305 respectively.

4.1.4 Concluding the Benchmark Return

In conclusion, the analysis of the 10-day log return of the NIFTY 50 index during the period 2000-2021 has shown that all three subsamples (2000-2007, 2007-2014, and 2014-2021) have statistically the same return as the whole period at a significance level of at least 95%.

The p-values from the three statistical tests (Two-Tailed-T-Statistics, Wilcoxon-Mann-Whitney, and Kruskal-Wallis) for each comparison were all greater than the significance level of 0.05, indicating that there is no evidence to reject the null hypothesis that the subsample return is the same as the whole period return. The power of the test is also low at all significance levels which further supports the conclusion.

Based on this analysis, it can be inferred that the overall performance of the NIFTY 50 index during the period 2000-2021 has been relatively consistent. Therefore, for further research, the 10-day log return of NIFTY 50 can be considered a reliable measure of the index's performance during this period.

4.2 Results from RSI Strategies

This section presents the results of various technical analysis strategies that utilize the Relative Strength Index (RSI) indicator. The section is broken down into several sub-sections, each of which examines a different RSI strategy. Each sub-section contains a table that presents the performance statistics for the strategy being examined.

4.2.1 Centerline Crossover - RSI(7,50)

Based on the data presented in table 4.3, it appears that the Buy RSI (7,50) strategy has a lower mean return of 0.002464972129, compared to the Buy & Hold strategy. However, it has a slightly higher standard deviation of 0.05012323703.

Strategy	Buy & Hold	Buy RSI (7,50)	Sell RSI (7,50)	Combined RSI (7,50)
N	522	236	231	280
Mean	0.004116596604	0.002464972129	0.0008230761691	0.0009455771712
Std	0.0480219062	0.05012323703	0.04797361402	0.04734066399
Max	0.1649565623	0.1350420972	0.1638993101	0.1378984695
Min	-0.3243596344	-0.1776984907	-0.1203787844	-0.1776984907
Skewness	-1.524121922	-0.9234802516	0.6067098138	-0.3528252575
Kurtosis	8.657950863	1.822548046	0.9520836658	1.353825285

Table 4.2.1 Performance of RSI (7,50) Strategies on NIFTY 50 Index

The Sell RSI (7,50) strategy has a mean return of 0.0008230761691 and a standard deviation of 0.04797361402. The Combined RSI (7,50) strategy has a similar mean return of 0.0009455771712 and a standard deviation of 0.04734066399.

The data also suggests that the Buy & Hold strategy has the highest maximum return of 0.1649565623, while the Sell RSI (7,50) strategy has the second highest maximum return of 0.1638993101 which is very close to Buy & Hold strategy. The Buy RSI (7,50) strategy has the lowest maximum return of 0.1350420972. The Buy & Hold strategy has a slightly higher minimum return than the Buy RSI (7,50) and the Sell RSI (7,50) strategies, at -0.3243596344 compared to -0.1776984907 and -0.1203787844 respectively.

In terms of skewness, the Sell RSI (7,50) strategy has the highest positive skewness of 0.6067098138, while the Buy & Hold strategy has the most negative skewness of -1.524121922. The Buy RSI (7,50) and Combined RSI (7,50) strategies have similar negative skewness values of -0.9234802516 and -0.3528252575, respectively.

Finally, the Buy & Hold strategy has the highest kurtosis of 8.657950863, while the Buy RSI (7,50), Sell RSI (7,50) and Combined RSI (7,50) strategies have much lower kurtosis values of 1.822548046, 0.9520836658 and 1.353825285, respectively.

Overall, the Buy RSI (7,50) strategy appears to have a lower potential for return, but also a lower potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (7,50) strategy also has a lower potential for return but also a higher potential for volatility. The Combined RSI (7,50) strategy has a similar level of return and volatility as the Buy RSI (7,50) strategy.

4.2.2 Centerline Crossover - RSI(14,50)

Based on the data presented in table 4.2.2, it appears that the Buy RSI (14,50) strategy

has a higher mean return of 0.005534238571, but a similar standard deviation to the Buy & Hold strategy.

Strategy	Buy & Hold	Buy RSI (14,50)	Sell RSI (14,50)	Combined RSI (14,50)
N	522	171	169	204
Mean	0.004116596604	0.005534238571	-0.002572784464	-0.0001132693836
Std	0.0480219062	0.04505488437	0.04553181239	0.04533972582
Max	0.1649565623	0.1160328794	0.138056159	0.138056159
Min	-0.3243596344	-0.1708158602	-0.1206676737	-0.1206676737
Skewness	-1.524121922	-0.9926175269	0.3365168081	-0.1378468641
Kurtosis	8.657950863	2.196295423	0.215308681	0.03316228077

Table 4.2.2 Performance of RSI (14,50) Strategies on NIFTY 50 Index

The Sell RSI (14,50) strategy has a negative mean return of -0.002572784464 and a standard deviation of 0.04553181239. The Combined RSI (14,50) strategy has the lowest mean return of -0.0001132693836, but has a similar standard deviation to the Buy & Hold strategy.

The data also suggests that the Buy RSI (14,50) strategy has the highest maximum return of 0.1160328794, while the Sell RSI (14,50) strategy has the lowest maximum return of -0.1206676737. The Buy & Hold strategy has a slightly higher minimum return than the Sell RSI (14,50) strategy, at -0.3243596344 compared to -0.1206676737.

In terms of skewness, the Buy & Hold strategy has the most negative skewness, at -1.524121922, while the Sell RSI (14,50) strategy has a positive skewness of

0.3365168081. The Buy RSI (14,50) and Combined RSI (14,50) strategies have similar skewness values of -0.9926175269 and -0.1378468641, respectively.

Finally, the Buy & Hold strategy also has the highest kurtosis of 8.657950863, while the Buy RSI (14,50) strategy has the second highest kurtosis of 2.196295423. The Sell RSI (14,50) and Combined RSI (14,50) strategies have much lower kurtosis values of 0.215308681 and 0.03316228077, respectively.

Overall, the Buy RSI (14,50) strategy appears to have the highest potential for return, but also a higher potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (14,50) strategy has a lower potential for return but also a lower potential for volatility. The Combined RSI (14,50) strategy has the lowest potential for return and a similar level of volatility as the Buy & Hold strategy.

4.2.3 Centerline Crossover - RSI(21,50)

Based on the data presented in table 4.2.3, it appears that the Buy RSI (21,50) strategy has a lower mean return of 0.001523291051 and a similar standard deviation to the Buy & Hold strategy.

Strategy	Buy & Hold	Buy RSI (21,50)	Sell RSI (21,50)	Combined RSI (21,50)
N	522	131	132	162
Mean	0.004116596604	0.001523291051	0.002817760687	-0.0004095896963
Std	0.0480219062	0.04482530913	0.04791678065	0.04663087932
Max	0.1649565623	0.07702389128	0.138056159	0.138056159

Min	**-0.3243596344**	**-0.1708158602**	**-0.09215198615**	**-0.1193450411**
Skewness	**-1.524121922**	**-0.9301098598**	**0.486478334**	**0.07295324239**
Kurtosis	**8.657950863**	**1.016384983**	**-0.07195293352**	**0.1339360742**

Table 4.2.3 Performance of RSI (21,50) Strategies on NIFTY 50 Index

The Sell RSI (21,50) strategy has a slightly positive mean return of 0.002817760687 and a standard deviation of 0.04791678065. The Combined RSI (21,50) strategy has a negative mean return of -0.0004095896963, and a similar standard deviation to the Buy & Hold strategy.

The data also suggests that the Buy RSI (21,50) strategy has the lowest maximum return of 0.07702389128, while the Sell RSI (21,50) strategy has the highest maximum return of 0.138056159. The Buy & Hold strategy has a slightly higher minimum return than the Combined RSI (21,50) strategy, at -0.3243596344 compared to -0.1193450411.

In terms of skewness, the Buy & Hold strategy has the most negative skewness, at -1.524121922, while the Sell RSI (21,50) strategy has the highest positive skewness of 0.486478334. The Buy RSI (21,50) and Combined RSI (21,50) strategies have similar skewness values of -0.9301098598 and 0.07295324239, respectively.

Finally, the Buy & Hold strategy also has the highest kurtosis of 8.657950863, while the Buy RSI (21,50) strategy has the second highest kurtosis of 1.016384983. The Sell RSI (21,50) and Combined RSI (21,50) strategies have much lower kurtosis values of -0.07195293352 and 0.1339360742, respectively.

Overall, the Buy RSI (21,50) strategy appears to have a lower potential for return but also a lower potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (21,50) strategy has a higher potential for return but also a higher potential for volatility in comparison to Buy RSI (21,50). The Combined RSI (21,50) strategy has the lowest potential for return and a similar level of volatility as the Buy & Hold strategy.

4.2.4 OS/OB Reversal - RSI(7,20/80)

Based on the data presented in table 4.2.4, it appears that the Buy RSI (7,20/80) strategy has a negative mean return of -0.004451949994, and a higher standard deviation of 0.07198086767 compared to the Buy & Hold strategy.

Strategy	Buy & Hold	Buy RSI (7,20/80)	Sell RSI (7,20/80)	Combined RSI (7,20/80)
N	522	63	88	148
Mean	0.004116596604	-0.004451949994	-0.009016366403	-0.006682642518
Std	0.0480219062	0.07198086767	0.04580043621	0.05796080058
Max	0.1649565623	0.08954145983	0.186871482	0.186871482
Min	-0.3243596344	-0.3420137776	-0.1267864407	-0.3420137776
Skewness	-1.524121922	-3.072717248	1.5452815	-1.943261336
Kurtosis	8.657950863	12.72273084	5.372399342	13.41548418

Table 4.2.4 Performance of RSI (7,20/80) Strategies on NIFTY 50 Index

The Sell RSI (7,20/80) strategy has a negative mean return of -0.009016366403 and a standard deviation of 0.04580043621. The Combined RSI (7,20/80) strategy has a similar mean return of -0.006682642518, but has a higher standard deviation of 0.05796080058.

The data also suggests that the Buy RSI (7,20/80) strategy has a maximum return of 0.08954145983, while the Sell RSI (7,20/80) strategy has the highest maximum return of 0.186871482. The Combined RSI (7,20/80) strategy has a similar maximum return of 0.186871482. On the other hand, the Buy RSI (7,20/80) and Combined RSI (7,20/80) strategies have the lowest minimum return of -0.3420137776, while the Sell RSI (7,20/80) strategy has a slightly higher minimum return of -0.1267864407.

In terms of skewness, the Buy RSI (7,20/80) strategy has the most negative skewness, at -3.072717248, while the Sell RSI (7,20/80) strategy has a positive skewness of 1.5452815. The Buy & Hold and Combined RSI (7,20/80) strategies have similar skewness values of -1.524121922 and -1.943261336, respectively.

Finally, the Buy RSI (7,20/80) strategy also has the highest kurtosis of 12.72273084, while the Combined RSI (7,20/80) strategy has the second highest kurtosis of 13.41548418. The Buy & Hold and Sell RSI (7,20/80) strategies have much lower kurtosis values of 8.657950863 and 5.372399342, respectively.

Overall, the Buy RSI (7,20/80) strategy appears to have a lower potential for return and a higher potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (7,20/80) strategy has a lower potential for return and a similar level of volatility as the Buy & Hold strategy. The Combined RSI (7,20/80) strategy has a similar potential for return and a higher level of volatility than the Buy & Hold strategy.

4.2.5 OS/OB Reversal - RSI(14,30/70)

Based on the data presented in table 4.2.5, it appears that the Buy RSI (14,30/70) strategy

has a lower mean return of -0.007289232679 compared to the Buy & Hold strategy. The standard deviation for this strategy is also higher at 0.07950363762.

Strategy	Buy & Hold	Buy RSI (14,30/70)	Sell RSI (14,30/70)	Combined RSI (14,30/70)
N	522	46	89	133
Mean	0.004116596604	-0.007289232679	-0.01147836855	-0.009186984779
Std	0.0480219062	0.07950363762	0.04338808298	0.05794032751
Max	0.1649565623	0.08452732557	0.1532961481	0.1532961481
Min	-0.3243596344	-0.3420137776	-0.1267864407	-0.3420137776
Skewness	-1.524121922	-3.087500718	0.6061281694	-2.432253419
Kurtosis	8.657950863	11.39594019	2.617640717	13.86617112

Table 4.2.5 Performance of RSI (14,30/70) Strategies on NIFTY 50 Index

The Sell RSI (14,30/70) strategy has an even lower mean return of -0.01147836855 and a standard deviation of 0.04338808298. The Combined RSI (14,30/70) strategy has the lowest mean return of -0.009186984779 and a standard deviation of 0.05794032751.

The data also suggests that the Buy RSI (14,30/70) strategy has the lowest maximum return of 0.08452732557, while the Sell RSI (14,30/70) strategy has the highest maximum return of 0.1532961481. The Buy & Hold strategy has a higher minimum return than the Sell RSI (14,30/70) strategy, at -0.3243596344 compared to -0.1267864407.

In terms of skewness, the Buy & Hold strategy has a negative skewness of -1.524121922, while the Buy RSI (14,30/70) and Combined RSI (14,30/70) strategies have even more

negative skewness values of -3.087500718 and -2.432253419 respectively. The Sell RSI (14,30/70) strategy has a positive skewness of 0.6061281694.

Finally, the RSI (14,30/70) strategy has the highest kurtosis of 13.86617112, while the Buy RSI (14,30/70) strategy has the second highest kurtosis of 11.39594019. The Sell RSI (14,30/70) has a much lower kurtosis value of 2.617640717.

Overall, the Buy RSI (14,30/70) strategy appears to have a lower potential for return, but also a higher potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (14,30/70) strategy has an even lower potential for return but also a lower potential for volatility. The Combined RSI (14,30/70) strategy has the lowest potential for return and a higher level of volatility compared to the Buy & Hold strategy.

4.2.6 OS/OB Reversal - RSI(21,60/40)

Based on the data presented in table 4.2.6, it appears that the Buy RSI (21,40/60) strategy has a negative mean return of -0.01891674799, and a much higher standard deviation of 0.1243970077 compared to the Buy & Hold strategy.

Strategy	Buy & Hold	Buy RSI (21,40/60)	Sell RSI (21,40/60)	Combined RSI (21,40/60)
N	522	17	49	66
Mean	0.004116596604	-0.01891674799	-0.01197273727	-0.01376134609
Std	0.0480219062	0.1243970077	0.04723985131	0.07393546092
Max	0.1649565623	0.08452732557	0.1532961481	0.1532961481
Min	-0.3243596344	-0.3420137776	-0.1099320061	-0.3420137776
Skewness	-1.524121922	-2.153228384	0.6001303714	-2.310566722

Kurtosis	**8.657950863**	**3.927635766**	**2.193104539**	**9.475925522**

Table 4.2.6 *Performance* of RSI (21,40/60) Strategies on NIFTY 50 Index

The Sell RSI (21,40/60) strategy has a negative mean return of -0.01197273727 and a standard deviation of 0.04723985131. The Combined RSI (21,40/60) strategy has a similar mean return to the Sell RSI (21,40/60) strategy, with a mean return of -0.01376134609, but has a higher standard deviation of 0.07393546092.

The data also suggests that the Buy RSI (21,40/60) strategy has a lower maximum return of 0.08452732557 compared to the Buy & Hold strategy. The Sell RSI (21,40/60) and Combined RSI (21,40/60) strategies have similar maximum returns of 0.1532961481. The Buy RSI (21,40/60) strategy has the lowest minimum return of -0.3420137776, which is same as the Combined RSI (21,40/60) strategy lowest minimum return of -0.3420137776.

In terms of skewness, the Buy & Hold strategy has a negative skewness, at -1.524121922, while the Buy RSI (21,40/60) and Combined RSI (21,40/60) strategies have the most negative skewness with values of -2.153228384 and -2.310566722, respectively. The Sell RSI (21,40/60) strategy has a positive skewness of 0.6001303714.

Finally, the Buy & Hold strategy has the kurtosis of 8.657950863, while the Sell RSI (21,40/60) strategy has a lower kurtosis value of 2.193104539. The Buy RSI (21,40/60) strategy has the second highest kurtosis of 3.927635766 while the Combined RSI (21,40/60) strategy has the highest kurtosis value of 9.475925522.

Overall, the Buy RSI (21,40/60) strategy appears to have the lowest potential for return and the highest potential for volatility in comparison to the Buy & Hold strategy. The Sell RSI (21,40/60) strategy has a similar potential for return as the Combined RSI (21,40/60) strategy, but with a lower potential for volatility. The Combined RSI (21,40/60) strategy has the lowest potential for return and the highest potential for volatility.

4.2.7 OS/OB Reversal - RSI(14,36/63)

Based on the data presented in table 4.2.7, it appears that the Buy RSI (14,36/63) strategy has a lower mean return of 0.001768217394 and a similar standard deviation to the Buy & Hold strategy. The Sell RSI (14,36/63) strategy has a negative mean return of -0.005353390821 and a standard deviation of 0.04515425048. The Combined RSI (14,36/63) strategy has a negative mean return of -0.004623766666 and a similar standard deviation as the Buy & Hold strategy.

Strategy	Buy & Hold	Buy RSI (14,36/63)	Sell RSI (14,36/63)	Combined RSI (14,36/63)
N	522	97	149	238
Mean	0.004116596604	0.001768217394	-0.005353390821	-0.004623766666
Std	0.0480219062	0.04483046626	0.04515425048	0.04506317164
Max	0.1649565623	0.1059750455	0.2027322841	0.2027322841
Min	-0.3243596344	-0.1337928263	-0.1877106994	-0.1877106994
Skewness	-1.524121922	-0.6244226623	0.5013023887	0.1135999511
Kurtosis	8.657950863	0.2568960359	4.504891487	2.798498558

Table 4.2.7 Performance of RSI (14,36/63) Strategies on NIFTY 50 Index

The data also suggests that the Buy RSI (14,36/63) strategy has the lowest maximum return of 0.1059750455, while the Sell RSI (14,36/63) strategy has the highest maximum

return of 0.2027322841. The Buy & Hold strategy has a higher minimum return than the Combined RSI (14,36/63) strategy, at -0.3243596344 compared to -0.1877106994.

In terms of skewness, the Buy & Hold strategy has the most negative skewness, at -1.524121922, while the Sell RSI (14,36/63) strategy has the highest positive skewness of 0.5013023887 followed by Combined RSI (14,36/63) strategy that has a positive skewness of 0.1135999511. The Buy RSI (14,36/63) strategy has a negative skewness value of -0.6244226623.

Finally, the Buy & Hold strategy also has the highest kurtosis of 8.657950863 followed by Sell RSI (14,36/63) strategy that has a kurtosis value of 4.504891487. The Buy RSI (14,36/63) and Combined RSI (14,36/63) strategies have much lower kurtosis values of 0.2568960359 and 2.798498558, respectively.

Overall, the Buy RSI (14,36/63) strategy appears to have the lowest potential for return, but also a lower potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (14,36/63) strategy has a lower potential for return but also a higher potential for volatility. The Combined RSI (14,36/63) strategy has a negative potential for return and a similar level of volatility as the Buy & Hold strategy.

4.2.8 OS/OB Reversal - RSI(14,70/30)

Based on the data presented in table 4.2.8, it appears that the Buy RSI (14,70/30) strategy has a higher mean return to the Buy & Hold strategy at 0.0051927391, but a slightly lower standard deviation of 0.0427935977. The Sell RSI (14,70/30) strategy also has a higher mean return of 0.005620667696 and a higher standard deviation of

0.05765059896. The Combined RSI (14,70/30) strategy also has a slightly higher mean return of 0.0053801566 and a similar standard deviation to the Buy & Hold strategy.

Strategy	Buy & Hold	Buy RSI (14,70/30)	Sell RSI (14,70/30)	Combined RSI (14,70/30)
N	522	89	46	134
Mean	0.004116596604	0.0051927391	0.005620667696	0.0053801566
Std	0.0480219062	0.0427935977	0.05765059896	0.04833230499
Max	0.1649565623	0.1235467404	0.204059816	0.204059816
Min	-0.3243596344	-0.1856643958	-0.1027406614	-0.1856643958
Skewness	-1.524121922	-1.409157969	1.454137979	0.1697331503
Kurtosis	8.657950863	5.671084724	4.351611455	5.187229538

Table 4.2.8 Performance of RSI (14,70/30) Strategies on NIFTY 50 Index

The data also suggests that the Sell RSI (14,70/30) strategy has the highest maximum return of 0.204059816 which is same for the Combined RSI (14,70/30) strategy, while the Buy RSI (14,70/30) strategy has the lowest minimum return of -0.1856643958 which is also same for the Combined RSI (14,70/30) strategy.

The Buy & Hold strategy has a slightly higher minimum return than the Sell RSI (14,70/30) strategy, at -0.3243596344 compared to -0.1027406614.

In terms of skewness, the Buy & Hold strategy has the most negative skewness, at -1.524121922, while the Sell RSI (14,70/30) and Combined RSI (14,70/30) strategies have a positive skewness of 1.454137979 and 0.1697331503, respectively.. The Buy RSI (14,70/30) strategy has similar skewness value to Buy & Hold strategy at -1.409157969.

Finally, the Buy & Hold strategy also has the highest kurtosis of 8.657950863, while the Buy RSI (14,70/30) strategy has the second highest kurtosis of 5.671084724. The Sell RSI (14,70/30) and Combined RSI (14,70/30) strategies have much lower kurtosis values of 4.351611455 and 5.187229538, respectively.

Overall, the Buy RSI (14,70/30) strategy appears to have a slightly higher potential for return and a similar volatility as the Buy & Hold strategy. The Sell RSI (14,70/30) strategy has a higher potential for return but also a higher potential for volatility. The Combined RSI (14,70/30) strategy has a slightly higher potential for return and a similar level of volatility as the Buy & Hold strategy.

4.2.9 Divergence - RSI(7,D)

Based on the data presented in table 4.2.9, it appears that the Buy RSI (7,D) strategy has a higher mean return of 0.01169170859, compared to the Buy & Hold strategy's mean return of 0.004116596604. The Buy RSI (7,D) strategy also has a higher standard deviation of 0.05933936426, indicating a higher potential for volatility.

Strategy	Buy & Hold	Buy RSI (7,D)	Sell RSI (7,D)	Combined RSI (7,D)
N	522	26	50	76
Mean	0.004116596604	0.01169170859	-0.009097400168	-0.001985336645
Std	0.0480219062	0.05933936426	0.02730765805	0.04194621605
Max	0.1649565623	0.1629335091	0.05600947164	0.1629335091
Min	-0.3243596344	-0.1019567557	-0.07472886786	-0.1019567557
Skewness	-1.524121922	0.9055013977	0.05786393529	1.354900612
Kurtosis	8.657950863	1.986277508	-0.2297799579	4.955565377

Table 4.2.9 Performance of RSI (7,D) Strategies on NIFTY 50 Index

The Sell RSI (7,D) strategy has a negative mean return of -0.009097400168 and a standard deviation of 0.02730765805. The Combined RSI (7,D) strategy has a lower mean return of -0.001985336645, but a higher standard deviation of 0.04194621605.

The data also suggests that the Buy & Hold strategy has the highest maximum return of 0.1649565623 closely followed by Buy RSI (7,D) strategy which has the maximum return of 0.1629335091, while the Sell RSI (7,D) strategy has the lowest maximum return of 0.05600947164. The Buy & Hold strategy has a higher minimum return than the Sell RSI (7,D) strategy, at -0.3243596344 compared to -0.1019567557.

In terms of skewness, the Combined RSI (7,D) has the most positive skewness at 1.354900612 followed by Buy RSI (7,D) strategy has the most positive skewness, at 0.9055013977, while the Sell RSI (7,D) strategy has a slightly lower yet positive skewness of 0.05786393529. The Buy & Hold strategy has a negative skewness value of -1.524121922.

Finally, the Buy & Hold strategy has the highest kurtosis of 8.657950863, while the Combined RSI (7,D) has the second highest kurtosis of 4.955565377. The Sell RSI (7,D) and Buy RSI (7,D) strategy strategies have lower kurtosis values of -0.2297799579 and 1.986277508, respectively.

Overall, the Buy RSI (7,D) strategy appears to have the highest potential for return, but also a higher potential for volatility in comparison to Buy & Hold strategy. The Sell RSI

(7,D) strategy has a lower potential for return but also a lower potential for volatility. The Combined RSI (7,D) strategy has a slightly lower potential for return and a higher level of volatility compared to the Buy & Hold strategy.

4.2.10 Divergence - RSI(14,D)

Based on the data presented in table 4.2.10, it appears that the Buy RSI (14,D) strategy has a significantly higher mean return of 0.0257572648, compared to the Buy & Hold strategy's mean return of 0.004116596604. The standard deviation for the Buy RSI (14,D) strategy is also slightly higher at 0.05405739733.

Strategy	Buy & Hold	Buy RSI (14,D)	Sell RSI (14,D)	Combined RSI (14,D)
N	522	12	22	34
Mean	0.004116596604	0.0257572648	-0.00006328154358	0.009049852458
Std	0.0480219062	0.05405739733	0.03695524177	0.04472151073
Max	0.1649565623	0.1629335091	0.0886917702	0.1629335091
Min	-0.3243596344	-0.03858675575	-0.04587319534	-0.04587319534
Skewness	-1.524121922	1.420044905	0.8482473377	1.346260467
Kurtosis	8.657950863	3.175776919	-0.1520506138	2.754069488

Table 4.2.10 Performance of RSI (14,D) Strategies on NIFTY 50 Index

The Sell RSI (14,D) strategy has a close to zero mean return of -0.000063281543 and a standard deviation of 0.03695524177 followed by the Combined RSI (14,D) strategy that has a similar mean return of 0.009049852458. The Combined RSI (14,D) strategy has a similar standard deviation to the Buy & Hold strategy at 0.04472151073.

In terms of maximum return, the Buy & Hold strategy has the highest at 0.1649565623 closely followed by the Buy RSI (14,D) strategy at 0.1629335091, while the Sell RSI (14,D) strategy has the lowest maximum return of 0.0886917702. The Buy & Hold strategy has a slightly higher minimum return than the Sell RSI (14,D) strategy, at -0.3243596344 compared to -0.04587319534.

In terms of skewness, the Buy & Hold strategy has the most negative skewness, at -1.524121922, while the Buy RSI (14,D) strategy has a positive skewness of 1.420044905. The Sell RSI (14,D) and Combined RSI (14,D) strategies have similar positive skewness values of 0.8482473377 and 1.346260467, respectively.

Finally, the Buy & Hold strategy also has the highest kurtosis of 8.657950863, while the Buy RSI (14,D) strategy has the second highest kurtosis of 3.175776919. The Sell RSI (14,D) and Combined RSI (14,D) strategies have much lower kurtosis values of -0.1520506138 and 2.754069488, respectively.

Overall, the Buy RSI (14,D) strategy appears to have the highest potential for return, but also a higher potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (14,D) strategy has a lower potential for return but also a lower potential for volatility. The Combined RSI (14,D) strategy has a higher potential for return than the Buy & Hold strategy but similar level of volatility.

4.2.11 Divergence - RSI(21,D)

Based on the data presented in table 4.2.11, it appears that the Buy RSI (21,D) strategy has a significantly higher mean return of 0.02587733329, compared to the other

strategies. However, it also has a smaller sample size (N=4) and a lower standard deviation of 0.0247533813.

Strategy	Buy & Hold	Buy RSI (21,D)	Sell RSI (21,D)	Combined RSI (21,D)
N	522	4	20	24
Mean	0.004116596604	0.02587733329	-0.00177163989	0.002836522306
Std	0.0480219062	0.0247533813	0.04360037257	0.04196544437
Max	0.1649565623	0.05195464155	0.0886917702	0.0886917702
Min	-0.3243596344	-0.004676693843	-0.08426290278	-0.08426290278
Skewness	-1.524121922	-0.4099640845	0.2619423754	0.02351096715
Kurtosis	8.657950863	-1.394359081	-0.3381512536	-0.4240298033

Table 4.2.11 Performance of RSI (21,D) Strategies on NIFTY 50 Index

The Sell RSI (21,D) strategy has a negative mean return of -0.00177163989 and a standard deviation of 0.04360037257. The Combined RSI (21,D) strategy has a higher mean return of 0.002836522306, but a similar standard deviation to the Buy & Hold strategy.

The data also suggests that the Buy RSI (21,D) strategy has the highest maximum return of 0.05195464155, while the Sell RSI (21,D) strategy has the lowest maximum return of -0.08426290278. The Buy & Hold strategy has a slightly higher minimum return than the Sell RSI (21,D) strategy, at -0.3243596344 compared to -0.08426290278.

In terms of skewness, the Buy & Hold strategy has the most negative skewness, at -1.524121922, while the Sell RSI (21,D) strategy has a positive skewness of

0.2619423754. The Buy RSI (21,D) and Combined RSI (21,D) strategies have similar skewness values of -0.4099640845 and 0.02351096715, respectively.

Finally, the Buy & Hold strategy also has the highest kurtosis of 8.657950863, while the Buy RSI (21,D) strategy has the second lowest kurtosis of -1.394359081. The Sell RSI (21,D) and Combined RSI (21,D) strategies have much lower kurtosis values of -0.3381512536 and -0.4240298033, respectively.

Overall, the Buy RSI (21,D) strategy appears to have the highest potential for return, but also a smaller sample size and a lower potential for volatility in comparison to Buy & Hold strategy. The Sell RSI (21,D) strategy has a lower potential for return but also a similar level of volatility to the Buy & Hold strategy. The Combined RSI (21,D) strategy has a slightly higher potential for return and a similar level of volatility as the Buy & Hold strategy.

4.3 Chapter Summary

This chapter presented the results of various strategies used to access the performance of the NIFTY 50 index and the RSI indicator. The results were in the form of statistical tables which included parameters such as the Number of trades, Mean log return, Standard deviation, Maximum and Minimum return, along with the Skewness and Kurtosis of the returns.

The results indicate that the Buy and Hold return of the NIFTY 50 index during the period of 2000-2021 is relatively consistent and can be used as a benchmark return for further comparisons.

The various RSI strategies analyzed in this chapter provided varying results in terms of potential for return and volatility which we shall discuss in the next chapter.

CHAPTER V:

DISCUSSION & CONCLUSION

Chapter 5 presents a comprehensive discussion and conclusion of the research findings presented in the previous chapters. It begins by providing a summary of the results and dive straight into their in-depth interpretation. Furthermore, the chapter presents the implications of the research findings for investors and practitioners in the field of financial decision-making. Finally, the chapter provides recommendations for future research in the area.

5.1 Summary of the Results

The research evaluated 33 RSI strategies along with the Buy & Hold strategy, but discussing each strategy individually can be confusing. To make the results more meaningful and easier to understand, the strategies were grouped into 6 strategy groups based on common characteristics, and color codes and chart identifiers were assigned to the groups and strategies for improved readability. Table 5.1 provides a summary of all the trading strategies performance studied in this research, grouped into the 6 strategy groups. The data has been rounded up to 3 decimal points.

Strategy	Identifier	N	Mean	Std	Max	Min	Skewness	Kurtosis
Buy & Hold	**bnh**	**522**	**0.004**	**0.048**	**0.165**	**-0.324**	**-1.524**	**8.658**
Buy RSI (7,50)	**1**	**236**	**0.002**	**0.050**	**0.135**	**-0.178**	**-0.923**	**1.823**
Sell RSI (7,50)	**2**	**231**	**0.001**	**0.048**	**0.164**	**-0.120**	**0.607**	**0.952**
Combined RSI (7,50)	**3**	**280**	**0.001**	**0.047**	**0.138**	**-0.178**	**-0.353**	**1.354**

Buy RSI (14,50)	**4**	**171**	**0.006**	**0.045**	**0.116**	**-0.171**	**-0.993**	**2.196**
Sell RSI (14,50)	**5**	**169**	**-0.003**	**0.046**	**0.138**	**-0.121**	**0.337**	**0.215**
Combined RSI (14,50)	**6**	**204**	**0.000**	**0.045**	**0.138**	**-0.121**	**-0.138**	**0.033**
Buy RSI (21,50)	**7**	**131**	**0.002**	**0.045**	**0.077**	**-0.171**	**-0.930**	**1.016**
Sell RSI (21,50)	**8**	**132**	**0.003**	**0.048**	**0.138**	**-0.092**	**0.486**	**-0.072**
Combined RSI (21,50)	**9**	**162**	**0.000**	**0.047**	**0.138**	**-0.119**	**0.073**	**0.134**
Buy RSI (7,20/80)	**10**	**63**	**-0.004**	**0.072**	**0.090**	**-0.342**	**-3.073**	**12.723**
Sell RSI (7,20/80)	**11**	**88**	**-0.009**	**0.046**	**0.187**	**-0.127**	**1.545**	**5.372**
Combined RSI (7,20/80)	**12**	**148**	**-0.007**	**0.058**	**0.187**	**-0.342**	**-1.943**	**13.415**
Buy RSI (14,30/70)	**13**	**46**	**-0.007**	**0.080**	**0.085**	**-0.342**	**-3.088**	**11.396**
Sell RSI (14,30/70)	**14**	**89**	**-0.011**	**0.043**	**0.153**	**-0.127**	**0.606**	**2.618**
Combined RSI (14,30/70)	**15**	**133**	**-0.009**	**0.058**	**0.153**	**-0.342**	**-2.432**	**13.866**
Buy RSI (21,40/60)	**16**	**17**	**-0.019**	**0.124**	**0.085**	**-0.342**	**-2.153**	**3.928**
Sell RSI (21,40/60)	**17**	**49**	**-0.012**	**0.047**	**0.153**	**-0.110**	**0.600**	**2.193**
Combined RSI (21,40/60)	**18**	**66**	**-0.014**	**0.074**	**0.153**	**-0.342**	**-2.311**	**9.476**
Buy RSI (14,36/63)	**19**	**97**	**0.002**	**0.045**	**0.106**	**-0.134**	**-0.624**	**0.257**
Sell RSI (14,36/63)	**20**	**149**	**-0.005**	**0.045**	**0.203**	**-0.188**	**0.501**	**4.505**
Combined RSI (14,36/63)	**21**	**238**	**-0.005**	**0.045**	**0.203**	**-0.188**	**0.114**	**2.798**

Buy RSI (14,70/30)	**22**	**89**	**0.005**	**0.043**	**0.124**	**-0.186**	**-1.409**	**5.671**
Sell RSI (14,70/30)	**23**	**46**	**0.006**	**0.058**	**0.204**	**-0.103**	**1.454**	**4.352**
Combined RSI (14,70/30)	**24**	**134**	**0.005**	**0.048**	**0.204**	**-0.186**	**0.170**	**5.187**
Buy RSI (7,D)	**25**	**26**	**0.012**	**0.059**	**0.163**	**-0.102**	**0.906**	**1.986**
Sell RSI (7,D)	**26**	**50**	**-0.009**	**0.027**	**0.056**	**-0.075**	**0.058**	**-0.230**
Combined RSI (7,D)	**27**	**76**	**-0.002**	**0.042**	**0.163**	**-0.102**	**1.355**	**4.956**
Buy RSI (14,D)	**28**	**12**	**0.026**	**0.054**	**0.163**	**-0.039**	**1.420**	**3.176**
Sell RSI (14,D)	**29**	**22**	**0.000**	**0.037**	**0.089**	**-0.046**	**0.848**	**-0.152**
Combined RSI (14,D)	**30**	**34**	**0.009**	**0.045**	**0.163**	**-0.046**	**1.346**	**2.754**
Buy RSI (21,D)	**31**	**4**	**0.026**	**0.025**	**0.052**	**-0.005**	**-0.410**	**-1.394**
Sell RSI (21,D)	**32**	**20**	**-0.002**	**0.044**	**0.089**	**-0.084**	**0.262**	**-0.338**
Combined RSI (21,D)	**33**	**24**	**0.003**	**0.042**	**0.089**	**-0.084**	**0.024**	**-0.424**

Table 5.1: Summary of the Results of All Strategies (Rounded Up To 3 Decimal Points)

5.2 Discussion of Results

This section discusses the results presented in Table 5.1 by using Bar Charts to compare the statistical measures studied in this research being the Number of trades, Mean log return, Std. of the log returns, Maximum log return, Minimum log return, Skewness of log returns and the Kurtosis of log returns.

5.2.1 Number of Trades

Number of Trades (N) is important because a higher number of trades may indicate that a strategy is more active and may be generating more opportunities for profits.

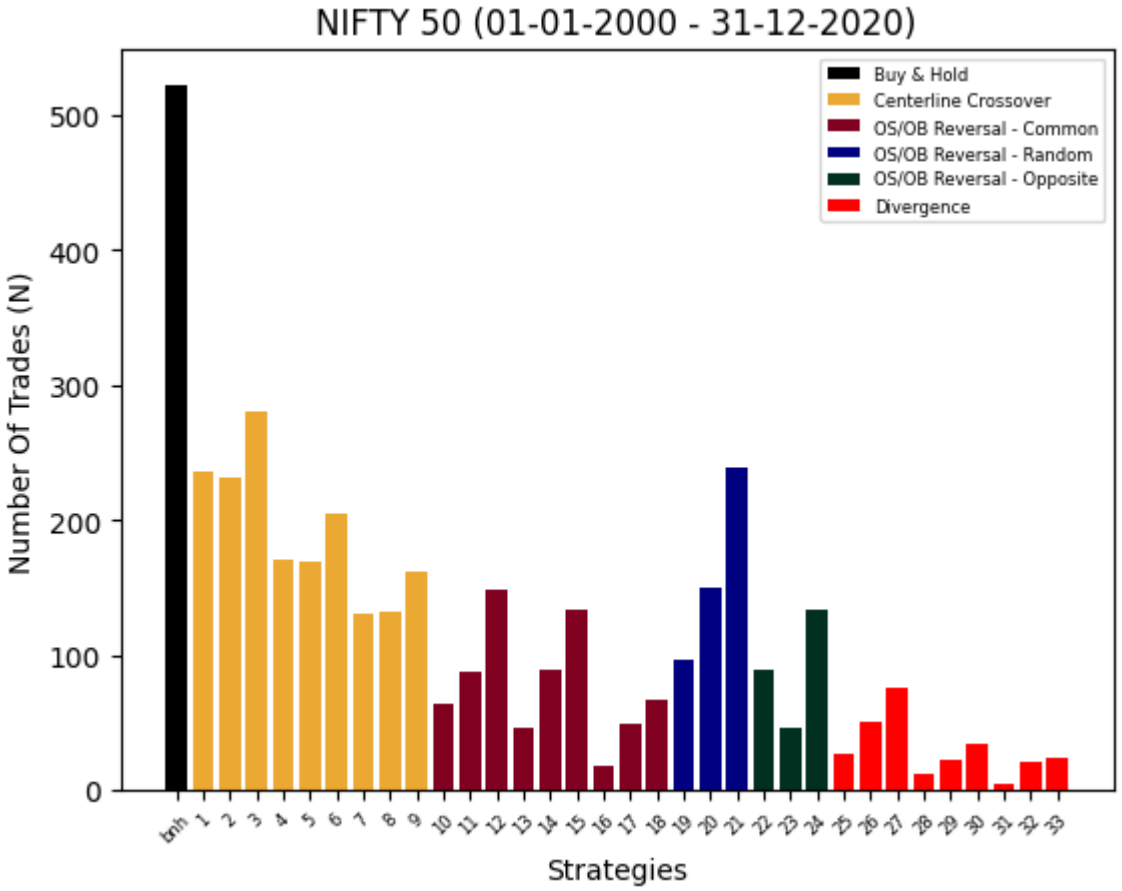

Figure 5.2.1: Bar Chart Comparison of Number of Trades For B&H and RSI Strategies

The data presented in Figure 5.2.1, the Buy and Hold strategy (Chart Identifier "bnh") resulted in a total of 522 trades. Among the 33 RSI strategies, "Combined RSI (7,50)" (Chart Identifier 3) resulted in the greatest number of trades which was 280.

The Centerline Crossover strategies generally resulted in more trades when compared to Oversold / Overbought and Divergence strategies.

It is also important to note that the Divergence strategies resulted in the lowest number of trades in comparison to other strategies with the "Buy RSI (21,D)" strategy (Chart Identifier 31) resulting in only 4 trades in the whole 21 years period.

We can also observe that the number of trades decreases as the length of RSI increases. For example, "Buy RSI (7, 50)" (Chart Identifier 1) and "Sell RSI (7, 50)" (Chart Identifier 2) resulted in 236 and 231 trades, respectively, while "Buy RSI (21, 50)" (Chart Identifier 7) and "Sell RSI (21, 50)" (Chart Identifier 8) resulted in only 131 and 132 trades, respectively.

5.2.2 Mean Log Return

The mean log return is important because it provides a measure of the average return of a trading strategy and helps us to determine which may be more profitable that others.

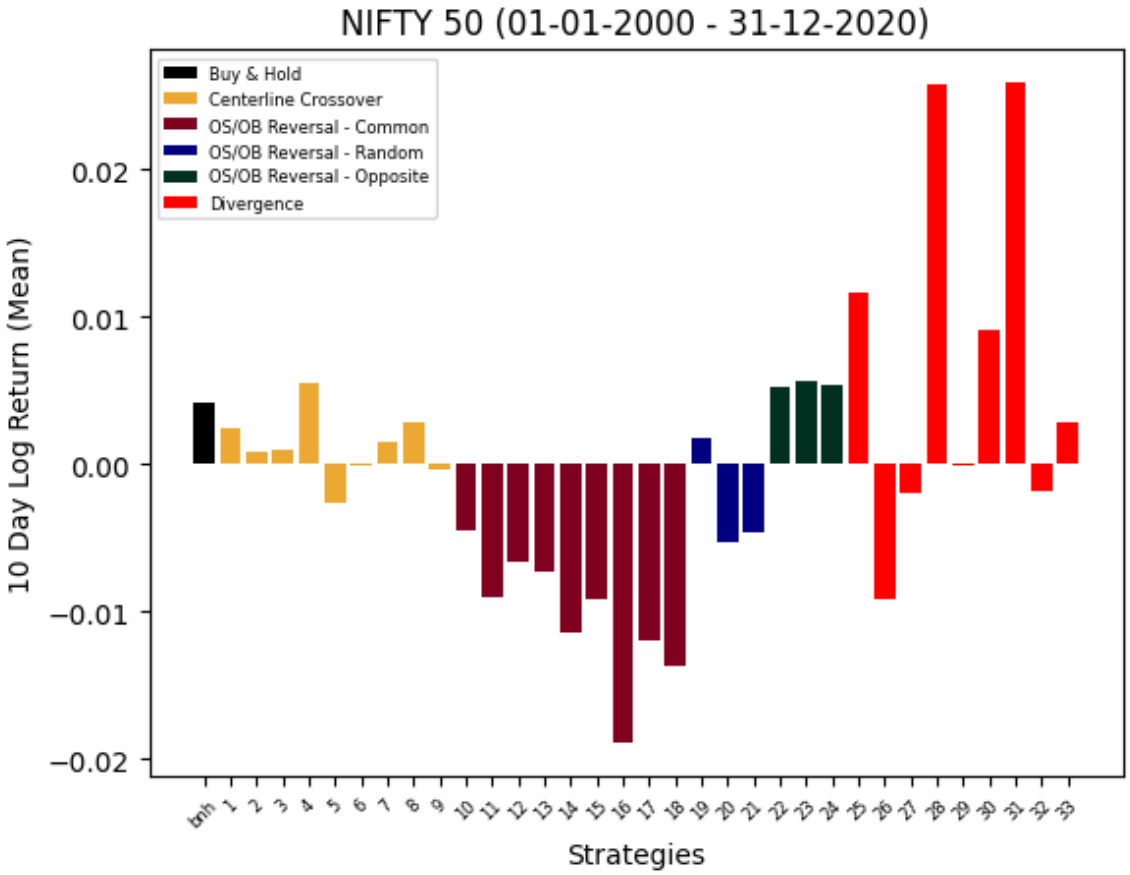

Figure 5.2.2: Bar Chart Comparison of Mean Log Return For B&H and RSI Strategies

The data presented in Figure 5.2.2, the mean of 10 day log return for the Buy and Hold strategy (Chart Identifier "bnh") is 0.004116596604. Among the 33 RSI strategies, "Buy RSI (21,D)" (Chart Identifier 31) has the highest mean of 0.02587733329.

It can be noted that Divergence strategies generally produce the higher mean log returns when compared to all other strategies.

The Buy Divergence strategies generally result in a higher mean return as compared to Sell Divergence strategies as the top three strategies in terms of the highest mean return

are "Buy RSI (21,D)" (Chart Identifier 31), "Buy RSI (14,D)" (Chart Identifier 28) and "Buy RSI (7,D)" (Chart Identifier 25) generating a mean return of 0.02587733329, 0.0257572648 and 0.01169170859 respectively.

It can be observed that all the strategies in the Oversold / Overbought Reversal - Opposite Levels group resulted in higher mean returns in comparison to Buy and Hold where "Sell RSI (14,70/30)" (Chart Identifier 23), "Combined RSI (14,70/30)" (Chart Identifier 24) and "Buy RSI (14,70/30)" (Chart Identifier 22) generated 0.005620667696, 0.0053801566 and 0.0051927391 respectively.

The only Centerline Crossover strategy that generated a higher mean log return in comparison to Buy and Hold strategy was "Buy RSI (14,50)" (Chart Identifier 4) which generated a return of 0.005534238571.

In addition, we can observe that the RSI Oversold / Overbought Strategies at the 21 RSI length perform worst as the strategies "Sell RSI (21,40/60)" (Chart Identifier 18), "Combined RSI (21,40/60)" (Chart Identifier 17) and "Buy RSI (21,40/60)" (Chart Identifier 16) all resulted in the worst mean return of -0.01197273727, -0.01376134609 and -0.01891674799 respectively.

5.2.3 Standard Deviation

The standard deviation of log return is important because it provides a measure of the volatility or risk associated with a trading strategy. A higher standard deviation indicates a more volatile or risky strategy, while a lower standard deviation indicates a less volatile or risky strategy.

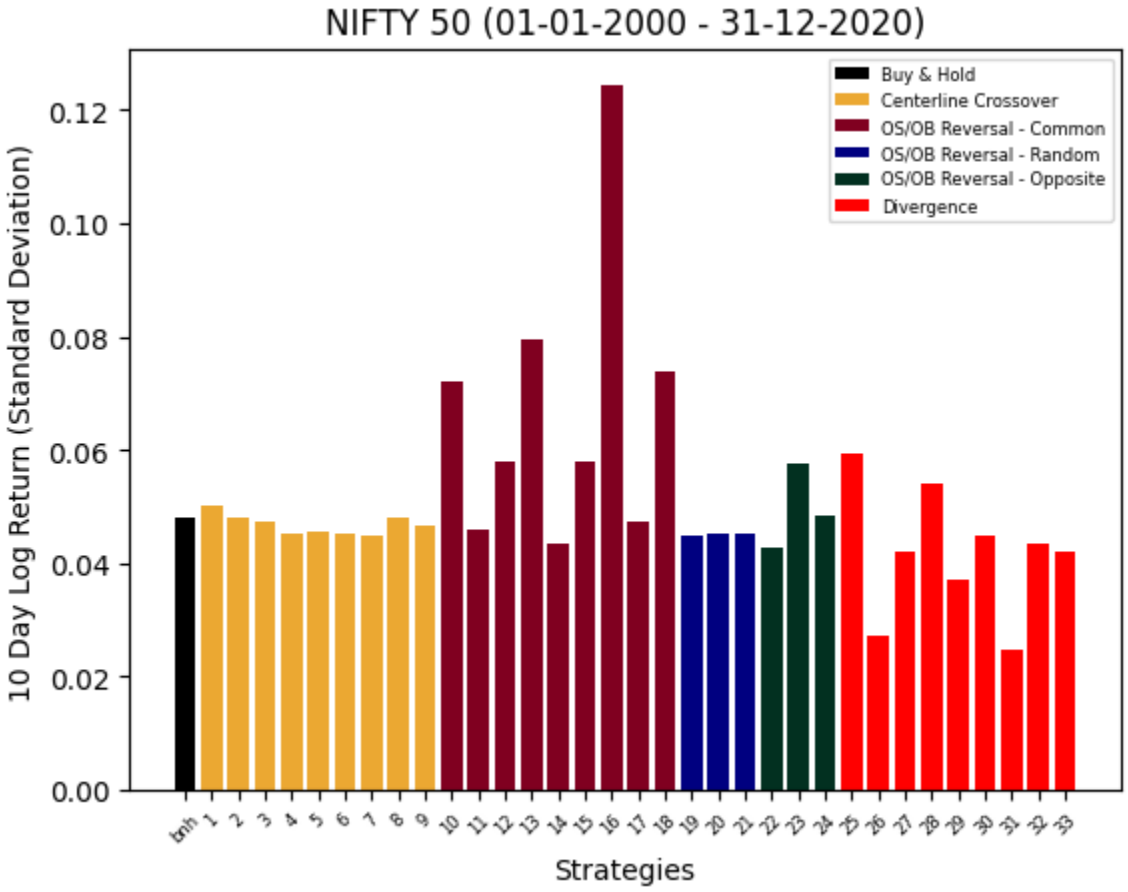

Figure 5.2.3 Bar Chart Comparison of Std. of Log Returns For B&H and RSI Strategies

The data presented in Figure 5.2.3, the standard deviation of 10 day log return for the Buy and Hold strategy (Chart Identifier "bnh") is 0.0480219062. Among the 33 RSI strategies, ""Buy RSI (21,40/60)" (Chart Identifier 16) has the highest standard deviation of 0.1243970077.

We can observe that the standard deviation of most Buy strategies is higher than the Buy and Hold strategy. This indicates that Buy RSI strategies may have been more volatile than the Buy and Hold strategy.

It can also be noted that the standard deviation of most Sell strategies is Lower than the Buy and Hold strategy. This indicates that Sell RSI strategies may have been less volatile than the Buy and Hold strategy.

The data also shows that all Divergence strategies produce a lower standard deviation with the exception of "Buy RSI (7,D)" (Chart Identifier 25) and "Buy RSI (14,D)" (Chart Identifier 28) with the standard deviation of 0.05933936426 and 0.05405739733 respectively..

5.2.4 Maximum Log Return

The maximum log return is important because it provide a measure of the potential upside of a trading strategy that helps in determination of the target profit level for the trade.

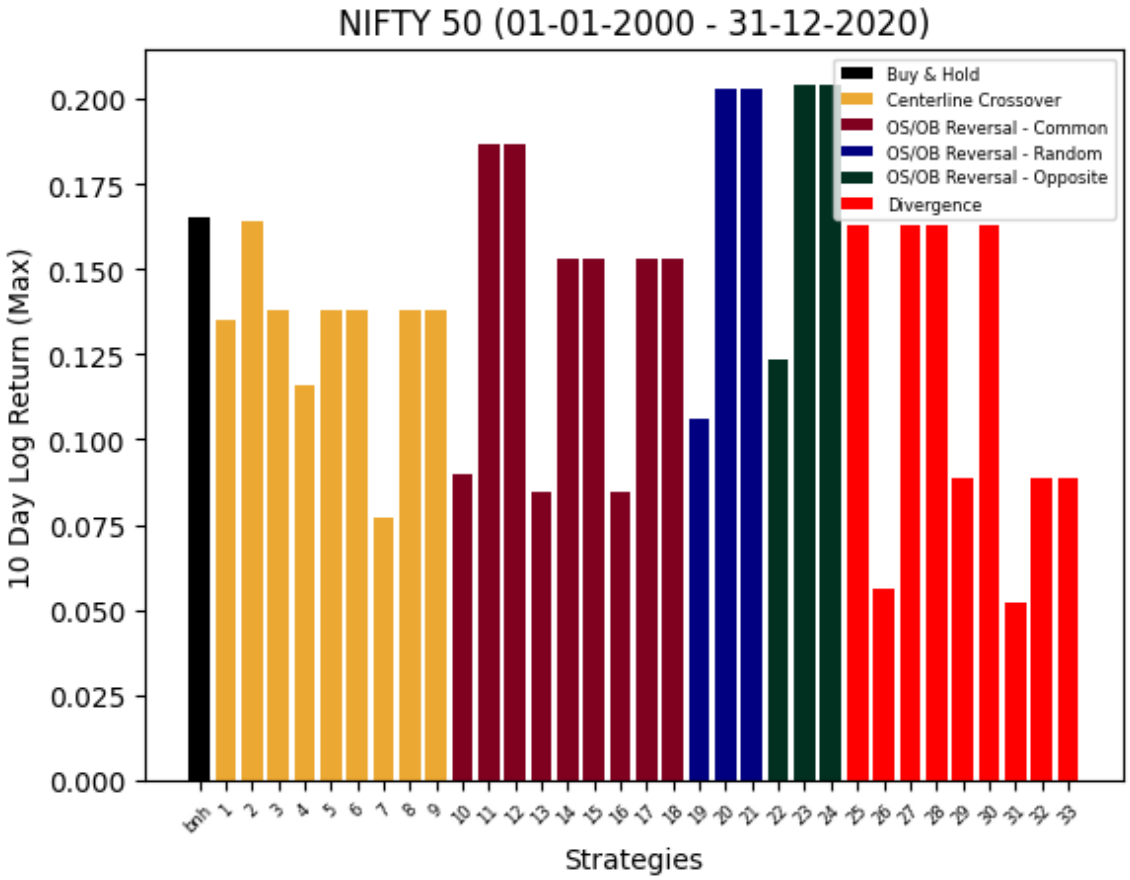

Figure 5.2.4: Bar Chart Comparison of Maximum Log Return For B&H and RSI Strategies

The data presented in Figure 5.2.4, the maximum return of the Buy and Hold strategy (Chart Identifier "bnh") is 0.1649565623. Among the 33 RSI strategies, "Combined RSI (14,70/30)" (Chart Identifier 24) has the highest return at 0.204059816 which was likely produced by a Sell signal as the same return can be seen with the "Sell RSI (14,70/30)" (Chart Identifier 23)

The highest return was closely followed by "Combined RSI (14,36/63)" (Chart Identifier 21) at 0.2027322841 which was again generated by a Sell signal which can be explained with the same return generated by "Sell RSI (14,36/63)" (Chart Identifier 20)

It can be observed that all Buy strategies resulted in a lower maximum return in comparison to Buy and Hold strategy

The data also shows that Divergence strategies "Buy RSI (7,D)" (Chart Identifier 25), "Combined RSI (7,D)"(Chart Identifier 27), "Buy RSI (14,D)" (Chart Identifier 28) and "Combined RSI (14,D)" (Chart Identifier 30) generated the maximum log return of 0.1629335091 which implies that it may have been generated by the same Buy signal present in all the strategies. This return is also very close to Buy and Hold strategy.

5.2.5 Minimum Log Return

The minimum log return is important because it provide a measure of the potential downside of a trading strategy that helps in determination of the stop loss level for the trade.

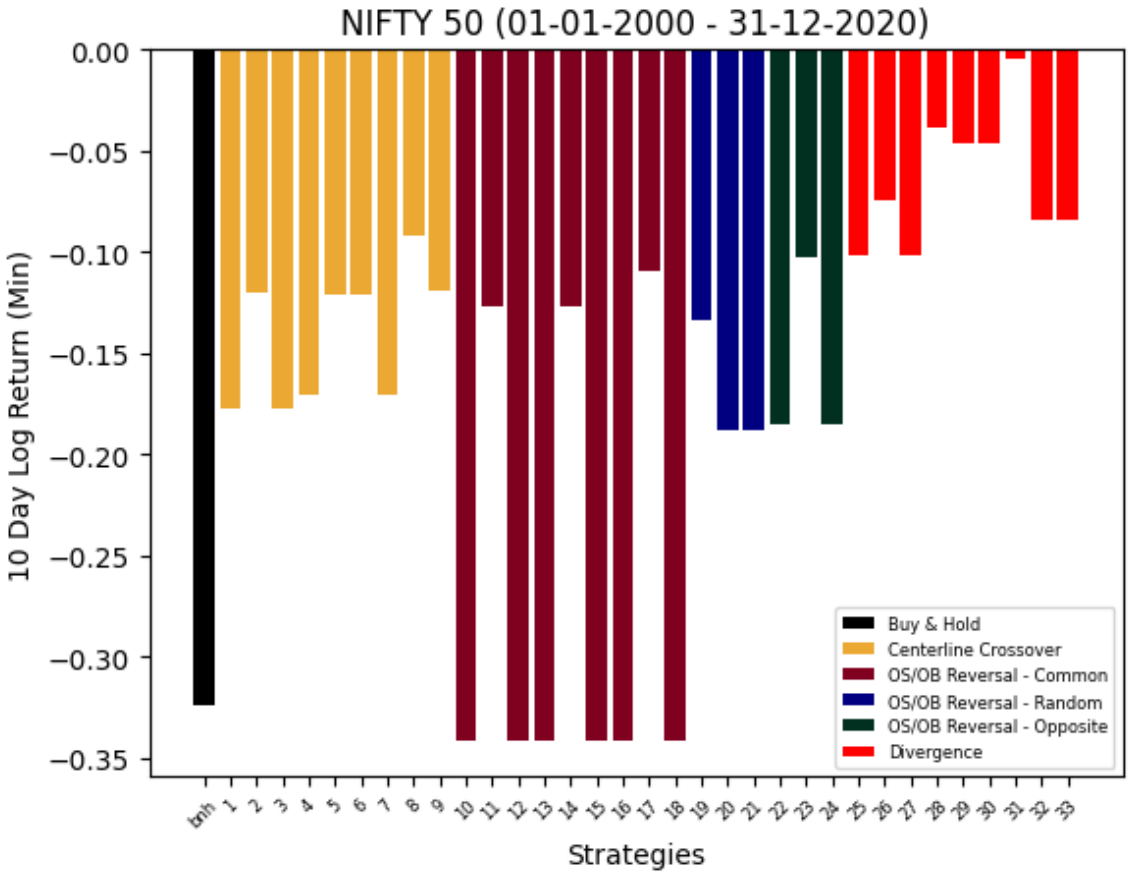

Figure 5.2.5: Bar Chart Comparison of Minimum Log Return For B&H and RSI Strategies

The data presented in Figure 5.2.5, the minimum log return of the Buy and Hold strategy (Chart Identifier "bnh") is -0.3243596344.

Among the 33 RSI strategies, "Buy RSI (7,20/80)" (Chart Identifier 10), "Combined RSI (7,20/80)" (Chart Identifier 12), "Buy RSI (14,30/70)" (Chart Identifier 13), "Combined RSI (14,30/70)" (Chart Identifier 15), "Buy RSI (21,40/60)" (Chart Identifier 16) and "Combined RSI (21,40/60)" (Chart Identifier 18) strategies generated the minimum log return of -0.3420137776. This also indicates that it may have been generated by the same

Buy signal present in all the strategies. This return is close but slightly less than Buy and Hold strategy minimum log return.

It can be observed that all Divergence strategies performed better in comparison all other strategies including Buy and Hold strategy which means that Divergence strategies might be more profitable and safer.

5.2.6 Skewness

The skewness of log returns is important because it provide a measure of asymmetry of the distribution which can be used to determine whether a strategy is more likely to generate positive returns or negative hence is useful in risk management decisions.

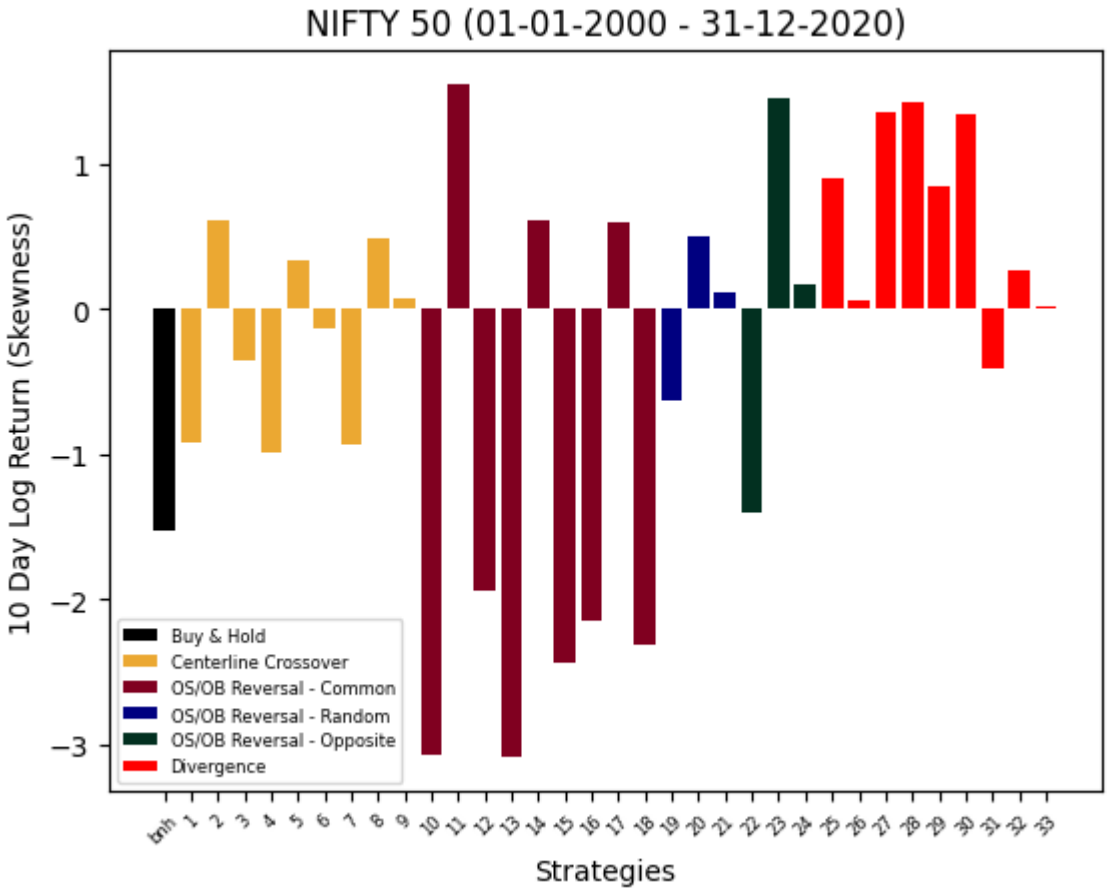

Figure 5.2.6: Bar Chart Comparison of Skewness of Log Return For B&H and RSI Strategies

The data presented in Figure 5.2.6, the skewness value for the Buy and Hold strategy (Chart Identifier "bnh") is -1.524121922, indicating a slight negative skewness. This means that there is a slight bias towards negative returns, but the distribution is still relatively symmetric.

All Divergence strategies are positively skewed with the exception of "Buy RSI (21,D)" (Chart Identifier "31"). This suggests that these strategies tend to generate positive returns more often than negative returns. This implies that Divergence strategies might be relatively safer than the Buy and Hold strategy.

It can also be observed that all Sell strategies are positively skewed and all Non-Divergence Buy strategies are negatively skewed.

5.2.7 Kurtosis

The kurtosis of log returns is important because it provide a measure of peakedness of the distribution. A high kurtosis can indicate that the strategy is more risky due to the presence of more extreme returns, while a low kurtosis can indicate that the strategy is less risky due to the absence of extreme returns.

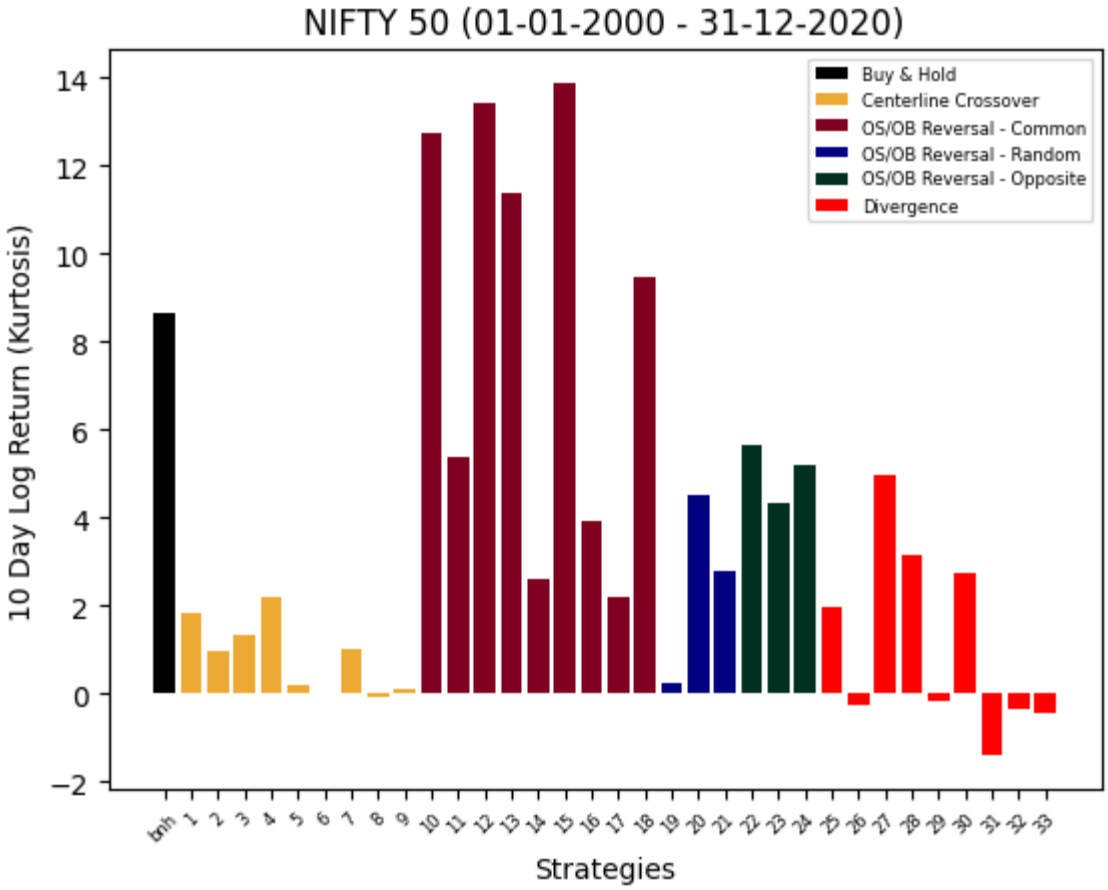

Figure 5.2.7: Bar Chart Comparison of Kurtosis of Log Return For B&H and RSI Strategies

The data presented in Figure 5.2.7, the kurtosis value for the Buy and Hold strategy (Chart Identifier "bnh") is 8.657950863, indicating that the distribution of returns for the Buy and Hold strategy has a higher frequency of extreme values compared to a normal distribution, which is commonly referred to as "leptokurtic" distribution.

All Divergence Sell strategies show Negative Kurtosis values which could imply that these strategies tend to generate more consistent returns, with fewer large gains or losses.

The same pattern can be seen with All the strategies of Divergence calculated at the RSI length of 21 again indicating that these strategies tend to generate more consistent returns, with fewer large gains or losses.

It can also be observed that the Oversold / Overbought Reversal - Usual Levels generally resulted in a higher Kurtosis value indicating that these strategies might not be consistent when compared to other strategies.

5.3 Conclusion & Insights

In this study, we aimed to answer the research question: How does RSI perform as a trading signal for the NIFTY 50 index, compared to a Buy and Hold strategy?

To accomplish this, we had three objectives: to study the price movement of the NIFTY 50 index and to access its Buy and Hold return, to retest various technical analysis strategies based on RSI from past studies, and to provide insights and implications for traders and investors on using RSI as an indicator for the NIFTY 50 index.

In order to accomplish the first objective, an analysis of the 10-day log return of the NIFTY 50 index was conducted for the period 2000-2021, revealing consistent overall performance of the index. Statistical tests showed that the returns for the subsamples (2000-2007, 2007-2014, and 2014-2021) were not significantly different from the whole period return at a 95% significance level. This suggests that the 10-day log return of NIFTY 50 can be considered a reliable benchmark for the index's performance during this period and can be used as a reference for future comparisons.

In order to accomplish the second objective, 33 RSI strategies were simulated and the statistical outcomes were outlined in chapter 4, along with Table 5.1 in this chapter offering a condensed overview of those results.

In order to accomplish the third objective, Results from chapter 4 were analysed and interpreted in a comprehensive and in-depth manner. The use of Strategy Groups, Color Codes, and Chart Identifiers helped to clearly present and compare the statistical measures studied in this research. The use of Bar Charts to compare the Number of

trades, Mean log return, Std. of the log returns, Maximum log return, Minimum log return, Skewness of log returns, and the Kurtosis of log returns helped in deriving meaningful and actionable insights for traders and investors.

In essence, The results of the study showed that the RSI can be an effective tool in identifying potential trading opportunities, but the performance of the indicator depends on the specific settings used. For example, when using a 14-period RSI with overbought and oversold levels set at 70/30, the strategy resulted in positive returns. However, when using a 7-period RSI with overbought and oversold levels set at 50/50, the strategy resulted in negative returns.

Additionally, the study found that the RSI performed better when used in divergence scenarios, with positive returns seen when using the indicator with in buy decisions. When using it for sell decisions, the results were negative.

It is also important to note that the one should not follow the herd and go for industry's most popular strategies like the OS/OB Reversal at usual levels as this study showed that in NIFTY 50 index, all the scenarios with this strategy group resulted in negative return.

Finally, to answer the question How does RSI perform as a trading signal for the NIFTY 50 index, compared to a Buy and Hold strategy?

RSI has the potential to outperform a Buy and Hold strategy in many aspects including the average return, maximum potential, lesser risk, as well as better stability and the results of this study especially the results from RSI Divergence clearly show that it is

better to use RSI while making buy decisions rather than buying at random times. However RSI should be used with a stop loss and other risk management techniques as it has a varying degree of standard deviation, skewness and kurtosis for each strategy. It is also better to backtest the data using specific settings first before making investment decisions.

5.4 Limitations & Future Opportunities

The results presented in this study have certain limitations that should be acknowledged in order to fully understand and interpret the findings.

The research was limited to one dataset, the NIFTY 50 Index historical price data for the period of 2000 to 2021. This may limit the generalizability of the findings, as different assets may produce different results. Therefore, it is important to back test the data on a different asset before considering the results of this research to be true.

The research tried to avoid any look-forward bias by considering the open prices of the next day when a signal was generated instead of using the close prices as done by most researchers. However, due to delays in broker or exchange market order execution, network issues, system processing issues, and other factors, results might vary when used in real life as getting the exact open price may not be possible all the times.

The research used a 10-day holding period to keep the findings consistent and comparable with other studies in the same space. However, different holding periods might generate different results.

The research did not consider the costs associated with trading including the broker's commission, the exchange fees, the stamp duty and other taxes, which might lead to different results when tested with real money.

The research did not test the RSI strategy results statistically using parametric or non-parametric tests as the results were generated using simulations. However, future researchers can consider running such tests.

Finally, the research included some strategies with very small sample sizes like the RSI(21,D) which has a sample size of 4. The results of such strategies might not be absolutely correct and should be considered with caution.

Despite the limitations outlined in this section, the research presented in this study provides valuable insights and potential avenues for further exploration in the field of financial asset management. Further research, building on the findings and methods presented here, has the potential to strengthen and deepen our understanding of the strategies and techniques discussed.

5.5 Chapter Summary

The chapter presented a comprehensive discussion and conclusion of the research findings. It summarized the results of the research and provided in-depth interpretation. The chapter also discusses the implications of the research findings for investors and practitioners in the field of financial decision-making and provides recommendations for future research in the area.

The chapter evaluated 33 RSI strategies along with the Buy & Hold strategy and grouped the strategies into 6 strategy groups based on common characteristics. The chapter also used Bar Charts to compare the statistical measures studied in the research, including the

number of trades, mean log return, standard deviation of log returns, maximum log return, minimum log return, skewness of log returns, and kurtosis of log returns.

The research aimed to answer the question: How does RSI perform as a trading signal for the NIFTY 50 index compared to a Buy and Hold strategy? The study found that RSI has the potential to outperform a Buy and Hold strategy in many aspects, including average return, maximum potential, lower risk, and better stability. However, the results showed that the performance of the RSI depends on the specific settings used.

The chapter also acknowledges the limitations of the study, including the use of one dataset (the NIFTY 50 Index historical price data for the period of 2000 to 2021), which may limit the generalizability of the findings to other assets.

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APPENDIX A

PYTHON SCRIPT FOR PRE-PROCESSING THE DATASET

This script reads in data from a CSV file "data.csv" and converts the "Date" column into a datetime object. Then it calculates the Relative Strength Index (RSI) for each row using the exponential moving average of gains and losses over a specified period (14 days). Finally, it filters the data to only include rows with a date between 01-01-2000 and 01-01-2021, and saves the resulting DataFrame with the "Date," "Open," "Close," and "RSI" columns to a new CSV file "rsi.csv."

```
# Reading The Data
df = pd.read_csv("data.csv")
df['Date'] = df['Date'].apply(lambda x: datetime.strptime(x, "%m/%d/%Y"))

# Calculate the RSI
rsi_len = 14
df['gain_loss'] = df['Close'].diff()
df['gain'] = df['gain_loss'].where(df['gain_loss']>0, 0)
df['loss'] = df['gain_loss'].abs().where(df['gain_loss']<0, 0)
df['avg_gain'] = df['gain'].ewm(com=rsi_len-1, min_periods=rsi_len).mean()
df['avg_loss'] = df['loss'].ewm(com=rsi_len-1, min_periods=rsi_len).mean()
df['RS'] = df['avg_gain']/df['avg_loss']
df['RSI'] = 100 - (100/(1+df['RS']))

df = df[(df['Date'] >= '01-01-2000') & (df['Date'] < '01-01-2021')]
df[['Date','Open','Close','RSI']].to_csv('rsi.csv', index=False)
df.tail
```