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RESEARCH ARTICLE

Effectiveness of Stop-Loss Trading Strategy VS Buy-And-Hold Strategy

Mohammad Amin Teymouri-Boghsani

Department of Management, Faculty of Industrial Engineering and Management, Shahrood University of Technology, Shahrood, Iran

Abdolmajid Abdolbaghi Ataabadi*

Department of Management, Faculty of Industrial Engineering and Management, Shahrood University of Technology, Shahrood, Iran

Majid Ameri

Department of Accounting, Faculty of Industrial Engineering and Management, Shahrood University of Technology, Shahrood, Iran

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Abstract

The current research investigates the top 30 companies of the Tehran Stock Exchange from 2009 to 2021, looking at each quarter. In this study, the traditional stop-loss (SL1) and trailing stop-loss (SL2) methods were used to calculate the stop-loss and buy-and-hold strategies to compare their trading effectiveness. The return variable was calculated separately for the first, second, and third months and all three were used together. To investigate the relationship between variables, EViews and SPSS software was used. The variables were subjected to significant and descriptive statistical analysis. The Paired Simple Test results showed that the Trailing Stop-loss (SL2) strategy had a higher return than the other two strategies during the three months. The Wilcoxon nonparametric and Sign tests' results confirmed that the Stop-Loss strategy (SL2) performed better than others. Time series tests such as the Unit Root, Self-correlation, Momentum Behaviour, and Variance Heterogeneity tests were accomplished to investigate the correlation between returns. In brief, the results showed that the Trailing Stop-loss (SL2) strategy functioned better than the other two strategies on the Iranian Stock Exchange. This finding can help investors decide among different strategies to profit more on the Tehran Stock Exchange.

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*Corresponding Author:

Abdolmajid Abdolbaghi Ataabadi

Email: abdolbaghi@shahroodut.ac.ir

Tel: 09133215022

ORCID:

1. Introduction

Monitoring stock market changes and carefully tracking its positive and negative fluctuations are effective in appropriately using emotional factors in an investor's decision-making. The availability of information and information about the dominant trend in the stock market affects the investor's decision-making process (Salmani Danglani et al., 2019). Supply and demand, trading volume, price fluctuations, commodity rates, interest rates, and other items are reflected in the price chart through the reactions of investors and market participants. These factors can be observed by studying price changes or market indicators (Kenny, 2005). Generally, risk and return are two critical factors that are taken into account by retail investors when making decisions. Unlike major investors, who have access to a wide range of tools and facilities to balance these two variables, individual investors often lack such tools. Furthermore, high rates of economic and political fluctuations, unstable laws and regulations, etc., increase the risk of decision-making in the stock market. All these factors cause the capital market to face a secondary risk due to the individualism and unpredictability of the behavior of individual investors (Ebrahimi Sarveolia and Jahanshahi, 2016).

Many questions surround investors' use of technical tools, and the profitability of strategies based on these tools has emerged as a new issue in the financial sciences (Saeidi Kousha and Mohebbi, 2022). Many investment strategies, such as moving average, RSI, MACD, and others, are based on the three principles of technical analysis: reflecting price information, maintaining its current trend, and repeating history (Sezer and Ozbayoglu, 2019). Technical analysis is a method used by investors and traders in financial markets to determine the best time and price to buy or sell stocks and other tradable assets (Bader et al., 2018). Financial analysts, in particular, encourage traders to invest in profitable trading strategies, and various models to describe asset price fluctuations have been developed. However, many technical strategies for securing profits, such as stopping loss, have been proposed and investigated and are widely used by traders and automated trading systems (Khodaparasti et al., 2019). Researchers and analysts have conducted extensive studies on the profitability of technical oscillators and indicators over the last few decades, yielding different results. Each of the stock market's technical indicators can produce contradictory signals about the future performance of the stocks under consideration (Alfonso and Ramirez, 2020). According to Alfonso and Ramirez (2020), each stock market's technical indicators can send different signals about how stocks will perform.

Whether the fundamental or technical analysis is superior is a perennial topic of debate in investing. In order to prioritize the use of these methods, it is usually essential to pay attention to the investment period and volume. Investors are willing to use technical analysis due to restricted access to information, a lack of expertise, and small individual investments. In the meantime, indicators and oscillators determining the time to enter and exit the market based on the stop-loss and take-profit levels have become crucial. The contradictory results of applying technical trading strategies have caused the use of new methods of buying and selling stocks. The buy-and-hold strategy requires fundamental analysis in long-term periods, while the stop-loss method requires the detection of stock return patterns and is more usable in the short term. Therefore, in this research, the performance of two investment strategies, buy and hold and stop loss, has been compared.

The following section presents the study's theoretical framework, followed by the literature review, methodology (the procedure and data analysis), and the results presented in the subsequent sections.

2. Literature Review

The definition of a stock market has changed in recent years; it has been characterized by significant turmoil in which investors struggle to maintain their savings. Buying low and selling high is not the main aim of trading during the economic crisis, but investors prioritize minimizing losses alternatively. They tend to hold their losing investments for too long and sell their winning investments too soon. (Leoni, 2008). An investor needs to know the best timing for entry and exit points of the financial market during investment (Salmani Danglani et al., 2019). Technical analysis is one of the tools used to predict prices and financial markets based on historical data. (Abbasi et al., 2020; Alfonso and Ramirez, 2020). This method creates a set of indicators to analyze historical data and help decide when to buy and sell in the financial markets.

The "Buy-and-Hold" strategy is a well-known trading strategy based on the efficient market hypothesis (EMH). According to the EMH, security prices reflect all available information entirely (Fama, 1970). Numerous studies support the EMH, like Malkiel (2003, 2005). Barber and Odean (2000) have shown that the market beats households trading stocks more frequently. Moreover, their finding supports the "Buy-and-Hold" strategy and, consequently, the EMH. However, it has also been reported that some other studies have found evidence contrary to the EMH. For instance, Joel-Carbonell and Rottke (2009) studied the REIT market and found some irregularities between 1991–2008, which went against underlying rational human behavior. In this context, it seemed necessary to substitute the "buy and hold" strategy with another to outperform it, so this goal was set for our study.

According to EMH, stock prices follow a random walk, which makes it sound impossible to answer the question if it is a good choice to sell a declining investment before the end of the holding period rather than wait until the end of the holding period as in the buy-and-hold strategy. But when an investor sells before the end of a holding period, he/she is protecting himself/herself from more losses. Nevertheless, it also deprives him/herself of the potential stock price improvement during the remaining holding period. (Malkiel, 2005).

Stop-loss strategies can be used as a possible remedy for this behavioral tendency, which would prompt the sale of losing investments. A stop-loss strategy helps an investor to determine a condition under which a losing investment is automatically sold. In this way, this strategy prevents investors from making selling decisions simultaneously. Therefore, it can be stated that stop-loss strategies probably inhibit behavioral biases and help investors realize their losses sooner. It is worth mentioning that stop-loss strategies are touted in practice to improve investment returns. (Lei and Li, 2009). A stop-loss strategy is considered an active investment strategy in which a stock is sold when it reaches a certain price, thereby limiting the amount of loss from a declining stock. (Lei and Li, 2009). In other words, stop-loss rules are a risk management tool that helps practitioners control their risk by covering their positions and rotating to safety assets such as cash, short-term treasury bills, etc. (Thomakos and Yahlomi, 2018). Specialists in the stock market strongly recommend using the stop-loss strategy as a powerful tool to minimize losses and improve portfolio performance (Lei and Li, 2009). On the other hand, stop-loss strategies may not be efficient when security returns are predictable. Research shows that stop loss strategies fail to combine and synthesize relevant information when a strategy is set until the contingent sell order is executed (Kaminski and Lo, 2014). When security returns are unpredictable, selling a losing investment before a holding period does not guarantee that an investor will be better off at the end of this holding period. In this approach, even though the investor will not incur any further loss on the specific investment, he has given up the opportunity that this investment may recover later (Kaminski and Lo, 2014). Using stop-loss rules has the significant advantage of decreasing a portfolio’s volatility and drawdown. However, it may reduce total portfolio return because investors are out of the market and may lose on up-market bounces. Since the value of most stock markets goes up slowly, there is no doubt that they have a lot of volatility and long periods of decline. Therefore, getting out of the stock market can be considered hazardous when missing positive (negative) days for investors with long (short) positions. When volatility and drawdown are the most critical factors in a market's return, investors might think about how to use stop-loss trading rules to improve the performance of their portfolio or strategy (Thomakos and Yahlomi, 2018).

Studies have been carried out on the problem of discerning the effectiveness of stop-loss in various contexts. Here, we mention a few which focus on particular interests for our work. Determining a trading strategy to confirm the financial market's best entry and exit points is crucial in investment. However, this is a difficult task and has become a trendy research topic in finance. Investors are faced with buying or selling stocks in any given stock trading. Any mistake in investing decisions will incur losses for investors. Because of this, investment decisions need to be based on a thorough and reliable analysis.

Dai et al. (2021) discovered that new technical indicator-based return forecasts were statistically and economically significant for both in-sample and out-of-sample prediction performance. Furthermore, the predictability of stock returns was significant when multivariate information was used. Alfonso and Ramirez (2020) developed a hybrid nonlinear technical index approach for identifying profitable technical indices for input to nonlinear models. Abbasi et al. (2020) discovered a significant difference in returns between some technical analysis indicators and some indices' buy-and-hold strategies. He also discovered that the effectiveness of technical analysis strategies varies by industry. By studying the effectiveness of the automatic system of fuzzy logic-based technical pattern recognition, Abdolbaghi et al. (2019) discovered that a comparison of the conditional distribution of daily returns under the condition of the discovered patterns with the normalized returns of all patterns contained useful information, practically leading to abnormal returns.

Keshavarz et al. (2022) investigated technical signal-based trading strategies. The results showed that using three indicators of moving average, exponential moving average, and relative strength over a weekly to six-month period to buy or sell stocks (as a strategy) could result in higher returns and profitability. They also advised investors to use a combination of these three indicators when investing and to spread out their investment period over a longer period to achieve lower risk and higher returns. Acar and Toffel (2000) studied how a stop-loss rule affects the return distribution; they presumed the asset follows a Brownian Random Walk with drift. Under the previous assumption, they assessed the financial profitability of a simple stop-loss strategy for the next step. In the same context, Kaminski and Lo (2014) developed a rigorous analytical framework to measure the impact of simple 0.1 stop-loss re-entry rules on the expected return and volatility of an arbitrary portfolio strategy (again assuming that assets follow a random walk) and provided a practical analysis of the performance of a stop-loss strategy against buy-and-hold strategy in U.S. equities. In the following, Lo and Remorov (2017) extended the previous work of Kaminski and Lo (2014) by analyzing the efficacy of stop-loss trading strategies on serially correlated asset returns. Their results follow a Markov regime-switching process and are subject to transaction costs. They conclude that the stop-loss strategy outperforms the buy-and-hold strategy as long as there is sufficient serial correlation in returns with some impact on downside risk. It is worth noting that this can be overturned due to the high trading costs of a stop-loss-re-entry strategy. In contrast to the previous studies, James and Yang (2010) based their analysis on the stationary bootstrap, which was adequately applied as a tool to replicate financial time series. No study has ever concentrated on the large variation in price, which has often been observed across non-trading hours, and discussing this part would be considered the novelty of our work. The price variation affects the correct triggering of a stop-loss rule because it would bypass the established stopping time.

Another study found that overnight returns (including weekends) are always positive in U.S. markets' more recent price history, while daytime returns are close to zero or negative. This suggests that the U.S. equity premium during the first decade of the 21st century was just because of overnight returns (Cooper et al., 2008). The study of return differences between trading and non-trading hours to higher moments of the return distribution was extended to European and Japanese markets by

Wiener and Tompkins (2008). They found that the distribution of non-trading period (or overnight) returns generally displays a higher degree of non-normality than the trading period returns, which suggests that while trading period returns may follow some diffusion process, the non-trading period returns follow a jump process. This finding had also been previously argued by Geman et al. (2001), who studied asset prices arising from market clearing conditions. Stop-loss strategies may benefit investors by implicitly correcting some of their behavioral biases. Shefrin and Statman (1985), Ferris et al. (1988), and Odean (1998) all used the disposition effect as an example of such bias. They discussed investors' tendency to hold losers for long periods and sell winners too early. It has been reported that there is evidence for the disposition effect in an empirical context, and it has been proposed this bias is offset by using the stop-loss theory (Wong et al., 2006). Nevertheless, studies exploring this possibility have not yielded conclusive results, and this assumption has remained controversial. For example, a sample of trading records for professional traders has been investigated in the U.S. Researchers found that while traders tend to use stop-loss orders and avoid large losses, they still exhibit the disposition effect (Garvey and Murphy, 2004). Richards et al. (2011) also found that the disposition effect is less strong for retail investors who use stop-loss strategies than those who do not.

Argimiro Arratia and Dorador (2017) discussed four methods of implementing the loss and concluded that even in cases where overnight gaps have been observed in the price model, the adjusted loss margin improves the risk according to most criteria in positive markets, while it improves the projected absolute return in negative markets. Wu and Chung (2019), in an article entitled "Empirical Evaluations on Momentum Effects of Taiwan Index Futures via Stop-loss and Stop-profit Mechanisms," concluded that loss-limit management and profit margin are critical in trading. This method can be used in many business methods to improve the quality of strategies. Managing money is also a way to plan a strategy different from focusing on technical mechanisms. Also, Yang and Zhang (2021) showed that the stop-loss strategy increased the value function and, in particular, the growth will be larger when the asset price is near the stop-loss level and smaller when the price is relatively high above it. Furthermore, they showed that the stop-loss strategy decreased the optimal liquidation point, which means it will eagerly persuade the investor to liquidate earlier at a lower take-profit level. Hsieh (2021) presented a closed-form expression for the cumulative distribution function of the trading profit or loss. Furthermore, he showed that the affine feedback controller with stop-loss order generalizes the result without a stop order in the distribution function.

Therefore, based on what was stated, the following hypothesis is considered in this study:

H1: The trading stop-loss strategy based on the three-day moving average price (SL1) has positive and significant performance.

H2: The performance of the trading stop-loss strategy based on the highest price over the last three days (SL2) is positive and statistically significant.

H3: There is a significant return difference between the stop-loss strategy (SL1) and the buy-and-hold strategy.

H4: There is a significant difference in return between the stop-loss strategy (SL2) and the buy-and-hold strategy.

Table 1. Codes of the third quarter of 2016 for Asan Pardakht Persian Company

Code of the third quarter of 2016 for Asan Pardakht Persian Company

```
clear all
close all
clc

A=xlsread('SA.xlsx','Sheet1','I2:I62')
for n=3:61
C(n,1)=(A(n,:)+A(n-1,1)+A(n-2,1))/3
end
xlswrite('SA.xlsx',C,'Sheet1','Q2:Q62')
for i=4:61
   if A(i,1)<(0.95*C(i-1,1))
      B(i,1)=1
   else
      B(i,1)=0
   end
end
xlswrite('SA.xlsx',B,'Sheet1','R2:R62')

for o=3:61
   if B(o,:)==1
      D(o-2,:)=log(A(o,:)/A(1,1))
   else
      D(o-2,:)=0
   end
end
xlswrite('SA.xlsx',D,'Sheet1','T4:T62')
for k=3:61
   S=[A(k,:) A(k-1,:) A(k-2,:)]
  Y(k,:)=max(S)
end
xlswrite('SA.xlsx',Y,'Sheet1','U2:U62')

for v=4:61
   if A(v,1)<Y(v,1)
      H(v,1)=1
   else
      H(v,1)=0
   end
end
xlswrite('SA.xlsx',H,'Sheet1','V2:V62')

for g=3:61
   if H(g,:)==1
      J(g-2,:)=log(A(g,:)/A(1,1))
   else
      J(g-2,:)=0
   end
end
xlswrite('SA.xlsx',J,'Sheet1','W4:W62')

P=log(A(61,:)/A(1,1))

xlswrite('SA.xlsx',P,'Sheet1','S62')
```

1. Research Methodology

This objective, data-driven retrospective study examined the effectiveness of stop-loss and buy-and-hold trading strategies. Avoid double counting by excluding investment companies, banks, insurance institutions, and financial intermediaries. The study's statistical population consisted of the leading companies for quarterly courses listed on the Tehran Stock Exchange from 2009 to 2021. Applying the criteria above, a statistical sample of 120 companies from 2009 to 2021 was selected. First, we determined the buy-and-hold return for the entire quarter, assuming the share was acquired on the first and sold on the last day. Monthly returns were also calculated separately to compare with monthly stop-loss strategies.

In this study, two stop-loss strategies were employed: First, SL1 will generate a sales order when the day's price is less than the average of 95% over the previous three days. Second, in SL2, a sales order will be generated if the day's price is less than 95% of the highest price of the previous three days.

Matlab software was used to locate the required quarterly data for this purpose (there were 943 quarterly periods). The quarterly Matlab software codes for the Persian company Asan Pardakht are shown in Table (1). In addition, Excel was used to determine the monthly periods of SL1 and SL2.

As a result, twelve different returns were obtained in this research, including the total quarterly return, first-month return, second-month return, third-month return, total stop-loss rate return (SL1), first-month stop-loss rate return (SL1), second-month stop-loss rate return, third-month Stop-Loss return (SL1), total stop-loss rate return (SL2), first-month stop-loss rate return (SL2), second-month stop-loss rate return, third-month Stop-Loss return (SL2).

After calculating buy-and-hold returns and stop-loss returns (SL1, SL2), the total data were sorted by year using Excel software (from 2009 to 2021). The average buy-and-hold return and average stop-loss returns of SL1 and SL2 were calculated for each period. This was performed so that SPSS and Eviews could test an index and variables.

To create a time series, the returns were sorted based on the first period of 2009 to the third period of 2021. For each period, the monthly average returns of three strategies were calculated (buy-and-hold, SL1 and SL2). They have formed a monthly time series from 2009 to 2021. From here on, the tests related to the time series are discussed.

4. Results

4.1. Descriptive statistics

Table (2) provides descriptive statistics of variable returns based on strategies for one-to-three-month intervals. This Table contains central indicators such as the mean, median, and dispersion indicators such as standard deviation, skewness, and kurtosis.

In the first section, Table (2) shows descriptive statistics of total returns caused by the buy-and-hold strategy and returns of stop-loss strategies (SL1, SL2). In the second section, Table (2) displays the return of the buy-and-hold strategy and the returns of stop-loss strategies (SL1, SL2) for the first month. Similarly, the results for the second and third months are presented in the third and fourth sections.

As can be seen, the average return on the quarterly buy-and-hold strategy is -0.004 with a standard deviation of 0.237, which indicates the high dispersion of quarterly returns among the top 120 companies. The quarterly return has a negative skewness, indicating that negative returns during the research period are greater than positive returns. The distribution of quarterly yields is also more kurtosis than normal. The average quarterly return for the stop loss (SL1) strategy is -0.005 with a standard deviation of 0.197. This strategy has a high return but less dispersion than the buy-and-hold strategy. In addition, skewness and kurtosis values indicate that this strategy has a leftward skewness and high kurtosis. These findings conclude the asymmetry of data compared to the normal mode. Compared to the SL1 quarterly strategy and the quarterly buy-and-hold strategy, the SL2 quarterly strategy has a higher average return of 0.012 and a lower standard deviation of 0.066, which indicates less dispersion.

The skewness value of 0.362 indicates that the data are nearly symmetrically distributed, whereas the kurtosis value of 21.981 indicates a high kurtosis. The average buy-and-hold return for the first month in the second section is 0.013, which is positive. The dispersion is equal to 0.117. In this case, the skewness is negative 0.946, and the positive kurtosis is 13.069. In addition, the mean and standard deviation of the SL1 strategy return (first month) is positive and equal to 0.014 and 0.112, respectively. Skewness is negative and close to the normal distribution, while kurtosis is high. The return of the SL2 strategy (first month) has a standard deviation of 0.071 and a lower average compared to the buy and hold return and the SL1 strategy return in the first month. In this case, the skewness is to the left, and the kurtosis is high.

Table 2. Descriptive statistics

First Section	**Mean**	**Median**	**Standard Deviation**	**Kurtosis**	**Skewness**
Return of quarterly Buy and Hold in quarter	-0.004	-0.009	0.237	4.473	-0.538
Return of quarterly Stop-loss 1 (SL1)	-0.005	-0.016	0.197	8.042	-1.133
Return of quarterly Stop-loss 2 (SL2)	0.012	-0.001	0.066	21.981	0.362
Second Section					
Return of Buy and Hold (First Month)	0.013	0.011	0.117	13.069	-0.946
Return of Stop-loss (SL1) (First Month)	0.014	0.010	0.112	14.817	-0.888
Return of Stop-loss (SL2) (First Month)	0.010	-0.001	0.071	53.833	-2.929
Third Section					
Return of Buy and Hold (Second Month)	0.012	-0.005	0.291	654.382	23.413
Return of Stop-loss (SL1) (Second Month)	0.010	-0.009	0.290	666.283	23.676
Return of Stop-loss (SL2) (Second Month)	0.011	-0.002	0.265	476.250	12.985
Forth Section					
Return of Buy and Hold (Third Month)	0.013	-0.000	0.331	698.325	24.505
Return of Stop-loss (SL1) (Third Month)	0.002	-0.004	0.384	449.078	11.785
Return of Stop-loss (SL2) (Third Month)	-0.010	-0.002	0.269	345.901	-17.579

In the third section, the highest average is assigned to the buy-and-hold strategy, which equals 0.012, and the lowest dispersion is assigned to the SL2 (second month) strategy, which equals 0.265. In addition, skewness and kurtosis values are positive and relatively high for all three strategies. In the third month, the average return of the buy and hold strategy is higher than the other two strategies and is equal to 0.013. All three strategies exhibit a relatively high degree of dispersion. All three strategies have positive and high skewness and kurtosis values, except for the SL2 strategy, which has negative skewness.

4.2. Correlation

Table (3) presents the results of the correlation analysis. The results of the Pearson correlation test are placed at the top of the correlation table. The results of the Spearman correlation test are deposited at the bottom of the Table.

4.3. Significance test

The hypothesis test is:

$$\mathrm{H}_0: \bar{\mathrm{r}}_s = 0$$
$$\mathrm{H}_1: \bar{\mathrm{r}}_s \neq 0$$

Table 3- Pearson and Spearman correlation test

	Return of quarterly Buy and Hold	Return of quarterly Stop-loss 1 (SL1)	Return of quarterly Stop-loss 2 (SL2)	Return of Buy and Hold (First Month)	Return of Stop-loss (SL1) (First Month)	Return of Stop-loss (SL2) (First Month)	Return of Buy and Hold (Second Month)	Return of Stop-loss (SL1) (Second Month	Return of Stop-loss (SL2) (Second Month)	Return of Buy and Hold (Third Month)	Return of Stop-loss (SL1) (Third Month)	Return of Stop-loss (SL2) (Third Month)
Return of quarterly Buy and Hold	1	0.801 (0.000)	0.311 (0.000)	0.511 (0.000)	0.495 (0.000)	0.320 (0.000)	0.505 (0.000)	0.468 (0.000)	0.211 (0.000)	0.556 (0.000)	0.517 (0.000)	0.331 (0.000)
Return of quarterly Stop-loss 1 (SL1)	0.801 (0.000)	1	0.390 (0.000)	0.619 (0.000)	0.647 (0.000)	0.391 (0.000)	0.343 (0.000)	0.351 (0.000)	0.107 (0.001)	0.305 (0.000)	0.343 (0.000)	0.215 (0.000)
Return of quarterly Stop-loss 2 (SL2)	0.311 (0.000)	0.390 (0.000)	1	0.550 (0.000)	0.580 (0.000)	0.983 (0.000)	0.057 (0.083)	0.028 (0.401)	-0.014 (0.671)	0.012 (0.769)	0.010 (0.769)	0.004 (0.892)
Return of Buy and Hold (First Month)	0.511 (0.000)	0.619 (0.000)	0.550 (0.000)	1	0.951 (0.000)	0.550 (0.000)	0.010 (0.754)	0.017 (0.615)	-0.101 (0.002)	0.041 (0.015)	0.080 (0.015)	0.088 (0.008)
Return of Stop-loss (SL1) (First Month)	0.495 (0.000)	0.647 (0.000)	0.580 (0.000)	0.951 (0.000)	1	0.580 (0.000)	0.029 (0.384)	0.011 (0.730)	-0.090 (0.007)	0.035 (0.293)	0.062 (0.062)	0.080 (0.016)
Return of Stop-loss (SL2) (First Month)	0.320 (0.000)	0.391 (0.000)	0.983 (0.000)	0.550 (0.000)	0.580 (0.000)	1	0.068 (0.038)	0.040 (0.226)	-0.009 (0.788)	0.020 (0.549)	0.018 (0.595)	0.018 (0.583)
Return of Buy and Hold (Second Month)	0.505 (0.000)	0.343 (0.000)	0.057 (0.083)	0.010 (0.754)	0.029 (0.384)	0.068 (0.038)	1	0.927 (0.000)	0.519 (0.000)	0.080 (0.016)	0.079 (0.017)	0.107 (0.001)
Return of Stop-loss (SL1) (Second Month)	0.468 (0.000)	0.351 (0.000)	0.028 (0.401)	0.017 (0.615)	0.011 (0.730)	0.040 (0.226)	0.927 (0.000)	1	0.558 (0.000)	0.060 (0.068)	0.077 (0.021)	0.125 (0.000)
Return of Stop-loss (SL2) (Second Month)	0.211 (0.000)	0.107 (0.001)	-0.014 (0.671)	-0.101 (0.002)	-0.090 (0.007)	-0.009 (0.788)	0.519 (0.000)	0.558 (0.000)	1	0.078 (0.018)	0.073 (0.028)	0.058 (0.079)
Return of Buy and Hold (Third Month)	0.556 (0.000)	0.305 (0.000)	0.012 (0.769)	0.041 (0.015)	0.035 (0.293)	0.020 (0.549)	0.080 (0.017)	0.060 (0.068)	0.078 (0.018)	1	0.927 (0.000)	0.501 (0.000)
Return of Stop-loss (SL1) (Third Month)	0.517 (0.000)	0.343 (0.000)	0.010 (0.769)	0.080 (0.015)	0.062 (0.062)	0.018 (0.595)	0.079 (0.017)	0.077 (0.021)	0.073 (0.028)	0.927 (0.000)	1	0.541 (0.000)
Return of Stop-loss (SL2) (Third Month)	0.331 (0.000)	0.215 (0.000)	0.004 (0.892)	0.088 (0.008)	0.080 (0.016)	0.018 (0.583)	0.107 (0.001)	0.125 (0.000)	0.058 (0.079)	0.501 (0.000)	0.541 (0.000)	1

Table 4. The significant test

	T-statistics	Degree of Freedom	Mean	Level of Significance	Confidence interval	
					Down	Up
Return of quarterly Buy and Hold	-0.588	951	-0.004	0.556	0.019	0.010
Return of quarterly Stop-loss 1 (SL1)	-0.838	951	-0.005	0.402	-0.017	0.007
Return of quarterly Stop-loss 2 (SL2)	5.717	951	0.012	0	0.008	0.016
Return of Buy and Hold (First Month)	3.561	944	0.013	0	0.006	0.021
Return of Stop-loss (SL1) (First Month)	4.004	942	0.014	0	0.007	0.021
Return of Stop-loss (SL2) (First Month)	4.331	944	0.010	0	0.005	0.014
Return of Buy and Hold (Second Month)	1.336	920	0.012	0.182	0.006	0.031
Return of Stop-loss (SL1) (Second Month)	1.088	921	0.010	0.277	-0.008	0.029
Return of Stop-loss (SL2) (Second Month)	1.265	919	0.011	0.206	0.006	0.028
Return of Buy and Hold (Third Month)	1.257	925	0.013	0.209	0.007	0.035
Return of Stop-loss (SL1) (Third Month)	0.225	925	0.002	0.822	0.021	0.027
Return of Stop-loss (SL2) (Third Month)	-1.195	925	-0.010	0.232	0.027	0.006

Regarding the above hypothesis and below Table (4), the average return of the buy and hold strategy for each quarter does not show a significant difference from zero. Our results showed that the average return of SL1 has no significant difference compared to zero. However, the H_0 for SL2 is rejected due to the average of 0.012 and t value of 0.717, which means the average quarterly SL2 is not zero. According to the Table, the prob. value is zero for all three strategies in the first month, so H_0 is rejected. Against, prob. values are higher than 0.05 for the second and the third month, so H_0 is accepted.

4.4. Paired Sample Test

Table (5) compares the outcomes of statistical hypothesis testing for various strategies.

For instance, the hypotheses for column 1 are:

Null hypothesis: The difference in return of the quarter's buy and hold strategy and the return of the quarter SL1 is not significant.

Alternative hypothesis: The difference in return of the quarter's buy and hold strategy and the return of the quarter SL1 is significant.

According to Table (5), the difference in return between the quarterly buy-and-hold strategy and the quarterly SL1 approach is not significantly different from zero. A paired sample test revealed that the difference between the quarterly returns of the buy-and-hold strategy and SL2 is statistically significant, indicating that the average return of SL2 is greater than that of the buy-and-hold strategy. In addition, the quarterly mean comparison of the SL1 and SL2 strategies reveals that SL2 has a higher return than SL1. Furthermore, the difference in return between the buy-and-hold, SL1, and SL2 strategies is not statistically significant. There is no significant between strategies for the second and third months, and the difference in returns does not differ from zero.

$$H_0: d_{rs} = 0$$

$$H_1: d_{rs} \neq 0$$

4.5. Wilcoxon test

The Shapiro-Wilk test and the Kolmogorov-Smirnov test were used to check for normality.

Null hypothesis: the data is normal.

Alternative hypothesis: the data is not normal.

In two tests, the significance level was zero. As a result, the null hypothesis is rejected. Since the data is not normal, nonparametric tests such as the Wilcoxon and Sign tests were used.

Table 5. The Paired Sample Test

	Mean	Standard Deviation	Standard Error	Confidence interval		T-statistics	Degree of Freedom	Level of Significance
				Down	Up			
Buy and Hold Strategy – SL1 Strategy (Quarterly)	0.000	0.133	0.004	-0.007	0.009	0.193	951	0.847
Buy and Hold Strategy – SL2 Strategy (Quarterly)	-0.168	0.229	0.007	-0.031	-0.002	-2.266	951	0.024
SL1 Strategy – SL2 Strategy (Quarterly)	-0.017	0.188	0.006	-0.029	-0.005	-2.899	951	0.004
Buy and Hold Strategy – SL1 Strategy (First Month)	-0.000	0.036	0.001	-0.003	0.001	-0.759	942	0.448
Buy and Hold Strategy – SL2 Strategy (First Month)	0.003	0.104	0.003	-0.003	0.010	1.024	944	0.306
SL1 Strategy – SL2 Strategy (First Month)	0.004	0.100	0.003	-0.001	0.010	1.389	942	0.165
Buy and Hold Strategy – SL1 Strategy (Second Month)	0.002	0.039	0.001	-0.000	0.004	1.772	920	0.077
Buy and Hold Strategy – SL2 Strategy (Second Month)	0.001	0.380	0.012	-0.023	0.262	0.124	918	0.901
SL1 Strategy – SL2 Strategy (Second Month)	-0.000	0.379	0.125	-0.025	0.023	-0.070	919	0.945
Buy and Hold Strategy – SL1 Strategy (Third Month)	0.010	0.200	0.006	-0.002	0.023	1.642	925	0.101
Buy and Hold Strategy – SL2 Strategy (Third Month)	0.024	0.417	0.013	-0.002	0.051	1.767	925	0.078
SL1 Strategy – SL2 Strategy (Third Month)	0.013	0.461	0.015	-0.016	0.432	0.884	925	0.377

Strategies are tested two by two in this test. Hypotheses were written for each pair of strategies; for instance, the following hypothesis is written for the quarterly buy and hold strategy and quarterly SL1 strategy.

Null hypothesis: returns of the buy and hold strategy and the returns of the SL1 strategy are the same.

Alternative hypothesis: the returns of the buy and hold strategy and returns of the SL1 strategy are not the same.

Results of the Wilcoxon test are presented in Table (6). It shows that the return on quarterly SL2 was higher than both quarterly SL1 and quarterly buy and hold. The first month's results reveal that all strategies' returns are the same. At the same time, the results show that SL2 has a better return than other strategies in the second month.

Table 6. The Wilcoxon Test

		N	Mean Rank	Sum of Ranks	Z	Asymp. Sig.
Buy and Hold Strategy – SL1 Strategy (Quarterly)	Negative Ranks	227	264.300	59995.000	-0.511	0.609
	Positive Ranks	269	235.170	63261.000		
	Ties	456				
	Total	952				
Buy and Hold Strategy – SL2 Strategy (Quarterly)	Negative Ranks	418	489.120	204454.000	-2.583	0.010
	Positive Ranks	533	465.710	248222.000		
	Ties	1				
	Total	952				
SL1 Strategy – SL2 Strategy (Quarterly)	Negative Ranks	363	483.800	175620.000	-4.090	0.000
	Positive Ranks	549	438.450	240708.000		
	Ties	40				
	Total	952				
Buy and Hold Strategy – SL1 Strategy (First Month)	Negative Ranks	104	100.480	10450.000	-0.364	0.716
	Positive Ranks	103	107.550	11078.000		
	Ties	736				
	Total	943				
Buy and Hold Strategy – SL2 Strategy (First Month)	Negative Ranks	468	477.590	10450.000	-0.745	0.456
	Positive Ranks	464	455.320	11078.000		
	Ties	13				
	Total	945				
SL1 Strategy – SL2 Strategy (First Month)	Negative Ranks	438	464.850	203603.000	-0.345	0.730
	Positive Ranks	458	432.870	198253.000		
	Ties	47				
	Total	943				

Buy and Hold Strategy – SL1 Strategy (Second Month)	Negative Ranks	84	84.650	7111.000	-1.143	0.253
	Positive Ranks	86	75.910	5769.000		
	Ties	761				
	Total	921				
Buy and Hold Strategy – SL2 Strategy (Second Month)	Negative Ranks	368	465.300	171229.500	-4.190	0.000
	Positive Ranks	535	442.850	236926.500		
	Ties	16				
	Total	919				
SL1 Strategy – SL2 Strategy (Second Month)	Negative Ranks	339	451.670	153117.500	-5.641	0.000
	Positive Ranks	546	437.610	238937.500		
	Ties	35				
	Total	920				
Buy and Hold Strategy – SL1 Strategy (Third Month)	Negative Ranks	106	86.110	9128.000	-2.738	0.006
	Positive Ranks	65	85.820	5578.000		
	Ties	755				
	Total	926				
Buy and Hold Strategy – SL2 Strategy (Third Month)	Negative Ranks	433	467.160	202281.000	-0.175	0.861
	Positive Ranks	463	431.050	199575.000		
	Ties	30				
	Total	926				
SL1 Strategy – SL2 Strategy (Third Month)	Negative Ranks	392	451.520	176996.000	-1.790	0.073
	Positive Ranks	480	424.230	203632.000		
	Ties	54				
	Total	926				

4.6. Sign the test

According to the results of the Wilcoxon test and its hypotheses, the hypothesis for the sign test was written as follows for each pair of strategies:

Null hypothesis: there was no difference between the return of the buy and hold strategy and the return of the SL1 strategy.

Alternative hypothesis: there was a difference between the return of the buy and hold strategy and the return of the SL1 strategy.

According to Table (7), the P-value and z-value of the quarterly buy and hold strategy vs SL1 are equal to 0,066 and -1.841, respectively, which means the null hypothesis was accepted at a 5% significance level. But since the alternative hypothesis was accepted at a 10% significance level and the sign of Z is negative, the return of SL1 was greater than the return of the buy-and-hold strategy. In addition, quarterly data demonstrated that the SL2 approach generated a greater return than the buy-and-hold and SL1 strategies.

Due to Table (7), there was no difference in the returns of any strategies in the first month. In addition, the second and third-month returns of the SL2 strategy were greater than those of the SL1 and buy-and-hold strategies.

Table 7. The sign test

		N	Z	Asymp. Sig.
Buy and Hold Strategy – SL1 Strategy (Quarterly)	Negative Differences	227	-1.841	0.066
	Positive Differences	269		
	Ties	456		
	Total	952		
Buy and Hold Strategy – SL2 Strategy (Quarterly)	Negative Differences	418	-3.697	0.000
	Positive Differences	533		
	Ties	1		
	Total	952		
SL1 Strategy – SL2 Strategy (Quarterly)	Negative Differences	363	-6.126	0.000
	Positive Differences	549		
	Ties	40		
	Total	952		
Buy and Hold Strategy – SL1 Strategy (First Month)	Negative Differences	104	0.000	1.000
	Positive Differences	103		
	Ties	736		
	Total	943		
Buy and Hold Strategy – SL2 Strategy (First Month)	Negative Differences	468	-0.098	0.922
	Positive Differences	464		
	Ties	13		
	Total	945		
SL1 Strategy – SL2 Strategy (First Month)	Negative Differences	438	-0.635	0.526
	Positive Differences	458		
	Ties	47		
	Total	943		
Buy and Hold Strategy – SL1 Strategy (Second Month)	Negative Differences	84	-0.553	0.580
	Positive Differences	86		
	Ties	761		
	Total	921		
Buy and Hold Strategy – SL2 Strategy (Second Month)	Negative Differences	368	-5.524	0.000
	Positive Differences	535		
	Ties	16		
	Total	919		
SL1 Strategy – SL2 Strategy (Second Month)	Negative Differences	339	-6.925	0.000
	Positive Differences	546		
	Ties	35		
	Total	920		

Buy and Hold Strategy – SL1 Strategy (Third Month)	Negative Differences	106	-3.059	0.002
	Positive Differences	65		
	Ties	755		
	Total	926		
Buy and Hold Strategy – SL2 Strategy (Third Month)	Negative Differences	433	-0.969	0.333
	Positive Differences	463		
	Ties	30		
	Total	926		
SL1 Strategy – SL2 Strategy (Third Month)	Negative Differences	392	-2.946	0.003
	Positive Differences	480		
	Ties	54		
	Total	926		

Table 8. The results of nonparametric and parametric tests

Strategies	Sign Test			Wilcoxon Test			Paired Sample Test		
	Z	Significance Level	Result	Z	Significance Level	Result	T	Significance Level	Result
Buy and Hold Strategy – SL1 Strategy (Quarterly)	-1.841	0.066	H_0 is accepted	-0.511	0.609	H_0 is accepted	0.193	0.847	H_0 is accepted
Buy and Hold Strategy – SL2 Strategy (Quarterly)	-3.697	0.000	H_0 is rejected	-2.583	0.010	H_0 is rejected	-2.266	0.024	H_0 is rejected
SL1 Strategy – SL2 Strategy (Quarterly)	-6.126	0.000	H_0 is rejected	-4.090	0.000	H_0 is rejected	-2.899	0.004	H_0 is rejected
Buy and Hold Strategy – SL1 Strategy (First Month)	0.000	1.000	H_0 is accepted	-0.364	0.716	H_0 is accepted	-0.759	0.448	H_0 is accepted
Buy and Hold Strategy – SL2 Strategy (First Month)	-0.098	0.922	H_0 is accepted	-0.745	0.456	H_0 is accepted	1.024	0.306	H_0 is accepted

SL1 Strategy – SL2 Strategy (First Month)	-0.635	0.526	H_0 is accepted	-0.345	0.730	H_0 is accepted	1.389	0.165	H_0 is accepted
Buy and Hold Strategy – SL1 Strategy (Second Month)	-0.553	0.580	H_0 is accepted	-1.143	0.253	H_0 is accepted	1.772	0.077	H_0 is accepted
Buy and Hold Strategy – SL2 Strategy (Second Month)	-5.524	0.000	H_0 is rejected	-4.190	0.000	H_0 is rejected	0.124	0.901	H_0 is accepted
SL1 Strategy – SL2 Strategy (Second Month)	-6.925	0.000	H_0 is rejected	-5.641	0.000	H_0 is rejected	-0.070	0.945	H_0 is accepted
Buy and Hold Strategy – SL1 Strategy (Third Month)	-3.059	0.002	H_0 is rejected	-2.738	0.006	H_0 is rejected	1.642	0.101	H_0 is accepted
Buy and Hold Strategy – SL2 Strategy (Third Month)	-0.969	0.333	H_0 is accepted	-0.175	0.861	H_0 is accepted	1.767	0.078	H_0 is accepted
SL1 Strategy – SL2 Strategy (Third Month)	-2.946	0.003	H_0 is rejected	-1.790	0.073	H_0 is accepted	0.884	0.377	H_0 is accepted

4.7. Unit root test

To generate a time series, the returns were sorted from the first period in 2009 to the third period in 2021. The average monthly returns of three strategies (buy and hold, SL1 and SL2) were calculated for each period. From 2009 to 2021, they created a monthly time series. Following that, the time series tests are discussed.

The unit root test is used to determine the procedure type. The following are the test hypotheses for this purpose:

Null hypothesis: there is a unit root. The alternative hypothesis is that there is no unit root.

Table (9) shows that the unit root test results revealed no unit root in all the strategies.

Table 9. The Unit Root test

Variables	Augmented Dickey-Fuller Test Statistic	Test critical - t-Statistic 1% level	Test critical - t-Statistic 5% level	Test critical - t-Statistic 10% level
Buy-and-hold	-8.670 (0.000)	-3.496	-2.890	-2.582
Stop-loss (SL1)	-9.083 (0.000)	-3.496	-2.890	-2.582
Stop-loss (SL2)	-9.801 (0.000)	-3.496	-2.890	-2.582

4.8. Momentum behavior test

A momentum test has been used to understand whether the period has momentum behavior. Firstly, this test has been examined for the buy-and-hold strategy.

According to the null hypothesis, the coefficients are not significantly different from zero.

The coefficients are significantly different from zero, according to the alternative hypothesis.

Because the significance level for all variables is greater than 0.05, the null hypothesis is correct, i.e., the coefficients are not significantly different from zero. There is no momentum behavior for the monthly buy and hold strategy, according to Table (10). There is no momentum behavior for SL1 or SL2, according to Tables (11,12).

Table 10. Momentum behavior test for Buy and Hold strategy

Variable	Coefficient	Std. Error	t-Statistic	F-Statistic	Level of Significance
C	0.008	0.007	1.229	-	0.222
BHR (-1)	0.124	0.102	1.214	-	0.227
BHR (-2)	0.100	0.103	0.969	-	0.334
BHR (-3)	-0.116	0.103	-1.131	-	0.260
	-	-	-	1.182	0.320

Table 11. Momentum behavior test for Stop-Loss 1 (SL1) strategy

Variable	Coefficient	Std. Error	t-Statistic	F-Statistic	Level of Significance
C	0.006	0.006	0.966	-	0.336
RSTOP1 (-1)	0.078	0.102	0.761	-	0.448
RSTOP1 (-2)	0.073	0.103	0.708	-	0.480
RSTOP1 (-3)	-0.070	0.103	-0.684	-	0.495
	-	-	-	0.501	0.682

Table 12. Momentum behavior test for Stop-Loss 2 (SL12) strategy

Variable	Coefficient	Std. Error	t-Statistic	F-Statistic	Level of Significance
C	0.005	0.005	1.060	-	0.291
RSTOP1 (-1)	0.016	0.102	0.162	-	0.871
RSTOP1 (-2)	0.109	0.101	1.075	-	0.285
RSTOP1 (-3)	-0.048	0.102	-0.470	-	0.639
	-	-	-	0.460	0.710

4.9. Breusch-Godfrey Serial Correlation LM Test and Heteroskedasticity Test

The autocorrelation test is another time series test. This test's hypotheses are as follows:

Null hypothesis: Lack of autocorrelation in the model.

Alternative hypothesis: the existence of autocorrelation in the model.

The heteroskedasticity test hypotheses are as follows:

Null hypothesis: There isn't heterogeneity of variance.

Alternative hypothesis: There is heterogeneity of variance.

According to Table (13), the F-statistic for the buy and hold strategy is 1.380, and the confidence level is 0.256, indicating that the null hypothesis is accepted and the model has no autocorrelation. Because the confidence level for the heterogeneity of variance test is 0.834, it indicates no variance heterogeneity. Tables (14) and (15) show no autocorrelation and variance heterogeneity for the SL1 and SL2 strategies.

Table 13. Breusch-Godfrey Serial Correlation LM Test and Heteroskedasticity Test for Buy and Hold Strategy

	F-statistic	Coefficient level
Breusch-Godfrey Serial Correlation LM Test	1.380	0.256
Breusch-Pagan Heteroskedasticity Test	0.286	0.834

Table 14. Breusch-Godfrey Serial Correlation LM Test and Heteroskedasticity Test for Stop-loss 1 (SL1) strategy

	F-statistic	Coefficient level
Breusch-Godfrey Serial Correlation LM Test	1.720	0.184
Breusch-Pagan Heteroskedasticity Test	0.848	0.470

Table 15. Breusch-Godfrey Serial Correlation LM Test and Heteroskedasticity Test for Stop-loss 2 (SL2) strategy

	F-statistic	Coefficient level
Breusch-Godfrey Serial Correlation LM Test	0.902	0.409
Breusch-Pagan Heteroskedasticity Test	0.668	0.573

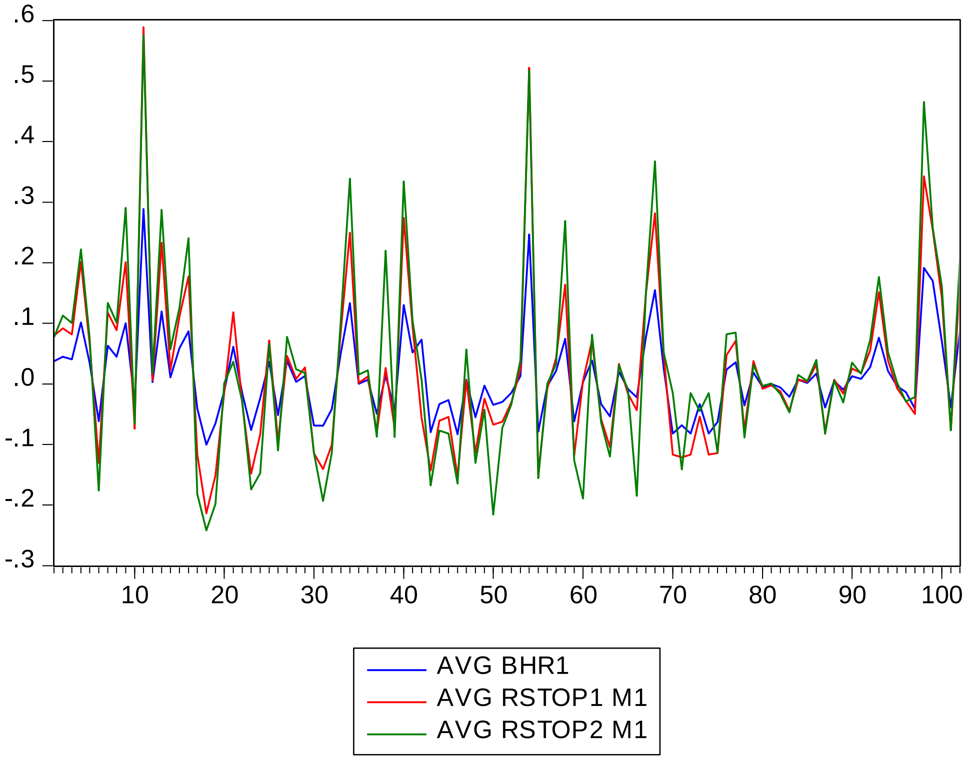

Chart 1. Compare the return of strategies

4.10. Comparison of the return charts of the strategies

Chart (1) depicts the period returns in terms of the monthly index time series calculated using the strategies. This chart's maximum and minimum returns show that the SL2 returns graph has had a greater impact than other strategies, indicating that this strategy includes lower and higher returns under these conditions. It will result in more losses during a downtrend and more profits during an uptrend. The buy-and-hold strategy is less volatile than the other two strategies, indicating that it is less risky. Furthermore, the chart shows that the difference between the SL2 strategy and others is significant in uptrends. This difference is less pronounced in downtrends. Furthermore, the chart shows that the SL2 strategy has a higher return rate than the other two strategies, higher than a 15% return rate, which is more than twice sometimes.

5. Conclusion

According to the significant test results, the average return for the SL2 strategy was not zero or positive for the quarter. However, the average return for the SL1 and buy and hold strategies was zero. Furthermore, when comparing two by two strategies over different periods, the Paired Sample Test shows that the SL2 strategy had a higher average return than the other two strategies and generated a higher return in the three-month period. However, the average returns of the three strategies in monthly periods did not differ significantly. The normality test results indicated that the data were not normally distributed. The Wilcoxon Test results also revealed that SL2's quarterly returns were higher than those of the other two strategies. Regarding the hypotheses, the results showed that the returns were similar in the first month. The SL2 strategy was also more efficient than other strategies in the second month. The average returns for the SL1 and SL2 strategies were higher than the buy-and-hold strategy in the third month. The quarterly sign test results also revealed that the SL2 strategy outperformed the other two strategies, while the SL1 strategy outperformed the buy and hold strategy. The returns of the three strategies were not significantly different in the first month, according to the sign test results, but in the second and third months, the SL2 strategy was ranked first, and the SL1 strategy was ranked second. Claiming that no momentum behavior existed for monthly strategies is also possible. In the same vein, Arratia and Dorador (2017) state that stop-loss rules primarily improve expected risk-adjusted return metrics in rising markets, while this strategy improves absolute expected return in falling markets. In another study, Wu and Chung (2019) discovered that managing stop-loss and take-profit was critical in determining the profit or loss of the trading strategy. Our findings are consistent with Lo and Remorov's (2017) findings, who demonstrated those tight stop-loss strategies underperform the buy-and-hold policy in a mean-variance framework due to high trading costs. In a nutshell, this study confirmed that the return of the SL2 strategy quarterly makes a higher profit than the two other strategies. The use of technical analysis alone cannot determine effective investor strategies. Still, due to the limitations of the volume of individual investments and short-term time frames, investment methods based on technical indicators have increased. The variety of technical capitalization methods can cause hesitation in the effectiveness of each method in a specific situation. Therefore, using these methods can bring conflicting results depending on the situation. On the other hand, volatility limits and base volume in the capital market can make it difficult to determine buying and selling signals based on technical methods. Therefore, combining investment methods based on technical and fundamental analysis or a combination of technical indicators can make interesting subjects for studies. In this regard, researchers are advised to look for the best investment strategy by combining technical methods and investigating the effectiveness of these methods over time with a dynamic study. Also, by comparing technical and fundamental methods in finance and investment studies, researchers can look at how these methods can be used in different situations and figure out how to use them.

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