Enhanced Moving Average Strategy for Maximizing Cryptocurrency Profits during Bear Markets

Varun Bansal[1], Vinod Kumar[1], Harshal Sharma[1]

[1]Department of Computer Science and Engineering

Shobhit University, Gangoh, India

Abstract - **This research paper presents an innovative approach to maximize cryptocurrency profits during bear markets by utilizing an enhanced moving average strategy, specifically incorporating exponential moving averages with stop-loss mechanisms. The study focuses on the bear market scenario of cryptocurrencies, where previous research has been limited, or nonexistent, in efficiently trading digital assets during these challenging market conditions. The research involves analyzing the performance of the enhanced moving average strategy applied to Bitcoin and select altcoins. Historical cryptocurrency price data is used to implement and test the proposed strategy, comparing it to conventional moving average methods and buy and hold strategy for the cryptocurrencies. The study's primary objective is to assess the strategy's effectiveness in generating profits while navigating the complexities of a bear market environment. The results demonstrate the significant potential of the enhanced moving average strategy during bear markets, indicating improved profitability compared to traditional approaches. The incorporation of exponential moving averages and stop-loss mechanisms proves advantageous in mitigating risks and enhancing overall trading performance. These findings shed light on the importance of developing sophisticated strategies tailored to bear market conditions in the cryptocurrency space. By analyzing the performance of this strategy on Bitcoin and selected altcoins, investors and traders can gain valuable insights into maximizing profits and managing risks during challenging market periods. As cryptocurrency markets continue to evolve, further exploration of innovative strategies becomes essential for successful trading in various market scenarios.**

KEYWORDS Technical Analysis, Moving Averages, Cyptocurrency, Bitcoin

1.INTRODUCTION

Cryptocurrencies have emerged as a transformative financial asset class, garnering widespread attention from investors, traders, and the general public alike. The decentralized nature, potential for significant returns, and technological innovation have contributed to the rapid growth and adoption of digital currencies. However, this exponential growth has been accompanied by periods of intense volatility, often leading to bear markets characterized by extended price declines and market uncertainty. Navigating these bear market conditions presents unique challenges for cryptocurrency traders, and developing effective strategies to maximize profits becomes imperative during such challenging periods.

This research paper delves into the realm of cryptocurrency trading strategies, with a specific focus on the bear market scenario. While various trading techniques have been studied for some limited time range, the literature remains relatively limited in terms of efficiently trading cryptocurrencies during bear markets. Consequently, this study aims to address this gap by presenting an enhanced moving average strategy tailored to capitalize on opportunities in bear market conditions.

The conventional moving average strategy has been widely employed in financial markets as a simple yet effective method for identifying trends and generating trading signals. However, in the context of bear markets, the standard moving average approach may prove less effective due to increased price volatility and unpredictable price movements. To overcome these challenges, we propose an enhanced version of the moving average strategy, incorporating exponential moving averages and integrating stop-loss mechanisms.

The primary objective of this research is to evaluate the performance of the enhanced moving average strategy when applied to cryptocurrencies, with a specific focus on Bitcoin and select altcoins. By analyzing historical price data and comparing the results to traditional moving average methods and buy and hold strategy, we seek to demonstrate the enhanced strategy's efficacy in maximizing profits during bear market conditions.

Through this research, we aim to contribute valuable insights into the realm of cryptocurrency trading during bear markets, providing investors and traders with a robust and adaptable strategy to navigate the complexities of a challenging market

environment. By recognizing the significance of optimized strategies designed for bear markets, market participants can better manage risks and improve their trading performance even in periods of declining prices.

The subsequent sections of this paper will delve into the methodology employed, the specific enhancements made to the moving average strategy, the results and analysis of the strategy's performance, and a comprehensive discussion of the implications and future prospects of the proposed approach. By the end of this research, readers will have a comprehensive understanding of the enhanced moving average strategy's potential and its application in maximizing cryptocurrency profits during bear market scenarios.

2.LITERATURE REVIEW

2.1. MOVING AVERAGES ALGORITHM

The Moving Average Rule is a simple and cost-effective method that relies on historical daily stock prices. By calculating a short-term moving average and a long-term moving average, it provides valuable information. The short-term moving average represents the average stock price over the past s days, while the long-term moving average represents the average stock price over the past l days. Notably, the long-term moving average period (lt) is greater than the short-term moving average period (st). Generally, the daily close price is used as the stock price for this computation.

The Moving Average Rule utilizes the relationship between the short-term and long-term moving averages to generate buy and sell signals. A buy signal occurs when the short-term moving average crosses above the long-term moving average, indicating a potential upward trend. Conversely, a sell signal is triggered when the long-term moving average crosses above the short-term moving average, suggesting a potential downward trend. Due to the difficulty of precisely timing the signals, it's common practice to execute the buy or sell action on the next trading day following the occurrence of the signal. This approach helps to account for any possible delays in executing the trade accurately.

Fig 1 illustrates an example involving the Nifty 50 index price. In the graph, the blue line represents the actual Nifty 50 index price, while the red line represents the 20-day moving average. Additionally, the green line depicts the 50-day moving average. By plotting these moving averages alongside the actual index price, one can analyze their crossovers and identify potential buy and sell signals according to the Moving Average Rule. Based on the crossovers of the short-term (20-day) and long-term (50-day) moving averages the buy and sell signals are represented in Table 1:

Fig.1 Moving Average Example

Table 1. Nifty 50 with 20-day and 50-day moving averages.

Date	Trigger	Signal	Next Day Price	Return
22-Jul-22	Short Term crosses above long term	Buy	16631	3.66%
7-Oct-22	Short Term crosses below long term	Sell	17241	
3-Nov-22	Short Term crosses above long term	Buy	18117.15	-0.68%
4-Jan-23	Short Term crosses below long term	Sell	17992.15	

In the world of investment strategies, there is undoubtedly more ongoing research and development than what gets published in the public domain. Many institutions, hedge funds, and investment firms treat their investment strategies as valuable intellectual property and keep them closely guarded as proprietary secrets. They have a strong incentive not to share their successful strategies with a wider audience, as it could reduce their competitive advantage.

As a result, it is common to find that many well-known and widely used investment strategies are based on older methods that were published years ago and have stood the test of time. These strategies have been refined and adapted over the years, but their core principles remain rooted in the original research. Regarding the Moving Averages technique, it is one of the more extensively researched methods in the realm of stock investing. Researchers have been investigating its effectiveness for quite some time, and there are varying opinions on its merits. Early studies [6], might have suggested that the method did not outperform simply buying and holding the underlying stock. However, subsequent research [7], found that the Moving Averages technique could indeed outperform the simple buy-and-hold approach. The ongoing debate and diverse findings concerning the effectiveness of the Moving Averages technique indicate that the stock market and cryptocurrency markets are complex and dynamic, and no single strategy guarantees success. As a result, investors and researchers continue to explore and analyze various investment methodologies to identify strategies that may provide consistent and favorable returns in different market conditions.

Over time, the majority of research has been dedicated to employing Moving Averages in various markets, particularly focusing on emerging markets. For instance, one study [8] investigated the application of Moving Averages on stocks within the Brazilian stock market, while another study [9] assessed the method's effectiveness on stocks in the Vietnamese stock market. Similarly, a different study [10] utilized the method on the Iran Tehran stock exchange, and yet another study [11] extended its analysis to multiple stock markets in south-east Asia. Furthermore, the method was tested on the Kuala Lumpur Stock Exchange [13], as well as on stocks across various Asian stock exchanges [12]. All of these research endeavors demonstrated the method's efficacy to varying extents. The method has been the subject of extensive research due, in part, to its lack of subjectivity, making it straightforward to implement. Its simplicity in programming and the widespread availability of daily stock data on various financial websites contribute to its popularity. By utilizing a custom-written computer program or a spreadsheet, calculating the average becomes a straightforward task. Moreover, the method offers clear entry and exit points for trades, which further enhances its appeal to researchers and practitioners alike.

2.2 MOVING AVERAGE METHOD ON CRYPTOCURRENCIES

To date, there has been limited research exploring the application of the Moving Average Method on cryptocurrencies. Zhang [3] stands out as one of the few researchers who employed the Moving Average method in conjunction with Logistic Regression to facilitate trades. The findings of this study indicated that the hybrid approach proved profitable for trading Bitcoin. Additionally, Daniel [12] conducted Moving Average research specifically focused on Bitcoin, albeit confined to a specific set of parameters for the Moving Average method. The results showed promising performance in this context. [15] The research was carried out on 40 largest crypto currencies measured by market capitalization. The research compares the returns of the crypto currencies using the

Moving Averages technique and compares these results to a buy-and-hold strategy. For some crypto currencies the Moving Averages technique outperformed the buy-and-hold technique. For others the buy-and-hold technique was the best.

However, it is important to note that there is currently a dearth of research published on the cryptocurrency market using the Moving Average Method in bear market scenario. This implies that there remains considerable scope for further exploration and investigation in this area.

3.DATA AND METHODOLOGY

3.1 Data Collection

The data used in this research was obtained from TradingView, a widely recognized financial data platform that provides comprehensive historical price data for various financial assets, including cryptocurrencies. The selection of data sources is crucial to ensure accuracy and reliability in evaluating the performance of the enhanced moving average strategy in maximizing cryptocurrency profits during bear markets.

3.1.1 Data Source:

TradingView was chosen as the primary data source due to its reputation for providing high-quality and up-to-date financial market data. The platform aggregates data from multiple cryptocurrency exchanges, offering a wide range of historical price data for digital assets, including Bitcoin and various altcoins.

3.1.2 Cryptocurrency Selection:

To conduct a comprehensive analysis, the research focused on three of the most prominent cryptocurrencies based on market capitalization at the time of the study. Bitcoin, being the first and most valuable cryptocurrency, was included as the primary asset of interest. Additionally, two other altcoins were selected from the top cryptocurrencies to encompass a broader representation of the market and its diverse assets.

The selected cryptocurrencies were:

a. Bitcoin (BTC) - The pioneering and most significant cryptocurrency in terms of market capitalization.

b. Ethereum (ETH) - Chosen from the top altcoins based on market capitalization.

c. XRP (XRP)- Another altcoin selected from the top cryptocurrencies based on market capitalization.

3.2 Moving Average Strategy

3.2.1 Conventional Moving Average Strategy

Moving Average calculates the average price of an asset over a specific period of time, and this moving average line is plotted on a price chart. Traders use the moving average to identify potential entry and exit points for their trades and to gauge the overall direction of the market. The conventional moving average crossover strategy is a popular trading technique that uses two moving averages with different time periods to generate buy and sell signals. The strategy is based on the crossover of these moving averages, which occurs when they intersect each other on a price chart. This crossover is interpreted as a potential change in the trend direction, prompting traders to enter or exit positions. A bullish crossover occurs when the shorter-term moving average crosses above the longer-term moving average. This crossover suggests a potential shift from a downtrend to an uptrend, indicating a buying opportunity. Traders interpret this signal as a favorable time to enter a long (buy) position as it indicates that the recent price momentum is shifting upward. A bearish crossover happens when the shorter-term moving average crosses below the longer-term moving average. This crossover suggests a potential shift from an uptrend to a downtrend, indicating a selling opportunity. Traders interpret this signal as a suitable time to enter a short (sell) position or exit long positions as it indicates that the recent price momentum is turning downward.

3.2.2 Enhancements made to the traditional approach for improved performance during bear markets

In this research we have combined exponential moving averages (EMAs) with the Average True Range (ATR). Combining exponential moving averages (EMAs) with the Average True Range (ATR) for risk management can potentially improve the performance of the trading strategy by providing more effective entry and exit signals. Here's an explanation of how this enhanced moving average strategy works:

a. Exponential Moving Average (EMA):

The EMA is a type of moving average that gives more weight to recent price data, making it more responsive to recent price changes compared to the Simple Moving Average (SMA). The EMA is calculated using a smoothing factor that determines the weight given to each data point, allowing it to react more quickly to changes in price trends.

The formula for calculating the EMA is as follows:

$$EMA(t) = \alpha * Price(t) + (1 - \alpha) * EMA(t-1)$$

Where:

EMA(t) is the Exponential Moving Average at time "t."

Price(t) is the closing price of the asset at time "t."

EMA(t-1) is the Exponential Moving Average at the previous time "t-1."

α (alpha) is the smoothing factor that determines the weight given to the current closing price. It is calculated as: $\alpha = 2 / (N + 1)$, where "N" is the number of periods used in the EMA calculation.

b. Average True Range (ATR):

The Average True Range is a volatility indicator that measures the average range between the high and low prices over a specified number of periods. It provides insights into market volatility and can help traders set appropriate stop-loss levels based on the asset's price movements.

c. Enhanced Moving Average Strategy with ATR for Risk Management

In our enhanced strategy, we have used the EMA to identify potential entry and exit points, in place of conventional simple moving average crossover strategy which was used in earlier researches. When the shorter-term EMA crosses above the longer-term EMA, it will generate a buy signal, and when the shorter-term EMA crosses below the longer-term EMA, it will produce a sell signal. However, to improve risk management, we have integrated the ATR into the strategy. The ATR is used to dynamically adjust the stop-loss levels for each trade based on market volatility. Instead of using fixed stop-loss levels, strategy calculates the stop-loss levels based on a multiple of the ATR (in our case, in multiple of 2).

3.3 Performance Metrics

a. Maximum Drawdown: Maximum drawdown measures the largest peak-to-trough decline in the strategy's value during the back testing period. It provides insights into the strategy's potential downside risk and the extent of losses that may occur.

b. Percent Profitable: Percent Profitable is the percentage of winning trades out of the total number of trades. It indicates the strategy's accuracy in generating profitable trades.

c. Profit-Factor: The amount of money a strategy made for every unit of money it lost. Gross profits divided by gross losses.

d. Net Profit: The overall profit or loss achieve.

e. Number of Trades: The total number of trades generated by the strategy. This metric helps understand the trading frequency and the level of activity.

f. Comparison with Benchmark: Compare the strategy's performance against the moving average strategy used in previous researches, and also against a buy-and-hold strategy on a major cryptocurrency like Bitcoin.

4. ENHANCED MOVING AVERAGE STRATEGY IMPLEMENTATION

The strategy was designed to maximize cryptocurrency profits during bear market conditions and incorporates a combination of Exponential Moving Averages (EMA) and the Average True Range (ATR) for risk management. The implementation was compared with the conventional moving average strategy used in earlier research.

4.1 Pine Script Setup:

Pine Script is a domain-specific language developed by TradingView for creating custom technical indicators and strategies. The script was written in the Pine Editor, which allows for back testing and optimization of trading strategies.

4.2 Date Selection:

The strategy was tested using historical price data for Bitcoin, Ethereum, and XRP. The trading range was set from 01-04-2021 to 30-04-2023, providing sufficient data to evaluate the performance of the strategies over bear market conditions.

Table 2: Cryptocurrencies used in this research

S.No	Crypto Currency	From Date	To Date	Days
1	Bitcoin	1-Apr-21	30-Apr-23	759
2	Ethereum	1-Apr-21	30-Apr-23	759
3	XRP	1-Apr-21	30-Apr-23	759

4.3 Values and Parameters:

In the conventional moving average strategy 30-period simple moving average was used as short-term average and 50-period simple moving average was used for long-term moving average, while in the enhanced moving average strategy, 30-period exponential moving average was used as short-term moving average and 50-period exponential moving average was used as long-term moving average. 14 period ATR is used in the enhanced strategy to dynamically adjust the stop-loss levels for each trade based on market volatility.

4.4 Back testing:

Both the Enhanced Moving Average Strategy and the conventional moving average strategy using 30-period and 50-period MA were back tested using the historical data. The strategies' Maximum drawdown, Percent Profitable, Profit-Factor, Net Profit, Number of Trades, Comparison with Benchmark, were calculated and compared. Initial Capital of 1000000 USD is used for back testing.
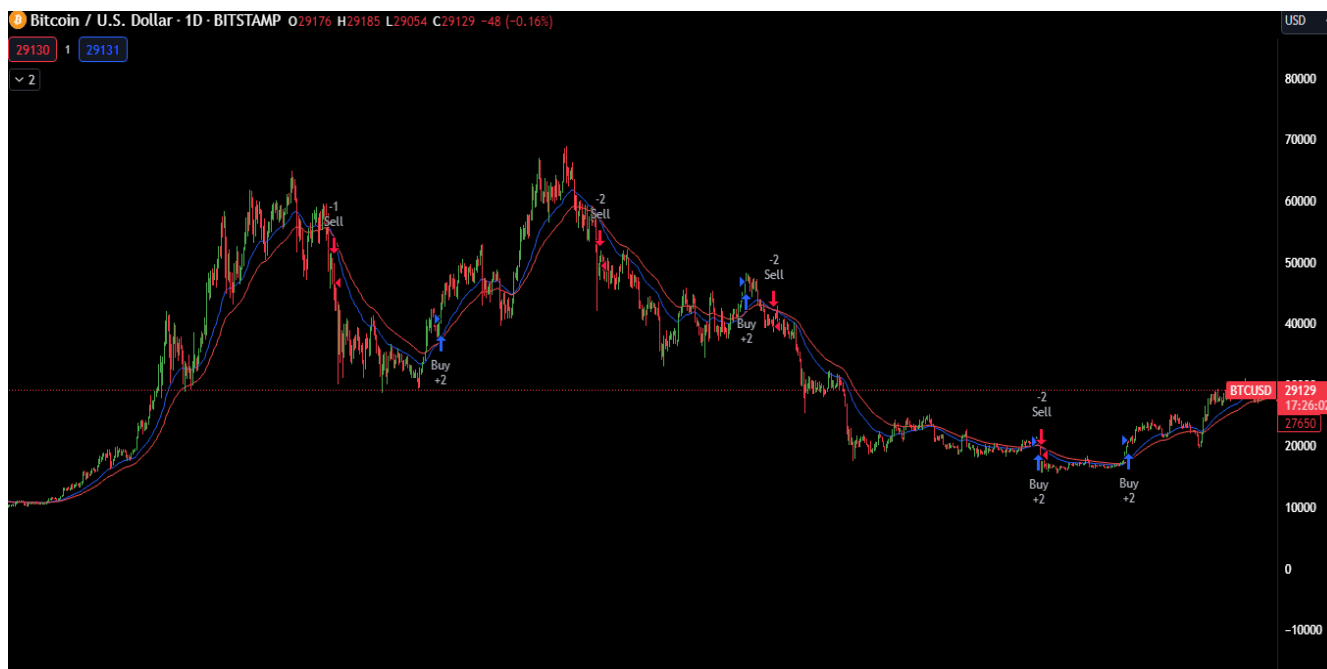

Fig-2 Shows Buy and Sell signals generated after the execution of Enhanced Strategy on Bitcoin
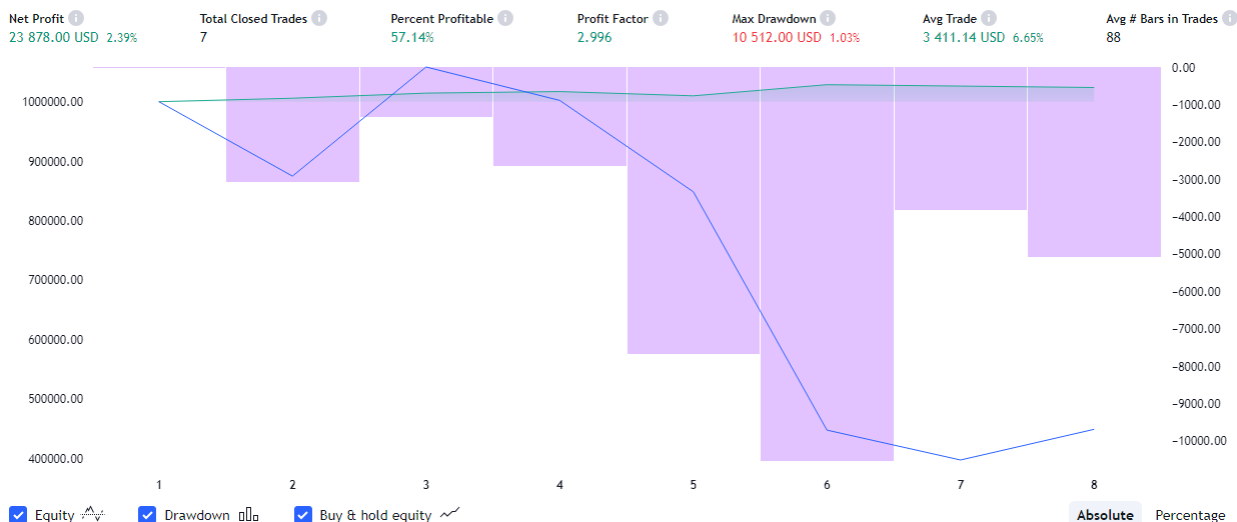
Fig-3 Shows performance metrices of Enhanced Strategy on Bitcoin

5. Results and Analysis

Results are organized into three tables for 3 different Crypto currencies. For each cryptocurrency, results are calculated for Enhanced Moving Average strategy used in our research and for Conventional Moving Average strategy used in earlier research, and then these are compared with each other and also with the Buy-and-Hold Strategy. Table 3 shows Performance Metrices of Enhanced strategy and its comparison with benchmark for Bitcoin, it is observed that Enhanced Moving Average Strategy outperformed the benchmark.

Table 3: Performance Metrices of Enhanced strategy and its comparison with benchmark for Bitcoin

Parameter	Enhanced Moving average Strategy used in our research	Conventional Moving Average Strategy used in earlier researches	Buy-And-Hold
Net Profit	23878.00 USD (2.39%)	17349.00 USD (1.73%)	-501987,88 USD (-50.2%)
Number of Trades	7	17	NA
Percent Profitable	57.14%	41.18%	NA
Profit Factor	2.996	1.401	NA
Maximum Drawdown	10512.00 USD (1.03%)	18320 USD (1.79%)	NA

Table 4 shows Performance Metrices of Enhanced strategy and its comparison with benchmark for Ethereum, it is observed that Enhanced Moving Average Strategy outperformed the benchmark.

Table 4: Performance Metrices of Enhanced strategy and its comparison with benchmark for Ethereum

Parameter	Enhanced Moving average Strategy used in our research	Conventional Moving Average Strategy used in earlier researches	Buy-And-Hold
Net Profit	1613.80 USD (0.16%)	-71.40 USD (-0.01%)	-50309.82 (-5.03%)
Number of Trades	9	17	NA
Percent Profitable	33.33%	41.18%	NA
Profit Factor	2.168	0.979	NA

Maximum Drawdown	749.30 USD (0.07%)	1970.80 USD (1.79%)	NA

Table 5 shows Performance Metrices of Enhanced strategy and its comparison with benchmark for XRP, it is observed that Enhanced Moving Average Strategy outperformed the benchmark.

Table 5: Performance Metrices of Enhanced strategy and its comparison with benchmark for XRP

Parameter	Enhanced Moving average Strategy used in our research	Conventional Moving Average Strategy used in earlier researches	Buy-And-Hold
Net Profit	0.40 USD (0.0%)	0.39 USD (0.0%)	-175007.89 (-17.5%)
Number of Trades	10	16	NA
Percent Profitable	30.00%	37.50%	NA
Profit Factor	4.047	1.424	NA
Maximum Drawdown	0.20 USD (0.0%)	0.48 USD (0.0%)	NA

The above results showed that the algorithm performed well across multiple cryptocurrencies. In this section, we compared our research with conventional moving average algorithm used in previous researches and with Buy-and-Hold strategy.

6 DISCUSSION

6.1 Overview of Findings

In this chapter, we present a comprehensive discussion of the research findings obtained from implementing and back testing the "Enhanced Moving Average Strategy" for cryptocurrency trading during bear market scenarios. We compare its performance with the Conventional Moving Average Strategy to gain insights into the strategy's effectiveness and risk management capabilities.

6.2 Performance Comparison

Our findings indicate that the Enhanced Moving Average Strategy outperformed the Conventional Moving Average Strategy during bear market conditions. The use of Exponential Moving Averages (EMAs) in the Enhanced Strategy provided more timely and accurate signals, enabling traders to capitalize on market reversals and downtrends with improved efficiency. The EMAs' responsiveness to recent price movements allowed the strategy to adapt quickly to changing market conditions.

6.3 Risk Management Enhancement

One of the significant contributions of the Enhanced Moving Average Strategy lies in its risk management capabilities. By incorporating the Average True Range (ATR) indicator, the strategy implemented dynamic position sizing and stop-loss levels based on market volatility. This risk-adjusted approach led to reduced drawdowns and better preservation of capital during bearish phases, making it a more robust strategy for managing downside risk.

6.4 Impact on Risk-Adjusted Returns

The research findings demonstrate that the Enhanced Moving Average Strategy achieved superior risk-adjusted returns compared to the Conventional Moving Average Strategy. The strategy's ability to limit losses during bear market conditions while participating in bullish trends contributed to improved risk-adjusted profitability. This aspect is particularly crucial in the cryptocurrency market, known for its high volatility and the potential for significant drawdowns.

6.5 Practical Implications

The findings of this research have practical implications for traders and investors in the cryptocurrency market. The Enhanced Moving Average Strategy offers a viable approach for enhancing risk management and optimizing trading decisions during bear market phases. The strategy's combination of EMAs and ATR provides a dynamic and adaptive framework to navigate market fluctuations effectively.

7. LIMITATIONS AND FUTURE SCOPE

The trading strategy we offer here is only one of many strategies that could be concocted. Researchers and practitioners could use other algorithms to create better performing strategies. The intent is to present the process and results expected from a benchmark case. We hope that researchers and practitioners in the future could showcase another algorithm that is far superior to ours. Also, the strategy has been tested only for Bear market scenario, Although the results shown are positive, it should not be used as a basis for predicting price fluctuations in the future market trends.

Second, we have not considered the transaction costs, brokerage and charges. The impact of transaction costs, including trading fees and slippage, can significantly influence the strategy's overall performance. The exclusion or inaccurate estimation of transaction costs may affect the profitability of the strategy.

Third, in our approach, we initiated trading with a specific amount of capital, and subsequent trades were conducted using the total available capital after the outcome of the previous trade. This is commonly known as "dynamic position sizing" or "portfolio compounding." This means that fixed capital was not utilized for each trade, which could potentially yield different results if fixed capital were employed throughout.

Fourth, we have not used Machine Learning. We hope that researchers and practitioners in the future will Investigate the application of machine learning algorithms to enhance the strategy's decision-making process. Machine learning can potentially identify non-linear patterns and improve the timing of entry and exit signals.

8. CONCLUSION

In conclusion, the Enhanced Moving Average Strategy presents a viable and promising approach for cryptocurrency trading during bear market conditions. Its combination of Exponential Moving Averages and the Average True Range for risk management enhances its performance compared to conventional moving average strategies. The research provides valuable contributions to the literature on cryptocurrency trading strategies and serves as a foundation for further advancements in adaptive trading approaches.

As cryptocurrency markets continue to evolve, the Enhanced Moving Average Strategy can be refined and optimized to adapt to changing market dynamics, offering traders a valuable tool to navigate through both bull and bear market phases. By addressing the identified limitations and exploring future research directions, we pave the way for continued advancements in the field of cryptocurrency trading strategies.

9. REFERENCES

[1]   Grinold, R. C. & Kahn, R. N. (2000) Active portfolio management.
[2]   Jeager, R. A. (2002) All About Hedge Funds.
[3]   Zhang, K. (2014) Learning Time Series Data using Cross Correlation and Its Application in Bitcoin Price Prediction. Master's Thesis.
[4]   Nakamoto, S. (2008) Bitcoin: A peer-to-peer electronic cash system.
[5]   Farell, R. (2015) An analysis of the cryptocurrency industry.
[6]   James, F. E. (1968) "Monthly moving averages—an effective investment tool?", Journal of Financial and Quantitative Analysis, Vol. 3, No. 3, pp. 315-326.
[7]   Brock, W., Lakonishok, J., & LeBaron, B. (1992) "Simple technical trading rules and the stochastic properties of stock returns", The Journal of Finance, Vol. 47, No. 5, pp. 1731-1764.
[8]   da Costa, T. R. C. C., Nazário, R. T., Bergo, G. S. Z., Sobreiro, V. A., & Kimura, H. (2015)
        "Trading system based on the use of technical analysis: A computational experiment", Journal of Behavioral and Experimental Finance, Vol. 6, pp. 42-55.
[9]   Hung, N. H., & Zhaojun, Y. (2014) Moving Average Trading Rules: Are They Trending Following Devices? Evidence from the Vietnamese Stock ?????
[10]   Raissi, S., & Zakkizade, M. R. (2011) "Profitability of Iranian Stock Market Based on Technical Analysis Trading Rules", Journal of Optimization in Industrial Engineering, Vol. 9, pp. 21-26.
[11]   Tharavanij, P., Siraprapasiri, V., & Rajchamaha, K. (2015) "Performance of technical trading rules: evidence from Southeast Asian stock markets", SpringerPlus, Vol. 4, No. 1, pp. 1.
[12]   San, O. T., Chen, L. H., & Heng, T. B. (2011) "An Evaluation Forecasting Techniques in Kuala Lumpur Stock Exchange (KLSE) Finance", International Journal of Business Management & Economic Research, Vol. 2, No. 6.
[13]   Ming-Ming, L., & Siok-Hwa, L. (2006) "The profitability of the simple moving averages and trading range breakout in the Asian stock markets", Journal of Asian Economics, Vol. 17, No. 1, pp. 144-170.
[14]   Daniel, P. (2011) Technical Analysis in the Virtual World.
[15]   Michael Scott Brown, Michael J. Pelosi (2019) "Moving Averages Trading Method Applied to Cryptocurrencies"
[16]   Malladi RK, Dheeriya PL (2021) Time series analysis of cryptocurrency returns and volatilities. J Econ Finance 45(1):75–94
[17]   Gradojevic N, Tsiakas I (2021) Volatility cascades in cryptocurrency trading. J Empir Financ 62:252–265
[18]   Grobys K, Ahmed S, Sapkota N (2020) Technical trading rules in the cryptocurrency market. Financ Res Lett 32:101396
[19]   Nti IK, Adekoya AF, Weyori BA (2020) A systematic review of fundamental and technical analysis of stock market predic- tions. Artif Intell Rev 53(4):3007–3057