ANALYSIS OF THE WEEKLY CLOSING PRICE OF BITCOIN: INFLUENCING FACTORS AND TRADER'S FORECASTS

АНАЛІЗ ЩОТИЖНЕВОЇ ЦІНИ ЗАКРИТТЯ БІТКОЇНА: ФАКТОРИ ВПЛИВУ ТА ПРОГНОЗИ ТРЕЙДЕРА

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The study focuses on the degree of correlation between the MACD histogram and the closing price of bitcoin on a weekly timeframe, which is an important factor in the formation of traders' forecasts within the framework of technical analysis. The main objectives of the study were to find out whether the minimum price of bitcoin increased or decreased compared to the previous week with similar changes in the MACD, as well as to determine the average and maximum series for the weekly closing price. The study found that in 54.45% of cases, a trader can expect the closing price of bitcoin to increase this week if the MACD histogram showed an increase in the previous week; or to decrease this week if the MACD histogram showed a decrease in the previous week. A trader can expect the closing price of bitcoin to continue its direction of movement in the second week 48.02% of the time. A trader can expect the closing price movement in one direction to end after the 4th week 95.48% of the time.
Keywords: cryptocurrency, bitcoin, MACD histogram, forecasting, trader.

Ринок біткоїнів продовжує залишатися однією з найбільш динамічних і цікавих сфер фінансового світу сьогодні. В останні роки біткойн зазнав значних цінових коливань, що змусило інвесторів і трейдерів займатися постійним моніторингом, аналізом і прогнозуванням вартості біткоїна. У цьому контексті аналіз динаміки ціни закриття біткоїна має вирішальне значення для трейдерів. Прогнозування, в свою чергу, є не менш важливим інструментом для досягнення успіху на ринку біткоїну, дозволяючи трейдерам приймати обґрунтовані рішення, знижувати ризики, визначати ринкові тенденції, оптимізувати свої портфелі та здійснювати стратегічне планування. Завдяки використанню технічних індикаторів, таких як гістограма MACD, вони можуть оцінити тенденції на ринку криптовалют і визначити потенційні можливості для входу і виходу. Метою дослідження є аналіз взаємозв'язку між динамікою ціни закриття біткоїна на тижневому таймфреймі та гістограмою MACD як передумови для прогнозування та поведінки трейдерів на криптовалютному ринку. Основні цілі включали дослідження того, чи зросла або знизилася мінімальна ціна біткоїна порівняно з попереднім тижнем у зв'язку з аналогічними тенденціями на MACD, а також визначення середнього і максимального діапазонів тижневих цін закриття. Дослідження підкреслило, як комплексне використання цих двох технічних індикаторів може підвищити здатність трейдерів приймати більш обґрунтовані та ефективні торгові та інвестиційні рішення. Результати показали, що в 54,45% випадків трейдер може передбачити підвищення ціни закриття біткоїна на поточному тижні, якщо гістограма MACD демонструє висхідний тренд на попередньому тижні, або зниження, якщо MACD демонструє низхідний рух. Крім того, аналіз показав, що в 48,02% випадків ціна закриття біткоїна, ймовірно, продовжить рухатися в тому ж напрямку і на наступному тижні. Крім того, дослідження продемонструвало 95,48% ймовірність того, що рух ціни в одному напрямку завершиться після четвертого тижня.
Ключові слова: криптовалюта, біткоїн, гістограма MACD, прогнозування, трейдер.

Problem statement. The Bitcoin market continues to be one of the most vibrant and alluring areas within contemporary finance. Over recent years, Bitcoin has experienced considerable price volatility, motivating investors and traders to closely observe and analyze this asset. Its importance is further magnified by its status as the pioneering decentralized cryptocurrency, which has fundamentally transformed financial transactions and emerged as a hallmark of a new era in the digital economy.

In the fast-paced cryptocurrency landscape, where market conditions can shift rapidly, having reliable forecasting tools becomes indispensable. Effective forecasting is a crucial instrument for success in the Bitcoin market, as it allows traders to make well-informed decisions, manage risks, detect emerging trends, optimize investment portfolios, and engage in long-term strategic planning. Given these considerations, forecasting is now a fundamental element of a sound Bitcoin trading strategy.

A key focus for traders is the examination of Bitcoin's closing price behavior, which is recognized as the most liquid and widely traded digital asset. Utilizing technical indicators like the Moving Average Convergence Divergence (MACD) histogram – based on the divergence between short-term and long-term moving averages – enables traders to gauge market trends and identify optimal entry and exit points. The authors assert that the combined analysis of Bitcoin's closing price and the MACD histogram provides traders with a potent tool for making informed predictions about future price movements.

Consequently, this article will delve into a practical framework for formulating trader forecasts, grounded in a comprehensive analysis of the dynamics of Bitcoin's closing price and the MACD histogram. Such an approach aims to enhance both the precision and effectiveness of decision-making, thus assisting traders in refining their strategies and improving market performance within the Bitcoin ecosystem.

Analysis of recent research and publications. In the contemporary digital society, cryptocurrencies, most notably Bitcoin, have emerged as a pivotal element within financial markets and the realm of technological innovation. The advent of Bitcoin, the inaugural decentralized cryptocurrency, signaled the commencement of a novel epoch in the domain of financial technology. Subsequent to its emergence, Bitcoin has garnered substantial attention from academics, economists and investors within the relevant scholarly community.

Notwithstanding its ubiquity on a global scale, the extant literature on the subject in Ukraine is, at the time of writing, limited in number and scope. The paucity of studies in the domestic professional financial literature devoted to the analysis of bitcoin price and its forecasting is a matter of some concern. In this context, it is pertinent to refer to the research conducted by such authors: Hur'yanova & Lutsenko [1], Pylypchenko et al. [2], Pupov & Zavhorodnya [3]; Ignatenko & Dokiienko [8; 9].

Concurrently, there has been a marked increase in global interest in bitcoin and the analysis of its price dynamics. This subject has been the focus of a substantial volume of research, for example, Al-Nefaie & Aldhyani [4], Bâra & Oprea [6], Chen & Yang [7], Maleki et al. [10], Rudd & Porter [11], Samizadeh [12], Shahzad et al. [13], Uras et al. [14], Zeba et al. [15].

Consequently, within the context of domestic scientific literature, there is an evident paucity of attention accorded to the technical analysis of bitcoin. This is a tool for predicting medium-term trends in the cryptocurrency market, thus rendering the topic of the scientific article highly pertinent.

The purpose of the article is to analyze the relationship between the dynamics of Bitcoin's closing price on the weekly timeframe and the MACD histogram as a prerequisite for traders' forecasting and behavior in the cryptocurrency market.

Summary of the main research material. The optimal determination of the price for the acquisition or disposition of Bitcoin is a critical strategic decision, as it directly impacts the timing and profitability of market entry and exit. In order to ascertain the optimal timing and develop a corresponding strategy, it is necessary to consider several factors, including investment objectives, risk tolerance, the trader's broader approach, and the results of technical analysis, among others. It is evident that a thorough preliminary technical analysis of the cryptocurrency market and the specific asset is essential for making well-informed decisions. The field of Bitcoin technical analysis is centered upon the examination of chart patterns, which represent the movement of the Bitcoin price over specified time periods. Through the integration of chart analysis with an appreciation for fundamental underlying factors, traders are able to attain a comprehensive perspective on the market dynamics of Bitcoin, its price trends,

and the behavior of the crypto market in general. This, in turn, serves to enhance the quality of decision-making processes within the field.

Moreover, the examination of Bitcoin's closing price is of particular significance for several reasons. Firstly, closing price points can indicate potential support levels, i.e. the price levels at which Bitcoin's price may find stability after a decline. Secondly, recognizing these levels enables traders to determine optimal entry points or establish stop-loss orders. Thirdly, by tracking Bitcoin's closing prices over time, investors can improve their ability to forecast when the market may experience a rebound. This, in turn, enhances the accuracy of their predictions and refines their strategy. Furthermore, the analysis of closing prices serves as an indicator of trend strength, with higher closing prices often mirroring stronger upward trends, signifying growing market momentum. Conversely, lower closing prices may point to a weakening trend or a potential reversal.

The closing price is of particular significance in this context, as the MACD indicator on cryptocurrency exchange charts is based on this price by default. Throughout the week, Bitcoin's maximum and minimum prices fluctuate and typically do not align with the weekly closing price. Consequently, ascertaining the approximate closing price for the week empowers traders to make more informed decisions, enabling them to capitalise on potential profits or avoid losses.

Furthermore, the MACD histogram is a pivotal analytical instrument in the formulation of trading strategies within the cryptocurrency market. It facilitates the identification of shifts in market direction, the assessment of the strength of prevailing trends, and, in conjunction with other indicators, enhances the accuracy of analysis and forecasts. In essence, the MACD histogram functions as a conditional signal for trend direction and strength. It is imperative for traders to discern the frequency with which trends recur and to be able to respond to such patterns in order to make optimal decisions in any given situation.

The sequence of operations constituting the algorithm for conducting a study on the analysis of results is hereby proposed to be carried out in the following manner:

– the subsequent alterations in the closing price of Bitcoin and the MACD histogram are depicted in a binary system, wherein each augmentation in the price or MACD histogram is assigned a value of "1" and each diminution is assigned a value of "0";

– the following changes in the MACD histogram and bitcoin price are then calculated;

– the relationship between the closing price of bitcoin and the MACD histogram from week to week is then calculated. The relationship between price changes in the current and next week must be established.

– the obtained values must be divided into the sectors of the beginning of the series depending on whether the MACD histogram started its change below or above the zero line.

– the total length of the series, as well as the growth series and the fall series, must be measured separately. The rising and falling series must be calculated when the MACD histogram starts below or above the zero line.

To build a MACD histogram, we used well-known tools [5]:

$$Histogram = MACD - SignalLine \qquad (1)$$
$$SignalLine = EMA_9(MACD) \qquad (2)$$
$$MACD = EMA_{12} - EMA_{26} \qquad (3)$$

where MACD values obtained from the difference between EMAs with periods of 12 and 26; Signal Line – 9-period EMA from MACD; MACD values obtained from the difference between EMAs with periods of 12 and 26; EMA12 – 12-period exponential moving average (for a short period); EMA26 – 26-period exponential moving average (for a long period).

This study employed statistical methodologies to analyze the weekly closing price of bitcoin and the MACD histogram constructed on the closing prices of each week. The analysis was based on a sample of 346 weeks for the study period from 2018-04-02 to 2024-11-11.

At the outset of the analysis, the focus was placed on examining the relationship between the MACD histogram and Bitcoin's closing price on a weekly basis, as a crucial factor for making predictions through technical analysis. The calculations revealed that, when comparing the numerical values of both the closing price and the MACD histogram, there was no significant correlation, with a correlation coefficient of 0.08 (Figure 1).

However, when analyzing the correlation between the closing price and the MACD histogram in binary terms, a moderate positive correlation was detected between the weekly data sets, yielding a correlation coefficient of 0.44. In contrast to studies [8] and [9], the correlation between the MACD histogram and the closing price shifted 1 week ahead is only 0.03 (in binary).
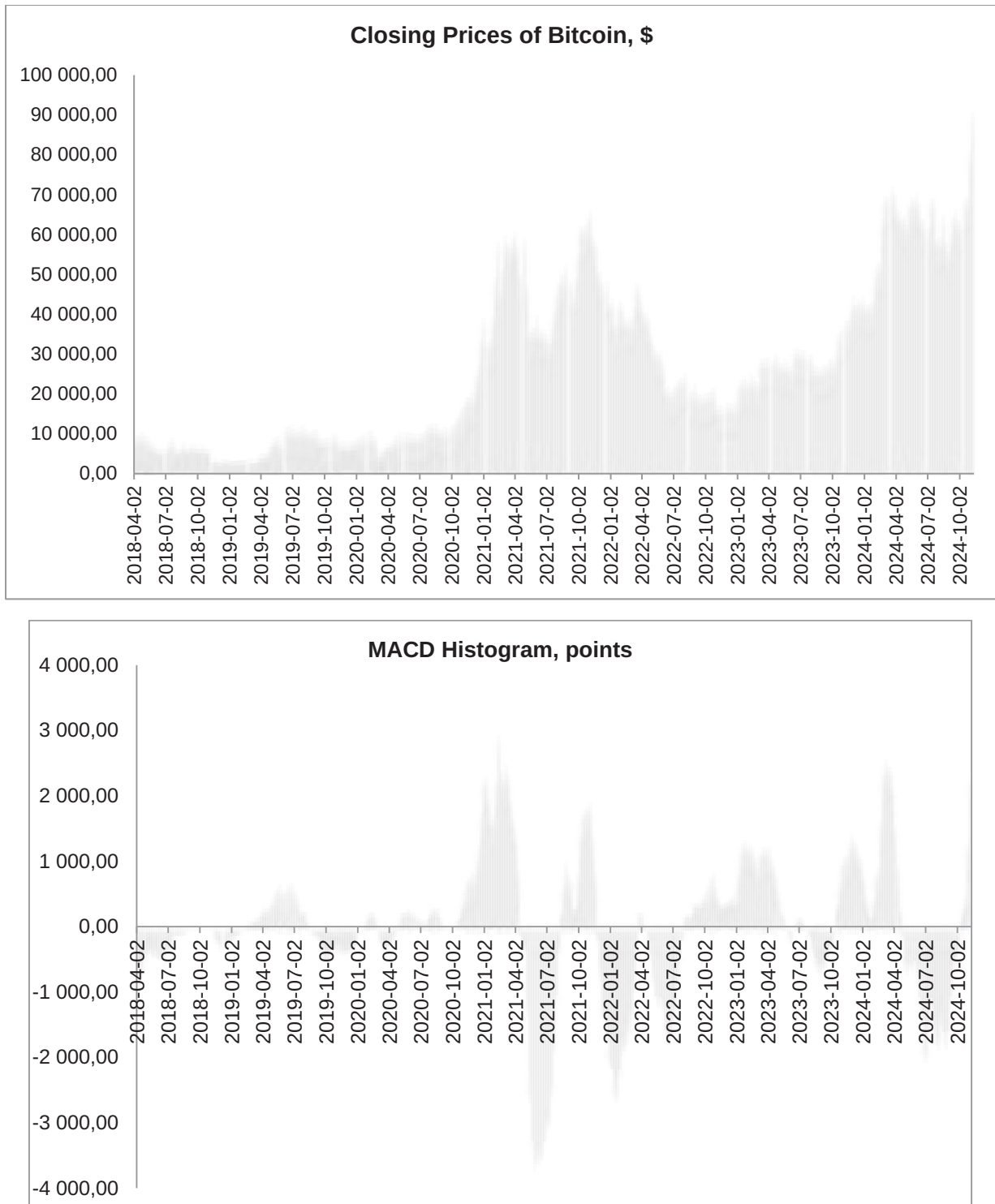
**Figure 1. The dynamics of the closing price of Bitcoin and MACD histogram
(period from 2018-04-02 to 2024-11-11)**

Source: calculated and constructed by the authors on the basis of [16]

ФІНАНСИ, БАНКІВСЬКА СПРАВА ТА СТРАХУВАННЯ

Moreover, the investigation revealed that the proportion of weeks characterized by rising prices (53.62%) surpassed the proportion of weeks marked by declining prices (46.38%), thereby indicating an overarching bullish trend during the period under scrutiny. This finding serves to reinforce the prevailing upward trajectory observed in the Bitcoin market during the specified timeframe.

Simultaneously, 88 series exhibited rising prices, while 89 series demonstrated falling prices. However, the number of series
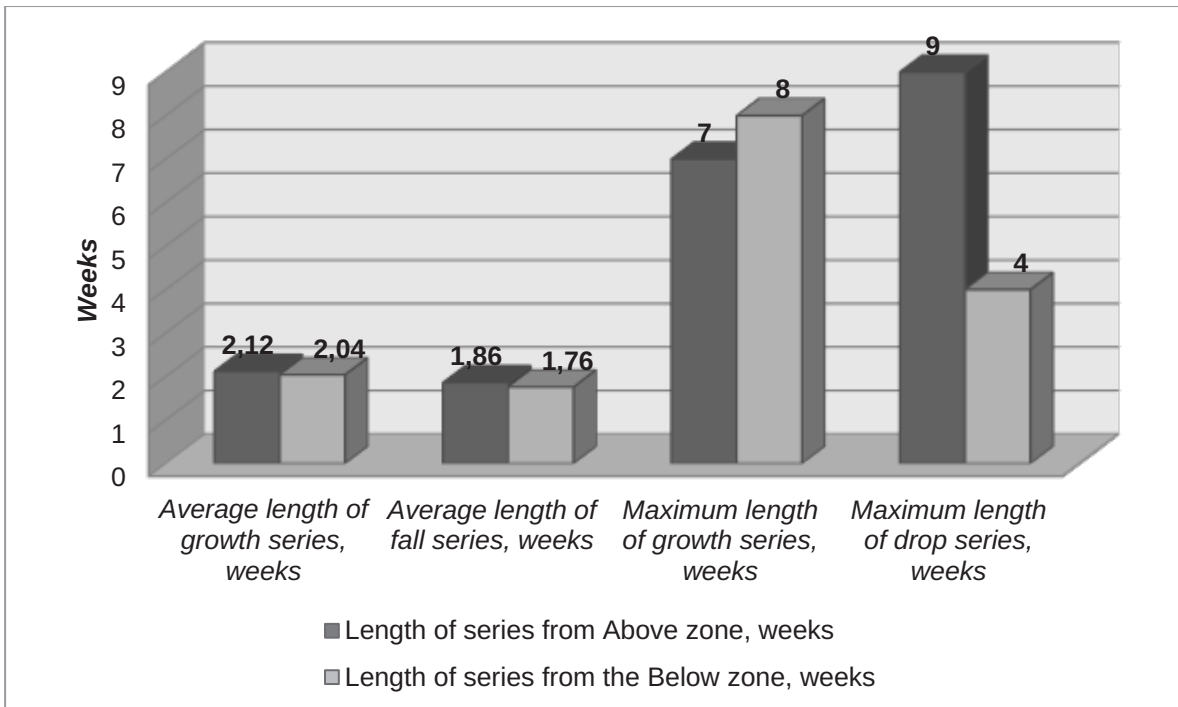
**Figure 3. Average and maximum durations of Bitcoin closing price series,
based on the starting zone of each series**

Source: calculated by the authors on the basis of [16]

commencing below the zero line on the MACD is 83, while the number of series commencing above the zero line is 94.

The mean duration of all series under consideration is 1.95 weeks. Growth series, on average, have a duration of 2.08 weeks, which is marginally longer than the decline series, which have an average length of 1.82 weeks. However, it is observed that the longest series are recorded in the downward trend, with the decline series extending up to 9 weeks, and the longest growth series lasting 8 weeks (Figure 2).
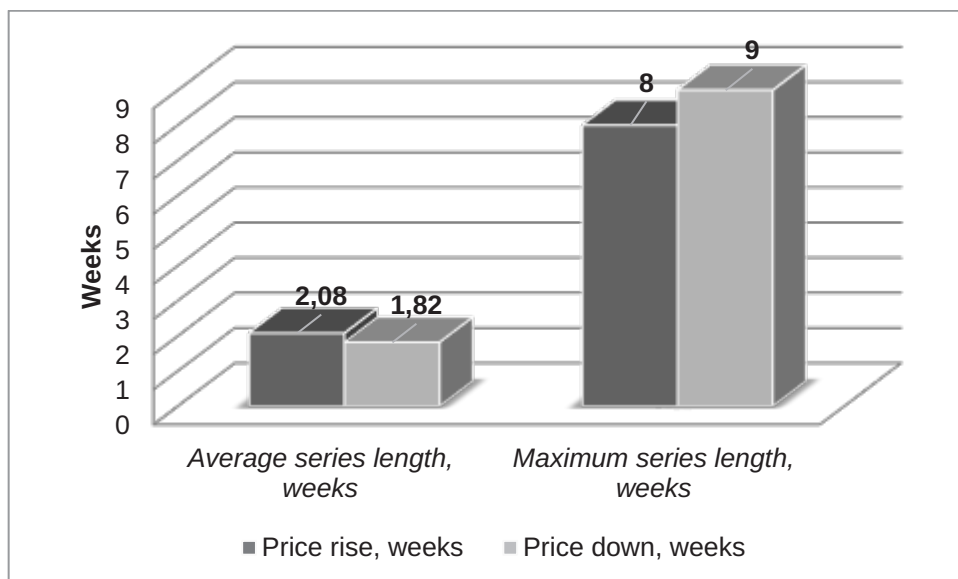

Figure 2. Maximum and average length of bitcoin closing price series

Source: calculated by the authors on the basis of [16]

In order to achieve a more comprehensive analysis, it is recommended that the duration of Bitcoin's closing price series be assessed, with consideration given to the zone in which each series commences.

The mean lengths of series originating from different zones are found to be nearly identical to the overall averages for upward and downward movements. However, it is noteworthy that the maximum duration of the decline series commencing from the Below zone is a mere four weeks, which is approximately half the maximum duration observed for series initiated in other zones (Figure 3).

In trading practice, this suggests that when engaging in a bearish trend in the zone below the zero MACD line, traders can expect much shorter decline series in Bitcoin's closing price. Consequently, it is imperative to exercise caution when engaging in a bearish trend from the Below zone, as a market reversal may be imminent.

Conversely, the duration of the series in other zones does not necessarily indicate a stronger trend. The mean duration of price growth series is 2.08 weeks, while the decline series lasts on average 1.82 weeks, with the percentages for each at 75.28% and 79.55%, respectively. Furthermore, it is notable that 95.48% of all series concluded on the fourth week, irrespective of their initial point. The overall balance remains quite similar, with 4-week (inclusive) downward series at 97.73% and 4-week (inclusive) upward series at 93.26% (Table 1).

From a pragmatic perspective, this signifies that when a trader observes a price movement that is consistently progressing in a single direction over a period of 2-4 weeks, there is an increased probability that they will anticipate a trend reversal, market stabilization, or a short-term shift in price direction. Consequently, they may opt to close or reduce their position, recognizing it as a potential indicator of heightened risk, thereby functioning as a "leading" indicator.

In addition, it was observed that almost half of all the series that were analyzed (51.98%) concluded after a single event, while the majority of the remaining series were characterized by multiple events. This finding suggests a 48.02% probability that a price movement series will persist after the initial occurrence, indicating the anticipation of at least one additional analogous movement. Should this tendency be corroborated by additional indicators, traders can proceed with greater assurance in the direction of the price movement, a state of affairs that is particularly beneficial for medium-term strategies with duration of 1-2 weeks.

The analysis further revealed a tendency for the price to align with the direction signaled by the MACD histogram movement from the preceding week. For series featuring a single MACD event, the price continued in the same direction 46.67% of the time on average.

When the MACD histogram commences from the Below zone and ascends, the price exhibited a mirrored movement in 42.86% instances during the initial week, and in 60% instances during the subsequent week. A comparable trend is observed when the MACD histogram commences from the Above zone and moves in the downward direction: in 40.00% of cases, the

Table 1

Maximum and average durations of Bitcoin price series expressed in percentage terms

Length of price series, weeks	Total length of the price series, %	Length of price growth series, %	Length of price drop series, %	Length of price series from Below zone,%	Length of price series from Above zone, %
1	51.98	49.44	54.55	53.01	51.06
2	77.4	75.28	79.55	79.52	75.53
3	88.7	86.52	90.91	89.16	88.3
4	95.48	93.26	97.73	95.18	95.74
5	96.61	94.38	98.86	96.39	96.81
6	96.61	94.38	98.86	96.39	96.81
7	98.87	98.88	98.86	98.8	98.94
8	99.44	100	98.86	100	98.94
9	100		100		100

Source: calculated by the authors on the basis of [16]

price replicated the movement in the first week, and in 66.67% of cases in the second week (Table 2).

In contrast, the pattern is reversed for the other two types of series. When the MACD histogram commences from the Below zone and moves in a downward direction, the price replicates the movement in 58.33% of cases during the first week, and in 42.86% during the second week. A similar phenomenon was observed when the MACD histogram initiated from the Above zone and moved upwards, with the price reflecting the movement in 52.94% of instances during the first week and in 46.15% of instances during the second week.

This analysis posits that the behavior of Bitcoin's price frequently exhibits repeating patterns, influenced by the initial position of the MACD histogram. Traders can utilize this information to identify potential trends and adapt their strategies accordingly, particularly when the price moves in a consistent direction over multiple weeks.

Contrary to the conclusions drawn in studies [8] and [9], the relationship between the closing price and the MACD movement demonstrates a more intricate and variable pattern, contingent on the initial zone. In general, the price followed the direction of the MACD histogram in 63.20% of cases in the following week. However, when the

Table 2

Duration of price series that mirror the direction of the MACD movement

MACD series length, weeks	Total length of MACD series with price repeating the same direction, %	Length of MACD series with price repeating the same direction, %			
		Start zone - Below, direction - Rise	Start zone - Below, direction - Down	Start zone - Above, direction - Rise	Start zone - Above, direction - Down
1	46.67	42.86	58.33	52.94	40.00
2	56.60	60.00	42.86	46.15	66.67
3	42.22	35.71	50.00	63.64	28.57
4	50.00	58.33	33.33	37.50	54.55
5	62.07	63.64	0.00	60.00	72.73
6	56.00	54.55		50.00	60.00
7	50.00	55.56		50.00	44.44
8	50.00	71.43		100.00	16.67
9	58.33	57.14		0.00	75.00
10	44.44	60.00		0.00	33.33
11	57.14	75.00			33.33
12	60.00	66.67			50.00
13	33.33	50.00			0.00
14	100.00	100.00			100.00
15	50.00	100.00			0.00
16	0.00	0.00			
17	100.00	100.00			
18	100.00	100.00			
19	100.00	100.00			
20	100.00	100.00			
21	100.00	100.00			
22	100.00	100.00			
23	100.00	100.00			
24	0.00	0.00			

Source: calculated by the authors on the basis of [16]

analysis is limited to the first 15 weeks, excluding the single 24-week series from the dataset, the percentage drops to 54.45%, providing a more nuanced and accurate result. This shift can be attributed to the influence of the single 24-week series, during which the price consistently reflected the MACD movement in almost every instance.

Moreover, in the event that, in the subsequent week, the price fails to align with the direction of the MACD, it is indicative of a heightened probability of a reversal in the MACD trend itself. This phenomenon is particularly evident in the most extensive MACD series, which invariably culminated at zero, signifying that the price did not persist in the same direction as the MACD movement. This observation underscores the necessity of incorporating longer series into analyses and the potential impact on the accuracy of short-term predictions based on the MACD indicator.

To encapsulate the findings of the study, the following conclusions can be drawn.

Firstly, in 54.45% of cases, traders have been shown to be capable of predicting an increase in Bitcoin's closing price for the current week if the MACD histogram indicated an upward movement in the previous week, or a decline in the closing price if the MACD histogram showed a downward shift in the prior week.

Secondly, in 48.02% of cases, traders can anticipate the closing price of Bitcoin to persist in its directional movement into the subsequent week.

Thirdly, there is a 95.48% probability that a price trend in one direction will reach its conclusion by the fourth week.

Conclusions. In summary, an examination of Bitcoin's closing price alongside the MACD histogram highlights the potential of this technical indicator in identifying medium-term trends within the cryptocurrency market. When employed in conjunction with other market signals, the MACD provides traders with a more comprehensive framework for decision-making, which could lead to increased profitability or reduced risk. The closing price, in particular, provides valuable information, often signaling key support levels and potential trend reversals, thereby enabling traders to time their market entries and exits more effectively.

However, despite its utility, the MACD histogram is not without limitations. Given the inherently volatile nature of the cryptocurrency market, influenced by a multitude of external factors, the ability to predict Bitcoin's price movements with certainty remains elusive. Consequently, while the MACD can be a beneficial instrument, its utilization should be judicious, forming part of a comprehensive strategy that incorporates multiple indicators to enhance predictive accuracy.

In order to enhance the comprehension of Bitcoin's price behavior, further research is imperative, particularly studies that examine the interaction between Bitcoin's price and other pivotal indicators such as the Relative Strength Index (RSI), moving averages, trading volumes, and market sentiment. A more holistic approach that combines these tools would enable traders to gain a more nuanced view of the market, thus improving their ability to anticipate trends and make more informed, data-driven decisions. Furthermore, exploring the impact of macroeconomic factors and global events on Bitcoin's price could offer further insights into its volatility, paving the way for more robust trading strategies.

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