

Bartłomiej Wiśniewski* 

Technical Analysis as a Tool for Determining Cryptocurrency Trends in Times of Chaos

Summary

Technical analysis is a widely applied method for forecasting market trends and making investment decisions. This article assesses the effectiveness of basic technical analysis indicators, such as MACD, EMA, and trendlines, in the volatile cryptocurrency market during significant events like the COVID-19 pandemic and Russia's aggression against Ukraine. The study utilizes weekly data from 2018 to 2023, focusing on Bitcoin and Ethereum due to their high market capitalization. The results confirm that these tools can provide valuable investment signals, particularly during periods of high market volatility, identifying trend changes and key entry or exit points. However, limitations of technical analysis, such as conflicting signals among indicators, highlight the need for caution and a multilayered analytical approach. Notable findings include the effectiveness of using multiple indicators simultaneously to enhance decision-making and the potential risks of relying solely on individual indicators.

* Bartłomiej Wiśniewski, MSc, Faculty of Economics and Sociology, University of Lodz, bartek_wisniewski@outlook.com, <https://orcid.org/0009-0007-8571-3905>

The research also acknowledges the challenges posed by external, unpredictable events, such as the collapse of major projects or regulatory changes, which can disrupt market dynamics. Despite these challenges, the findings underscore the relevance of technical analysis in modern financial contexts, providing investors with practical insights for navigating volatile markets.

This study contributes to the understanding of cryptocurrency markets by demonstrating the utility of traditional technical tools in identifying trends, while stressing the importance of their thoughtful application in conjunction with other analytical methods.

Key words: technical analysis, cryptocurrencies, cryptocurrency exchange

JEL codes: D40

Analiza techniczna jako narzędzie do predykcji trendów kryptowalut w Czasach Chaosu

Abstrakt

Analiza techniczna jest szeroko stosowaną metodą prognozowania trendów rynkowych i podejmowania decyzji inwestycyjnych. Niniejszy artykuł ocenia skuteczność podstawowych wskaźników analizy technicznej, takich jak MACD, EMA i linie trendu, w zmiennym rynku kryptowalut podczas znaczących wydarzeń, takich jak pandemia COVID-19 i agresja Rosji przeciwko Ukrainie. Badanie wykorzystuje dane tygodniowe z lat 2018–2023, koncentrując się na Bitcoinie i Ethereum ze względu na ich wysoką kapitalizację rynkową. Wyniki potwierdzają, że narzędzia te mogą dostarczać wartościowych sygnałów inwestycyjnych, szczególnie w okresach wysokiej zmienności rynkowej, identyfikując zmiany trendów oraz kluczowe momenty wejścia i wyjścia z rynku.

Jednakże ograniczenia analizy technicznej, takie jak konflikty sygnałów między wskaźnikami, podkreślają potrzebę ostrożności oraz wielowarstwowego podejścia analitycznego. Kluczowe wnioski obejmują skuteczność jednoczesnego stosowania wielu wskaźników w celu poprawy procesu decyzyjnego oraz potencjalne ryzyko polegania wyłącznie na pojedynczych wskaźnikach.

W badaniu uwzględniono także wyzwania związane z nieprzewidywalnymi wydarzeniami zewnętrznymi, takimi jak upadek dużych projektów czy zmiany regulacyjne, które mogą zakłócać dynamikę rynkową. Pomimo tych trudności, wyniki podkreślają znaczenie analizy technicznej we współczesnym kontekście finansowym, dostarczając inwestorom praktycznych wskazówek dotyczących nawigowania po zmiennych rynkach.

Artykuł wnosi wkład w zrozumienie rynków kryptowalut, ukazując użyteczność tradycyjnych narzędzi analizy technicznej w identyfikowaniu trendów, przy jednoczesnym podkreśleniu znaczenia ich przemyślanego stosowania w połączeniu z innymi metodami analizy.

Słowa kluczowe: analiza techniczna, kryptowaluty, giełda kryptowalut

1. Introduction

The cryptocurrency market, characterized by high volatility and decentralization, is attracting private and institutional investors. Since Bitcoin's inception in 2009, this segment has grown in importance, offering a growth potential and diversification of portfolios. However, due to unique features such as uninterrupted 24/7 availability and the lack of central regulation, cryptocurrency markets present special analytical challenges, and thus a natural demand for analytical tools is awakening.

Research problem: How effectively can technical analysis indicators such as MACD, EMA or trendline predict turning points in the cryptocurrency market under high volatility?

The purpose of the study is to evaluate the effectiveness of MACD, EMA and trendline indicators in identifying turning points in the cryptocurrency market and their ability to generate accurate signals under conditions of high market volatility.

The article is based on the research hypothesis that technical analysis indicators, such as MACD and EMA, provide valuable investment signals comparable to those used in traditional financial markets, are effective in identifying trends and turning points in the cryptocurrency market, and provide investment signals comparable to traditional financial markets. The article examines this hypothesis by analyzing the price changes of Bitcoin and Ethereum in the period 2018–2023. The choice of cryptocurrencies is justified by their high capitalization among cryptocurrencies, which allows us to assess the effectiveness of technical analysis under conditions of high market volatility on well-known cryptocurrencies.

To better understand the peculiarities of the cryptocurrency market and the need to apply technical analysis, the following section includes basic information on the structure and history of this market. In today's world, the cryptocurrency market has become one of the most dynamic and intriguing segments of the global

economy. Since the inception of Bitcoin and its derivatives, the market has attracted many private investors and institutions. The ability of cryptocurrencies to fluctuate widely makes them a fascinating field of study for economists. The purpose of this text is to introduce the essence of the most important cryptocurrencies and the possibilities of using technical analysis in this market. Cryptocurrency is a new financial instrument, characterized primarily by being a fully digital currency based on the Blockchain organization system. Unlike fiat currencies, cryptocurrencies do not have a physical form and are not controlled or issued by central banks. They are designed to be independent of political or governmental power, functioning in a peer-to-peer network. Satoshi Nakamoto is the first creator of cryptocurrency, who wrote his manifesto under this pseudonym in 2008 (Nakamoto, 2008). It is unclear whether Satoshi Nakamoto is an individual or a group. In his manifesto, he explains the idea of money based on a *peer-to-peer* (P2P) network, allowing money to flow online directly between two entities without the need for a third party – a financial institution. He proposed a system that would be public and anonymous, like the information available on the stock exchange, where only the timing and size of individual transactions are made public without disclosing the parties involved. Satoshi's model emphasizes creating new keys with each transaction to prevent linking transactions to common owners, ensuring privacy. Each coin is assigned an individual code that gives a sense of ownership, and to prevent double spending, a peer-to-peer network records public transaction. If most of the computing power controls the code, attacking the network becomes unattractive. Despite its simplicity, the network operates simultaneously without external coordination, allowing users to leave and return, accepting changes that occurred during their absence. The year of the manifesto's publication is significant, as October 2008 marked the height of the financial crisis in the USA, with the collapse of Lehman Brothers and the NASDAQ crash causing global panic (Amadeo, 2022). Satoshi acknowledged that the electronic payment system worked well but had trust-related drawbacks, which his proposed system aimed to overcome by being self-regulating and more private. The study aims to prove that even the basic tools of technical analysis can accurately assess moments of entry or exit of trades and indicate changes in trends. By analyzing cryptocurrency markets using technical analysis indicators, the study seeks to determine whether these tools provided signals about the outbreak of the COVID-19 pandemic and Russia's aggression against Ukraine, confirming the assumption that "the market discounts everything". The study focuses on Bitcoin and Ethereum against the US dollar, chosen due to their largest capitalization, popularity, and market impact.

Technical analysis is recommended for use by analysts, brokers, and investment advisors to understand stock market sentiment and predict trends. It is utilized in weekly market reports and forecasts prepared by institutions such as the Brokerage House of Bank Ochrony Środowiska (BOŚ, 2024) and the XTB Brokerage House (XTB, 2024).

This article aims to contribute to the study of cryptocurrency markets through the application of technical analysis, despite its subjective and interpretive nature. By explaining the essence of technical analysis, its applications in cryptocurrency markets, and discussing related controversies and challenges, the article seeks to enhance understanding of the mechanisms influencing cryptocurrency prices and informed investor decisions. This study contributes to the ongoing discussion in the literature regarding the effectiveness of cryptocurrency markets and provides practical implications for investors, especially those using algorithmic strategies based on technical analysis.

2. Literature review

Cryptocurrencies are often characterized by their high volatility, continuous market operation, and the dual nature of their appeal, attracting both risk-seeking investors and those cautious about significant risk exposure. This inherent volatility and the fact that the cryptocurrency market operates 24/7 mean that investing in these assets involves substantial risk. Effective investing requires a deep understanding of how cryptocurrencies function and the ability to analyze them to navigate the significant risks involved. The literature review will cover key studies and theories that shed light on these aspects, as well as how various analytical approaches contribute to a better understanding of cryptocurrency investments.

In 2009, the Bitcoin (BTC) network was created, Satoshi Nakamoto “mines” his first Bitcoin, and its rate is determined by its mining cost. When talking about Bitcoin mining, it is about lending the computing power of graphics processing units (GPUs). Cryptocurrency mining is a sector of blockchain technology. The previously mentioned blockchain is a share-based technology that allows a group of users to share data. The data is not stored in one place but is scattered to other locations – network participants. Even though the data is shared between the participants of the network, it cannot be manipulated or modified, because other participants of the network will be informed about it, and the network itself will not allow modifications, because the data will be different from that of its other participants. It has also begun to build a belief among some people that Bitcoin is an invention as revolutionary as the automobile or the Internet (Mezrich, 2019). Bitcoin’s early years come with a poorly developed infrastructure. This is related to the initial nature of Bitcoin, which was of interest to hobbyists and was a rather marginal phenomenon, enjoying low interest. As mentioned in Chapter II of Bitcoin’s history of creation, the price was set on October 5, 2009 based on the cost of its mining (Mezrich, 2019). At that time, one dollar could buy 1309 BTC.

To acquire Bitcoin, one had to mine it or purchase it from third parties, which was a complex and time-consuming process due to the lack of market knowledge

and the absence of services available today. In 2010, the Mt. Gox exchange was established, where the first Bitcoin exchange rate during the session was priced at \$0.05. The Mt. Gox exchange was the most popular exchange at the time, offering instant exchange for Bitcoin or fiat currency. Bitcoin was referred to as a speculative bubble, comparing it to *tulipmania*, i.e., a speculative bubble prevailing in the Netherlands in the 17th century concerning tulips, which Oczko from the Jagiellonian University wrote about in his work (Oczko, 2016). Quite often, in the public opinion, one could and still can hear opinions negatively expressing themselves about investing in Bitcoin, comparing them to historical investment bubbles, including the Mississippi or South Seas company stock bubbles (Bitcan, 2021). An important year is 2011, when altcoins began to appear as an alternative to Bitcoin, offering various solutions, including *Litecoin*. It is worth mentioning that today there are currently more than 1000 cryptocurrencies and the new ones are constantly appearing. There is also the first crisis caused by waves of hacker attacks aimed at stealing cryptocurrencies from exchanges or crypto wallets (Ashmore & Pradhan, 2023). The stock market in 2014 was valued at \$450 billion (Berdnard, 2021). Technical analysis is one of the most popular methods of market analysis, along with fundamental analysis, which focuses on interpreting charts. As Borowski writes, behavioral finance contributed the most to the popularity of technical analysis, as it contributed to the promotion of the thesis that investors are also torn by emotions, and their analysis also contributes to increasing the rate of return on investment. He also mentions that we can quite often come across technical analysis during the exams for an investment advisor organized by the Polish Financial Supervision Authority, or the analyses prepared on Wall Street not only include a fundamental analysis, but also a short technical analysis of the examined asset is posted (Borowski, 2015). As Staszak points out in “Fundamentals of technical analysis”, the most important task of technical analysis is to find the moment of a trend, and this moment is the most important element of the strategy, and recognizing the pattern before it is formed is extremely difficult, as it resembles a typical upward movement (Staszak, 1995)

Some attribute the popularity of cryptocurrencies to a certain natural factor, along with a digitalization trend in our social life. The rise in popularity is often linked in research (An Nguyen & Ching Chan, 2024) to the growing popularity of fintech services, virtual reality, and metaverse during the same period, suggesting a natural progression of events. Bitcoin is considered one of the most recognizable cryptocurrencies, given its largest market capitalization and being the first cryptocurrency, as concluded by Magnusson and Stenberg (Magnusson & Stenberg, 2022) in their publication, which also suggests that Bitcoin plays the most crucial role in the cryptocurrency market and has the greatest influence on other cryptocurrencies. Thus, Bitcoin sets the main trend for other alternatives. Moreover, some publications argue that Bitcoin can be considered as a hedge

asset like gold, as demonstrated in their study (Gambrielli, et al., 2023), which proves that gold can act as a safe haven during bear markets but not always. It is emphasized that the need to explore alternatives, and cryptocurrencies, despite the high risk, can offer the opportunity to diversify one's investment portfolio.

Technical analysis receives mixed opinions; some believe it is justified and can indeed lead to profit and predict future movements, while others believe it does not work at all and consider its use irrational. This often makes technical analysis the subject of various debates and discussions, which may arise from research findings as well as personal beliefs. Technical analysis has been used in the studies by Hudson and Urquhart (Hudson & Urquhart, 2019), among others, who used moving averages in their research, precisely indicating that it is one of the most popular methods. Their results suggest that technical analysis tools can bring significant benefits to investors. These studies motivate efforts to increase access to technical analysis tools so that investors can use them more effectively. There are also studies (Dingyu & Tahir Ismail, 2022) demonstrating the effectiveness of technical analysis, indicating that econometric models using technical analysis had lower errors than those that did not, suggesting that combining technical analysis with advanced deep learning models could be an effective investment strategy. This indicates that despite the complexity and volatility of the cryptocurrency market, even basic technical analysis methods can be effective in making investment decisions. Another study on machine learning to predict future Bitcoin prices utilized indicators from technical analysis, including EMA (*Exponential Moving Average*), indicating that it had a significant impact on prediction results. Therefore, it can be concluded that technical analysis, combined with neural networks, can yield potential profits, as mentioned in an article that uses simple technical analysis indicators, RSI (*The Relative Strength Index*), and MACD (*Moving Average Convergence Divergence*) (Zatwarnicki, et al., 2023) in the study. These mentioned studies highlight the value of technical analysis and its ability to predict future price movements.

3. Methodology and data

The study analyzes the cryptocurrency market in the period from 2018 to 2023, which was characterized by high volatility, caused, among other things, by the COVID-19 pandemic and Russia's aggression against Ukraine. The selected events had a significant impact on financial markets and allow us to see how the cryptocurrency market reacted amidst volatility.

Two popular technical analysis indicators were used to identify trends and turning points in the cryptocurrency market: Exponential Moving Average (**EMA**) with a 30-day period and Moving Average Convergence Divergence (**MACD**).

These indicators were chosen because of their widespread use in a trend analysis in financial markets, as well as their usefulness in high volatility conditions. In addition, trend lines were used to better identify the main directions of price changes.

The analysis was carried out using weekly price data of Bitcoin (BTC) and Ethereum (ETH) against the US Dollar. The choice of these cryptocurrencies was justified by their high capitalization and influence on the cryptocurrency market, which allows to evaluate the indicators in the context of well-recognized assets with high liquidity. Weekly interval data minimizes the impact of short-term fluctuations and allows the identification of long-term trends. The following tools will be used for technical analysis:

- Exponential Moving Average (EMA) – 30-period;
- Moving Average Convergence Divergence (MACD) indicator – with basic settings of 12,6,9;
- Trend line determination.

Exponential Moving Average (EMA) – 30-period – a technical analysis tool used to track the average price of an asset for the last 30 trading periods. It is a type of moving average that gives more weight to the most recent data, making it react faster to current price changes compared to simple moving averages. It is often used to identify trend direction and support resistance levels.

Moving Average Convergence Divergence (MACD) Indicator – a technical analysis indicator that uses the difference between two moving averages (usually EMAs) to detect changes in trends. It consists of two lines: the MACD line (calculated as the difference between the shorter-term EMA and the longer-term EMA) and the signal line (the EMA of the MACD line). The MACD is used to identify moments to enter or exit a position in the market depending on the crossover of these lines.

Trend Lines – straight lines that connect two or more points on a chart, allowing one to visually determine the direction and slope of a trend. They are used to identify market trends and forecast future price movements.

These tools will be applied using the xStation5 program, created by the Polish broker XTB as an alternative to the MetaTrader program.

Despite their simplicity, these tools are still used in market analysis for several reasons:

- *Ease of Understanding*: EMA 30, MACD, and trend lines are easy to understand and relatively simple to use, making them accessible to both beginners and experienced traders;
- *Versatility*: They can be applied to a variety of markets and financial assets, from stocks to currencies and commodities;
- *Efficiency*: Despite their simplicity, these tools are often effective in identifying market trends and entry or exit points for potential profits;

- *Quick Response:* EMA 30 and MACD react relatively quickly to price changes, allowing traders to quickly adjust to changing market conditions;
- *Consideration of Historical Data:* Both EMA 30 and MACD consider previous prices, allowing analysis of price behavior over a longer period.

4. Empirical results

4.1. Bitcoin Exchange Rate Analysis

The chart below shows a study of the Bitcoin cryptocurrency exchange rate, where the quote currency is the US dollar in the period 2018–2022 using trend lines and the EMA and MACD indicators.

Figure 1. Bitcoin exchange rate in the period 2018–2023



Source: In-house analysis using xStation5.

Bitcoin’s price in 2018 starts with a downward trend. The dashed red line indicates a strong downtrend, which starts with the first price breakout in the first quarter, and finds two consecutive peaks during this period, which are a strengthening of this trend. At the turn of the third and fourth quarters, there is a slight break of the downward trend, which could indicate a possible reversal of the downward trend (orange area). To check, the trend guideline (black dashed line) was used, considering a slight breakout to see if it would find support. The

line does not find a third vertex that could confirm the downtrend, so this is a signal that the trend may change in some time. The EMA indicator has been generating signals to sell for almost the whole year, when there have been slight breakouts, which are support lines for the trend, it signaled to buy. Therefore, it can be assumed that the EMA indicator mainly gave signals to sell. The MACD indicator, where the MACD line is marked in yellow and the signal line in purple, gave a bright signal to sell at the beginning of the year, but a slight departure of both lines indicates a weak downtrend. Since the second half of the year, both lines have been running very closely, which indicates a significant weakening of the downward trend and the possibility of its change.

The year 2019 and its beginning continues the trend from the end of 2018, but both trend-setting lines are broken in the middle of the first quarter. By the first half of 2019, the price has been broken out. An attempt to draw a trend line from the first vertex clearly indicates a downtrend, which is strongly confirmed by the next four vertices. To confirm this trend, a secondary line from the second vertex is drawn, however, it does not find as strong a confirmation as the first line. It is confirmed at the very beginning, however, it is crossed by the third vertex, which was the resistance line for the red trend line. This signals that the trend, as in 2018, may change. The EMA indicator started generating signals to buy now of the crossover of the 2018 auxiliary trendline and it lasted until September, when the main red trendline was confirmed by the third peak. Throughout 2019, the MACD indicator signaled a weak upward and downward trend. It gave a weak signal to buy, now of the breakout of the Bitcoin price, as well as signaled weak selling in the second half of the year.

The year 2020 opens with a slight breakout and an attempt to reverse the trend, but it is a short-lived phenomenon that is interrupted by a slight low, which, interestingly, is a support line by the auxiliary trend. From this low, an attempt is made to establish a new trend line. The trend maintains a horizontal but upward trend. The main red trend line indicates a slight increase, which is confirmed by as many as three lows. An important moment occurs in the second half of the year, which is marked with a purple area. This is the moment of confirmation of the previously mentioned trend line, with three upward lows, which may already signal a change in trend. An auxiliary red dashed line is drawn to the assistance, which also confirms the uptrend. However, this is the moment when it is difficult to predict whether this trend will continue, change pace or change. However, from the angle of the slope of the line, one could conclude another breakout. At the end of 2020, there is a clear break above the trend previously indicated by the market. The key moment is marked by the blue area, which is the biggest breakout of 2020, and may be a continuation of the trend, where the auxiliary red line will continue the horizontal trend as a support line. The EMA indicator, after the low of the first half of the year, started to generate signals to buy. At the very beginning they are

quite weak, but with each month it starts to generate a stronger signal, especially around the area highlighted in blue, it gives strong indications to buy. The MACD indicator has shown weak signals to buy and sell throughout the year, and both MACD and signal lines have given signals of a weak trend. The key moment is the three lows, which indicated an uptrend, then the MACD gave strong signals to buy. Thus, both indicators signaled that there would be an increase in price.

The year 2021 is a year of massive fluctuation for Bitcoin. The moment of drawing the trend line is the moment marked in the red area. The red trend line indicates that this is a strong price increase, but the weak trend is due to the lack of confirmation in even the third low. The weak trend is confirmed already in the first quarter, where there is a decline and a slight breakout to fall sharply downwards. At this point, an attempt is made to draw a trend line from the blue area, it is confirmed by three upward lows, where the trend line is then a support line for the price. This may signal the continuation of the uptrend, but it is not possible to set a trend guide, which may already signal that the uptrend will not be confirmed by the trend lines themselves. The EMA indicator continues the signals from the end of 2020, giving strong signals to buy all the time, which are not weakening. The first breakdown occurs at the last high, which forms a low, giving a signal to sell. At the first stronger breakout, it gives a buy signal again, but it is not as strong as in the first half of the year. With the end of 2021, it gives signals to sell. The MACD indicator, on the other hand, also generates strong signals to buy, which started at the end of 2020. However, the lines of this indicator suggest a weak uptrend. The MACD also generates similar sell signals as the Exponential Moving Average. The year 2021 closes with a downward spiral for Bitcoin, which has not found any support line.

The year 2022 opens with a slight breakout, where the dashed line from the red area is already a support line rather than a resistance line for the price. This may still be heralded by an uptrend, but the trend line will be a resistance line here. However, the assumptions are not confirmed. The price of Bitcoin begins to gradually fall in the second quarter, and the exchange rate is so chaotic that it is difficult to draw a new trend line during this period. Thus, the attempt to draw a new trend line starts from the highest point of the last quarter of 2021, which is the orange dashed line. Because it finds only the third support just in the fourth quarter, it indicated a certain slowdown of the downward trend (red area). It is worth mentioning the purple trend line that has been drawn since 2018, which was constantly signaling the main uptrend, and after the great price fluctuations of 2021 and the sharp declines of 2022, constituted some resistance (red area) that was not broken, which already gave indications that this line will now be providing some support and signaling upward tendencies. The EMA indicator strongly specifies sales throughout the year, only occasionally did it indicate a purchase at the end of the first quarter. Similar signals are also generated by the MACD, which already

started generating strong sell signals at the end of 2021. In the second half of the year, both MACD lines were close to each other, which proved a weak trend, but they were already generating subtle buy signals.

The year 2023 starts with strong gains, which was signaled by the main trendline (purple) after a sharp rebound in the last quarter of 2022. The price of Bitcoin gained slightly compared to last year, and what is also worth mentioning is that the trend line from 2020, which signaled a potential increase, found support twice, one from 2022 and the third from 2023, which could potentially be a resistance to growth, but in the last quarter it is broken. The EMA indicator signals to buy almost all year, only once it signaled to sell around the third quarter, however, it was quite a weak signal. Similar signals are given to us by the MACD, which has been signaling successively from the second half of 2022 to the first half of 2023, where, however, it has been sending signals to sell, and recently signaling quite a strong buy.

4.2. Ethereum Exchange Rate Analysis

The chart below shows a study of the Ethereum cryptocurrency exchange rate, where the quote currency is the US dollar, in the period 2018–2023 using trend lines and the EMA and MACD indicators.

Figure 2. Ethereum exchange rate in the period 2018–2023



Source: In-house analysis using xStation5.

The year 2018, as in the case of Bitcoin, opens with a downtrend, which, despite being confirmed at two peaks in the first half, is weakly confirmed at the third peak in 2019, which ends this downward trend, as it is about to be broken. A black dashed trend guideline is drawn to confirm the downtrend. The second peak is only found at the beginning of 2020, which indicates a horizontal and long-term downtrend. The blue area in 2019 marks a moment that could confirm the strength of this trend, but the auxiliary line does not become a resistance line. Thus, the year 2018 from the second half opens a slow downward trend that continues until the first half of 2020. The EMA indicator, for the second half of the year, generates a signal to buy, which ends in a similar period as the red trend line. Then, for the rest of the period, it generated weak buy and sell signals. The MACD indicator behaved similarly, which also indicated a weak trend.

In 2019, the exchange rate was quite stable and only a slight breakout in the second quarter can be noticed, but as it has just been mentioned, this is a continuation of the trend that has been taking shape since the second half of 2018. Also, the EMA or MACD indicators did not indicate different signals. Thus, 2019 was a quiet period with a stable exchange rate.

The first half of 2020 was also a continuation of the trend from the second half of 2018. A slight decline could be observed, where there is a slight rise in the price until the end of the first half of 2020. At this point, the first breakout of the auxiliary trend line occurs, which signaled a long-term slight downtrend. This is an important moment (the area marked in orange) as it foreshadows the rebound that will take place at the beginning of 2021. However, by the end of the year, there has been a slight decline and increase from this rebound. In the first half of the year, the EMA indicator informed us about buying, only for a moment with this slight decline it informed about selling, then successively until the end of the year it informed us about buying. The MACD indicator, on the other hand, did not give clear signs to buy, in the first quarter it generated a very weak buy signal, but it can be assumed that the MACD did not announce clear signals to buy, and the lines running close to each other rather informed about a weak trend. Only the last quarter of 2020 gave clearer signals to buy.

The year 2021 brought sharp increases and, like Bitcoin, the price fluctuated quite a lot throughout the year. To draw a trend line, the moment of the first increase from 2020 was used, but the main red trend line was not supported by three vertices that would confirm a certain strength of the trend. A subsidiary line was also drawn, which, like the main one, did not find three vertices that would confirm the strength of the trend, but only one. Therefore, both lines give a strong signal that the trend is quite weak despite the spectacular growth and may change. The EMA indicator has been generating buy signals since the beginning of the year, only at the turn of the half of the year, it generated a short-term sell signal, only to generate a strong buy signal again by the end of the year. The MACD

showed a similar trend to the EMA, however, the MACD at the end of the year, began to generate a strong sell signal, just after the first decline.

In 2022, Ethereum's exchange rate, like Bitcoin's, behaved quite erratically, and setting a trend line in the 2022 period alone was pointless. An interesting phenomenon is that from the moment marked in orange in 2020, where the red uptrend line for 2021 was drawn, when trying to create a trend line with the fan principle, we have slight signals, when the purple line is a bounce point and in the middle of the year. The third line was resistance once and tried to be a resistance line a second time at the end of 2022. This may indicate that the exchange rate did not want to return to its pre-2020 state. The EMA indicator has been generating a sell signal throughout the year, only for a short period of time, a weak buy signal can be noticed. In contrast, the MACD from the beginning of the year to the first half of 2022, showed a strong selling trend, just as the EMA showed a buy signal over the same period. It is interesting to note that, unlike the EMA, the MACD indicator showed weak buy signals in the second half of the year.

Overall, 2023 is on a rather slow upward trend. A red line is drawn from the first low of 2022, which is confirmed at the end of 2022 and in the last quarter of 2023. This line confirmed an uptrend that had rather little upward strength, the last quarter confirmed the uptrend with the last low and then rebounded to close 2023 with the biggest high. The EMA line, as in the case of Bitcoin, sent quite similar signals, but they were not as clear, and the MACD indicator, which signaled a purchase, also behaves similarly.

5. Conclusion

The main research hypothesis was that technical analysis, particularly MACD, EMA and simple trendline indicators, can be effective in identifying trends and key turning points in the cryptocurrency market. The study confirms that these analytical tools provided valuable signals in many cases, especially during periods of high volatility, such as the COVID-19 pandemic and the conflict in Ukraine, where they reacted dynamically to price changes. The simple trendline proved to be a useful tool for tracking market direction and overall structure, supporting long-term trend analysis, while MACD and EMA offered more timely information on possible price changes.

However, it is worth noting that in many cases these indicators generated conflicting signals, which posed the risk of making wrong investment decisions. For example, when analyzing the 2020 trend, the MACD indicated the possibility of further increases, while the EMA began to generate sell signals, suggesting a potential weakness. Such discrepancies underscore that neither indicator should be used in isolation – their simultaneous use provides a more complete picture

of the market situation. In situations where the trendline confirmed the signals generated by the MACD and EMA, traders were able to make more informed decisions, but more caution is recommended when there are inconsistencies between the indicators.

In addition, the volatility of the cryptocurrency market makes technical analysis vulnerable to sudden, unpredictable events, such as the collapse of the *Terra Luna* project. These types of events are difficult to predict using technical analysis alone and point to the need to integrate technical indicators with other risk assessment methods, in this case fundamental analysis, which could provide a broader macroeconomic context. Cryptocurrency markets, which are still a new and growing segment, but mainly through their speculative nature, react to global events and regulatory changes in a less predictable manner than traditional financial markets, further increasing the importance of using a more nuanced analytical approach.

In conclusion, the results of the study suggest that technical analysis based on MACD, EMA and straight trendline can be a valuable tool in the cryptocurrency market, but its effectiveness is highest when investors use these indicators thoughtfully, considering their limitations and the possibility of conflicting signals. Using additional indicators can help reduce the risk of false signals, providing a more comprehensive picture of the market and increasing the certainty of investment decisions. This approach is particularly useful in the volatile cryptocurrency market, where rapid price changes and high volatility require diversified analysis to better manage risk.

Key findings:

Technical analysis in the cryptocurrency market:

- Technical analysis and its indicators can be used in cryptocurrency markets.
- Simple trend lines can indicate a change in trend.

Multi-layered approach:

- It is important to use multiple indicators at the same time to get a comprehensive picture.
- Relying on a single indicator can often result in wrong signals and is not always effective.

Volatile cryptocurrency markets:

- The cryptocurrency market is characterized by high volatility, leading to rapid price changes.
- The COVID-19 pandemic and war had a noticeable impact on cryptocurrency values.
- Bitcoin and Ethereum showed similar price movements, indicating little correlation.

Limitations of technical analysis:

- Technical analysis cannot predict unpredictable events such as the collapse of a cryptocurrency exchange.
- Events such as pandemic and war were evident in the cryptocurrency markets and did not come as a surprise to the market – the market discounted this news.

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