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CYCLICALITY OF THE CRYPTOCURRENCY MARKET

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Purpose: This article examines the cyclicality of the cryptocurrency market, focusing on Bitcoin and Litecoin. The study aimed to understand the characteristics of price movements and identify halving-related patterns that may indicate recurring trends or anomalies.
Design/methodology/approach: The paper adopted two research hypotheses: (H1) the cryptocurrency market is characterized by cyclicality resulting from Bitcoin halvings, and (H2) halving cyclicality is not exclusive to Bitcoin. The study was conducted based on data covering the period from August 16, 2014, to August 31, 2024, spanning across the second, third, and part of the fourth Bitcoin cycle. Classic Bitcoin cycle models were employed.
Findings: The results indicate significant connections between Bitcoin and altcoin prices, confirming Bitcoin as a leading indicator in forecasting altcoin price highs and lows. Additionally, Litecoin analysis showed halving cyclicality is not exclusive to Bitcoin, though weaker in altcoins. The findings highlight cyclicality's significance in cryptocurrency market analysis and suggest further investigation.
Research limitations/implications: The limitation of the conducted research was the amount of available data. The cryptocurrency market is very young, less than a dozen years old.
Practical implications: The research results can be used to shape the investment decisions for investors.
Originality/value: The small number of studies related to the behavior of cryptocurrency prices other than Bitcoin within its halving cycles and the lack of studies on potential cycles resulting from halvings of other cryptocurrencies constitute a research gap worth filling.
Keywords: cryptocurrencies, bitcoin, altcoins, cyclicality.
Category of the paper: research paper, conceptual paper.

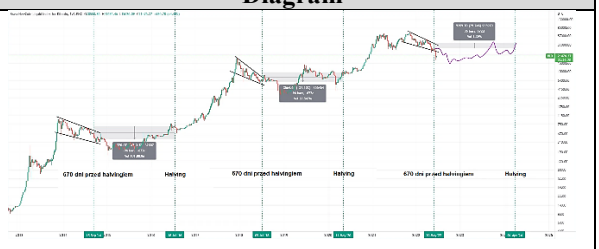
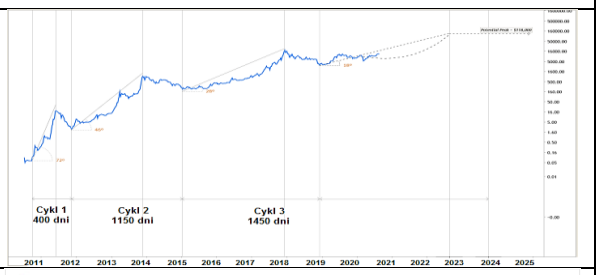
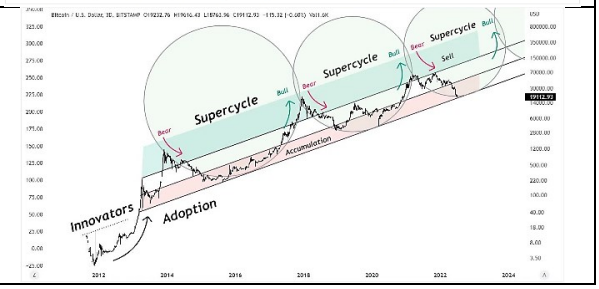
1. Introduction

In recent years, cryptocurrencies have attracted considerable attention from investors, researchers, and the media due to their volatility, unique market mechanisms, and potential for high returns. This phenomenon is justified because no asset class has reached a market capitalization of one trillion dollars faster than Bitcoin. Given the growing popular appeal of

cryptocurrencies, it is becoming increasingly critical to understand the factors that influence their value on the financial market. Importantly, cryptocurrency prices show evident fluctuations, and these, in turn, may suggest the existence of cyclical patterns. Although the literature devoted to this subject is extensive, there is still a lack of precise results that could help us better understand these cycles.

Cyclic models are used to forecast the Bitcoin price. In the literature and investment practice, four basic concepts can be distinguished in chronological order: classic cycles, lengthening cycles, the stock-to-flow model, and circular cycles (see Table 1).

Table 1.
Bitcoin cyclic concepts

Cycle	Description	Diagram
Classic cycles	They result from *halvings* that occur approximately every four years. Each cycle consists of three phases: an upward phase lasting about a year and ending with a new high, a downward phase lasting about a year and ending with a new low, and a two-year consolidation.	
Lengthening cycles	They refer to the classical concept, assuming at the same time that each subsequent cycle is longer and that the returns on investment, measured by the ROI indicator, decrease over time.	
Stock-to-flow model	It was built based on the relationship between Bitcoin's supply and its creation possibilities. It takes into account more variables than the classic and lengthening cycles.	
Circular cycles	According to the concept of circular cycles, the Bitcoin rate aligns with self-similar circular patterns. Unlike the previously described circular patterns, several distinct concepts can be identified.	

Source: own study based on Podgórski, 2023, pp. 197-201.

The study aimed to understand the characteristics of price movements in the cryptocurrency market and identify possible patterns centered around the halving phenomenon, which could indicate recurring trends or anomalies. Market practice suggests that attempts to find such patterns can be successful, which, in turn, can significantly contribute to understanding the

mechanics of the better-known cyclicality of Bitcoin and the cyclicality specific to other cryptocurrencies with a halving mechanism. The potential for cycles or market patterns to occur is rooted in a key economic theory known as efficient markets, which asserts that the prices of financial assets reflect all available information (Dobrowolski, 2014).

Research demonstrates that cryptocurrency cycles are significantly influenced by various macroeconomic factors, including exchange rates, stock indices, and commodity prices, in both short-term volatility and long-term trends.

Short-term analyses detail that Bitcoin volatility significantly responds to several factors. Akkaya (2021) reports that changes in the EUR/USD exchange rate, gold price, USD 10-year bond yield, US Dollar Index, and VIX all affect volatility at the 1% level. In a similar time frame, Błoński (2023) finds strong positive Pearson correlations between Bitcoin and the S&P 500 (0.87), the Warsaw Stock Exchange Index (0.82), and gold price (0.76). By contrast, Nakagawa and Sakemoto (2020a, 2020b) observed no significant short- term effect of individual indicators such as inflation or money supply on cryptocurrency returns.

Long-term relationships also emerge. Błoński (2023) shows that the S&P 500 (0.88) and gold price (0.63) maintain strong correlations with Bitcoin over a five- year horizon, while Gökçe (2023) identifies long-term influences from the US 10-year bond yield, West Texas Intermediate crude oil price, Dollar index, and NASDAQ-100 index. Additional insights include findings that GARCH models capture volatility patterns (Akkaya, 2021), two or three principal factors account for 77% of yield variation (Kozubík), and that regulatory policies, expert opinions, media intensity, tax restrictions, and payment acceptance shape price dynamics (Pudło, 2018). Regional effects also appear, with Błoński (2023) linking Bitcoin closely to both US and Polish market indices, even as Pudło (2018) argues for market independence from national economies. Collectively, these studies support the view that both short-term fluctuations and long-term trends in cryptocurrencies - primarily Bitcoin - are influenced by an array of macroeconomic factors.

Bitcoin halving events align with recurring shifts in cryptocurrency market behavior. Fabuš et al. (2024) report that Bitcoin prices peak 12, 15, and 17 months after halving events, with these rebounds accompanied by heightened volatility and speculative activity. Meynkhard (2019) shows that following the 2012 and 2016 halvings, prices surged by 9200% and 2910%, respectively, after an approximate five- month lag. Chan et al. (2023) note that volatility regime shifts occur in low- and high-volatility conditions rather than coinciding directly with halving stages, and Phiri (2022) describes a trend of diminishing market efficiency with successive halving cycles. In addition, El Mahdy (2021) observes a significant negative reaction in the U.S. capital market, and Jiménez et al. (2024) identify positive volatility transmission from forex markets to Bitcoin. These studies indicate that Bitcoin halvings are linked to cyclical patterns in price dynamics and market effciency, although the timing and strength of effects vary across analyses. Concerning cross-market effects, one study notes a negative reaction in U.S. capital markets, whereas another finds Bitcoin price movements largely independent of

traditional asset trends (El Mahdy, 2021). The literature thus documents key facets of Bitcoin halving cycles yet remains fragmented in its integrated examination of these cyclical phenomena (Chan et al., 2023). A theoretical analysis proposes that built- in halving mechanisms - characteristic of Bitcoin's design - may also prompt adjustments in miner rewards in other cryptocurrencies. Although detailed market responses and statistical evidence exist solely for Bitcoin, the theoretical framework implies that halving cyclicity may not be unique to Bitcoin but could extend to other digital currencies with similar protocols (Courtois, 2014).

Based on the above data the paper adopts two research hypotheses that are verified based on the methodology proposed by the authors:

- **H1**: The cryptocurrency market is characterized by cyclicality from Bitcoin halvings.
- **H2**: Halving cyclicality is not exclusive to Bitcoin.

The article consists of six sections. Section 1 is an introduction that covers the research's economic context, aim, and hypotheses. Section 2 reviews previous research works that fit into the issue of the cryptocurrency market cyclicity. Section 3 describes the authors' research methodology. Section 4 contains a presentation of the results of the conducted research. Section 5 presents conclusions, discusses the results obtained by other researchers, and indicates the research's limitations and further directions for future analyses. The last section includes information on the article's funding sources.

2. Cryptocurrency Market Cyclicality – A Literature Review

At the outset, it is worth drawing attention to the streams of research addressing the issue of cryptocurrencies. Bibliometric analysis is a popularly used quantitative method for assessing the development and dynamics of research in a given area. Merediz-Solà, I. and Bariviera, F.A. (2019), in their work covering data from 2012 to January 2019, stated that literature studies on cryptocurrencies mainly concern economic and IT issues. The authors emphasized that Bitcoin is fundamental to the market and literature. The latest bibliometric studies on Bitcoin were conducted by Wang, G. and Hausken, K. (2024). For this work, the authors created a data set for 2013-2022 containing 3837 publications published in 1024 scientific journals. The study results indicate a steady increase in the number of publications from 2013 to 2017 and an outburst in the number of publications from 2017 to 2019 (from 63 to 591). This trend continued after 2019, with the number of publications reaching 1032 in 2022. The same trend of changes, indicating an increasing interest in Bitcoin in the academic community, was also identified for the number of citations. The analysis showed that the literature is particularly keen to consider the economic and financial aspects of Bitcoin. The published works cover various aspects of Bitcoin, including price dynamics, market efficiency, market volatility, the relationship between Bitcoin and traditional financial markets, the role of Bitcoin as

an alternative investment asset, regulatory challenges related to Bitcoin adoption, and implications for monetary policy. Based on the bibliometric analysis, the authors divided the Bitcoin research into three stages, i.e., conceptualization and foundations of Bitcoin (2012-2016), cryptocurrencies and market efficiency (2007-2018), and technical analysis, big data, data privacy, and Bitcoin's links to financial markets (2019-2020).

Cagli, E.C. (2019) analyzed the phenomenon of the price explosion in Bitcoin and seven altcoins: Ethereum, Ripple, Litecoin, Stellar, Nem, Dash, and Monero. The research covered the daily prices of these cryptocurrencies from September 2015 to January 2018. The analysis results showed that, except for Nem, all cryptocurrencies from the studied sample showed a price explosion. This means that the prices of these cryptocurrencies are experiencing sharp increases, which may indicate the presence of speculative bubbles. It was also found that there are statistically significant bilateral relationships between the following pairs of cryptocurrencies: Bitcoin - Dash, Ethereum - Litecoin, Ethereum - Dash, Ethereum - Monero, and Ripple - Stellar. These results suggest that price changes of one cryptocurrency can affect the price changes of another, which thus emphasizes the strong connections between these assets.

The subject of the survey by Gül (2022) was the analysis of the relationships between the prices of selected cryptocurrencies in the period from January 21, 2020, to April 19, 2022. The work included seven cryptocurrencies selected based on the market capitalization criterion, which were Binance Coin (BNB), Bitcoin (BTC), Cardano (ADA), Dogecoin (DOGE), Ethereum (ETH), Polkadot (DOT), and Ripple (XRP). Cryptocurrencies representing a wide market range were selected for the analysis, from the oldest and most well-known cryptocurrency, Bitcoin, to more modern and specific projects like Cardano. The results of the study indicated a strong correlation between the cryptocurrencies studied. Only Ripple (XRP) was characterized by a low correlation with the other cryptocurrencies. The study also showed that the cryptocurrencies studied influence each other in the long and short term.

Gerlach, J. C., Demos, G., and Sornette, D. (2019) focused on analyzing Bitcoin price cycles and attempting to assess their predictability. For this purpose, they conducted a detailed analysis of the dynamics of Bitcoin prices against the U.S. dollar from January 2012 to February 2018. The automatic bubble detection method allowed for classifying price time series into periods of uninterrupted market growth and periods of continuous market decline. The authors identified three prominent bubbles and ten additional smaller bubbles that interrupted the Bitcoin price dynamics in the analyzed period. The main socio-economic factors responsible for the increase in Bitcoin prices were skepticism toward the traditional banking system, growing investment demand in China, and technical progress in the field of cryptocurrency mining itself. Despite its high volatility, Bitcoin showed the ability to quickly rebound after price declines, which, according to the authors, may suggest a future increase in its value. The study results also showed that the prices of many other cryptocurrencies are strongly correlated with the price of Bitcoin, which makes its analysis crucial for understanding the cryptocurrency market as a whole.

The results of a study conducted by Hayes, A. S. (2017) indicated the importance of production costs in shaping the value of cryptocurrencies. The author analyzed 66 most commonly used cryptocurrencies to determine the main factors influencing their value. It turned out that the three main factors driving their value are the level of competition in the network of producers, the rate of unit production, and the difficulty of the algorithm used to mine them. These factors come down to the emergence of relative differences in the costs of producing one digital currency concerning another. The work indicated that the increasing efficiency of cryptocurrency mining caused by technological progress reduces production costs and thus affects the price decline. The study's author also pointed out the block reward halving phenomenon as an essential factor determining the value of cryptocurrencies. Reducing the block reward leads to an immediate increase in the costs of producing cryptocurrencies, which may affect their price.

Masiak, C., Block, J.H., Masiak, T., Neuenkirch, M., and Pielen, K.N. (2018) conducted a study of the interactions between the market cycles of Initial Coin Offerings (ICOs) and the prices of Bitcoin and Ethereum, with a special focus on the influence of these variables on each other. The study covering 2014-2022 showed the occurrence of bullish and bearish price cycles of ICOs. The results also demonstrated that shocks in the prices of Bitcoin and Ethereum have a significant and positive effect on the volume of ICOs, with the impact of Bitcoin shocks being shorter than that of Ethereum shocks. It was also noted that higher ICO volumes cause lower prices of Bitcoin and Ethereum. The conclusions also indicated that innovations in Bitcoin and Ethereum positively affect future ICOs. Interestingly, however, innovations in ICOs are seen as drivers for changes in cryptocurrencies, not vice versa. The authors also concluded that Bitcoin, the leading cryptocurrency, influences Ethereum prices, but not the other way around, thus confirming its status as a benchmark in the cryptocurrency market.

Saad, M., Choi, J., Nyang, D., Kim, J., and Mohaisen, A. (2019) also addressed the explanation of Bitcoin and Ethereum's changing price and market trends. A Bayesian neural network was used along with other linear and nonlinear models to explain the volatility of Bitcoin's price. The authors analyzed the activity of users of the network of a given cryptocurrency from June 2015 to April 2017. Then, they identified the key features of cryptocurrencies that affect their prices, which included the hash rate used in cryptocurrency mining, reflecting the speed at which a computer can perform calculations, the number of users, the transaction rate, and the total number of a given cryptocurrency. Using machine learning methods, a model was built to predict the prices of Bitcoin and Ethereum and what is worth emphasizing based on features other than their past prices. As the authors claimed, the proposed model ensures accuracy of up to 99% in predicting the price of both cryptocurrencies.

In their article, Tanwar, S., Patel, N.P., Patel, S.N., Patel, J.R., Sharma, G., and Davidson, I.E. (2021) proposed a hybrid deep-learning model for predicting cryptocurrency prices. The authors focused on Litecoin (LTC) and Zcash (ZEC), considering interactions with Bitcoin as the base currency. The research was conducted for empirical data from August 24, 2016,

to May 26, 2021. What is particularly important is that the analysis of the relationships between cryptocurrencies revealed a significant impact of Bitcoin price changes on Litecoin and Zcash forecasts. These results thus emphasize the importance of interactions between different cryptocurrencies in the context of the possibility of formulating market forecasts.

Wheatley, S., Sornette, D., Huber, T., Reppen, M., and Gantner, R.N. (2019) also worked on speculative bubbles and price crashes of Bitcoin. The authors claimed that the existence of a relationship between the value of Bitcoin, its adoption, and the online activity of network users (searches, tweets, etc.) is entirely natural. They also pointed to macroeconomic variables that may determine the attractiveness of the cryptocurrency, e.g., in the context of treating Bitcoin as a hedge against the collapse of sovereign monetary systems. The analysis, conducted on empirical data from January 1, 2012, to January 26, 2018, allowed them to identify four different Bitcoin bubbles characterized by their high overvaluation. The LPPLS (Log-Periodic Power Law Singularity) model used in the study provided an ex-ante warning of market instability, indicating a probable time frame for a crash consistent with actual corrections. The conclusions regarding the impact of Bitcoin price changes on other cryptocurrencies are crucial. It was found that short-term price movements of different cryptocurrencies can be caused by Bitcoin price corrections, regardless of their valuations.

Che, M.N.X., Che, N., Copestake, A., Furceri, D., and Terracciano, T. (2023) analyzed the price movements of cryptocurrencies and their relationship with stock markets. The authors assumed that cryptocurrency markets have become more integrated and synchronized with the stock cycle. They also added that cryptoasset prices are strongly correlated. They pointed to Bitcoin as an example, whose average correlation with other cryptocurrencies is 52%. On this basis, the authors also assumed the existence of a common crypto factor that moves in line with the price movements of cryptoassets. The results confirmed that although crypto assets differ significantly in their construction and value proposition, their prices essentially move in the same direction. They also indicated that a single cryptographic factor could explain 80% of their price volatility, and since 2020, it has notably correlated with the technology stock market and small companies. These results also confirm the earlier observations of Iyer, T. (2022), who found a growing correlation between Bitcoin and the American S&P 500 stock index precisely since 2020. This phenomenon results from the increasing presence of institutional investors in the cryptocurrency market, which makes the risk profile of an individual investor in the stock market and the cryptocurrency market increasingly similar.

The issue of the formation of speculative bubbles in the Bitcoin and Ethereum markets and the importance of halving in forming price cycles was taken up by M'bakob, G.B. (2024). This author noted at the beginning of his work that the analysis of speculative bubbles in the cryptocurrency market requires considering the market dominance of Bitcoin. This dominance is measured by the ratio of Bitcoin's market capitalization to the market capitalization of all other cryptocurrencies. In 2023, Bitcoin's dominance exceeded 52.17%, indicating its significant impact on a majority market share. This means that any event responsible for the

formation of Bitcoin's price, such as halving, will probably impact all other cryptocurrencies. The results of the conducted research confirmed that the largest fluctuations in the prices of Bitcoin and Ethereum follow a four-year pattern, which can be characterized as a series of cyclical speculative bubbles. In the case of Bitcoin, bubbles were identified in 2013, 2017, and 2021. Halving analysis showed a significant correlation with the price cycles of the studied cryptocurrencies. The Bitcoin price peak occurs on average about a year after halving, which indicates a close relationship between halving and the breakout of the following currency peak. As the authors claimed, the halving phenomenon is also associated with additional lengthening of the price cycles of Bitcoin and Ethereum, and economic arguments can explain its existence. First, halving the reward for miners mining Bitcoin has a key impact on creating new coins. On the other hand, reducing supply contributes to creating an environment conducive to the growth of Bitcoin prices, thus encouraging the formation of speculative bubbles. Second, expectations of an increase in Bitcoin prices after halving may encourage investors to enter the market, also contributing to the formation of bubbles. Moving on, as investors experience subsequent price increases following each halving, they become increasingly confident in Bitcoin's long-term value, fueling speculative cycles.

Taskinsoy 's (2021) research also showed the cyclical nature of Bitcoin prices. This study indicated that Bitcoin's high valuations are related to its halving dates, as each resulted in a bubble within one year and a crash within the next few months. The behavior of Bitcoin prices after its halvings in 2012, 2016, and 2020 confirms this.

According to Chan, J.Y.L., Phoong, S.W., Phoong, S.Y., Cheng, W.K., and Chen, Y.L. (2023), the Bitcoin halving cycle suggests that its price movements follow specific sequences and are independent of the prices of other assets. Therefore, the implication of the above is the possibility of considering Bitcoin in the context of a haven investment. The authors also drew attention to the growing institutional and industrial adoption of Bitcoin and the outflow of capital from the gold market to the Bitcoin market in 2021. The mentioned authors' work aimed to examine the volatility of Bitcoin and determine its properties as a safe haven. The empirical data covered the period from October 2017 to February 2021, thanks to which it was possible to analyze Bitcoin prices before and after the stock market sell-off caused by the outbreak of the COVID-19 pandemic. The results indicated, among other things, that the Bitcoin halving cycle is not correlated with the stock market, which is why investors should not treat Bitcoin as a safe haven investment. The authors emphasized the need for further research into the properties of Bitcoin, bearing in mind that further adoption of the currency could affect the traditional halving cycle.

While the previously discussed works focused mainly on the supply effect of Bitcoin halving, i.e., speculation and price dynamics, Lashkaripour, M. (2024) considered not only the supply effect but also the security effect in his research. The reduction of the block reward reduces the profitability of cryptocurrency mining and thus forces miners to suspend operations. Limitations in Bitcoin's creation capabilities weaken the network's security, leading to

a decline in its price and undermining transaction utility. Studies have shown that the security effect is more visible in the short term. According to the authors, Bitcoin halvings cause an adverse price reaction, reduce price volatility and increase transaction fees.

The impact of Bitcoin halving on the cryptoasset market and the benefits and limitations resulting from this event are collectively presented in the work by Singla, A., Singla, M., and Gupta, M. (2023). The benefits of Bitcoin halving are considered from the perspective of supply constraints, market sentiment, and technical mining capabilities. Halving contributes to a decrease in the rate of introduction of new bitcoins into circulation and, therefore, may be a fundamental factor supporting the long-term value of Bitcoin. Events related to Bitcoin halving have a profound impact on market sentiment. The reduction in Bitcoin supply and increasing demand may create positive market sentiment in the months preceding and following the halving. These may, in turn, attract new investors and lead to a further increase in the price of Bitcoin. Considering the technological factor, it is noted that although halving events may pose a challenge for miners due to reduced rewards for new blocks, they can also encourage the use of more efficient mining technologies and sustainable practices. In the long term, developing mining technologies may create a more environmentally friendly mining ecosystem. However, the authors also noted the adverse effects of Bitcoin halving, including short-term price fluctuations and the mining centralization risk. Although the Bitcoin market is known for its high volatility, Bitcoin halving events often amplify short-term price fluctuations. This is due to, among other things, the increased involvement of traders in speculative activities. Reducing the rewards for mining another Bitcoin may also affect the profitability of smaller miners, potentially leading to increased centralization of mining activities. Larger mining companies with access to broader and more profitable resources may gain a competitive advantage, thus creating challenges to the decentralized nature of the network. The paper finally noted that the Bitcoin halving phenomenon is not isolated from the broader economic and regulatory context. This means that macroeconomic trends and regulatory or technological changes may overshadow the effects of the events that accompany the Bitcoin halving.

Based on the conducted literature analysis, it was decided to join the research trend on the cyclicality of cryptocurrencies, verify their relevance in the context of changing market conditions, and propose our research approach, allowing for explaining the timeliness of cryptocurrency peaks and troughs based on bitcoin halvings and attempting to find analogous patterns resulting from the halving of a lesser-known cryptocurrency, which is Litecoin. The small number of studies related to the behavior of cryptocurrency prices other than Bitcoin within its halving cycles and the lack of studies on potential cycles resulting from halvings of other cryptocurrencies constitute a research gap worth filling.

3. Research Methodology

The implementation of the objectives adopted in the article required the use of a multi-stage research procedure, the essence of which is the analysis of the cyclicality of the cryptocurrency market by determining the impact of classic Bitcoin cycles on altcoin prices and determining the "halving" cyclicality of other cryptocurrencies.

The study was conducted according to a procedure consisting of the following stages:

1. Determining the average number of days between Bitcoin halvings, which was taken as the average cycle length.
2. Determining the start and end dates of individual Bitcoin cycles, taking the halving date as the middle of the cycle.
3. Determining temporary highs and lows for the cryptocurrencies selected for research.
4. Establishing the dependence level of cryptocurrency prices between cycles.
5. Establishing the dependence level between altcoin prices and the Bitcoin price in individual Bitcoin cycles.
6. Determining the forecasts of cryptocurrency prices within the fourth Bitcoin cycle.
7. Determining and analyzing Litecoin's current cycles.
8. Comparing Bitcoin and Litecoin cycles.

The study was conducted based on data from August 16, 2014, to August 31, 2024. The starting date is the estimated beginning of the second Bitcoin cycle. The end date is the end of the entire month before starting work on the article. The research period includes the second, third, and part of the fourth Bitcoin cycle. The first cycle was deliberately omitted because, on the one hand, cryptocurrencies were not very popular and relatively difficult to access at that time. On the other hand, most altcoins, especially those currently characterized by high capitalization, did not yet exist, which would significantly limit the research sample (Majewska-Bielecka, Grzelczak, 2021). The study used daily closing prices of cryptocurrencies expressed in dollars from the website (Stooq.pl, 2024). First of all, any gaps were filled in based on the closing prices from (CoinGecko, 2024) website, and in the absence of a daily price for a given day, the price from the previous day was used. For the study, a forecast of cryptocurrency prices was prepared for the period from September 1, 2024, to March 13, 2026, i.e., from the end of the period from which the data came to the potential end of the fourth Bitcoin cycle, assuming the current cyclicality is maintained. The length of a single Bitcoin cycle was estimated at 1387 days.

The study examined Bitcoin prices and five altcoins with the largest capitalization expressed in dollars as of August 31, 2024, which simultaneously existed on August 16, 2014. The capitalization of individual cryptocurrencies was taken from www.coingecko.com. These were Ripple, Dogecoin, Litecoin, Monero, and Stellar. Classic Bitcoin cycles were used for the analyses, as they are characterized by a fixed length, allowing for the comparability of data between cycles, which is necessary for performing calculations.

The dependence level of cryptocurrency prices between cycles and between altcoin prices and Bitcoin prices in individual cycles was determined using the Spearman rank correlation coefficient. Tests of normality of the distribution of the studied variables preceded the selection of the correlation coefficient. The following tests were used: Shapiro-Wilk and Kolmogorov-Smirnov with Lilliefors correction, assuming a significance level of 5%. In the case of both tests, the hypotheses about the normality of distributions were rejected for all analyzed cryptocurrencies. The graphs of normality of distributions of individual cryptocurrencies are presented in Figure 1.

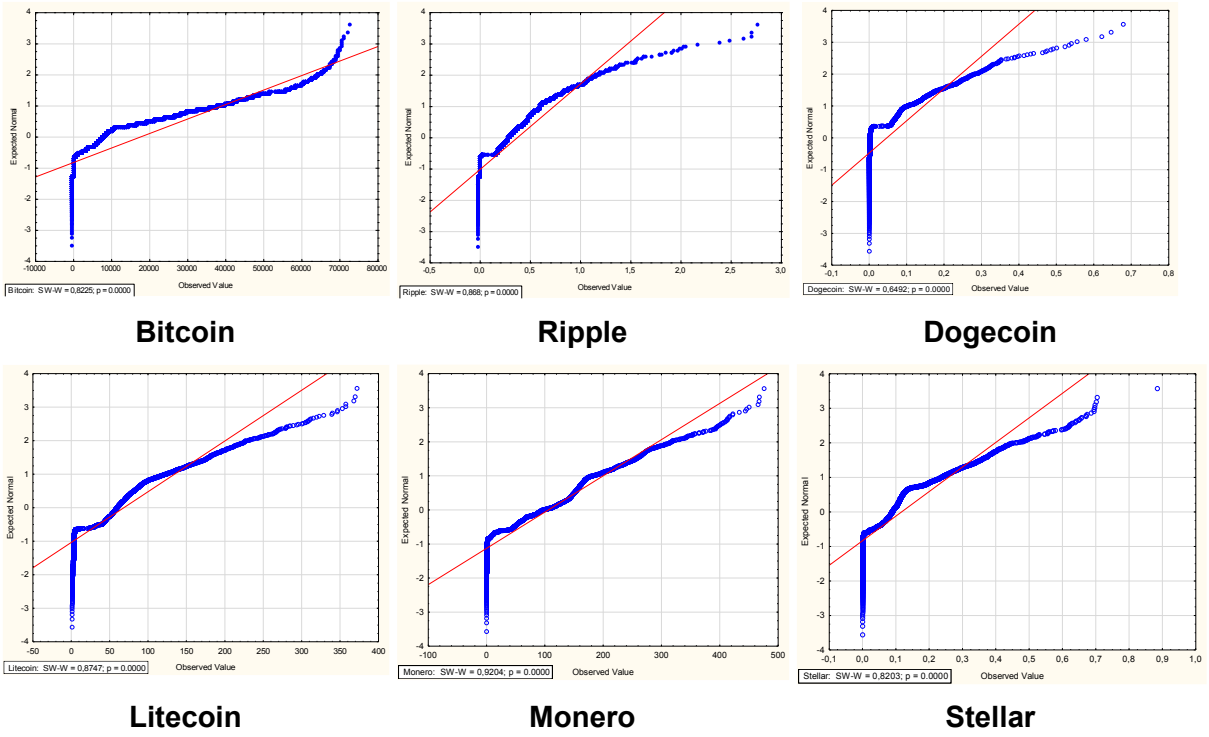


Figure 1. Normality charts of selected cryptocurrencies.

Source: own study.

Cryptocurrency price forecasts were made employing the Forecast Sheet tool with the ETS algorithm using exponential smoothing, available in Microsoft Excel. A confidence level of 95% was adopted, which is a commonly known compromise between the interval width and the forecast certainty (Kallogjeri, Francis, Piccirillo, 2019). The advantages of the exponential smoothing algorithm include the ability to detect clear trends and strong seasonality (Hema et al., 2025). The limitations include: lack of adaptation to sudden changes and poor ability to detect significant anomalies such as sudden price jumps caused by fundamental events (Akyildirim et al., 2022).

Of the five analyzed altcoins, Dogecoin, Litecoin, and Monero are characterized by a proof-of-work consensus mechanism, while Ripple and Stellar are proof-of-stake cryptocurrencies (Gans, 2023). Only Litecoin has a halving mechanism that occurs every 840,000 blocks among the proof-of-work cryptocurrencies, so the last part of the study checked Litecoin's cyclicality based on its halvings and compared the obtained results with Bitcoin's cyclicality.

4. Research Results

Halving, the process of reducing by half the current reward for miners for mining a single block and aimed at controlling the supply of the cryptocurrency, occurs approximately every four years in the case of Bitcoin. However, the number of days between individual halvings is not fixed and has so far ranged from 1319 to 1439 days. To apply the classic concept of cycles based on their fixed length in further analyses, the average length of the Bitcoin cycle was calculated at 1387 days. Based on the halving dates and average cycle length, individual cycles' start and end dates were determined (see Table 2).

Table 2.
Parameters of individual Bitcoin cycles

Cycles	Start of a cycle	Halving day	End of a cycle
Cycle 1	01/05/2011	11/28/2012	10/22/2014
Cycle 2	08/16/2014	07/09/2016	06/02/2018
Cycle 3	06/18/2018	05/11/2020	04/04/2022
Cycle 4	05/27/2022	04/19/2024	03/13/2026

Source: own study.

In Table 2, Cycle 1 is marked in orange, which was excluded from further analysis due to the low popular appeal and difficult accessibility of cryptocurrencies and the fact that most of the currently existing altcoins did not exist at that time. It is also worth noting that in the first cycle, market liquidity was very low, meaning that Bitcoin prices were more susceptible to manipulation and rapid changes. In later cycles, the development of technology, the growth of the number of users and acceptance by financial institutions had a significant impact on its cyclicality, so analyses omitting this period seem more reliable. In the next part of the study, the peaks and troughs occurring in the classic Bitcoin cycle were determined for cycles that have been completed. In the case of cycle four, the trough has potentially already been determined, but until the cycle ends, the price may fall lower and determine a new trough. Such a situation could occur if the previous cyclicality had not been maintained. Table 3 presents the temporality of individual peaks and troughs of the examined cryptocurrencies.

Table 3.
Timeline of the examined cryptocurrencies' highs and lows in the full Bitcoin cycle with the Bitcoin price variation

Crypto-currency	Cycle 2 – low (variation from Bitcoin)	Cycle 3 – low (variation from Bitcoin)	Low – mean (variation from Bitcoin)	Cycle 2 – high (variation from Bitcoin)	Cycle 3 – high (variation from Bitcoin)	High – mean (variation from Bitcoin)
Bitcoin	152nd day	181st day	**167th day**	1219th day	1241st day	**1230th day**
Ripple	248th day (+96 days)	638th day (+457 days)	**443rd day (+276 days)**	1241st day (+22 days)	1032nd day (-209 days)	**1137th day (-93 days)**
Dogecoin	263rd day (+111 days)	638th day (+457 days)	**451st day (+284 days)**	1241st day (+22 days)	1055th day (-186 days)	**1148th day (-82 days)**

Cont. table 3.

Litecoin	152nd day (0 days)	179th day (-2 days)	**166th day (-1 day)**	1221st day (+2 days)	1058th day (-183 days)	**1140th day (-90 days)**
Monero	186th day (+34 days)	638th day (+457 days)	**412th day (+245 days)**	1223rd day (+4 days)	1057th day (-184 days)	**1140th day (-90 days)**
Stellar	201st day (+49 days)	638th day (+457 days)	**420th day (+253 days)**	1237th day (+18 days)	1059th day (-182 days)	**1148th day (-82 days)**

Altcoin low lags against Bitcoin | Altcoins and Bitcoin lows co-occur | Altcoin low accelerates against Bitcoin

Source: own study.

In the first and second Bitcoin cycles, the altcoin lows came later than the Bitcoin lows (except for Litecoin). At the same time, it can be observed that the altcoin lows came much later in the third cycle than in the second cycle. In predicting the lows, Bitcoin can be considered a leading indicator, as its price rises faster than the altcoin prices.

Considering the timeline of the highs, it can be observed that in the second cycle, the highs on altcoins occurred slightly later than on Bitcoin. In contrast, in the third cycle, this relationship was not maintained. It is worth noting here that a relatively specific course characterized the third cycle of Bitcoin. A double top formation known from technical analysis could be observed in the third cycle on the Bitcoin chart (Murphy, Madej, Kalinauskas, 1995). The first peak was formed on the 1033rd day of the cycle (63,460.86 USD), while after another 208 days, the price formed a second peak at 67,305.13 USD. Figure 2 shows the double top on Bitcoin visible in the third cycle.

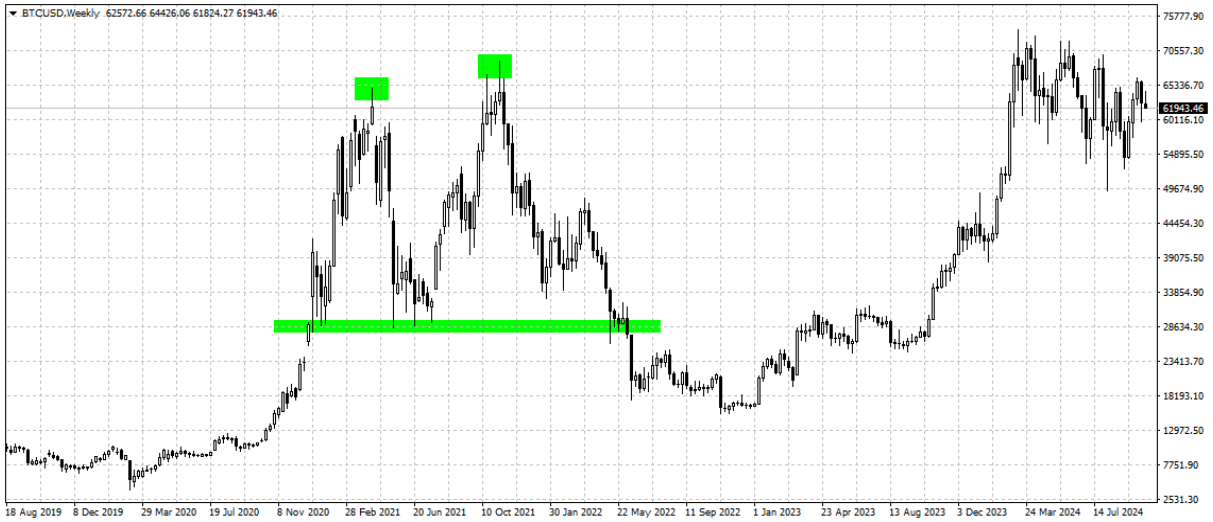


Figure 2. Double top in Bitcoin's third cycle.

Source: own study.

Table 4 considers the timeline of the highs and lows of the studied cryptocurrencies in the full Bitcoin cycle after correction to include the first Bitcoin top in the third cycle.

Table 4.
Adjusted timeline of highs and lows of the studied cryptocurrencies in the full Bitcoin cycle with the variation from the Bitcoin price

Crypto-currency	Cycle 2 – low (variation from Bitcoin)	Cycle 3 – low (variation from Bitcoin)	Low – mean (variation from Bitcoin)	Cycle 2 – high (variation from Bitcoin)	Cycle 3 – first BTC high (variation from Bitcoin)	High – mean (variation from Bitcoin)
Bitcoin	152nd day	181st day	**167th day**	1219th day	1033ed day	**1126th day**
Ripple	248th day (+96 days)	638th day (+457 days)	**443ed day (+276 days)**	1241st day (+22 days)	1032nd day (-1 day)	**1137th day (+11 days)**
Dogecoin	263rd day (+111 days)	638th day (+457 days)	**451st day (+284 days)**	1241st day (+22 days)	1055th day (+22 days)	**1148th day (+22 days)**
Litecoin	152nd day (0 days)	179th day (-2 days)	**166th day (-1 day)**	1221st day (+2 days)	1058th day (+25 days)	**1140th day (+14 days)**
Monero	186th day (+34 days)	638th day (+457 days)	**412th day (+245 days)**	1223ed day (+4 days)	1057th day (+24 days)	**1140th day (+14 days)**
Stellar	201st day (+49 days)	638th day (+457 days)	**420th day (+253 days)**	1237th day (+18 days)	1059th day (+26 days)	**1148th day (+22 days)**

Altcoin low lags against Bitcoin | Altcoins and Bitcoin lows co-occur | Altcoin low accelerates against Bitcoin

Source: own study.

Considering the corrected data, it can be concluded that even in the case of peaks, Bitcoin can serve as a leading indicator of the altcoin price. It is also worth noting that the number of days between the highs of the Bitcoin price and the highs of the altcoin prices is much lower than in the case of analogous lows. At the same time, it can be observed that the number of days between bottoms and peaks has decreased significantly when comparing the second and third cycles.

Then, Spearman rank correlations were calculated between cryptocurrency prices in individual Bitcoin cycles (see Figure 3).

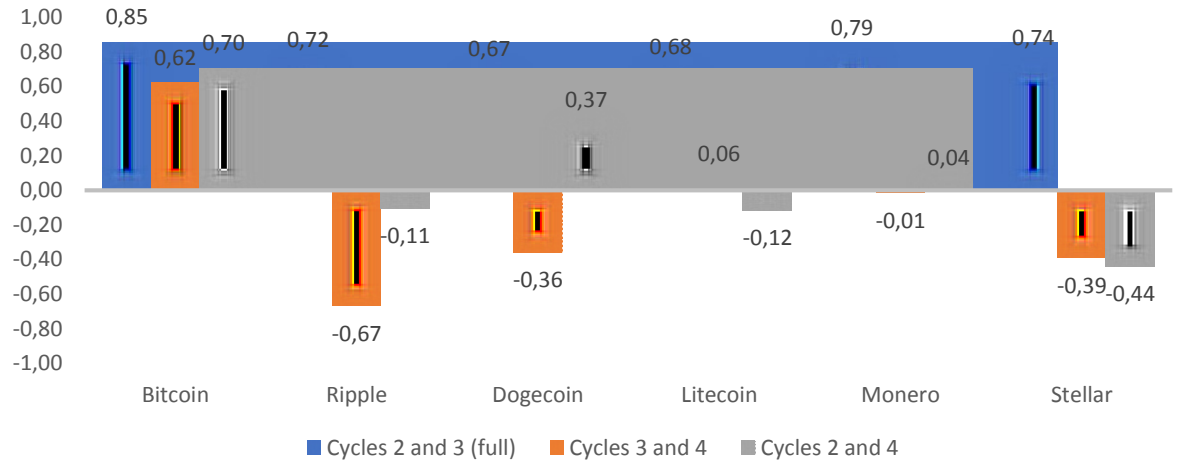


Figure 3. Cryptocurrency price correlations between cycles across Bitcoin cycles.

Source: own study.

The correlations between the prices in the second and third cycles are worth noting because only these cycles have been completed, while the fourth cycle should end in 2026. For the indicated cross-section, the correlation was significant in four cases (for Bitcoin, Ripple, Monero, and Stellar) and moderate in two (for Dogecoin and Litecoin). The correlation values between the third and fourth cycles and the second and fourth cycles in most cases (66.67%) turned out to be small at most. Still, if the current cyclicality is maintained, they should increase significantly in the later phase of the fourth cycle.

In the next step of the research procedure, correlations between altcoin prices and the Bitcoin price in individual Bitcoin cycles were calculated (see Figure 4).

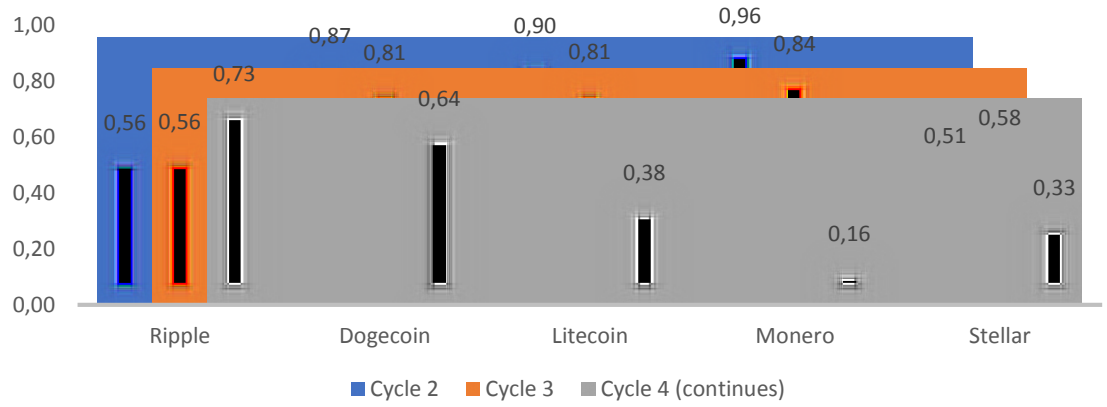


Figure 4. Correlations of altcoin prices with Bitcoin prices within Bitcoin cycles.
Source: own study.

In the cycles completed so far (the second and third), the correlations between the Bitcoin and altcoin prices were strong in two cases (Litecoin and Monero – Cycle 2), significant in four (Dogecoin – Cycles 2 and 3, Litecoin and Monero – Cycle 3) and moderate in four cases (Ripple and Stellar – Cycles 2 and 3). This indicates a statistically significant connection between the Bitcoin price and the prices of the analyzed altcoins and that the cyclicality persists over time. Only in the case of the fourth cycle were the correlation values lower on average, which should change if the current cyclicality is maintained.

The next step of the research procedure was to prepare price forecasts of the analyzed cryptocurrencies for the period from September 1, 2024, to March 13, 2026, i.e., for the rest of the fourth cycle. The Forecast Sheet with the ETS algorithm using exponential smoothing was used to prepare the forecasts. From the point of view of further analysis, it seems essential that the used algorithm indicated the possibility of double tops at a similar level in the fourth cycle – identical to the third cycle. The first of the peaks would be USD 83,619.66, and the second higher at USD 91,105.79. The timeliness of the analyzed cryptocurrencies, considering the forecasts for the fourth cycle, is presented in Table 5.

Table 5.
Adjusted timeline of highs and lows of the studied cryptocurrencies in the full Bitcoin cycle with the variation from the Bitcoin price with Cycle 4 forecast

Crypto-currency	Cycle 2 – low (variation from Bitcoin)	Cycle 3 – low (variation from Bitcoin)	Cycle 4 – forecasted low (variation from Bitcoin)	Cycle 2 – high (variation from Bitcoin)	Cycle 3 – first BTC high (variation from Bitcoin)	Cycle 4 – forecasted highs (variation from Bitcoin)
Bitcoin	152nd day	181 day	179 day	1219 day	1033 day	I top: 981st day II top: 1169th day
Ripple	248th day (+96 days)	638th day (+457 days)	23ed day (-156 days)	1241st day (+22 days)	1032nd day (-1 days)	1174th day (+193 days) 1174th day (+5 days)
Dogecoin	263ed day (+111 days)	638th day (+457 days)	23ed day (-156 days)	1241st day (+22 days)	1055th day (+22 days)	1003ed day (+22 days) 1003ed day (-166 days)
Litecoin	152nd day (0 days)	179th day (-2 days)	18th day (-161 days)	1221st day (+2 days)	1058th day (+25 days)	1155th day (+174 days) 1155th day (-14 days)
Monero	186th day (+34 days)	638th day (+457 days)	23ed day (-156 days)	1223ed day (+4 days)	1057th day (+24 days)	1156th dzień (+175 dni) 1156th day (-13 days)
Stellar	201st day (+49 days)	638th day (+457 days)	219th day (+40 days)	1237th day (+18 days)	1059th day (+26 days)	1170th day (+189 days) 1170th day (+1 day)

Altcoin low lags against Bitcoin | Altcoins and Bitcoin lows co-occur | Altcoin low accelerates against Bitcoin

Source: own study.

When analyzing the obtained forecasts of Bitcoin and altcoin prices for the fourth cycle, it is worth noting that, unlike the second and third cycles, the bottoms on altcoins in most cases (for Ripple, Dogecoin, Litecoin, and Monero) occurred much earlier than for Bitcoin. Only the lowest value of the Stellar price occurred 40 days after the bottom in the Bitcoin price. The forecasted peaks for three out of five analyzed altcoins should be formed earlier than the second Bitcoin peak. However, assuming an alternative scenario, considering only the first peak, Bitcoin would remain a leading indicator for all altcoins whose price was forecasted.

The next part of the study was to check whether halving cycles are a specific feature of Bitcoin or also occur in other cryptocurrencies. For this purpose, the halving cyclicity of Litecoin was examined. To compare individual cycles, we started by standardizing their lengths – as in the case of Bitcoin. To achieve comparability of data, the average cycle length was determined, which was rounded to 1450 days. Based on the halving dates and average cycle length, individual cycles' start and end dates were determined (see Table 6).

Table 6.
Parameters of individual Litecoin cycles

Cycle	Start of a cycle	Halving Day	End of a cycle
Cycle 1	08/30/2013	08/25/2015	08/19/2017
Cycle 2	08/10/2017	08/05/2019	07/30/2021
Cycle 3	08/07/2021	08/02/2023	07/27/2025

Source: own study.

So far, Litecoin has had three cycles, the last of which is scheduled to end on July 27, 2025. Figure 5 presents the Litecoin price in the individual cycles.

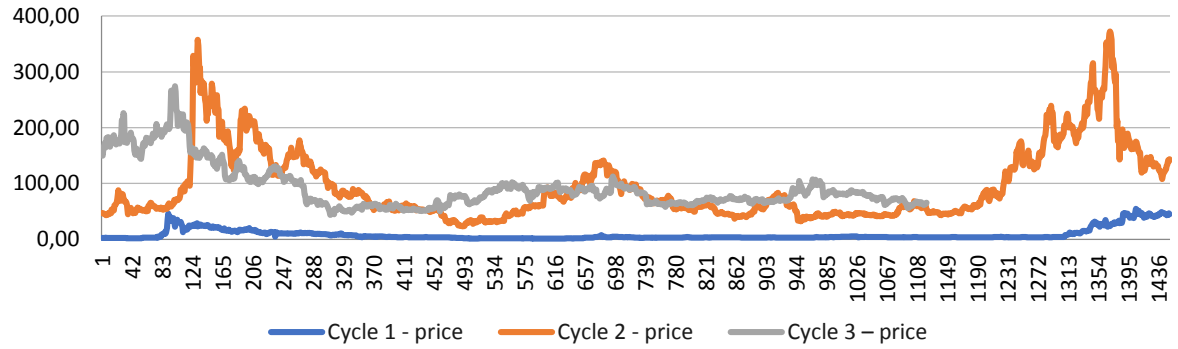


Figure 5. Litecoin price in individual cycles.

Source: own study.

The Litecoin cycle graph resembles a U-pattern with clearly formed tops in their initial and final phases. Spearman rank correlation coefficients were calculated between individual cycles to examine the strength of the relationship between the price in the Litecoin cycle. The value of the correlation coefficient between the first and third cycles was 0.60, between the second and third cycles 0.24, and between the first and third cycles 0.07. The strongest correlation is, therefore, between Litecoin prices in two completed cycles.

Table 7 presents a comparison of Bitcoin and Litecoin cycles.

Table 7.
Comparison of Bitcoin and Litecoin cycles

Comparison criterion	Bitcoin Cycles	Litecoin Cycles
Current cycle count	4	3
Average cycle length	1387	1450
Average price correlation between cycles	0.73	0.30
Planned last halving event	The year 2141	The year 2142
Maximum cryptocurrency resources	21 000 000	84 000 000
Cycle progress	The upward trend lasts about a year and ends with a new high on the chart, followed by a downward trend lasting about a year and ending with a new low. Then, Bitcoin's price consolidates for about two years.	The chart resembles a U-pattern. Two distinctive tops: - first between 91st and 131st day - second between 1370 and 1405 day

Source: own study.

In the case of Bitcoin, there have been more cycles, as many as four, while in the case of Litecoin, only three cycles have been recorded. Classic Litecoin cycles are 63 days longer than Bitcoin cycles. The average correlation between the rates of the cycles in the case of Bitcoin is significant (0.73), while in the case of Litecoin, it is small (0.30). The dates of the last halving and, thus, the potential end of the cyclicality of Bitcoin and Litecoin are similar. The Bitcoin cycle progression is characterized by annual phases: growth and decline, followed by a two-year consolidation. In turn, the shape of the Litecoin cycle resembles a U-pattern with clearly formed peaks at the beginning and end of the cycle.

5. Conclusions and Discussion

The research that was conducted allowed us to draw the following conclusions.

- C1: The classic Bitcoin cycles concept remains relevant, highlighted by the significant correlations in Bitcoin prices across its cycles.
- C2: The Bitcoin price may be a leading indicator in forecasting the lows and highs in altcoin prices, as indicated by a statistically significant correlation between the prices of Bitcoin and altcoins and the timeliness of the highs and lows. However, the altcoin peaks may occur after the first Bitcoin peak but before the second one.
- C3: The cyclical nature of cryptocurrency halvings is not unique to Bitcoin, as evidenced by the correlations between rates in Litecoin cycles. Still, it is weaker than in the case of Bitcoin.

Based on the obtained results, the hypotheses that the cryptocurrency market is characterized by cyclicality resulting from Bitcoin halvings and that halving cyclicality is not exclusive to Bitcoin have been positively verified.

The research results allowed us to draw three main conclusions. First, the concept of classic Bitcoin cycles remains relevant, as confirmed by the high correlation of Bitcoin prices across individual cycles (C1). This means that Bitcoin, despite changing market conditions, is still subject to similar cyclical mechanisms that allow for the prediction of its rises and falls.

Second, the Bitcoin price can be a leading indicator in forecasting the troughs and peaks of altcoin prices. The significant correlation between Bitcoin and altcoin prices and the analysis of the temporality of tops and bottoms indicate that movements in the Bitcoin market can signal future changes in the altcoin market. Therefore, these results are consistent with the findings obtained by other authors and presented in the literature review. However, it is worth noting that altcoin peaks can occur after the first Bitcoin high but before its second high (C2), which requires considering this specific phenomenon in forecasts.

The research also allowed us to formulate an innovative conclusion regarding halving, which, as it turned out, is not a phenomenon reserved exclusively for Bitcoin. Although the correlations between Litecoin and Bitcoin cycles indicate certain similarities, the halving cyclicality in the case of Litecoin is less pronounced and weaker than in the case of Bitcoin (C3). This may indicate differences in the dynamics and characteristics of both markets, which should be considered when analyzing and forecasting their future movements.

Based on the obtained results, the hypotheses that the cryptocurrency market is characterized by cyclicality resulting from Bitcoin halvings and that halving cyclicality is not exclusively Bitcoin's domain were positively verified. The research conclusions highlight the significance of cyclical patterns in cryptocurrency market analysis. They also point out the complexity of this phenomenon and underscore the necessity for further investigation in future studies, which we are committed to pursuing.

6. Limitation of the research

The limitation of the conducted research was undoubtedly the amount of available data. The cryptocurrency market is very young, less than a dozen years old. Most currently popular projects have been listed for only a few years, which is why the most significant projects in terms of capitalization that existed at the beginning of the second Bitcoin cycle at the time of launching this study were ranked from 7th to 36th in terms of capitalization. This situation will change over time, especially concerning currently existing cryptocurrencies, which can get through subsequent cycles, systematically making up their market position during periods of a bull market. The presented study is worth repeating in subsequent Bitcoin cycles, which the authors of this article would like to undertake. Halving cycles of other cryptocurrencies also seem worth investigating, especially in a few or a dozen years, when the amount of available data will be much greater, which may help find patterns similar to those known in the case of Bitcoin.

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