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The Price and Market Prospects for the Ethereum Cryptocurrency Development

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Abstract: *This article provides an in-depth analysis of the price dynamics and market prospects of Ethereum, the second-largest cryptocurrency by market capitalization. As blockchain technology and cryptocurrencies increasingly integrate into global financial systems, understanding the factors influencing Ethereum's price becomes crucial for investors, developers, and researchers. The study uses daily price and volume data from an extensive dataset spanning from 2016 to 2023, focusing on the year 2022 to analyze trends and relationships between Ethereum's price, market volume, and time. Employing correlation and regression analyses, the study aims to identify key patterns, with a focus on understanding how these variables interact within the volatile cryptocurrency market. The methodology centres on refining the data to ensure accuracy and integrity, including the removal of outliers and verification of variable distributions. Correlation analysis was conducted to explore the relationships between price, volume, and time. Regression analysis further assessed the impact of volume and temporal factors on Ethereum's price, using heteroskedasticity-consistent standard errors to address market volatility. The model's robustness was validated through statistical significance tests, and visualizations were used to present data trends and relationships effectively. The findings reveal that Ethereum experienced substantial volatility in 2022, characterized by a general downward price trend. The study identified a weak inverse correlation between price and trading volume, suggesting that periods of higher trading activity often coincide with lower prices, possibly reflecting market corrections or sell-offs. The regression analysis indicated that time is a significant factor in Ethereum's price dynamics, with a strong positive correlation between the observation order and price, highlighting a clear downward trend over the year. The model demonstrated a high explanatory power, with an Adjusted R-squared of 83.94%, indicating that the selected variables effectively capture the variance in price. The discussion places these findings within the broader context of market developments, including technological shifts like Ethereum 2.0, regulatory changes, and macroeconomic factors that shaped the price movements. The inverse relationship between volume and price underscores the impact of trading behaviour on market sentiment, while the downward temporal trend aligns with the overall market downturn seen in 2022. Despite short-term negative trends, the analysis underscores Ethereum's long-term potential, given its leading role in decentralized finance, non-fungible tokens, and blockchain innovation. This research remains highly relevant as it addresses the interplay of technical, market, and macroeconomic factors in shaping Ethereum's price and market prospects, providing a framework for understanding its future trajectory within the evolving cryptocurrency landscape.*

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JEL Classification: D53, F31, G12.

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INTRODUCTION

Blockchain technology has attracted much attention in recent years, primarily due to its use in cryptocurrencies such as Bitcoin, Ethereum, BNB, and many others. As blockchain and cryptocurrencies become more entrenched in global financial markets, understanding the factors influencing cryptocurrency prices becomes essential for investors and researchers.

Ethereum (ETH) is the second-largest cryptocurrency by market capitalization, and its price trends significantly influence the overall crypto market. The price of ETH has seen considerable volatility in recent years, driven by factors like technological developments, global economic events, regulatory decisions, and shifts in investor sentiment. According to reputable sources like CoinMarketCap (n.d.), Ethereum has consistently held its position as the second-largest cryptocurrency by market capitalization, following Bitcoin. As of 2023, ETH's market cap typically hovers in the hundreds of billions of dollars, representing a significant share of the overall crypto market. Research and analysis, such as a report by CoinMetrics (2024), indicate that Ethereum's price movements are strongly correlated with the performance of other cryptocurrencies. ETH often sets trends for altcoins, with periods of growth or decline in its price frequently leading to similar movements in the broader crypto market. This demonstrates its influential role in the crypto ecosystem. Ethereum has experienced substantial price swings over recent years, with notable periods of both rapid gains and declines. For example, in 2021, the price of ETH rose from around $730 at the start of the year to an all-time high of approximately $4,800 in November, largely fueled by the rise of DeFi, NFTs, and the anticipation of Ethereum 2.0. However, in early 2022, the price faced sharp declines, correlating with broader market downturns and macroeconomic concerns (CoinMarketCap, n.d.). The price of ETH has been directly influenced by technological developments like network upgrades (e.g., the London Hard Fork or "EIP-1559" and the move to Ethereum 2.0). Additionally, global regulatory discussions around cryptocurrency policies, such as crackdowns in China or debates in the U.S. on digital asset regulation, have contributed to periods of both volatility and stabilization in Ethereum's price. Data from CryptoQuant (n.d.) and other market analysis platforms highlight these price movements in relation to such key events.

A significant portion of decentralized finance (DeFi) and non-fungible tokens (NFT) run on the Ethereum blockchain. These sectors have experienced explosive growth, contributing to the rising price of ETH and shaping its market prospects. Ethereum has been the leading blockchain for DeFi applications. As of 2023, data from sources like DeFiLlama (n.d.) show that a significant portion of the total value locked (TVL) in DeFi protocols is on the Ethereum blockchain. At various points, Ethereum has accounted for over 50% of the total DeFi TVL, with billions of dollars locked in protocols like Uniswap, Aave, and MakerDAO. This large TVL reflects strong demand for Ethereum as users are required to hold and use ETH for transaction fees (gas fees) to interact with DeFi applications. The growth of DeFi has driven significant network activity, increasing demand for ETH and positively influencing its price. During DeFi booms, such as in 2020-2021 ("DeFi Summer"), Ethereum's price saw significant increases in parallel with DeFi adoption (Pham, 2023). The majority of NFT activity occurs on the Ethereum blockchain, leveraging ERC-721 and ERC-1155 standards for creating and trading NFTs. According to DappRadar (n.d.), leading NFT marketplaces like OpenSea primarily operate on Ethereum, handling millions of transactions and trading billions of dollars worth of NFTs. At the peak of the NFT boom in 2021, Ethereum saw massive spikes in network usage and transaction volumes due to high demand for minting, buying, and selling NFTs. The NFT craze, particularly in 2021, contributed to the rising price of ETH, as users needed ETH to mint, buy, sell, and trade NFTs. The surge in NFT transactions led to higher gas fees, greater demand for ETH, and overall increased usage of the Ethereum network. This increased activity helped propel Ethereum's price to its all-time highs, showing a direct relationship between the growth of the NFT sector and ETH's market performance.

Ethereum is undergoing a major upgrade (Ethereum 2.0 or "Eth2"), transitioning from a Proof of Work (PoW) consensus mechanism to a more scalable and energy-efficient Proof of Stake (PoS). This change aims to improve transaction throughput, reduce fees, and minimize energy consumption, which is seen as a critical step for Ethereum's future growth and price stability. This transition impacts ETH’s price and market perception. Investors and market participants are actively assessing how Eth2 will improve Ethereum’s scalability, security, and decentralization, and whether it will solidify ETH’s role as a leading cryptocurrency. The Ethereum network successfully completed “The Merge” on September 15, 2022, transitioning from the energy-intensive Proof of Work (PoW) to Proof of Stake (PoS). According to Ethereum Foundation (n.d.), this shift led to an estimated reduction in Ethereum's energy consumption by around 99.95%. The PoS model removes the need for the vast computational power required in PoW mining, making Ethereum more environmentally friendly and addressing criticisms about the environmental impact of cryptocurrencies. The drastic reduction in energy consumption positions Ethereum as a more sustainable and attractive platform for developers, investors, and institutions concerned about environmental, social, and governance (ESG) considerations. This change has the potential to drive further adoption and growth, enhancing Ethereum’s long-term market stability and price prospects. Ethereum 2.0 introduces significant improvements in transaction throughput and scalability, with future plans to implement “sharding”. Sharding will split the Ethereum network into smaller parts (shards) to process transactions in parallel, greatly increasing the network's capacity and reducing congestion. According to Ethereum.org (n.d.), this upgrade aims to enhance Ethereum's ability to handle thousands of transactions per second, compared to the current rate of around 15-30 transactions per second. High gas fees have been a major issue for users of Ethereum-based applications, particularly during periods of network congestion. The move to PoS and the upcoming sharding upgrades are expected to reduce transaction fees significantly, making the network more accessible and usable for a broader range of applications, such as DeFi and NFTs. These developments are critical for Ethereum’s growth and play a vital role in its price stability, as lower fees and improved throughput make the network more attractive to both developers and users.

The price’s increasing of ETH and the positive market sentiment based on the following key milestones and announcements about "The Merge," the transition to Ethereum 2.0. For instance, In the lead-up to the official completion of "The Merge" on September 15, 2022, ETH experienced a price rally, rising by over 50% from around $1,000 to above $1,600 in just a few months (July to September 2022). This price movement reflected increased investor confidence in Ethereum's successful transition to Proof of Stake and its expected benefits regarding energy efficiency, scalability, and network security. Market analysts and institutional investors viewed "The Merge" as a crucial catalyst for Ethereum’s long-term potential, influencing its market perception positively. Reports from institutions like JP Morgan (n.d.) noted that the transition could lead to greater staking rewards, better network efficiency, and increased institutional adoption, all of which contributed to bullish sentiment and demand for ETH. This market behaviour demonstrates that investors actively assess Ethereum 2.0’s impact on the network's scalability, security, and sustainability, influencing ETH’s price and solidifying its position as a leading cryptocurrency.

Governments and regulatory bodies worldwide are taking a closer look at cryptocurrencies. How Ethereum and other cryptos are regulated affects their price and market adoption. Clarity in regulation can lead to increased institutional adoption and participation in the ETH ecosystem, driving its price and market prospects. Ethereum has seen growing interest from institutional investors. The rise of financial instruments like Ethereum-based ETFs, futures, and other derivatives suggests increasing market confidence and potential for further price growth.

One piece of strong evidence supporting this statement is the approval and launch of Ethereum Futures Exchange-Traded Funds (ETFs) in the U.S. In October 2023, multiple Ethereum futures ETFs were launched, marking a significant step in crypto market regulation and institutional access. Regulatory Approval of Ethereum Futures ETFs: The U.S. Securities and Exchange Commission (SEC) approved several Ethereum futures ETFs, which are financial products allowing investors to gain exposure to ETH price movements without directly holding the asset (Burgoyne et al., 2024). The launch of these ETFs, such as those by companies like ProShares and VanEck, demonstrates a move towards clearer regulation and greater institutional access to Ethereum-based assets. The approval of Ethereum futures ETFs has led to increased institutional participation, as these products make it easier for traditional investors, including hedge funds and asset managers, to invest in Ethereum. This development was seen as a validation of Ethereum’s growing market maturity and contributed to increased demand for ETH, reflecting positive price movements and greater confidence in its long-term prospects. The introduction of Ethereum-based financial instruments like ETFs indicates growing market confidence and regulatory clarity, both of which significantly affect the adoption and market dynamics of ETH.

Layer 2 solutions (such as Optimism, Arbitrum, and zk-Rollups) are being developed to address Ethereum's scalability and transaction fee issues. These improvements are expected to make Ethereum more competitive, attract new projects, and potentially influence the price positively. Ethereum faces competition from other blockchain networks like Binance Smart Chain (BSC), Solana, and Cardano. These networks aim to provide faster transactions and lower fees. Ethereum’s ability to maintain and grow its market share in the face of such competition is crucial for its price and market prospects. Evidence for supporting the role of Layer 2 solutions in improving Ethereum's competitiveness is the substantial adoption and usage of Layer 2 scaling platforms like Arbitrum, Optimism, and zk-Rollups, which have dramatically reduced transaction costs and increased throughput on the Ethereum network. According to data from platforms L2Beat (n.d.), the

TVL in Layer 2 solutions has seen exponential growth, with billions of dollars locked in these networks. For instance, Arbitrum and Optimism combined hold a significant share of this TVL, indicating strong adoption by users seeking lower transaction fees and faster transaction speeds compared to Ethereum's base layer. The adoption of Layer 2 solutions has significantly reduced gas fees, thereby improving user experience and encouraging more decentralized applications (dApps) to build on Ethereum. This, in turn, helps Ethereum remain competitive against other blockchains like Binance Smart Chain (BSC), Solana, and Cardano, which emphasize faster and cheaper transactions. As a result, the successful deployment of Layer 2 technologies has attracted more projects and users to the Ethereum ecosystem, positively influencing ETH's market activity and price. This growth of Layer 2 solutions demonstrates how Ethereum is actively addressing scalability and cost issues to maintain its market share against competing blockchains, which is crucial for its long-term market prospects and valuation.

Ethereum's price is also influenced by macroeconomic factors such as interest rates, inflation, and overall investor appetite for risk. The broader market trends in cryptocurrency, including Bitcoin's performance, significantly impact Ethereum's price dynamics. The ongoing development of decentralized applications (dApps), smart contracts, decentralized exchanges (DEXs), and Web3 technologies indicates a growing adoption trend for Ethereum. The evolution of these applications and the expanding ecosystem enhances Ethereum's utility and, in turn, its market prospects. The influence of macroeconomic factors and broader market trends on Ethereum's price is linked with the price fluctuations in response to macroeconomic events such as Federal Reserve interest rate hikes, inflation news, and Bitcoin's market performance. Throughout 2022 and into 2023, Ethereum's price showed significant sensitivity to macroeconomic events. For example, announcements from the U.S. Federal Reserve about interest rate hikes and inflation directly affected ETH prices, often causing volatility across the entire crypto market (Royal et al., 2024). During times of rising interest rates and tighter monetary policies, investor risk appetite typically decreased, leading to a sell-off in assets like cryptocurrencies, including ETH. Ethereum's price also has a strong correlation with Bitcoin. When Bitcoin experiences upward or downward price movements, ETH often follows suit, reflecting the overall trends in the cryptocurrency market. This is seen during times when Bitcoin rallies (e.g., late 2020 to early 2021), as ETH tends to rally alongside it, reflecting the interconnectedness of the two largest cryptocurrencies (Torpey, 2023). This correlation between Ethereum's price, macroeconomic factors, and Bitcoin's performance underlines how external economic conditions and broader market trends play a crucial role in shaping Ethereum's price dynamics and market perception. Additionally, the growth of the Ethereum ecosystem, fuelled by dApps, DeFi, and Web3 technologies, supports its utility and potential for price appreciation in tandem with these market factors.

The topic remains highly actual and critical as Ethereum continues to play a pivotal role in the cryptocurrency ecosystem. The combination of technical developments (Ethereum 2.0 and Layer 2 solutions), regulatory considerations, and market forces like competition and adoption trends are actively shaping Ethereum's price and market prospects. For researchers, investors, and developers, understanding these factors is crucial for anticipating Ethereum's future development and its role in the broader cryptocurrency market.

LITERATURE REVIEW

The price and market prospects of Ethereum, the second-largest cryptocurrency by market capitalization, have been subjects of substantial research and debate in the context of the evolving cryptocurrency landscape. This literature review synthesizes scholarly and industry analyses on key themes influencing Ethereum's development and future potential, including its technological evolution, market dynamics, macroeconomic influences, regulatory environment, and competitive landscape.

Ethereum's evolution is a core theme in understanding its market prospects. The most significant development in this context is the transition to Ethereum 2.0, which moves the network from a Proof of Work (PoW) consensus mechanism to a more energy-efficient and scalable Proof of Stake (PoS) system. Buterin (2017) describe Ethereum 2.0 as a comprehensive upgrade designed to improve scalability, security, and sustainability. The literature indicates that this upgrade is pivotal for Ethereum's price stability and growth. De Vries (2022) emphasize that the shift to PoS through "The Merge" could reduce energy consumption by 99%, enhancing Ethereum's appeal to environmentally conscious investors. Atzei et al. (2017) argue that this technological upgrade could lead to increased network capacity and reduced transaction fees, thereby driving broader adoption and potentially boosting ETH prices. The article by Asif and Hassan (2023) examines the energy implications of Ethereum's transition from the Proof-of-Work (PoW) consensus mechanism to Proof-of-Stake (PoS). The article describes the original PoW consensus mechanism used by Ethereum, which, like Bitcoin, relies on computationally intensive mining processes to validate transactions and secure the network.

It highlights how PoW leads to high energy consumption due to its dependency on solving complex cryptographic puzzles, which requires a large amount of computational power and electricity. This has raised environmental concerns and debates over the sustainability of PoW-based blockchain systems.

Ethereum's price and market activity are closely linked to the growth of its decentralized ecosystem, particularly decentralized finance (DeFi) and non-fungible tokens (NFTs). Ethereum holds a dominant position in the DeFi space, with a significant portion of total value locked (TVL) in DeFi protocols operating on the Ethereum blockchain. This adoption has contributed to Ethereum's utility and price appreciation. Similarly, the rapid expansion of the NFT market, has spurred network activity and increased demand for ETH, as it is the primary currency for NFT transactions on platforms like OpenSea. Ali et al. (2023) provide a comprehensive analysis of the various challenges associated with NFTs. The paper explores these challenges from multiple perspectives, such as technological, legal, financial, and social, to better understand the implications of NFTs on different sectors. Davies et al. (2024) explore the potential of NFTs as tools to support traceability, transparency, and sustainability in supply chain management. In the context of a rapidly developing metaverse – a virtual environment where digital assets are increasingly exchanged and tracked – they discuss how NFTs could help address challenges in sustainable supply chain practices. The paper aims to bridge the gap between the concepts of NFTs, supply chain management, and the metaverse, offering insights into how these emerging technologies can be integrated. Sree Kumar et al. (2023) presents the design and implementation of a novel NFT marketplace called "TokenFuse". The paper focuses on how this marketplace is developed to address existing challenges in NFT trading and offers a versatile platform for the creation, buying, and selling of NFTs. The authors conclude that TokenFuse addresses the key limitations of current NFT marketplaces by offering multi-chain support, user-friendly minting and trading processes, and enhanced security measures. They envision that TokenFuse could significantly contribute to the wider adoption of NFTs in diverse industries and enable more efficient trading and management of digital assets. The paper also suggests future development directions, including improving scalability, supporting more blockchain networks, enhancing security features, and adding more advanced trading functionalities to make the marketplace even more robust and versatile.

The literature also covers the growing demand for Layer 2 solutions such as Arbitrum, Optimism, and zk-Rollups, which aim to improve Ethereum's scalability and transaction efficiency (Buterin, 2017). These solutions are designed to lower gas fees and enhance transaction speed, making the network more attractive for dApp developers and users. Research by Rao et al. (2024) detailed analyse the blockchain scalability challenges, solutions, and research directions. The review examines various scalability solutions, both on-chain (Layer 1) and off-chain (Layer 2), that have been developed to address the limitations. Neiheiser et al. (2023) provide an in-depth analysis of Ethereum's Layer-2 (L2) scaling solutions and their limitations. The authors describe how L2 solutions, like rollups (Optimistic and zk-rollups), state channels, and sidechains, are designed to handle a significant volume of transactions off-chain before settling them on the main Ethereum chain (Layer-1). This process helps to alleviate congestion and reduce fees while improving throughput. The authors discuss the blockchain trilemma, which is the balance between scalability, security, and decentralization. They highlight that while Layer-2 solutions improve scalability, they can introduce trade-offs in security or decentralization depending on their design and implementation.

Several studies explore how macroeconomic conditions, such as global financial markets, interest rates, and inflation, influence Ethereum's price. According to a report by Nakagawa and Sakemoto (2022), Ethereum and other cryptocurrencies show a significant correlation with broader financial markets and investor risk sentiment. Fluctuations in ETH price have often coincided with shifts in macroeconomic policies, particularly in the U.S., where Federal Reserve interest rate decisions affect market liquidity and risk appetite. Doan et al. (2021) explores the role of institutional investors in the price formation and dynamics of the cryptocurrency market. The paper provides empirical evidence on how institutional activity affects price discovery, volatility, and market efficiency in cryptocurrencies, with a focus on major assets like Bitcoin and Ethereum. The authors conclude that institutional activity plays a significant role in enhancing price discovery and reducing volatility in the cryptocurrency market. They suggest that as more institutional investors enter the market, we can expect greater efficiency, reduced speculative bubbles, and increased stability of cryptocurrency prices. Additionally, Katsiampa et al. (2019) suggest that Ethereum's price dynamics are heavily influenced by Bitcoin, as the market often moves in tandem with Bitcoin's trends. Almeida et al. (2023) conclude that while significant strides have been made in understanding the microstructure of cryptocurrency markets, there is still much to learn about how these markets function and how they differ from traditional financial markets. The authors suggest several directions for future research, including: a deeper exploration of market fragmentation and exchange behaviour, understanding the impact of regulation and policy changes on market dynamics, investigating the effects of emerging technologies, such as decentralized finance (DeFi) protocols and automated market-making, on market microstructure.

The literature indicates that regulatory clarity is a crucial factor affecting Ethereum's price and adoption. Goforth (2022) provides a critical analysis of the U.S. Securities and Exchange Commission's (SEC) regulatory approach towards cryptocurrency exchanges. The paper evaluates the effectiveness and implications of the SEC's strategies and discusses the complexities and challenges of applying traditional financial regulatory frameworks to the rapidly evolving crypto markets. The author concludes that the SEC's efforts to regulate cryptocurrency exchanges are well-intentioned but face significant challenges in application and enforcement. Goforth (2022) calls for more proactive and transparent regulatory frameworks that consider the unique aspects of cryptocurrency markets and provide clearer guidance to exchanges. Such frameworks should strive to protect investors without unduly stifling innovation and growth in the crypto industry. Guseva and Goforth (2022) discusses how increasing regulatory scrutiny globally influences both retail and institutional participation in the cryptocurrency market. This book serves as a comprehensive resource for understanding the complex regulatory landscape of crypto assets, offering insights into the legal challenges, policy considerations, and regulatory responses across different jurisdictions. It provides a deep dive into how crypto assets fit into existing legal frameworks and the emerging regulatory trends that stakeholders in the crypto industry need to be aware of. Positive regulatory developments, such as the approval of Ethereum futures Exchange-Traded Funds in the U.S. (SEC, 2023), have been identified as key drivers for institutional adoption of ETH. However, regulatory uncertainty remains a challenge, as highlighted by Doyle (2024). Ongoing debates over cryptocurrency classification, taxation, and anti-money laundering (AML) compliance can introduce volatility and affect the growth of the Ethereum ecosystem. Moreover, regulatory stances vary significantly across jurisdictions, creating an uneven landscape for Ethereum's global adoption.

Ethereum's competitive position is also thoroughly examined in the literature. It faces competition from other blockchain networks like Binance Smart Chain (BSC), Solana, and Cardano, which aim to offer faster transactions and lower fees. These competing networks present challenges for Ethereum's market share, especially in areas such as DeFi and NFTs, which rely heavily on transaction efficiency and cost-effectiveness. Halaburda and Gandal (2014) provide an early analysis of the dynamics of competition in the emerging cryptocurrency market. The authors focus on understanding how cryptocurrencies compete with each other and what economic forces drive their adoption and growth. The authors conclude that the cryptocurrency market is characterized by strong network effects, technological differentiation, and relatively low barriers to entry, leading to an environment of dynamic competition. They suggest that while network effects favour the dominance of one or a few cryptocurrencies, there is also potential for a diverse set of cryptocurrencies to coexist and cater to different user needs or use cases. The paper by Hu and Zhang (2023) concludes that competition among cryptocurrency exchanges has both positive and negative implications for market quality. While increased competition tends to lower fees and improve market liquidity, it can also lead to fragmented trading volumes and varying price levels across exchanges. The study suggests that the market is likely to continue evolving, with exchanges differentiating through a combination of fee structures, innovative products, and user experiences. The authors also posit that as the crypto exchange market matures, there may be consolidation, leading to a more centralized structure, or increased adoption of decentralized exchanges that could further alter the competitive landscape.

The literature collectively underscores that Ethereum's price and market prospects are influenced by an interplay of technological advancements, market activity within the DeFi and NFT sectors, macroeconomic conditions, regulatory developments, and competitive pressures. The transition to Ethereum 2.0 and the adoption of Layer 2 solutions are seen as key drivers for future scalability, usability, and price stability. At the same time, Ethereum's ability to adapt to evolving regulations and outcompete alternative blockchain platforms will be crucial to its sustained market growth. Understanding these factors provides a comprehensive perspective on the potential future development and valuation of Ethereum in the rapidly changing cryptocurrency landscape.

METHODOLOGY

Ether (ETH) is the main cryptocurrency of the Ethereum network. The main feature of this network is the built-in mechanism of smart contracts. Smart contracts are software agreements that are automatically executed and stored in the blockchain system (Ethereum.org, n.d.). As of September 2024, according to Coinranking (n.d.), Ether is the second cryptocurrency after Bitcoin in terms of market capitalization (its market capitalization is 292.85 billion USD and its market price is 2398.40 USD), so the choice of this cryptocurrency as the object of further analysis allows us to better understand the peculiarities of using blockchain in the modern world.

For the analysis, the Ethereum Cryptocurrency Historical Dataset hosted on the Kaggle platform (Kash, 2023) was used. The dataset consists of daily Ethereum prices from March 1, 2016 to May 6, 2023 (2614 observations). It contains 7 variables (6 of them are numeric), the content of which is described in Table 1.

Table 1. Variables of the Ethereum Cryptocurrency Historical Dataset

№	Variable	Definition
1	Date	ETH price observation date
2	Price	ETH price, USD USD
3	Open	Starting price of ETH on the relevant date, USD USD
4	High	Highest price of ETH on the respective date, USD USD
5	Low	Lowest ETH price on the respective date, USD USD
6	Vol.	ETH volume on the corresponding date, USD USD
7	Change %	Percentage of change in ETH price on the respective date

Source: compiled by the authors.

The purpose of the analysis is to understand the dynamics of Ethereum prices and study the relationship between the token price and trading volume, a time factor (represented by observation numbers). Given the volatility of cryptocurrency markets, identifying patterns and trends in price movements is crucial to understanding market dynamics. The last calendar year with complete statistical data was chosen as the time period for the study, i.e., 365 observations of the calendar year 2022 were included in the subsequent sample.

Correlation analysis is a statistical method used to measure the strength and direction of the relationship between two or more variables. The goal is to determine if, and how, variables are related or move together. The methodology generally includes data collection, selection of the appropriate correlation coefficient, analysis of the results, and interpretation.

Data Collection and Preparation. Select the variables you wish to analyse for potential relationships. These could be continuous variables like price and volume of sales, or discrete variables, depending on the type of correlation analysis. Obtain reliable and accurate data for the variables. The data should be quantitative (numeric) and can be obtained through experiments, surveys, observations, or existing datasets. Check for missing values, outliers, or errors in the dataset. Ensure that the data is complete, consistent, and suitable for analysis.

Selection of the Correlation Coefficient. The type of correlation coefficient to use depends on the nature of the data:

- Pearson Correlation Coefficient (r) –the most commonly used measure, appropriate when both variables are continuous and normally distributed. It measures the linear relationship between two variables.
- Spearman Rank Correlation Coefficient (ρ) – a non-parametric measure that assesses how well the relationship between two variables can be described by a monotonic function. It is used when the data is not normally distributed or when one or both variables are ordinal.
- Kendall's Tau (τ) – another non-parametric measure that assesses the ordinal association between two variables. It is useful when the sample size is small or when the data contains many tied ranks.
- Point-Biserial and Other Correlations – for specific cases where one variable is continuous and the other is dichotomous (e.g., binary outcomes), specialized correlation coefficients like point-biserial can be used.

Calculating the Correlation Coefficient. Pearson Correlation Coefficient Formula:

$$r = \frac{\sum_i^N (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i^N (x_i - \bar{x})^2 (y_i - \bar{y})^2}} \quad (1)$$

where:
x_i and $y_i$are the individual data points of variables *x* and *y*.
$\bar{x}$ and $\bar{y}$are the mean values of *x* and *y*.

Spearman Rank Correlation Coefficient Formula:

$$\rho = 1 - \frac{6\sum_i^N d_i^2}{n(n^2-1)}, \tag{2}$$

where:

d_i is the difference between the ranks of each pair of variables.

n is the number of pairs.

Kendall's Tau calculated based on the number of concordant and discordant pairs in the data.

The value of the correlation coefficient will range from:

- -1: Perfect negative correlation (as one variable increases, the other decreases).
- 0: No correlation (no linear relationship between the variables).
- +1: Perfect positive correlation (both variables increase together).

Significance Testing. A significance test (often using a t-test for Pearson's correlation) is conducted to determine whether the observed correlation is statistically significant. The null hypothesis (H_0) is that there is no correlation, while the alternative hypothesis (H_1) is that there is a significant correlation. Calculate the p-value to assess the significance. A small p-value (typically < 0.05) indicates that the correlation is statistically significant. Establish confidence intervals to understand the precision of the correlation coefficient.

Interpretation of Results. Assess the magnitude and direction of the correlation coefficient:

- Strong Positive Correlation: A coefficient close to +1.
- Strong Negative Correlation: A coefficient close to -1.
- Weak or No Correlation: A coefficient close to 0.

While statistical significance is important, it's also critical to consider the practical implications of the correlation in the context of the data. Remember that correlation does not imply causation. Even a strong correlation does not necessarily mean that one variable causes the other to change.

Visualization and Further Analysis. A scatter plot can visually demonstrate the relationship between two variables, helping to identify potential outliers or non-linear patterns that may not be evident from the correlation coefficient alone. If further relationships or dependencies are suspected, additional analyses such as regression, moderation, or mediation analyses might be appropriate to explore deeper relationships between the variables.

Assumes linearity, normality, homoscedasticity, and that the data is continuous. Correlation does not account for non-linear relationships, is sensitive to outliers, and should be used carefully when variables have different distributions.

Regression analysis is a statistical technique used to model and analyze the relationship between a dependent variable (often called the "outcome" or "response" variable) and one or more independent variables (often called “predictors” or “explanatory” variables). The methodology for conducting a regression analysis involves several structured steps, from data collection to model evaluation and interpretation.

The type of regression model depends on the nature of the data and the research question:

- Simple Linear Regression used when there is a single independent variable and a continuous dependent variable. The model assumes a linear relationship between the two.
- Multiple Linear Regression used when there are two or more independent variables and a continuous dependent variable.
- Logistic Regression, appropriate when the dependent variable is binary (0 or 1).
- Polynomial Regression, suitable for modelling non-linear relationships by adding powers of the independent variable.
- Other Types, models like Ridge Regression, Lasso Regression, or Generalized Linear Models (GLMs) can be used based on the complexity, distribution, and requirements of the analysis.

Model Specification for **multiple regression**:

$$Y=\beta 0+\beta 1X1+\beta 2X2+\ldots+\beta kXk+\epsilon, \tag{3}$$

where $X1$, $X2$, …, Xk are the multiple independent variables.

Model Fitting (Estimation). Use statistical software to fit the regression model to your data. The most common method for estimating the coefficients (β\betaβ) is Ordinary Least Squares (OLS), which minimizes the sum of the squared residuals (differences between observed and predicted values). Regression models can be built using tools like R, Python (e.g., statsmodels, scikit-learn), SPSS, SAS, and others.

Model Assumptions and Diagnostics. Before interpreting the results, ensure that the model assumptions are met. These include:

- Linearity – the relationship between the independent and dependent variables should be linear.
- Homoscedasticity – the residuals (errors) should have constant variance across all levels of the independent variables.
- Independence – observations should be independent of each other.
- Normality of Residuals – the residuals should be approximately normally distributed (important for small sample sizes).
- Model Diagnostics. Use diagnostic plots like:
- Residual vs. Fitted Plot to check for linearity and homoscedasticity.
- Normal Q-Q Plot to check for normality of residuals.
- Variance Inflation Factor (VIF) to detect multicollinearity among predictors (for multiple regression).
- Model Evaluation and Goodness-of-Fit
- R-squared (Coefficient of Determination) measures the proportion of variance in the dependent variable explained by the independent variables. A higher R^2indicates a better fit.
- Adjusted R-squared (Adjusts R^2) for the number of predictors and is more appropriate for multiple regression to avoid overestimating model performance.
- F-statistic and p-value used to assess the overall significance of the model. A small p-value indicates that at least one predictor is significantly related to the dependent variable.
- Residual Standard Error (RSE) provides an estimate of the standard deviation of the residuals, giving a measure of how well the model fits the data.

Statistical Significance of Coefficients. t-Tests for Coefficients evaluate the null hypothesis that a particular coefficient is equal to zero (no effect). If the p-value is below a chosen significance level (e.g., 0.05), the coefficient is considered statistically significant. Provide a range of values within which the true coefficient is likely to fall, offering additional context to the estimated effects.

Model Interpretation. For linear regression, the coefficient (βi) of an independent variable indicates the expected change in the dependent variable for a one-unit change in that independent variable, holding all other variables constant. Consider both the sign (positive or negative relationship) and magnitude (strength of effect) of the coefficients.

Model Validation and Robustness Checks. Use techniques like k-fold cross-validation to assess the model's predictive performance on unseen data. Explore alternative model specifications, remove potential outliers, or use different subsets of the data to ensure that the results are consistent and not overly sensitive to assumptions or specific observations.

Model Prediction and Reporting. Use the final model to make predictions on new data. Report the predicted values along with their confidence intervals to communicate the range of likely outcomes. Present the findings clearly, including the estimated coefficients, their significance, model fit statistics, and any limitations or assumptions made.

RESULTS

Before starting the statistical analysis, it is necessary to clean and preprocess the data. In accordance with the purpose of the study, a sample was formed from the initial data set containing two variables price (price of ETH, USD) and volume (volume of ETH on the corresponding date, USD) of observations from January 1 to December 31, 2022 (from 127 to 491 inclusive by observation number) and containing no missing values. Also, the variable number was added to the sample, which contains the serial number of the observation starting from 1. Thus, as a result of the initial cleaning, a sample of three variables (price, number, and volume) was formed, containing 365 observations. The statistical characteristics of the resulting variables are shown in Table 2.

Table 2. Statistical characteristics of the initial sample

	Price	Number	Volume
n	365	365	365
mean	1 986,67	183	873 141,12
sd	774,57	105,51	568 391,21
median	1 680	183	699 690
trimmed	1 924,68	183	774 370,31
mad	686,53	134,92	386 795,51

Table 2 (cont.). Statistical characteristics of the initial sample

	Price	Number	Volume
min	995,61	1	131510
max	3 830,67	365	4 390 000
range	2 835,06	364	4 258 490
skew	0,57	0	2,15
kurtosis	-1,15	-1,21	7,05
se	40,54	5,52	29 750.96

Source: compiled by the authors.

According to the statistical characteristics of the initial data, we can confirm that the sample contains 365 observations and none of the variables has missing values. The average price of Ethereum for the year is approximately USD 1,986.67. The standard deviation (sd) is quite high ($774.57), indicating significant price volatility, which is quite typical for cryptocurrency markets. This is confirmed by a fairly wide range of Ethereum's price (from USD 995.61 to USD 3,830.67). The skewness of the distribution of the variable is 0.57, which is greater than zero, so the center of the distribution of the value of the indicator is probably slightly shifted to the left. The negative kurtosis (-1.15) indicates that the price distribution is flat-topped, which means that there are fewer extreme values (tails) compared to a normal distribution.

The average value of Etherium volume on the market was 873.14 thousand USD. USD, but with a high standard deviation of 568.39 USD. We can notice significant fluctuations in the daily Ethereum volume, which are likely related to market events or trader behavior. It is also worth noting that the distribution of the volume variable is very different from the normal distribution, in particular, the skewness (2.15) indicates a shift in its center to the left, and the kurtosis (7.05) indicates a sharp-peaked distribution, i.e., the presence of more extreme values than in the normal distribution, which corresponds to days with very high trading volume.

As part of the dataset cleanup, we also checked for outliers or anomalous data by constructing "Box-and-Whisker plot" for the two main variables of the price and volume model (Figures 1-2).

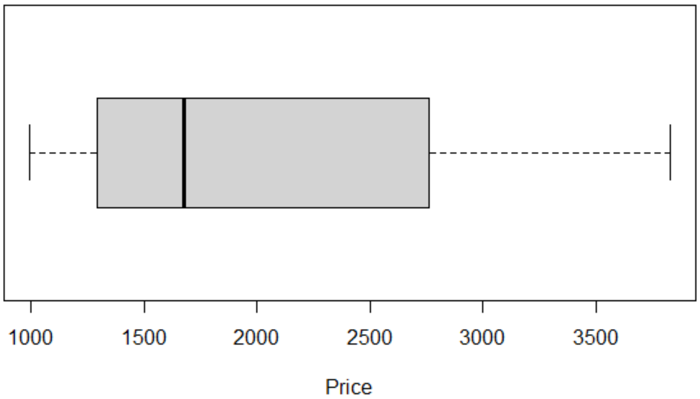

Figure 1. "Box-and-Whisker plot" for the price variable

Source: compiled by the authors.

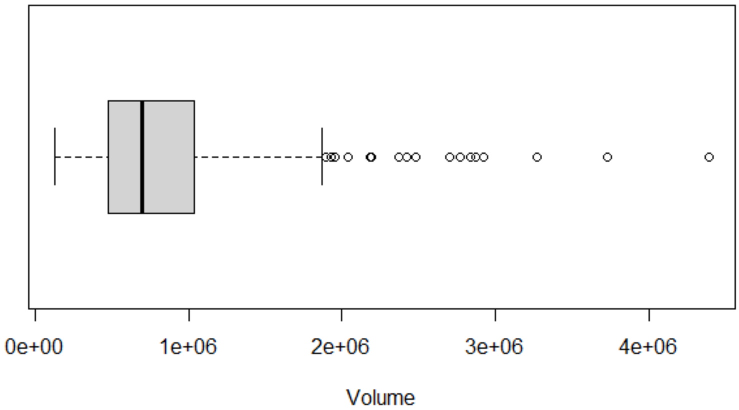

Figure 2. "Box-and-Whisker plot" for the volume variable

Source: compiled by the authors.

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The visualizations (Figures 1-2) show that the price variable, i.e. the price of Ethereum during 2022, did not have significant outliers, unlike the volume variable. In Figure 2, with the volume of Ethereum on the corresponding date (volume), it is noticeable that 34 points fall outside the graph, i.e. we have 34 observations with abnormal values or outliers. Such observations exceed the upper limit (1,580,000) and will therefore be excluded from further analysis.

After excluding outliers from the sample, the sample was reduced to 331 observations. Also, based on the data obtained, descriptive statistics for each of the variables were re-found (Table 3).

Table 3. Statistical characteristics of the sample after outliers were excluded

	Price	Volume	Number
n	331	331	331
mean	2 042,09	723 664,86	183,53
sd	782,64	336 537,13	109,54
median	1 737,71	656 940	182
trimmed	1 987,29	695 390,68	183,67
mad	772,09	340 701,48	145,29
min	1 038,56	131 510	1
max	3 830,67	1 580 000	365
range	2 792,11	1448490	364
skew	0,46	0,64	0,00
kurtosis	-1,28	-0,28	-1,33
se	43,02	18 497,75	6,02

Source: compiled by the authors.

According to the statistical characteristics of the variables after excluding emissions (Table 3), we can see that the average price of Ethereum (price) for the year slightly increased to USD 2,042.09, while the standard deviation (sd) is high (USD 82). The standard deviation (sd) remained high (782 USD). This is confirmed by a fairly wide range of values of Ethereum's price (from USD 1,038.56 to USD 3,830.67). The skewness and kurtosis of the price distribution have not changed significantly.

As for the volume of Ethereum, its average value decreased by 149.48 thousand US dollars. USD and amounts to 723.66 thousand USD for the new sample. The standard deviation, on the contrary, decreased by USD 231.85 thousand for the new sample and amounted to USD 723.66 thousand. The standard deviation, on the contrary, decreased by 231.85 thousand USD and amounts to 336.54 thousand USD for the old sample. The standard deviation of the variable has decreased by $211.85 thousand and is $366.54 thousand for the new sample. This confirms that the variable now has fewer fluctuations and extreme values. Also, it is worth noting that the distribution of the volume variable has become somewhat closer to normal, as the skewness and kurtosis have decreased by modulus to 0.64 and -0.28, respectively.

The absence of abnormal values in the distribution of the variables can be confirmed by re-constructing the “Box-and-Whisker plot” (Figures 3-4).

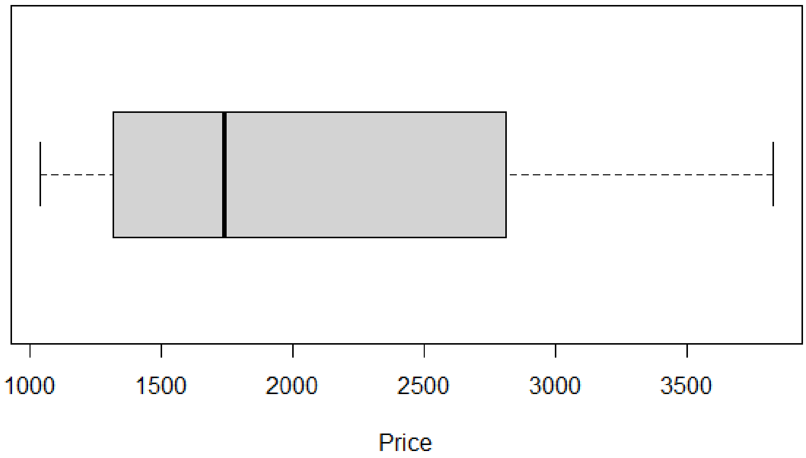

Figure 3. “Box-and-Whisker plot” for the price variable (after excluding outliers)

Source: compiled by the authors.

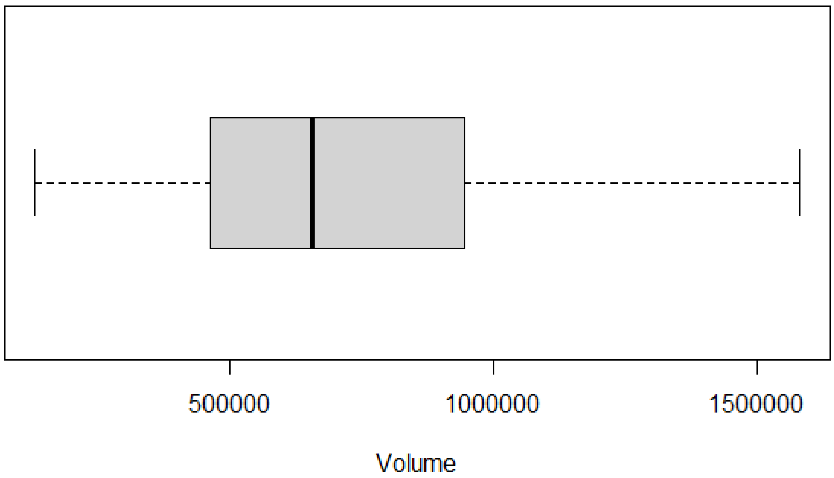

Figure 4. "Box-and-Whisker plot" for the volume variable (after outliers are excluded)

Source: compiled by the authors.

For a more detailed analysis of the distribution of variables, histograms were constructed for the two main variables of the price and volume analysis (Figures 5-6).

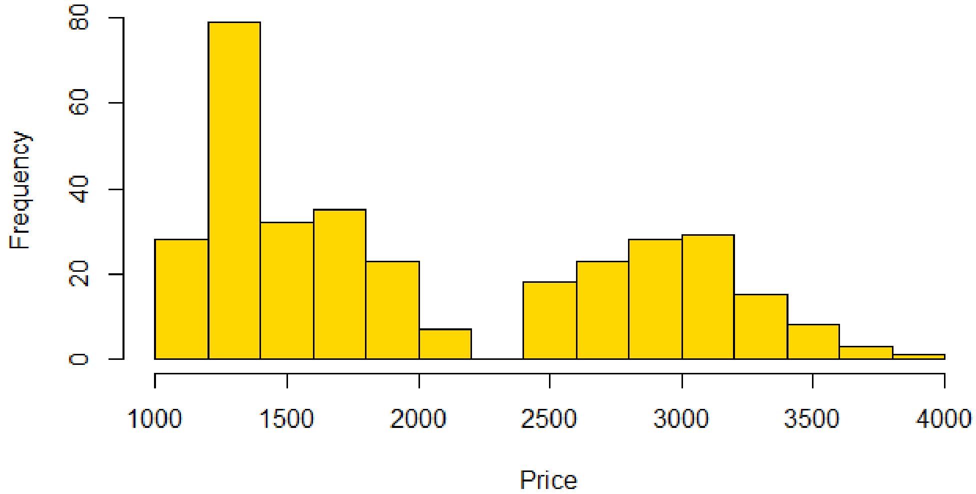

Figure 5. Histogram of the price variable distribution

Source: compiled by the authors.

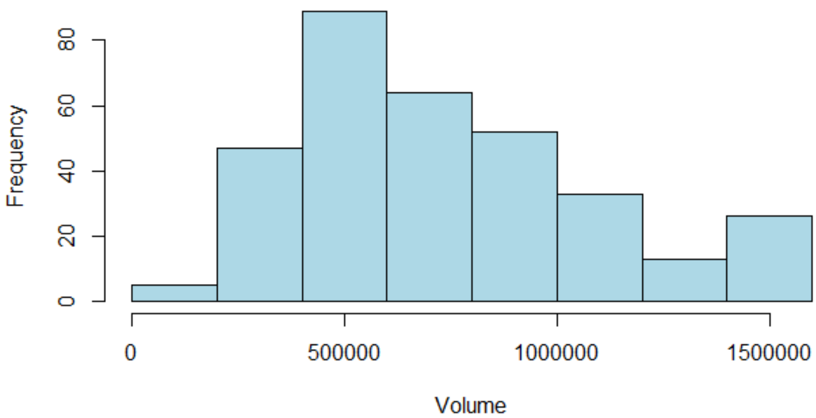

Figure 6. Histogram of the volume variable distribution

Source: compiled by the authors.

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Based on the histograms (Figures 5-6), we can confirm the previous conclusions about the distribution of the variables. The distribution of both variables differs significantly from the normal distribution, in particular, the distribution of the price variable is flat-topped and its center is shifted to the left, and the distribution of the volume variable is somewhat closer to the normal distribution, but its center is also slightly shifted to the left.

Another useful characteristic of the input variables can be the analysis of their dynamics. To accomplish this task, we constructed graphs on the vertical axis of which the corresponding price and volume variables are plotted, and on the horizontal axis the serial numbers of the corresponding observations are plotted (Figures 7-8).

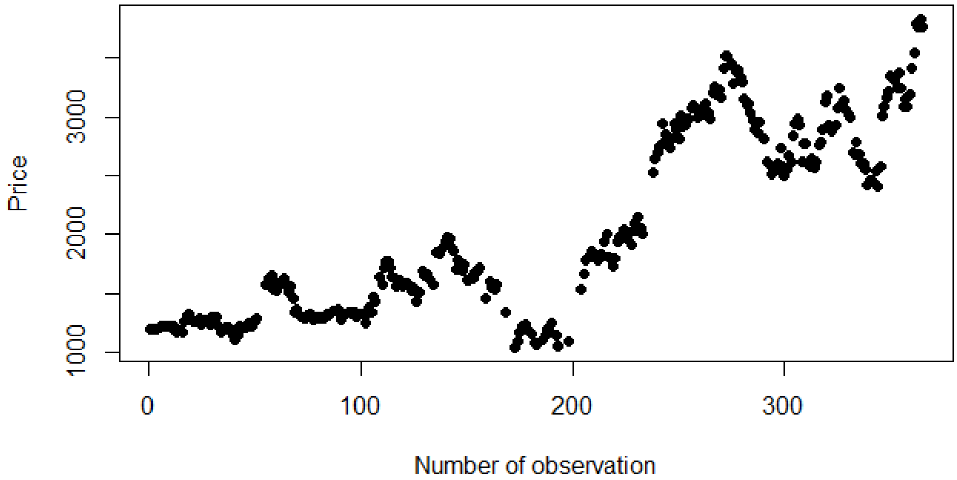

Figure 7. Dynamics of the price variable (Etherium prices in USD during 2022)

Source: compiled by the authors.

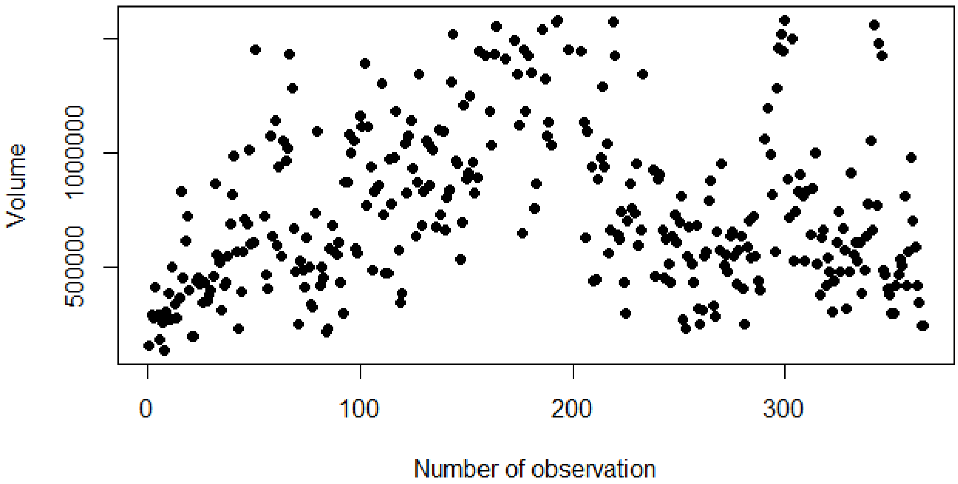

Figure 8. Dynamics of the volume variable (volume of Ethereum as of the relevant date, USD during 2022)

Source: compiled by the authors.

It is important to note that in the dataset, all observations are arranged in reverse chronological order. Thus, observation number 1 corresponds to December 31, 2022, and observation number 365 to January 1, 2022. With this approach, it becomes obvious that during January-April 2022 (246-365 observations), the price of Ethereum mainly fluctuated between USD 2500-3500. USD with a gradual downward trend. Then, in May-June (185-246 observations), the price of Ethereum began to decline rapidly at an increasing rate and reached its minimum values. Such a change in dynamics can probably be explained by a significant loss of confidence in the crypto market during this period caused by the collapse of the Terra (LUNA) ecosystem in May 2022 (Royal and Strickland, 2024). Further (1-185 observations), the price of Ethereum returned to the initial downward trend with fluctuations ranging from $1,000 to $2,000. US DOLLARS. As for the dynamics of Ethereum's volume on the corresponding date, as can be seen from Fig. 8, it is much more chaotic and has no clear trend or seasonality.

For a preliminary assessment of the relationship between the sample variables, a matrix of pairwise correlations between the variables was constructed as shown in Table 4.

Table 4. Matrix of pairwise correlations between sample variables

	pre	vol	numb
pre	1,0000000	-0,23089481	0,87869838
vol	-0,2308948	1,00000000	0,03238725
numb	0,8786984	0,03238725	1,00000000

Source: compiled by the authors.

According to the pairwise correlation coefficients, we can assume that there is a weak inverse relationship between the price and volume variables (correlation coefficient -0.23), and a strong direct relationship between the price and number variables (correlation coefficient 0.87). The presence of these relationships allows us to consider the volume and number variables as having a certain impact on the price of Ethereum, while the relationship between these factors is almost absent or significantly nonlinear (correlation coefficient of 0.03).

For further analysis of the variables, a correlation-regression model with standard residuals consistent with heteroscedasticity was chosen to analyze the relationship between the price of Ethereum (the dependent variable) and the two independent variables observation number (time factor) and market volume.

This type of model was chosen due to the simplicity and clarity of correlation and regression analysis, which allows us to assess the relationship between variables. The model used heteroscedasticity-resistant standard residuals, because given the high volatility of cryptocurrency markets, extreme deviations in both price and market volume are common. These outliers could distort a standard linear regression model by disproportionately affecting the regression line. By using persistent residuals, the model can mitigate the impact of these outliers, providing more reliable estimates.

The presence of an observation number in the model allows us to capture the effect of time on the time series of Ethereum prices through 2022. This is relevant because cryptocurrencies, including Ethereum, tend to exhibit time trends, such as gradual price increases or decreases due to market cycles, technological developments, or regulatory news. The inclusion of the time factor helps the model to account for these trends.

Another independent variable in the model is the market size of Ethereum. This variable is also a critical factor in pricing, as in financial markets, higher trading volumes can be associated with increased liquidity or volatility, which can affect the price.

The modeling results with the described approaches and variables are shown in Table 5.

Table 5. Results of the linear regression model

call:
lm_robust (formula = pre ~ numb + vol, data = df_clean)
Standard error type: HC2
Coefficients:

	Estimate	std, Error	t value	Pr(> t)	CI Lower	CI Upper	DF
(intercept)	1,316e+03	3,5296+01	37,28	5,634e-120	1,2466+03	1,385e+03	328
numb	6,338e+00	1,330e-01	47,66	1,6776-149	6,0776+00	6,600e+00	328
vol	-6,038e-04	5,321e-05	-11,35	2,133e-25	-7,0856-04	-4,991e-04	328

Multiple R-squared: 0,8394, Adjusted R-squared: 0,8385 F-statistic: 1154 on 2 and 328 DF, p-value: < 2,2e-16

Source: compiled by the authors.

Based on the modeling results (Table 5), we can see that the resulting model describes 83.94% of the variation in the price of Ethereum (R-squared value is 0.8394). This value is quite high, which indicates a good choice of factor variables that sufficiently describe the behavior of the dependent variable. The adjusted R-squared (0.8385) is very close to the R-squared value, which means that the model is probably not overfitting the input data by adding too many independent variables. According to Fisher's criterion (1154) and the p-criterion (2.2-10-16<0.05), we can confirm the statistical significance of the model.

The estimation of the model parameter for the volume variable indicates that, on average, with an increase in the volume of the Ethereum market by 1 thousand USD. USD, the price of Ethereum decreases by 0.6038 USD. USD with all other parameters held constant. This indicates an inverse relationship between the price of Ethereum and the market volume, which confirms the assumption that an increase in market volume may reflect increased pressure from sellers or market correction, which leads to a price drop. The p-value for this indicator (2.13-10-25<0.05) confirms that market volume has a statistically significant negative impact on Ethereum's price.

Since all observations in the dataset are placed in reverse chronological order (i.e., observation number 1 corresponds to December 31, 2022, and observation number 365 to January 1, 2022), the estimation of the model parameter for the number variable (6.338) indicates that, on average, with a decrease in the number variable by 1 (one calendar day), the price of Ethereum decreases by $6.338. USD, ceteris paribus. This positive relationship between the variables implies a general downward trend in Ethereum prices during 2022, which may be due to factors such as a significant increase in interest rates for most of the year, as well as high-profile bankruptcies of crypto exchanges (in particular FTX) that have undermined investor confidence. The very low value of the p-value (1.677-10-149<0.05) indicates that this parameter is statistically significant, meaning that time also has a strong and reliable impact on the price of Ethereum.

The results of the modeling can be visually displayed using a graph of the actual and expected values of the price of Ethereum in USD. USD (Figure 9).

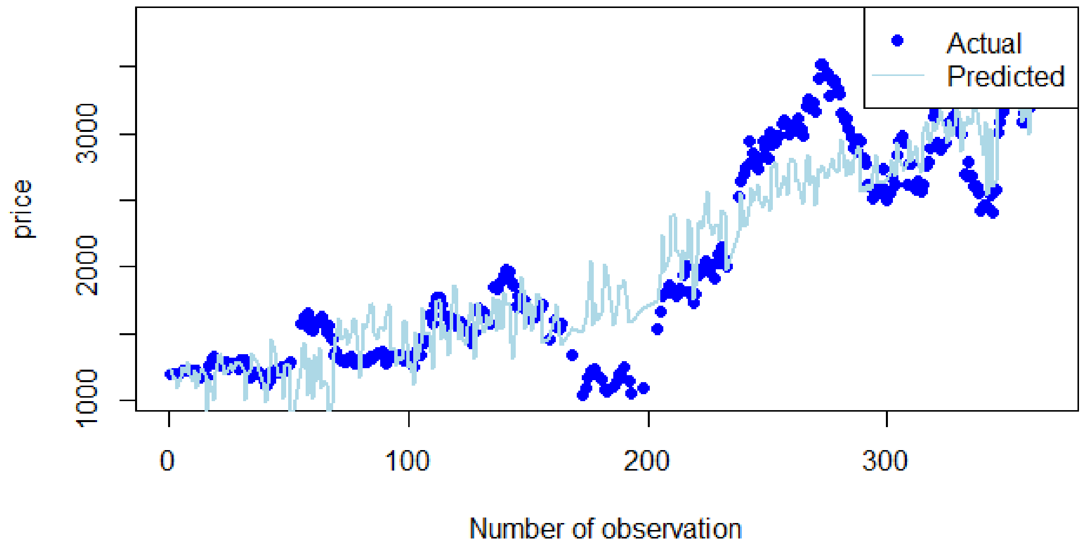

Figure 9. Graph of actual and expected values of Etherium price in USD according to the model. USD in 2022

Source: compiled by the authors.

As can be seen in Figure 9, the largest deviations of the actual values of Ethereum's price from those expected by the model are 185-275 observations (April-June 2022). During this period, the price of Ethereum began to decline rapidly and reached its lowest values. Obviously, such a change in the dynamics of the indicator was due to factors not taken into account in the model, including, for example, the loss of confidence in the crypto market caused by the collapse of the Terra (LUNA) ecosystem in May 2022 (Atzei et al., 2017).

Based on the analysis of Ethereum's price trends in 2022, several key conclusions can be drawn about the broader blockchain landscape, with a special focus on Ethereum.

First, it is worth noting the short-term downward trend in Ethereum prices. The analysis shows that the price of Ethereum had a clear downward trend during 2022, which is consistent with the overall decline in the cryptocurrency market during this year. This can be attributed to several macroeconomic factors, including rising interest rates, the bankruptcy of several crypto exchanges, geopolitical instability, and increased regulatory control.

Second, an inverse relationship was found between Ethereum's price and its market size. This relationship can be explained by the fact that an increase in sales activity on the market may indicate negative sentiment on the market. If a significant part of trading involves sales, this reflects a significant increase in the supply of cryptocurrency, and such an increase in the amount of available Ethereum may outstrip demand, leading to a decrease in its price.

Therefore, the identification of trends and analysis of Ethereum dynamics during 2022 indicates rather negative short-term trends in this area, associated with a significant decrease in the price of Ethereum and negative market sentiment. However, despite these short-term fluctuations in the price of Ethereum, the long-term adoption of blockchain technology and Ethereum in particular remains promising, as the use of blockchain goes far beyond cryptocurrency trading and includes supply chain management, data privacy, asset tokenization and decentralized governance, and the versatility of Ethereum as a platform makes it attractive to both developers and businesses.

CONCLUSIONS

In conclusion, this article emphasizes the significant role of Ethereum in the current cryptocurrency landscape and provides a comprehensive analysis of its price dynamics and market prospects. The study's methodology was built on a robust statistical analysis of a large dataset, utilizing correlation and regression techniques to understand the relationship between Ethereum's price, market volume, and the factor of time. This approach allowed for the identification of key patterns and trends, which are critical for investors, researchers, and developers interested in the Ethereum market. In terms of actuality, the study remains relevant as Ethereum continues to evolve, providing insights into its price behaviour, technological advancements, and market dynamics. Understanding these factors is essential for anticipating future trends and investment opportunities within the Ethereum ecosystem and the broader blockchain industry. This research contributes to a deeper understanding of the factors driving the price and market prospects of Ethereum, offering a valuable perspective for market participants looking to navigate the rapidly evolving cryptocurrency landscape.

The methodology employed in this article centres on a systematic and quantitative analysis of Ethereum's price dynamics and trading volume over time. By using a robust dataset from *Ethereum Cryptocurrency Historical Dataset* on Kaggle, the research takes a structured approach to data analysis to provide insights into how the price of Ethereum fluctuates in relation to time and market volume. The steps and tools involved in this methodology are aimed at ensuring that the analysis is both statistically rigorous and applicable to real-world market conditions. The dataset spans daily Ethereum price data from March 1, 2016, to May 6, 2023, capturing 2,614 observations across seven variables: date, price, opening price, highest price, lowest price, volume, and percentage change. For the analysis, the focus is on the last full calendar year of data (2022), providing a sample of 365 observations. Variables of primary interest include *price*, *volume*, and *time*, which is represented by the order of the observations within the dataset. The primary aim of the analysis was to understand the relationship between Ethereum's price and its trading volume and how it changes over time. The study used correlation coefficients to measure the strength and direction of relationships between variables. A robust linear regression model was employed to further explore the relationship between the dependent variable (*price*) and the independent variables (*volume* and *time*). This methodology provides a statistically sound framework for analysing Ethereum’s price dynamics. By using correlation and regression techniques, alongside robust data cleaning and visualization, the study aims to offer clear insights into the interconnected factors that drive Ethereum’s market behaviour over time.

The findings indicate that Ethereum experienced significant volatility in its price over the examined period, reflecting broader market uncertainties and events. The study’s detailed statistical analysis showed that while Ethereum’s price has a strong correlation with time, indicating a general downward trend throughout 2022, there exists a weak inverse relationship between price and market volume. This suggests that higher trading volumes may coincide with lower prices, potentially indicating sell-offs or market corrections that exert downward pressure on the price. The results indicated a high Adjusted R-squared of 83.94%, implying that the model successfully explains a significant portion of the variance in Ethereum's price. A positive relationship was found between price and time, suggesting that Ethereum's price tends to decrease as time progresses within the dataset period. Conversely, the relationship between price and volume was found to be negative, indicating that higher trading volumes are associated with lower prices, possibly due to market corrections or periods of intense selling pressure.

Ethereum's price exhibited significant volatility throughout 2022, with a clear downward trend. The mean price was approximately $1,986.67 USD, but with a high standard deviation of $774.57 USD, this variation underscores the market's susceptibility to external pressures and events. This volatility is typical for cryptocurrencies, indicating that Ethereum's price is highly reactive to market sentiment, investor behaviour, and external shocks. The range of the price within the studied period spanned from a minimum of $995.61 to a maximum of $3,830.67, showing wide fluctuations that can have substantial implications for traders and long-term holders. A key finding was the weak inverse correlation between price and volume, with a Pearson correlation coefficient of -0.23. This suggests that when trading volume increases, the price tends to decrease, albeit not strongly. This relationship might be indicative of market corrections or periods of heavy selling, where increased trading activity corresponds to downward pressure on the price.

From a market perspective, such an inverse relationship can be explained by sell-offs during market downturns, leading to higher trading volumes and lower prices and market corrections, where significant trading activity occurs as investors adjust their positions, often leading to price declines. The study finds that spikes in volume tend to coincide with these downward price movements, highlighting the potential for volume to act as a predictor for short-term price movements or market sentiment shifts. The time factor played a crucial role in Ethereum’s price trajectory. There was a strong positive correlation between the observation number (representing the progression of days throughout 2022) and price, with a coefficient of +0.87. Since the data is in reverse chronological order, this positive correlation translates to a downward trend in Ethereum's price over the course of 2022.

Regression analysis further revealed that as time progresses (each additional day), Ethereum’s price decreases by an estimated $63.38 on average, indicating a significant declining trend over the studied period. This trend was most noticeable in two phases: (1) January to April 2022, prices fluctuated between $2,500 to $3,500, showing relative stability but with an overall slight decline; (2) May to June 2022, a sharp drop in Ethereum’s price was observed, attributed to major market disruptions like the collapse of the Terra (LUNA) ecosystem, which caused a widespread loss of confidence in the crypto market. The downward trend continued moderately through the rest of the year, with prices mostly ranging between $1,000 and $2,000. The inclusion of the time factor in the model helped account for these macro trends and underlined the importance of temporal elements in price forecasting.

The regression results showed that the coefficient for volume was negative (-0.6038), indicating that an increase in the market volume of $1,000 leads to a price decrease of $0.6038. While this effect may seem small in magnitude, it is statistically significant, with a p-value well below 0.05, confirming the inverse relationship between volume and price. The implication is that when there is a surge in trading volume, it is often accompanied by selling pressure that drives prices lower. This is particularly relevant for investors who may view volume as an indicator of potential market shifts. However, it's crucial to note that the relationship is not linear, and volume alone does not fully explain price changes.

The findings reflect broader market conditions and suggest that Ethereum’s price movements in 2022 were shaped by a combination of macroeconomic factors, investor sentiment, technological developments, and global events:

- Macroeconomic Trends – interest rate hikes, regulatory pressures, and economic uncertainties had a substantial impact on Ethereum and the broader crypto market.
- Technological Shifts – the transition to Ethereum 2.0 (Proof of Stake) and the development of Layer 2 solutions contributed to fluctuations in demand and market perception.
- Market Sentiment – negative market events, such as exchange collapses and high-profile failures (e.g., FTX bankruptcy), deeply affected investor confidence, contributing to price drops and higher trading volumes.

The discussion highlights that Ethereum's market movements are influenced by a complex interplay of factors, including technological developments like Ethereum 2.0 and Layer 2 scaling solutions, macroeconomic trends, and market sentiment. The transition to a Proof of Stake (PoS) consensus mechanism has been a pivotal factor in enhancing Ethereum's scalability and sustainability, addressing concerns about energy consumption, and shaping investor confidence. Moreover, the integration of DeFi and NFT activities into the Ethereum blockchain continues to drive demand for ETH, demonstrating its crucial role in the decentralized finance ecosystem. Additionally, the research discusses the external factors influencing Ethereum's price, such as global regulatory developments and macroeconomic conditions, which have an observable impact on the entire crypto market. The approval of Ethereum futures ETFs and the broader growth of Ethereum-based financial instruments point to growing institutional interest and regulatory acceptance, which play a significant role in shaping long-term price stability and market adoption.

While the findings provide valuable insights into Ethereum's market behavior, they do not account for all possible external influences, such as regulatory developments, macroeconomic policies, or news events, which can significantly affect prices. Future research might incorporate these additional factors or expand the model to cover other years for a more comprehensive trend analysis. In conclusion, the study highlights how Ethereum’s price is influenced by its volume and temporal factors, confirming that market activity and time play crucial roles in its price dynamics. The overall downward trend in 2022 was driven by a combination of market corrections, external economic factors, and loss of confidence in the crypto market, offering a nuanced understanding of Ethereum's behaviour within a rapidly changing environment.

Author Contributions

Conceptualization: V. K., A. K.; validation: K. M., D. K.; formal analysis: D. K.; investigation: K. M., A. K; methodology: K. M., A. K.; resources: K. M., D. K.; data curation: V. K., D. K.; writing – original draft preparation: V. K., K. M.; writing – review and editing: V. K., A. K.; visualization: K. M.; supervision: V. K., D. K.; project administration: V. K., A. K.

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Not applicable.

Conflicts of Interest
Authors declare no conflict of interest.

Informed Consent Statement
Not applicable.

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