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Original scientific paper

A STUDY ON BITCOIN PRICE BEHAVIOUR WITH ANALYSIS OF DAILY BITCOIN PRICE DATA

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Abstract. *Cryptocurrencies, which have begun to become an important rival to cash due to the changing lifestyle and technological developments, are gradually increasing their coverage area. Whether Bitcoin prices, which have exhibited different behaviors over the years since the day they were developed, are on a rational basis has become an important topic of discussion. Within the scope of this study, bitcoin prices between 2010 and 2023 were analyzed and factors that could make price behavior meaningful were tried to be determined. In addition, a forecast was also made in which Bitcoin prices for the coming years were calculated on a daily basis together with various statistical parameters using the the triple exponential smoothing method based on same historical data, and the results were discussed from various perspectives. In Bitcoin prices, which change mainly within the framework of supply and demand balance, attention has been drawn to the importance of different factors such as rational or irrational herd behavior, decisions taken about Bitcoin or news that may affect this balance and fall within the scope of behavioral finance. Along with the behavioral finance parameters that will make Bitcoin price behavior meaningful, it may not always be possible to attribute some changes in the relevant data to a specific reason. The main view supporting this situation is based on the personal nature of cryptocurrency itself.*

Key words: *Bitcoin, Bitcoin Price Behaviour, Behavioral Finance*

1. INTRODUCTION

Time, as an inexorable law of existence, has a strong influence on all things, compelling the financial sector to undergo profound transformation. The foundation of this shift was influenced by changing requirements, as well as the ease and innovations resulting from technology improvements [1]. These considerations may include elements such as the

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surge in e-commerce, the responsibilities imposed by the pandemic era, and the alteration of payment methods.

The rise of cryptocurrencies in recent years has created innovative methods for conducting economic transactions and offered alternative forms of currency [2]. Their influence on central financial markets is substantial. These electronic payment systems include a cutting-edge technology called blockchain, which enables the processing and authentication of transactions without relying on a central authority [3]. Cryptocurrencies are decentralized digital or virtual currencies that use cryptographic techniques for security and function autonomously without the need for a central bank. Bitcoin, the most renowned cryptocurrency, was launched in 2009 by an anonymous individual known as Satoshi Nakamoto [4]. Subsequently, a multitude of other cryptocurrencies have been created, each with distinct characteristics and uses. The advent of cryptocurrencies has had a profound influence on the financial industry, providing an alternative to conventional fiat currencies and bringing novel approaches to conducting economic transactions.

Cryptocurrencies are decentralized and function on a technology known as blockchain, which is a distributed ledger that documents all transactions across a network of computers. This technology has the capacity to transform the manner in which financial transactions are carried out, providing enhanced transparency, security, and efficiency. Multiple studies have examined the ramifications of cryptocurrencies on the economy and financial institutions. An example is the investigation conducted by Yermack (2015) which analyzed the possible influence of Bitcoin on monetary policy, financial regulation, and the stability of the conventional banking industry [5]. A separate investigation conducted by Gandal, Halaburda, and Moore (2018) examined the manipulation of prices and trading behaviors inside cryptocurrency marketplaces [6]. These studies emphasize the increasing curiosity in comprehending the economic and financial consequences of cryptocurrencies. In addition, the emergence of cryptocurrencies has also resulted in the creation of novel financial tools and investment prospects. Cryptocurrency exchanges and trading platforms have arisen, enabling people and institutions to purchase, sell, and exchange diverse digital assets. Furthermore, the notion of initial coin offerings (ICOs) has introduced a novel method for entrepreneurs to generate funds by issuing digital tokens. To summarize, the development of cryptocurrencies has undeniably brought about novel methods of carrying out economic transactions and offered alternative kinds of currency. The influence of cryptocurrencies on the financial industry and the wider economy is a subject of considerable interest and investigation. Given the increasing popularity and utilization of cryptocurrencies, it is essential for policymakers, regulators, and industry stakeholders to comprehend the ramifications and possible obstacles linked to these digital assets. Instead, all participants in the peer-to-peer network are involved in these processes. The market comprises more than one thousand cryptocurrencies that use the same foundational blockchain technology, either as replicas of Bitcoin or with notable technical advancements, and the majority of them operate on separate transaction networks [7].

Currently, it is widely known that an anonymous individual or collective known as Satoshi Nakamoto was the creator of bitcoin in 2008. The use of it began in 2009, coinciding with its release as open source software. Bitcoin is a decentralized digital currency that operates independently from any central bank or single administration. It may be moved directly between users on the bitcoin network (blockchain) without the involvement of middlemen [8]. Nodes verify transactions using encryption and store them on a publicly accessible ledger known as the blockchain.

The factors influencing bitcoin values remain uncertain. One perspective argues that the value of digital currencies may be determined by the real users and their interactions, taking inspiration from the rich and diverse literature on network theory. Another opinion contends that these prices may be a result of irrationality and have resemblance to historical bubbles that have happened over the course of human history. Regulators have differing opinions about the validity and purpose of digital currency. As an example, governments often issue stern admonitions, contending that these currencies are incapable of substituting for or substantially fulfilling the roles of conventional fiat currencies. They may also facilitate and support criminal operations. Nevertheless, despite these admonitions, there is a growing proliferation of firms who are embracing digital currencies like Bitcoin. Given the increasing interest, central bankers are now deliberating on the practicality of implementing government-backed digital currencies as a replacement for decentralized digital currencies [9]. Nevertheless, regardless of the ongoing debates, it is certain that bitcoin and its advocates will have a growing influence on the future of the financial industry.

This research examined the historical Bitcoin values from 2010 to the present, focusing on the period between 2010 and 2023 due to the availability of price data. The study also explored the elements that might influence the behavior of Bitcoin prices. Firstly, a compilation of literature research investigating the behavior of bitcoin was conducted. Subsequently, the subsequent part elucidated the determinants that influence the behavior of bitcoin prices. The data analysis section examines the fluctuations in bitcoin data on a yearly and monthly basis, and incorporates the elements that provide significance to these patterns. Additionally, using the historical Bitcoin values and applying the triple exponential smoothing method, it was predicted how bitcoin prices would be in the coming years. The conclusion portion included assessments based on the results gathered from the research.

2. Literature Review

There are many articles in the literature that have studied Bitcoin price behavior. These studies have been examined and various findings obtained from some studies have been shared in this section. Firstly, Stosic et al. (2018) examined cross-correlations between price changes of different cryptocurrencies. They found that many of the eigenvalues they considered in their study were not consistent with the universal predictions of random matrix theory. They also discovered quite different community structures in minimum spanning trees. As a result of the study, they concluded that collective behavior in the cryptocurrency market is different from other financial markets [7].

Khan et al. (2010) analyzed the relationship between global economic policy uncertainty (GEPU) and Bitcoin prices (BCP) in their study where they applied the sliding window method, and concluded that there was no causality between GEPU and BCP. As a result of the study, they pointed out that decision-makers should trigger the improvement of blockchain technology, which can be used for risk protection and portfolio diversification, and pointed out the importance of bringing laws and regulations into life regarding state interventions and prohibitions, which gives confidence to investors. They also stated that in order to protect against random market fluctuations, information about policy changes should be taken into account in the portfolio selection process. They pointed out the importance of investors being able to obtain detailed information about the global economy

and policy changes in the crypto market, which is more uncertain, variable and prone to sudden changes in the short term due to its unregulated structure [10].

Jang and Lee (2018) analyzed the volatility of the Bitcoin currency using Bayesian Neural Network (BNN), Support Vector Regression (SVR) and linear models with the help of time series created with the closing prices between September 11, 2011 and August 22, 2017 and evaluated the results [11]. The study conducted by Chen et al., (2020) focuses on the utilization of machine learning and statistical techniques to forecast Bitcoin values. The authors examine several prediction models and emphasize the significance of feature selection and data pretreatment in attaining precise outcomes [12]. In their study, Salisu et al., (2019) examine the use of statistical models in forecasting Bitcoin values and analyze the potential impact on the worldwide economy. They stress the need of using strong modeling tools to accurately represent the intricate dynamics of digital assets in a continuously changing market context [13].

Karalevicius et al. (2017), in their study using investor sentiment and bitcoin price variables and the Liquid-Based Sentiment Analysis and Sharpe Ratio method, concluded that news about Bitcoin is effective on semi-short-term Bitcoin movements [14]. Flori (2019), using the Black-Litterman Model and Bitcoin news and Bitcoin returns variables, found that the effect of news on the Bitcoin price is significant [15]. Many studies analyze various machine learning and deep learning algorithms for Bitcoin price prediction ([16]; [17]). Sharma et al. (2023) explore the use of social media activities and past trends in predicting Bitcoin prices [18]. These studies contribute to a better understanding of risk hedging strategies in the cryptocurrency market.

Ciaian et al. (2015) determined and evaluated the factors behind Bitcoin price formation. For this purpose, in their study of daily Bitcoin prices between 2009 and 2015, they first concluded that the market forces that direct Bitcoin supply and demand are effective on the Bitcoin price. Furthermore, it has been shown that engaging in speculative behavior has a significant impact on the fluctuations of Bitcoin values. One indication of this phenomenon is the direct correlation between the number of internet searches for information on Bitcoin and the fluctuation of Bitcoin prices. Several research investigate various methodologies for forecasting the influence of social media statements on the valuation of cryptocurrencies [19]. Yue et al., (2018) concentrate on extracting valuable information from large-scale data analysis, while Rane and Dhage, (2019) and Wood et al., (2022) use advanced computational algorithms to forecast the price of Bitcoin using machine learning methods ([20]; [21]; [22]). Vidal-Tomás (2021) examines bitcoin statistics and emphasizes the ongoing nature of the market [23]. Gronwald (2014) discussed the Bitcoin economy, using economic terms to determine how to seize Bitcoins, and also discussed the debate on the comparison of Bitcoin and gold. The application phase included the empirical analysis of Bitcoin prices using the autoregressive jump density GARCH model. The article's conclusion highlights that the price of Bitcoin is marked by very volatile fluctuations, a phenomenon often found in nascent markets [24]. Kervanci & Akay (2020) emphasized the higher predictive capabilities of machine learning techniques in comparison to conventional statistical methods for forecasting Bitcoin values [25]. In addition, Tong et al. (2022) conducted an in-depth examination of the nonlinear dynamics study of cryptocurrency price variations using Bitcoin as a basis, providing insights into the intricate nature of cryptocurrency price changes [26]. The non-linear structure of bitcoin price movements highlights the difficulties in precisely forecasting cryptocurrency values.

Kristoufek (2013) examined the correlation between Google Trends, Wikipedia searches, and the price of Bitcoin. The results demonstrate a bidirectional correlation between search queries and the price of Bitcoin. Additionally, they indicate that the impact of heightened interest in Bitcoin is notably uneven when prices deviate from the overall trend. This suggests that such circumstances create a favorable environment for the emergence of bubble-like behavior [27]. The influence of social media messages, particularly those from influential figures like Elon Musk, on cryptocurrency markets has been a subject of interest ([28]; [29]), which explored the prediction of the impact of social media messages on the value of cryptocurrency, highlighting the insights gained from big data analytics [29]. This is essential as it illuminates the influence of social media on the formation of bitcoin market dynamics

In 2018, Bouri and his colleagues used the non-linear ARDL model to examine the impact of gold and commodity index prices on Bitcoin prices. Their findings revealed a non-linear, asymmetric quantile link between the commodities index and Bitcoin, as well as between gold and Bitcoin [30].

The research conducted by Guo et al. (2021) centers on the correlation between Bitcoin price prediction and the fundamental blockchain transactions, offering a distinct viewpoint that might enhance comprehension of cryptocurrency markets. The authors use data analytic tools to examine the correlation between blockchain transactions and Bitcoin price fluctuations, providing significant information for investors and academics in this domain. The study results illuminate the potential advantages of incorporating blockchain transaction patterns into Bitcoin price forecasts, indicating that this strategy might improve accuracy and dependability in comparison to conventional forecasting techniques [31].

Coulter (2022) demonstrated that the impact of cryptocurrency news in the media and factors such as media sensitivity and Bitcoin price on cryptocurrencies is significant, using the Latent Dirichlet Allocation (LDA) approach [32]. De Vries (2021) investigates the correlation between the increasing value of Bitcoin and its use of electricity. The author examines the effects of rising costs on the energy consumption of the network [33]. Griffin and Shams (2020) examine the extent to which Bitcoin is really independent. The researchers analyze the possible impact of Tether, a stablecoin, on the fluctuations of Bitcoin's price [34]. Kavitha, Sinha, and Jain (2020) assess the effectiveness of several machine learning algorithms in forecasting Bitcoin values. They evaluate the efficacy of various algorithms in predicting the volatility of Bitcoin's price [35]. In Sapkota's (2022) study, the Heterogeneous Autoregressive Volatility Model was used to examine the relationship between news sentiment and Bitcoin price variability [36]. The findings indicate that media news sentiment significantly influences fluctuations in Bitcoin price.

3. Bitcoin Price Behaviour

This section discusses the fundamental elements that may influence the price of Bitcoin, which has shown diverse patterns since its inception. Bitcoin's price is governed by the interplay between supply and demand. The stock market's performance is contingent upon several elements, including worldwide events like price drops, advancements in stock and

bond prices, and global economic developments such as the continuing trade war between the USA and China[1] [37].

However, unlike monetary policy in countries with fiat currencies, which are subject to change in line with political and economic developments, the Bitcoin ecosystem is a completely decentralized monetary system. The factors influencing Bitcoin prices are multifaceted and encompass a wide range of economic, technological, and regulatory aspects. The supply and demand dynamics of Bitcoin, the cost of production through mining, rewards for miners, the presence of competing cryptocurrencies, the exchanges on which Bitcoin is traded, and regulatory and political developments all play a role in shaping Bitcoin prices. Additionally, local regulations, current events, and economic and political developments contribute to the volatility and valuation of Bitcoin. Several studies have delved into the various factors influencing Bitcoin prices. Guo et al. (2021) provide a perspective on how underlying blockchain transactions impact Bitcoin price forecasting, shedding light on the role of transactional data in predicting Bitcoin price movements [31]. Ciaian et al. (2015) have explored the impact of market fundamentals and Bitcoin's attractiveness for investors on Bitcoin price formation, emphasizing the significance of these factors in influencing Bitcoin prices [19]. Zaman et al. (2022) have examined the impact of dramatic events and impactful news on Bitcoin prices, highlighting the role of global events and public sentiment in shaping Bitcoin valuations [38]. Furthermore, Wu & Wang (2023) have studied the impact of Chinese policies and regulations on Bitcoin, emphasizing the influence of economic policy uncertainty on Bitcoin prices [39]. Wang et al. (2016) have analyzed the driving forces behind Bitcoin prices, emphasizing the role of supply and demand dynamics and external factors in shaping Bitcoin valuations [40]. Makarov & Schoar (2020) have investigated trading and arbitrage in cryptocurrency markets, shedding light on the price impact and market dynamics of cryptocurrencies [41]. Madiche et al. (2023), in their study on crypto assets as a risk reduction tool, applied the ARDL model and as a result of the study, they found an answer to the question of whether crypto assets are an independent asset class and concluded that gold and crude oil assets can be used against crypto assets as a risk hedging tool [42]. In conclusion, the factors influencing Bitcoin prices are diverse and encompass a wide array of economic, technological, and regulatory elements. The interplay of supply and demand dynamics, mining costs, regulatory developments, and global events collectively shape the valuation and volatility of Bitcoin. Understanding these multifaceted influences is crucial for comprehending the dynamics of the cryptocurrency market and its impact on the broader financial landscape.

Bitcoin and other cryptocurrencies exhibit more volatility compared to conventional investing tools. The price of bitcoin fluctuates in accordance with the supply and demand dynamics on cryptocurrency exchanges. These fluctuations are noticed in each exchange as a result of variations in supply and demand. The price is determined by the investors' expectations. Essentially, when there is a large demand for purchasing, the price rises, and when there is a high demand for selling, the price falls.

[1] https://www.bitpanda.com/academy/tr/dersler/bitcoin-fiyatini-belirleyen-faktorler-nelerdir/(What are the factors that determine the Bitcoin price?)

4. DATA ANLYSIS

Table 1. Max Bitcoin Price Per year

	Jan	Feb	Mar	Apr	May	Jun	Jul	Agu	Seb	Oct	Nov	Dec
2010							0,1	0,1	0,2	0,2	0,5	0,3
2011	0,9	1,1	1	4,2	9,5	31,9	16,7	13,6	8,7	5,3	3,4	5
2012	7,2	6,2	5,4	5,5	5,2	6,8	9,7	15,4	12,7	13,1	12,6	13,9
2013	21,4	34,5	95,7	266	140,1	130,1	111,7	148,7	148,9	233,4	1241,9	1239,9
2014	1093,4	969,2	695,4	549	629	676,5	652,5	608,2	498,5	407,7	480,5	384,9
2015	321,4	264,6	301	261,5	247,9	268,7	315,9	285,7	246,4	334,9	492,8	467,7
2016	462,9	447,6	439	468,9	548	776	701,5	627,9	705	720,2	755,3	982,6
2017	1150,6	1211,7	1330,4	1358,9	2781,8	2985,1	2932,8	4765,1	4976,5	6467,2	11417,8	19870,6
2018	17252,8	11791,5	11506,9	9753,1	9992,8	7775	8484,6	7753,2	7409,9	7358,4	6594,3	4316,1
2019	4070,5	4194,2	4138,1	5594,4	9045,9	13929,8	13134,4	12291,9	10896,2	10540	9500,4	7702,2
2020	9569	10482,6	9180,8	9437,5	10033	10301,8	11434,8	12444,1	12045,9	14065,4	19831,2	29298,8
2021	41921,7	58335,1	61795,8	64778	59523,9	41318	42285,3	50498,8	52885,3	66967,1	68990,6	59064,3
2022	47944,9	45755,2	48199	47435	40021	31969,9	24605,3	25205,7	22702,5	21038,1	21464,7	18351,8
2023	23952,9	25236,8	29160,4	30964,9	29816,4	31395,4	31764,5	30168,6	27480,7	35191,4	38400,8	

In this study, the price behavior of bitcoin over the years was analyzed based on bitcoin price data for the years 2010-2023. In the analysis, daily Bitcoin opening data and the lowest and highest values reached during the day were used. However, since approximately 13 years of data were analyzed and it is not possible to display this data on a daily basis in the article, a monthly summary is included in the prepared tables for readability. Bitcoin data used in the study was obtained from "investing.com"[2] data archive. In this context, using the MS Excel environment, the ups and downs of bitcoin over time were determined by creating pivot tables and with the help of different functions such as maximum, minimum and average in various breakdowns, and the reasons for this behavior were investigated.

First of all, as can be seen below, using Bitcoin data from 2010 to 2023, the maximum values reached by the Bitcoin price on a yearly and monthly basis were determined by using daily price values. In this context, while the highest bitcoin price reached on a monthly basis is shown in Table 1, the trend of the maximum values reached on a yearly basis is presented graphically in Figure 1.

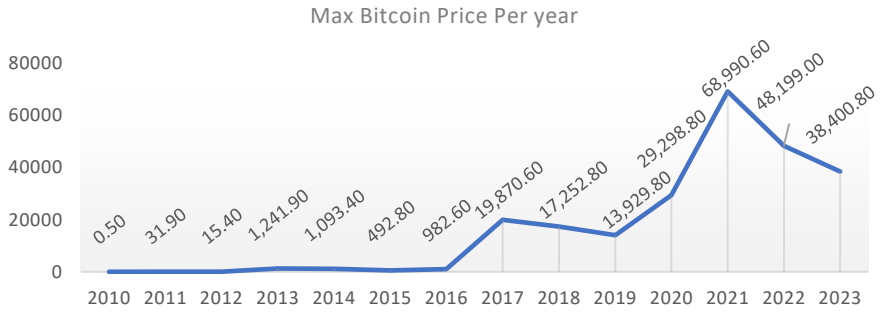

Fig. 1 Max Bitcoin Price Per year

[2] https://www.investing.com/

As can be seen from Figure 1, Bitcoin reached its highest value ever in 2021. When Table 1 is examined, it is seen that the highest value on a monthly basis corresponds to November 2021. When analyzing what could be the reasons that make this behavior of Bitcoin meaningful in 2021 and whether these reasons will be on a rational basis, the main effects of this year can be expressed as follows. 2021, which started in the shadow of the pandemic, was a turning point for the cryptocurrency industry. Bitcoin, in particular, has become one of the popular topics even among friends, as its price reached historical peaks. As new investors stepped into the sector, Blockchain, NFT, DeFi, Metaverse became among the most trending words on the agenda. So much so that statistics show that searches made with the term "Bitcoin" in Google search trends in many countries in 2021 have increased significantly compared to the previous year.

So, when we think about what could be the real reason that makes 2021 so important for Bitcoin, in 2021, Bitcoin investments of corporate players and companies' plans and projects for the cryptocurrency sector came to the fore. The interest of institutions accelerated mass adoption. This pushed regulators to take action. While these regulatory studies increased the confidence of investors, new developments such as DeFi, NFT and GameFi, which are based on blockchain technology, also had a great impact.

When we look at 2021 in more detail, Bitcoin's price increases with corporate investments, developments in the Lightning Network, El Salvador's acceptance of Bitcoin as its official currency, and the Tesla company owned by Elon Musk announcing that it bought $1.5 billion worth of Bitcoin. It has exceeded 50 thousand dollars. Following the news that Elon Musk accepted Bitcoin as a payment unit at Tesla, Bitcoin broke a new record by reaching 63 thousand dollars. Bitcoin reached a record in 2021. There have been significant changes in the Bitcoin price with the economic difficulties caused by COVID-19 in the world, historical inflation news and the FED interest rate increase signal. With the news that the FED will increase interest rates by 75 basis points on June 15, 2022, especially in connection with the highest inflation of 41 years in the USA, Bitcoin gradually fell below 20 thousand 500 dollars. In this context, we can say that positive or negative Bitcoin news appearing at different times plays an important role on the Bitcoin price [43].

Secondly, as can be seen below, using Bitcoin data from 2010 to 2023, the minimum values reached by the Bitcoin price on a yearly and monthly basis were determined using daily price values. In this context, while the lowest bitcoin price reached on a monthly basis is shown in Table 2, the trend of the minimum values reached on a yearly basis is presented graphically in Figure 2.

Table 2 Min Bitcoin Price Per year

	Jan	Feb	Mar	Apr	May	Jun	Jul	Agu	Seb	Oct	Nov	Dec
2010							0,10	0,00	0,10	0,00	0,10	0,20
2011	0,30	0,50	0,70	0,60	2,50	8,30	11,00	5,70	4,20	2,00	2,00	2,60
2012	4,60	3,90	4,30	4,60	4,80	5,20	6,40	7,60	9,70	9,70	10,30	12,40
2013	13,20	18,00	32,90	50,00	79,00	88,00	65,40	101,00	121,30	109,70	209,70	454,90
2014	771,00	91,70	262,80	355,70	420,20	560,80	564,00	450,00	372,60	294,90	319,80	303,40
2015	157,30	209,70	234,80	214,10	228,20	221,00	243,20	196,30	224,10	234,70	292,40	347,20
2016	350,40	365,30	386,90	412,40	435,40	521,30	605,00	471,40	569,30	606,50	670,40	741,10
2017	739,50	924,70	890,40	841,50	1.342,80	2.125,60	1.809,00	2.659,60	2.979,90	4.143,40	5.493,60	9.420,90
2018	9.271,30	5.996,60	6.603,80	6.460,10	7.069,80	5.785,30	6.088,80	5.898,30	5.977,00	6.034,90	3.634,20	3.177,00
2019	3.368,20	3.382,50	3.681,80	4.076,80	5.319,50	7.480,40	9.082,60	9.343,00	7.749,00	7.329,20	6.534,80	6.462,20
2020	6.884,10	8.451,90	3.869,50	6.157,40	8.235,60	8.865,30	8.932,10	10.730,70	9.877,10	10.387,60	13.214,20	17.600,10
2021	28.204,50	32.324,90	45.008,80	47.098,50	30.261,70	28.901,80	29.310,20	37.365,40	39.646,80	43.292,90	53.448,30	42.587,80
2022	32.985,60	34.357,40	37.182,10	37.596,00	26.500,50	17.630,50	18.794,40	19.542,90	18.191,80	18.207,90	15.504,20	16.331,20
2023	16.499,70	21.418,70	19.591,80	27.054,30	25.853,10	24.838,00	28.890,70	25.481,90	24.923,10	26.558,40	34.124,20	

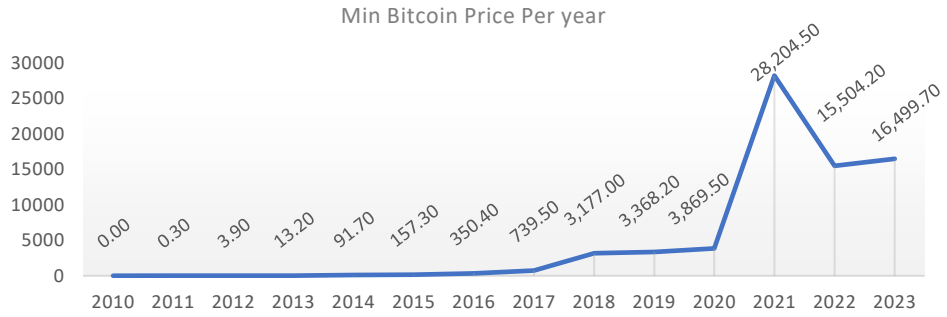

Fig. 2 Min Bitcoin Price Per year

As can be seen from Figure 2, Bitcoin reached its lowest value ever in 2010. When Table 2 is examined, it is seen that the lowest values on a monthly basis corresponds to nearly almost every month of 2010 (Bitcoin price data has been available since July 2010.) When analyzing what could be the reasons that make this behavior of Bitcoin meaningful in 2010 and whether these reasons will be on a rational basis, the main effects of this year can be expressed as follows. In fact, the main reason for this result can be explained as the fact that the recognition of a completely new product is still at a very early stage. In other words, when compared to personal shopping preferences that are still focused on physical money, such as cash, Bitcoin has not yet established the trust factor, which contains many unknowns and is one of the biggest threats to financial risk. In this sense, it is not difficult to say that in 2010, Bitcoin stood out as a new technology that was still in its infancy and was pregnant with many unknowns for people, institutions and countries.

Finally, as can be seen below, using Bitcoin data from 2010 to 2023, the average values reached by the Bitcoin price on a yearly and monthly basis were determined. Average values are calculated based on bitcoin opening prices. In this context, while the average bitcoin price reached on a monthly basis is shown in Table 3, the trend of the average values reached on a yearly basis is presented graphically in Figure 3.

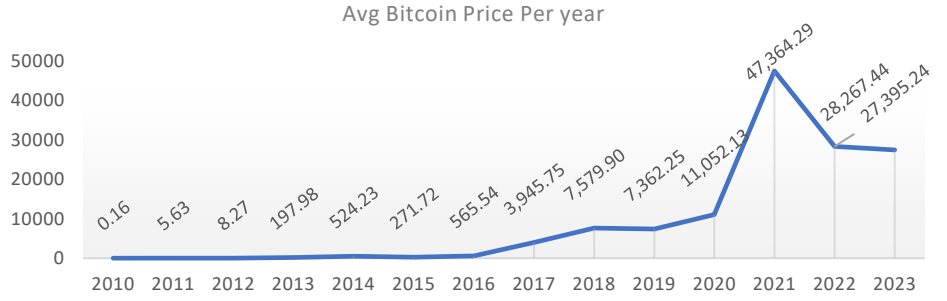

Fig. 3 Avg Bitcoin Price Per year

Table 3 Avg Bitcoin Price Per year

	Jan	Feb	Mar	Apr	May	Jun	Jul	Agu	Seb	Oct	Nov	Dec
2010							0,09	0,10	0,10	0,12	0,26	0,24
2011	0,35	0,91	0,86	1,16	6,05	17,82	14,12	10,16	6,04	3,70	2,70	3,44
2012	6,10	5,13	4,90	4,98	5,06	6,00	7,85	10,92	11,56	11,76	11,44	13,34
2013	15,38	25,58	55,58	128,80	120,30	108,86	90,40	113,70	136,65	165,89	548,99	853,15
2014	931,18	528,13	583,04	465,16	479,87	616,83	618,02	540,99	449,41	364,00	364,57	343,44
2015	251,43	232,93	268,95	235,26	237,18	236,85	278,12	252,87	233,06	262,48	344,67	421,87
2016	412,88	401,50	415,62	432,35	458,76	634,94	661,71	579,57	604,59	638,57	722,67	817,00
2017	909,61	1.053,34	1.132,82	1.206,14	1.846,87	2.626,38	2.512,75	3.819,17	4.108,16	5.283,65	7.655,60	14.908,59
2018	13.119,08	9.399,63	9.087,11	7.957,13	8.494,54	6.817,81	7.087,33	6.700,65	6.607,70	6.532,36	5.525,41	3.696,13
2019	3.662,13	3.677,70	3.932,32	5.107,76	7.191,55	9.329,01	10.696,10	10.664,27	9.826,22	8.346,92	8.393,69	7.266,19
2020	8.309,39	9.664,63	6.931,63	7.137,28	9.226,49	9.492,56	9.518,90	11.628,25	10.672,66	11.790,60	16.465,84	21.683,64
2021	34.601,79	45.863,30	54.413,93	57.109,78	47.100,59	35.900,12	34.231,93	45.501,88	46.037,14	57.333,48	60.825,52	49.642,80
2022	41.342,99	40.572,10	41.882,62	41.672,03	31.885,62	24.773,65	21.423,76	22.458,34	19.815,83	19.613,05	17.704,19	16.962,23
2023	20.029,02	23.292,40	24.907,27	28.816,56	27.554,69	27.649,87	30.096,47	27.972,46	26.273,05	29.499,90	36.315,54	

As can be seen from Figure 3, Bitcoin reached its highest average value ever in 2021. When Table 1 is examined, it is seen that the highest value on a monthly basis corresponds to November 2021. In addition, Bitcoin reached its lowest average value ever in 2010. When Table 2 is examined, it is seen that the lowest values on a monthly basis corresponds to nearly almost every month of 2010 (Bitcoin price data has been available since July 2010.) These results are consistent with the results given in the previous stage. In other words, Bitcoin generally maintained the highest and lowest values it reached throughout its life during the same year. This situation shows that the price behavior mentioned in the relevant sections is generally valid for the whole year.

When all three Tables and Graphs are examined and interpreted together, it is possible to explain the price behavior, which can be expressed with a typical supply-demand balance, under headings such as herd psychology within the scope of behavioral finance, the positive/negative effect of the media news that feeds it, and how the element of trust, which is the most important factor for financial investment, is shaped.

With the increasing technological developments in recent years, access to news around the world has become easier and with this, there has been a significant increase in the number of readers. Especially for people who trade Bitcoin and other cryptocurrencies, news sensitivity has been effective in buying and selling activities, portfolio management, and also determining future price predictions. Positive or negative news conveyed to investors by the media has caused significant changes in the price of Bitcoin. Government bans, taxes, hacking of cryptocurrency exchanges, scams and excessive energy consumption of cryptocurrencies, etc. Just as negative news caused a decrease in the price of Bitcoin, news about some important companies accepting the use of crypto money and officially accepting crypto money in their countries also led to an increase in the price of Bitcoin. As an example of such news, with the news that China banned Bitcoin in December 2013, Bitcoin fell below a thousand dollars. Then, in January 2014, Zynga company started testing payment with Bitcoin, which increased the Bitcoin price to over a thousand dollars again. Stripe, the popular payment system in the USA, opened its doors to Bitcoin in February 2015. However, with the news that Barclays, BBVA, Commonwealth Bank of Australia, Credit Suisse, JP Morgan, State Street, Royal Bank of Scotland and UBS, which are among the world's leading banks, will meet to explain the transaction principles regarding Bitcoin, Bitcoin rose to its highest level in 2015. With the spread of news that Japan and South Korea officially recognized Bitcoin in 2017, Bitcoin broke a record and rose to 3 thousand 785 dollars in August 2017. Following this news, the news that the Chinese government would impose restrictions and regulations on cryptocurrency exchanges caused a decrease of nearly 34% in the Bitcoin price [43].

In addition, some examples of behavioral finance factors affecting Bitcoin price behavior can be given when the data of years of 2014 and 2018 are examined. In the sixth year of Bitcoin's existence (2014), the biggest leap forward came when Microsoft accepted Bitcoin payments. This company was the first to get big-name companies to accept the currency as a payment method [44]. As we moved from 2017 to the beginning of 2018, the price of Bitcoin dropped to 10,000 USD as fear, uncertainty and doubt shook the market. This year, Facebook banned the advertising of cryptocurrencies and ICOs on its platform. Another thing that hasn't helped the situation has been rumors that South Korea will ban cryptocurrencies and China will further increase restrictions that already exist.

Another important trend change that draws attention in the tables is the decrease in values from 2018 to 2019. A global event etc. that could cause this situation. When researched, the following news was found. Timothy Tam, co-founder and CEO of Cryptocurrency research company CoinFi in Hong Kong, stated that although there was no new development that would cause a sharp sale in digital currencies, he noticed a large transfer of 40 thousand Ether to an exchange an hour before the drop[3].Tam said, "The transfer of Ethereum to an exchange usually indicates an intention to sell, and if there is a sale on one exchange, its effect increases by spreading to others in a domino effect. Because arbitrageurs will immediately sell it on other exchanges" [45]. In another news article on the subject, the following analysis is included.[4] Bitcoin has attracted attention all over the world with its serious performance in the last few days. Both visual and print media brought Bitcoin to the top of their agenda after these increases. Naturally, this event caused many new investors to enter the cryptocurrency market. However, BTC, which tested the $ 14,000 levels, fell sharply from these levels. The declines reached as low as $10,700 and bounced back to $11,000 from there. How should we interpret this decline in BTC, which is currently trading at $ 11,000? Big Investors made profit sales. This situation, which is colloquially called "shrinkage" and generally occurs due to manipulation on stock markets or sales by big investors, has/is happening on Bitcoin. Large investors and institutions, called whales, negatively affected the price by selling profits on BTC, which increased by 25 percent in 24 hours. Small investors, who were afraid of this situation and believed that BTC would drop further, started to sell their BTCs. As such, the BTC price fell and small investors became the ones who lost money [46].

With the end of 2013, Bitcoin, which attracted worldwide attention, encountered a significant fluctuation in both its value and transaction volume. In the literature, the predictability of bitcoin returns has been examined through various parameters such as social media attention and historical technical indicators related to bitcoin. For example, the results obtained in the study where it was determined how many times the term "Bitcoin" was tweeted for a certain date range revealed that the number of tweets sent could affect the BTC transaction volume on the next day. In addition, in a study which explored the effect of user comments on various platforms on price fluctuations and the number of cryptocurrency transactions revealed that BTC was especially associated with the number of positive comments on social media, and even obtained an accuracy rate of 79% with the Granger causality test they applied, showing that consumer ideas have effect in predicting price fluctuations.

As Tambe (2023) stated that the decline in the cryptocurrency market in the last few years is explained by global events and their financial effects, such as the post-Russia-Ukraine effects, the Terra-Luna collapse, the FTX collapse or tightened tax regulation[5]

[3] https://www.bloomberght.com/kripto/haber/2187994-kripto-paralar-sert-dustu-bitcoin-4-bin-dolarin-altina-geriledi
[4] https://tr.investing.com/news/cryptocurrency-news/bitcoin-btc-fiyat-analizi--27-haziran-2019-1896702
[5] https://www.forbes.com/advisor/in/investing/cryptocurrency/why-crypto-market-is-down/

[47]. FTX has been named as one of the industry crashers that caused Bitcoin to fall to its lowest price since 2020. With Bticoin losing more than half its value last year, Singapore was hit by the collapse of stablecoin terraUSD, which led hedge fund Three Arrows Capital to file for bankruptcy, causing even more devastating damage to the crypto market. In November 2021, it saw below $ 16,000[6] [48].

As a result, when the relevant data was examined, while some declines can be directly explained by specific factors such as a global event or behavioral finance factors, each change could not be matched with a rational factor that directly corresponded. In this sense, Bitcoin price behavior may not always be based on a meaningful reason or basis. The main view supporting this situation is based on the personal nature of cryptocurrency itself. Namely; the extraordinary fluctuations in the price of Bitcoin would be considered extremely unusual for traditional financial assets, and therefore the price formations of digital currencies should have their own unique determinants. The dynamics of digital money markets consist of transactions made speculatively, not based on fundamentals, and explained his rationale as follows: It is possible to explain the changes in the prices of digital currencies satisfactorily with basic economic and financial models. While the value of traditional currencies can be explained by supply and demand dynamics and the macroeconomic variables that drive these dynamics, the supply side of cryptocurrencies is fixed or varies depending on a well-known algorithm. On the demand side, the expected profitability remains the only factor, which can only be achieved by selling the asset, because there is no cash flow (such as dividends or interest) that will be provided by holding it.

In the second stage of the application, future predictions of bitcoin prices were made based on the "forecast.ETS" function on the MS Excel platform. While making the prediction since the data for 2010 started on July 18; in order not to disrupt the standard date range, daily data set has been included in the calculation as of 1.1.2011.

Details about the functions and parameters used in this application are given below.

Table 4 Functions and parameters used in Forcasting Daily Bitcoin Price

FORECAST.ETS:	Calculates a future value based on existing (historical) values applying the AAA version of the Exponential Smoothing (ETS) algorithm. The projected value is a continuation of past values at the specified target date (which must be a continuation of the timeline).
FORECAST.ETS.CONFINT:	Returns a confidence interval for the forecast value on the specified target date. A 95% confidence interval means that 95% of future points are expected to fall within this radius (with normal distribution) from the outcome predicted by FORECAST.ETS.
Confidence interval	The confidence interval is the range (in a normal distribution) surrounding each predicted value that is expected to contain 95% of the future points based on the prediction.
Alpha parameter	Alpha parameter of the ETS algorithm returns the Base value parameter (a higher value gives more weight to the final data points).
Beta parameter	The beta of the ETS algorithm returns the trend value parameter (a higher value gives more weight to the recent trend).
Gamma parameter	The gamma parameter of the ETS algorithm returns the Seasonality value parameter (a higher value gives more weight to the last seasonality period).
MASE metric	Returns the mean absolute scaled error metric (a measure of the accuracy of predictions).
SMAPE metric	Returns the symmetric mean absolute percent error metric (a measure of accuracy based on percent errors).

[49] Source from: https://support.microsoft.com/tr-tr/office/tahmin-ets-istat-islevi-60f2ae14-d0cf-465e-9736-625ccaaa60b4

[6] https://www.reuters.com/technology/crypto-market-still-bears-scars-ftxs-collapse-2023-10-03/

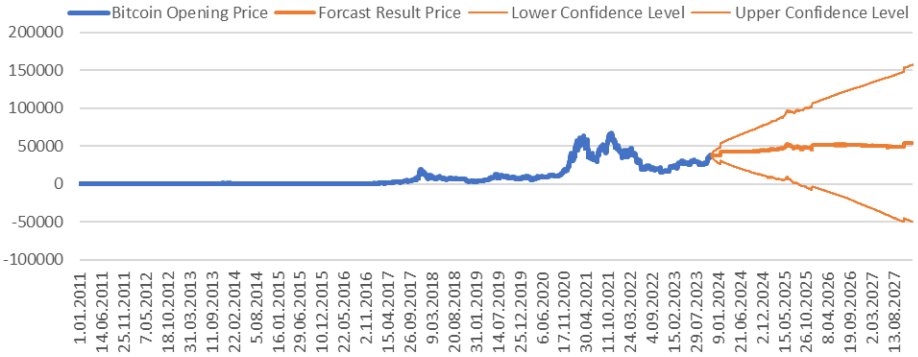

Fig. 4 Result Graphic of in Forcasting Daily Bitcoin Price

The statistical parameters and error metrics given in Table 5 are within acceptable limits.

Table 5 Statistical parameters calculated in the analysis

Alpha	0,83
Beta	0,00
Gamma	0,08
MASE	13,67
SMAPE	0,03

When the prediction results are compared with the Bitcoin data from the beginning of 2024 to date, as a cross-check, it is seen that the predictions have reached very close values to each other as of the end of January. For this purpose, when comparing the January.2024 forecast data given in Table 5 with the Bitcoin data realized so far as given in Figure 4, it can be said that the results are consistent.

Table 6 Sample daily Bitcoin Data obtained as a result of the forecast

Date	Forcast Result Price	Lower Confidence Level	Upper Confidence Level
19.01.2024	37587,45864	27204,64	47970,28
20.01.2024	37535,50144	27051,60	48019,41
21.01.2024	37543,66152	26959,41	48127,91
22.01.2024	37530,26096	26846,39	48214,13
23.01.2024	37497,78389	26714,99	48280,58
24.01.2024	37398,7829	26517,75	48279,82
25.01.2024	37511,60357	26532,99	48490,22
26.01.2024	37383,36085	26307,81	48458,91
27.01.2024	37433,87098	26262,01	48605,74
28.01.2024	37449,84997	26182,29	48717,41
29.01.2024	**41168,84276**	29806,17	52531,51
30.01.2024	42796,13538	31338,94	54253,33
31.01.2024	42864,21725	31313,06	54415,37

(Source from: https://tr.investing.com/crypto/bitcoin/chart)

Fig. 4 Real Bitcoin data for Jan.2024

When we look at the results on a yearly basis, the situation is as given in Table 7. As seen in the table, when looking at the monthly averages of the next four years for the near future, it is predicted that although there may be decreases in some months, the overall upward trend continues. However, as noted in the first part of the analysis, which is based on the actual data, Bitcoin prices are sensitive to economic and global changes and bitcoin is an investment tool that is fed by consumer trends within the scope of behavioral finance. Therefore, it is clear that the values obtained in the forecast will be affected by daily events and consumer behavior.

Table 7 Yearly and monthly estimated prices for future years as a result of the forecast

Date	Min Estimated Price	Average Estimated Price	Max Estimated Price
2024	37.383,36	42.595,33	44.751,39
Jan	37.383,36	38.034,60	42.864,22
Feb	42.176,64	42.286,50	42.478,43
Mar	42.233,08	42.294,35	42.328,23
Apr	42.311,41	42.370,84	42.471,80
May	42.411,76	42.503,36	42.586,20
Jun	42.576,31	42.716,78	42.900,98
Jul	42.734,97	42.848,53	43.021,49
Agu	42.863,74	43.081,29	43.295,80
Sep	42.993,84	43.198,12	43.499,16
Oct	42.978,86	43.457,96	43.926,31
Nov	43.399,34	44.035,54	44.751,39
Dec	43.962,84	44.358,73	44.737,14
2025	44.006,66	47.819,75	53.282,95
Jan	44.006,66	44.553,86	45.461,23
Feb	45.068,05	45.738,02	46.498,47
Mar	44.910,45	45.608,31	46.159,71
Apr	45.839,49	46.661,64	47.327,74
May	46.121,23	48.126,03	51.917,06
Jun	49.875,18	51.431,31	53.282,95
Jul	47.130,70	49.285,52	51.276,49
Agu	47.515,12	48.708,40	49.839,68
Sep	47.065,58	47.753,36	48.830,13
Oct	47.139,74	48.197,06	48.813,51
Nov	47.221,35	47.685,73	48.374,06
Dec	46.642,02	49.958,93	52.092,82

Date	Min Estimated Price	Average Estimated Price	Max Estimated Price
2026	50.848,47	51.919,32	52.653,42
Jan	51.394,12	51.683,27	51.971,77
Feb	51.543,44	51.844,29	52.101,95
Mar	51.665,32	51.926,25	52.179,53
Apr	51.847,27	51.964,90	52.200,28
May	51.969,52	52.140,49	52.295,37
Jun	52.022,80	52.255,06	52.384,05
Jul	52.192,33	52.294,45	52.376,87
Agu	52.154,32	52.272,07	52.653,42
Sep	52.048,38	52.156,88	52.253,74
Oct	51.633,88	51.891,98	52.071,31
Nov	51.237,54	51.478,25	51.731,03
Dec	50.848,47	51.122,41	51.383,96
2027	48.936,73	50.805,97	54.417,58
Jan	50.795,59	50.992,43	51.178,10
Feb	50.775,59	50.925,78	51.018,24
Mar	50.689,51	50.864,04	51.142,32
Apr	50.334,24	50.552,63	50.748,47
May	50.049,40	50.318,88	50.484,42
Jun	49.666,56	49.918,05	50.134,60
Jul	49.358,75	49.563,98	49.771,66
Agu	49.091,70	49.359,38	49.539,05
Sep	49.190,36	49.323,66	49.680,95
Oct	48.936,73	50.185,74	54.417,58
Nov	53.755,24	53.839,73	53.910,42
Dec	53.786,44	53.852,19	53.897,33

5. CONCLUSION

Bitcoin price fluctuation may be attributed to behavioral finance, which is a significant contributing element. Conventional financial theories operate on the assumption that investors behave in a rational manner. Behavioral finance is a comprehensive examination of the convictions and appraisals of investors in the actual world. It aims to uncover market outcomes in the presence of a group of investors that make irrational decisions. Herd behavior, a significant concept in behavioral finance, refers to the phenomenon where investors mimic the assessments of their peers, disregarding their own judgments while making investment choices. The significance of herd behavior lies in its strong correlation with market inefficiencies and instability. The spike in cryptocurrency prices raises concerns about the presence of herd behavior in the market due to factors including volatility, the absence of an underlying asset in cryptocurrencies, and insufficient regulation of the cryptocurrency market. Discovering indications of anti-herd behavior in cryptocurrency markets implies that participants in these markets lack a collective agreement or consensus. The majority of buying and selling activities involving cryptocurrencies are mostly driven by speculation, given there is no tangible asset behind these assets. Hence, transactions involving cryptocurrencies cannot be seen as a conduct rooted in economic principles, like to conventional investment products [50].

The widespread usage of cryptocurrencies, particularly Bitcoin, for speculative reasons is an undeniable reality. During instances of cryptocurrency price increases, a greater amount of news is generated. Investors who are interested in investing in Bitcoin and altcoins should consider the news related to Bitcoin, which has a significant market share,

in order to safeguard the profitability of their investment. It is important to remember that there is a reciprocal relationship between Bitcoin prices and news on Bitcoin, particularly during times of price surges. Similarly, the results indicated a positive correlation between the amount of news articles and times of increasing Bitcoin returns. Investors should also monitor this scenario closely [43].

Gocmen (2022) highlights that crypto assets lack a definitive fundamental price and are highly susceptible to speculation due to the absence of economic underpinnings for calculating their intrinsic value. This leads to extreme price volatility and substantial uncertainties regarding their returns. These properties are in great demand in the industry. It is believed to initiate the construction of bubbles, as well as increase volatility and uncertainty. These qualities are believed to stimulate the building of bubbles, as well as contribute to high levels of volatility and uncertainty in the market [51]. Furthermore, as highlighted by Shahzad et al. (2022), the valuation of cryptocurrencies is not grounded in traditional principles [52]. Gupta and Chaudhary (2022) have identified a strong spill over within the different cryptocurrencies, noted especially between Bitcoin and Ether. In their study, a strong spillover between three virtual currencies through the DCC GARCH model and EGARCH was justified with the fact that there exists a significant interconnection within the cryptocurrency market [53]. Consequently, the crypto market is highly responsive to psychological factors such as popularity, speculative and manipulative activities, economic sentiment, and fear of missing out. This susceptibility contributes to the occurrence of abrupt fluctuations in cryptocurrency prices.

Factors that influence the volatility and returns of cryptocurrencies like Bitcoin range from economic uncertainty, gold return all the way to social media sentiment. Similarly, Benhamed et al. (2023) employed the Gets reduction approach to evaluate the principal determinants influencing Bitcoin returns and volatility and pointed out the contribution of foreign economic as well as social determinants [54].

As a result, within the scope of this study, the price behavior of Bitcoin, which is the main actor of the cryptocurrency world and one of the most important financial trends of the new world, was examined. In the study, Bitcoin price data from past to present was used as the basic input, and the main factors affecting the ups and downs in this data were emphasized. In the light of the findings, the herd psychology of bitcoin price behavior, which is mostly discussed within the scope of behavioral finance, and the effects of positive/negative news about Bitcoin on investor confidence come to the fore. Along with the behavioral finance parameters that will make Bitcoin price behavior meaningful, it may not always be possible to attribute some changes in the relevant data to a specific reason. The main view supporting this situation is based on the personal nature of cryptocurrency itself. Therefore, it is crucial to consider the diverse perspectives and individual motivations of investors when analyzing Bitcoin's price fluctuations. In addition, although the Bitcoin price predictions made within the scope of the study show a certain degree of consistency based on historical data trends up to a certain point due to the independent nature of Bitcoin, it is not wrong to say that they will be subject to different effects within the framework of the above-mentioned economic changes, global events and behavioral finance elements. In the future studies, it is aimed to make a more advanced prediction based on this study including the factors that will affect Bitcoin with machine learning and artificial intelligence tools. In their crypto prediction study with machine learning modeling, Tiwari et al. (2021) emphasized the importance of feature engineering in cryptocurrency price prediction and stated that the model built without this engineering would decrease important performance indicators such as accuracy and AUC [55].

As stated in the estimation study conducted by Saha (2023), such predictive studies have some limitations and potential sources of bias that should not be ignored. Firstly, relying solely on historical cryptocurrency price data cannot fully reveal the highly volatile and dynamic behavior of the crypto market. Therefore, regulatory changes, market sentiment and other external factors that are important determining factors for cryptocurrency prices are not possible to predict with only historical price data. In this sense, external data sources also need to be considered [56].

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