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The Ultra-short-, Short- and Short-medium- Term Impact of Covid-19 Pandemic on Bitcoin Prices

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Abstract: The global outbreak of the COVID-19 pandemic has led to significant disruptions in financial markets, including the virtual currency market. This study examines the impact of the pandemic on Bitcoin prices across ultra-short, short, and short-medium time scales. Using ARIMA modeling, this paper analyze the dynamic behavior of Bitcoin prices in response to the effects of the pandemic. This findings illustrate distinct patterns of behavior in different time frames. First of all, from the ultra-short term perspective, after the local outbreak of the epidemic in China, compared with the control group constructed by the model, the price of Bitcoin has a relatively obvious upward trend during this period. In the short term, the outbreak of the global epidemic has led to a setback in investor confidence in all kinds of financial assets, and Bitcoin is no exception, and it is also facing a sharp decline. In the short to medium term, Bitcoin has acted as a safe haven asset in the context of the global pandemic of Covid-19. Understanding these intricate dynamics provides valuable insights into Bitcoin's multifaceted role during times of global uncertainty.

Keywords: COVID-19 pandemic, Bitcoin prices, ARIMA modeling, market fluctuations, safe-haven asset

1. Introduction

Since the outbreak of the COVID-19 pandemic, global financial markets and economic systems have experienced unprecedented impacts and challenges. In this period of heightened uncertainty, various assets and markets have undergone significant fluctuations, including the realm of digital currencies. Particularly, Bitcoin, one of the most prominent cryptocurrencies, has garnered considerable attention for its performance against the backdrop of the pandemic.

Bitcoin has consistently played the role of a non-traditional financial asset, with its price being influenced by a multitude of factors including market sentiment, global economic dynamics, and changes in government policies, among others. However, the eruption of the COVID-19 pandemic has injected a greater degree of complexity and variables into Bitcoin's trajectory. The pandemic triggered global market turmoil, heightened investor anxiety, and posed challenges to market liquidity, all of which have had profound implications on Bitcoin's price and trading activity.

Beyond the short-term market volatility, the COVID-19 pandemic has also cast a deep impact on the global economic framework. Lockdowns, isolation measures, and disruptions in global trade have resulted in production and supply chain interruptions, thereby affecting real-world economic performance. Against this backdrop, there has been heightened interest in how Bitcoin has performed

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during this period. During the pandemic, did investors consider Bitcoin as a safe-haven asset? Did Bitcoin assume a more significant role in digital payments and value storage? Is the impact of the COVID-19 pandemic on Bitcoin transient, or does it manifest as a lasting effect over a longer time horizon?

The objective of this paper is to comprehensively analyze existing literature and data, in order to delve into the impact of the COVID-19 pandemic on Bitcoin. This paper will focus on examining the price trends of Bitcoin across different timeframes and investigate its relationships with market and economic factors. Through this study, this paper aim to enhance the understanding of Bitcoin's performance within the context of global crises, offering valuable insights for investors, decision-makers, and the academic community to better navigate future challenges in the financial markets.

The remaining structure of this paper is outlined as follows: Section 2 constitutes the literature review, encompassing pertinent research concerning the impact of the COVID-19 pandemic on the U.S. stock market and the realm of cryptocurrencies. This paper shall embark on a comprehensive exploration of how the COVID-19 pandemic has affected the price dynamics and trading activities of Bitcoin, alongside its broader implications on the digital currency landscape. The section concludes by summarizing the salient points extracted from the literature review. Section 3 describes the research methods. This paper collected the closing price of bitcoin from 2016 to the present, focusing on the price of bitcoin around the time of the emergence of COVID-19 on January 24, 2020. This paper use the ADF test to test the stability of the model and introduce the ARIMA model to predict the price of bitcoin. The goal is to analyze the impact of COVID-19 on bitcoin on different timescales. Section 4 will employ actual price data, calculated Fitted data, and generated visual representations to illustrate the multifaceted impact of the COVID-19 pandemic on Bitcoin across varying temporal scales. Utilizing these empirical analytical outcomes, this paper shall conduct an indepth analysis of the reverberations of the pandemic within the Bitcoin market. Ultimately, this paper shall draw conclusions and formulate predictions, while also delving into the discourse surrounding market volatility and Bitcoin's role as a safe-haven asset.

2. Literature Review

2.1. Impact of the Epidemic on the Virtual Currency Market

Impact of the epidemic on the Virtual Currency Market The virtual currency market, as an emerging financial field, is marked by high price volatility, which is largely driven by market sentiment and investor confidence. Studies show that the COVID-19 pandemic has had a noticeable impact on the virtual currency market [1, 2]. In particular, during the initial phase of the pandemic, market panic caused sharp drops in the prices of major virtual currencies such as Bitcoin [1, 2]. However, over time, some virtual currencies have shown signs of being safe-haven assets, attracting the interest of investors [3]. For example, Bitcoin has recovered from its initial plunge and reached new highs in 2020 and 2021, surpassing $60,000 in March 2021 [4]. Similarly, Ethereum, the second-largest virtual currency by market capitalization, has also increased its value and popularity during the pandemic [5]. Some researchers suggest that virtual currencies can provide a hedge against inflation and currency devaluation in times of crisis [6]. Others argue that virtual currencies are still subject to high uncertainty and risk, and their long-term performance depends on various factors such as regulation, innovation, and adoption [7].

2.2. Impact of the Epidemic on the US Stock Market

As one of the largest stock markets in the world, the US stock market has been directly affected by the outbreak of the COVID-19 pandemic [8-10]. Research highlights the profound and widespread effects of this pandemic on the US stock market [8-10]. In the early stages, panic sentiment spread

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quickly, leading to multiple occurrences of market circuit breakers being activated—a phenomenon not seen since 1987 [8, 9]. Circuit breakers are meant to reduce excessive market volatility, but in the face of the pandemic's impact in 2020, the market still experienced extremely intense fluctuations [8, 9]. On various trading days in that year, market volatility surged like a wave, resulting in four consecutive circuit breaker events [8, 9]. This series of events reflected investors' deep anxiety about the global economic outlook, as well as the market's increased sensitivity to information [8-10]. The interaction of investor panic and market uncertainty had significant negative impacts on the stock market [8-10]. However, with the introduction of government stimulus measures, the market gradually stabilized [8, 9].

2.3. Interplay Between the Virtual Currency Market and the US Stock Market

In the context of the COVID-19 pandemic's spread, the relationship between the virtual currency market and the US stock market has become more complex. Research indicates that during the initial phase of the pandemic, there was some degree of correlation between the volatility of the virtual currency market and that of traditional stock markets [11, 12]. Both domains were affected by global market sentiment and increased investor anxiety [11, 12]. However, as the pandemic progressed, the virtual currency market gradually showed features different from traditional financial markets [13, 14]. Investors started to perceive virtual currencies as potential safe-haven instruments, leading to a higher complexity in the relationship between virtual currencies and the stock market [13, 14].

2.4. Review

In summary, the existing literature underscores the substantial impact of the COVID-19 pandemic on both the Virtual Currency Market and the US Stock Market. The initial phase of the pandemic induced widespread market panic, resulting in sharp declines in both virtual currency prices and stock market indices. The unprecedented activation of circuit breakers in the US Stock Market highlighted the magnitude of investor anxiety and economic uncertainty. However, over time, virtual currencies exhibited a nuanced response, with some evolving into perceived safe-haven assets, such as Bitcoin and Ethereum, thereby altering their relationship with traditional stocks. This shift in perception introduces a complex interplay between the two markets, underscoring the dynamic nature of investor sentiment and its influence on financial instruments amid crisis.

3. Research Design

3.1. Data Source

The data for this study is sourced from the financial website Investing, specifically utilizing its resources to acquire the closing price data of the Bitcoin market. The data spans from 2016 to the present day, with a particular focus on the period surrounding the outbreak of the COVID-19 pandemic, which is set at January 24, 2020. This paperhave collected daily closing prices of Bitcoin to analyze the impact of the pandemic on the Bitcoin market. These data points will serve as a robust foundation for empirical analysis, shedding light on the influence of the COVID-19 pandemic on the trends in Bitcoin prices.

3.2. Weak Stationarity Test

Prior to finalizing the model construction, the paper conducts a unit root test (also known as a smoothness test) on the model. The initial hypothesis posits that the model lacks smoothness. After inputting the dataset into Stata and conducting the Augmented Dickey-Fuller (ADF) test, the results in Table 1 reveal that the p-values associated with the first and second-order differences of daily,

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weekly, and monthly log-returns are all below 0.1. Consequently, this leads to the rejection of the original hypothesis that the model is stable and viable.

Table 1: ADF test.

Variables	t-statistic	p-value
	Daily	
Raw	-1.021	0.9412
1st order difference	-26.799	0.0000
2nd order difference	-47.961	0.0000
	Weekly	
Raw	-1.118	0.9260
1st order difference	-10.136	0.0000
2nd order difference	-19.153	0.0000
	Monthly	
Raw	-3.414	0.0495
1st order difference	-4.844	0.0004
2nd order difference	-5.745	0.0000

3.3. ARIMA Model

Autoregressive Integrated Moving Average（ARIMA）model is shown in equation (1).

$$\nabla^d X_t = \phi_0 + \sum_{i=1}^{p} \phi_i \nabla^d X_{t-i} + a_t - \sum_{i=1}^{q} \phi_i a_{t-i} \quad (1)$$

In the above formula, each letter has the following meanings:

X_t: The value of the time series at time t.

$\nabla^d X_t$: The value of the time series after dd order differencing at time t.

ϕ_0: The constant term, representing the mean of the time series without lagged terms and errors.

ϕ_i: The coefficients of the autoregressive model, representing the influence of the ith lagged term.

p: The order of the autoregressive model, representing how many lagged terms are considered.

a_t: The volatility of the time series at time t.

q: The order of the moving average model, representing how many lagged error terms are considered.

The equation (1) presented above illustrates that $\phi_0 + \sum_{i=1}^{p} \phi_i \nabla^d X_{t-i}$ represents the Auto Regressive (AR) model. This model employs past returns of Bitcoin to project future outcomes. On the other hand, while $a_t - \sum_{i=1}^{q} \phi_i a_{t-i}$ constitutes a component that employs previous volatilities to anticipate future trends. This component forms the latter part of the model.

In the context of this paper, the AR model employs historical gains before the emergence of the COVID-19 pandemic, spanning from January 1, 2016, to January 24, 2020. In parallel, the Moving Average (MA) model utilizes error terms to make predictions about the future.

3.4. ARMA(p,q) Identification

In this section of the article, the primary imperative entails the sequential arrangement of the second-order differences of the daily, weekly, and monthly log-return series. This arrangement is accomplished through the utilization of PACF and ACF pairings. The ensuing outcomes of this procedure are presented herewith. The main reason why first-order difference modeling is not used in this paper is that it is difficult to determine the order of first-order difference after testing, so second-order difference is chosen.

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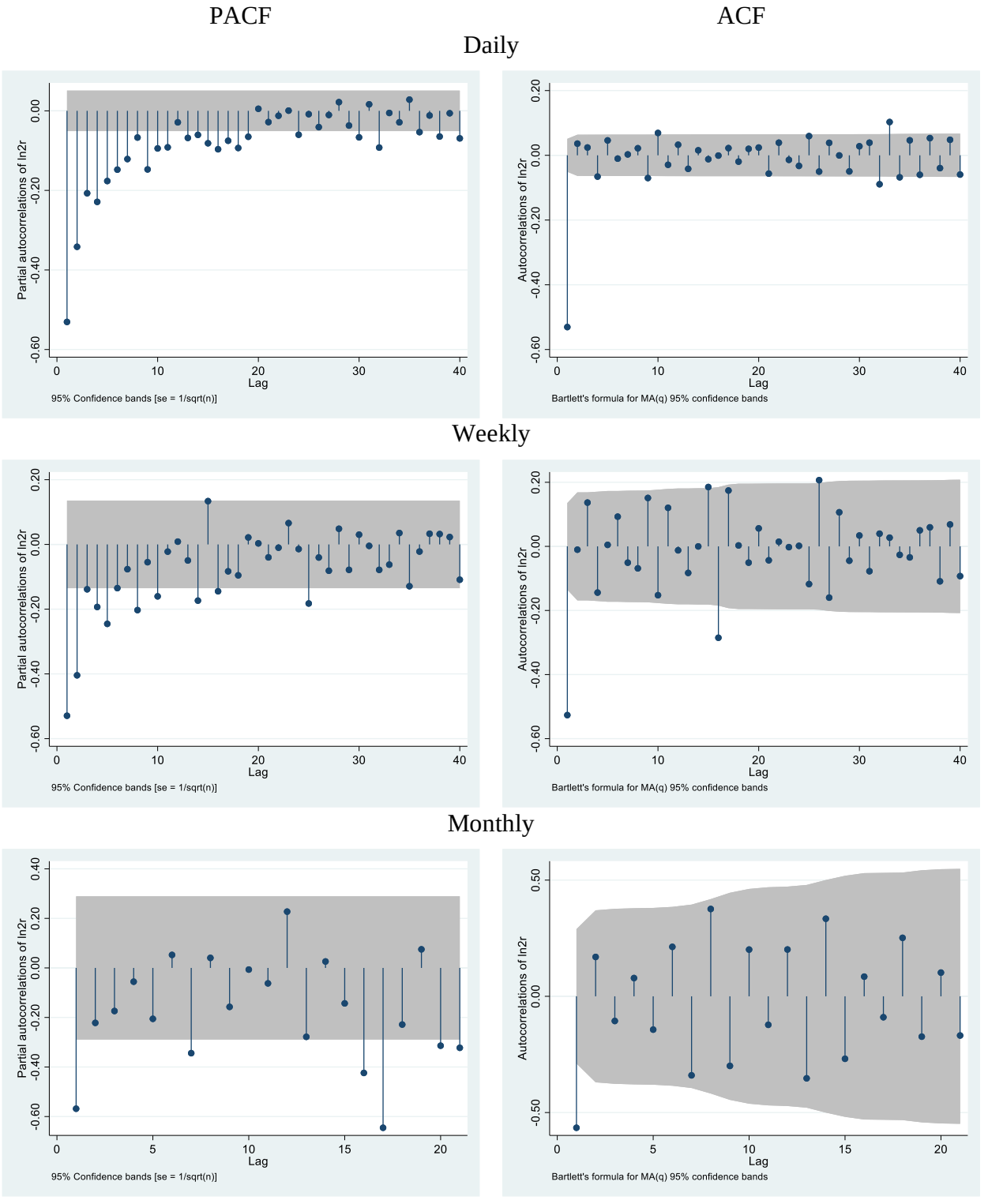

Figure 1: ARMA (p, q) identification.

Photo credit: Original.

The vertical axis portrays the dependent variable, depicting the Partial Autocorrelation Function (PACF) and Autocorrelation Function (ACF) of the second-order differences in the logarithmic returns of Bitcoin across daily, weekly, and monthly intervals. Meanwhile, the horizontal axis reflects

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the temporal lag order. The area demarcated by y=-2 and y=2 designates the 95% confidence interval applicable to the AR(p) and MA(q) models.

Initially, this study necessitates the arrangement of second-order differences pertaining to daily log-returns, followed by their graphical representation in Figure 1.In the PACF plot, observations ranging from orders 1 to 11 consistently exceed the critical thresholds. Nevertheless, it is acknowledged that when dealing with higher orders of Autoregressive (AR) components (AR(P)), the process of Maximum Likelihood Estimation (MLE) often encounters convergence issues. Consequently, a judicious decision is made to set the order of AR(P) to 10. Concomitantly, the ACF plot reveals that the initial segment exceeding the x-axis corresponds to a lag of 1, thereby guiding the selection of the Moving Average (MA(q)) order as 1.

Subsequently, the focus shifts to the sequencing of second-order differences associated with weekly log-returns, which are then visually depicted in the aforementioned figure. Within the PACF plot, the 10th order transgresses the critical values. In consideration of ensuring the convergence of MLE, a deliberate choice is made to designate the AR(P) order as 10. Meanwhile, the ACF plot showcases a primary segment beyond the x-axis at lag 1, followed by a secondary segment extending beyond the x-axis and spanning beyond lag 10. Consequently, the MA(q) order is established as 1.

Lastly, the investigation extends to the arrangement of second-order differences related to monthly log-returns, subsequently showcasing the outcomes within the same figure. In the PACF plot, the first part beyond the x-axis is 1, the second part beyond the x-axis is 7, Therefore, AR(P) is chosen to be of order 7. In the ACF plot, the first part beyond the x-axis is 1, so MA(q) should be of order 1. Nevertheless, subsequent to rigorous computation, the outcome deduced via MLE does not exhibit convergence under these circumstances. Consequently, the determination is made to set the order of the MA(q) component to 0, leading to a degeneration of the ARMA model into the AR model.

3.5. Residual Test

This section present a comprehensive analysis of the residual test results for three distinct ARIMA models: Daily-ARIMA(10,2,1), Weekly-ARIMA(10,2,1), and Monthly-ARIMA(7,2,0). The residual tests serve as a critical assessment tool to evaluate the models' adequacy in capturing temporal dependencies within the data, as well as the presence of significant residual autocorrelations.

Table 2: Residual test.

Model	Portmanteau (Q) statistic	Prob > chi2
Daily-ARIMA(10,2,1)	69.8211	0.0024
Weekly-ARIMA(10,2,1)	30.3834	0.8643
Monthly-ARIMA(7,2,0)	32.0421	0.8108

For the Daily-ARIMA(10,2,1) model, the Portmanteau (Q) statistic yielded a substantial value of 69.8211. Accompanying this, the calculated p-value (Prob > chi2) of 0.0024 is significantly lower than the conventional significance level of 0.05. These results collectively indicate the presence of notable residual autocorrelations. The implication is that the model does not fully capture certain temporal patterns or trends present in the data. This outcome suggests that this model face challenges in effectively predicting the precise magnitude of short-term fluctuations. However, concerning the trends of upward or downward movements, the insights provided by this model still hold valuable reference.

Turning to the Weekly-ARIMA(10,2,1) model, the Portmanteau (Q) statistic returned a value of 30.3834. Correspondingly, the computed p-value of 0.8643 exceeds the 0.05 threshold.As for the Monthly-ARIMA(7,2,0) model, the Portmanteau (Q) statistic produced a value of 32.0421. The

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associated p-value of 0.8108 exceeds the 0.05 significance level. These outcomes suggest a relatively favorable scenario where the residual autocorrelations are not statistically significant. This indicates that the model adequately accounts for temporal dependencies within the data, pointing to promising model performance in terms of residual autocorrelation.

3.6. Estimation Results and Discussion

After January 24, 2020, Wuhan initiated a city-wide lockdown. Subsequent to this, the price of Bitcoin exhibited a rapid escalation. This stands in direct contrast to the projected scenario derived from the fitted model, which anticipated a gradual decrease in Bitcoin price in the absence of the pandemic.

Table 3: Actual value and fitted value, daily.

	Actual value	Fitted value	Difference
2020-01-14	8775.6		
2020-01-15	8807.7		
2020-01-16	8720.6		
2020-01-17	8875.4		
2020-01-18	8891.5		
2020-01-19	8694		
2020-01-20	8638.2		
2020-01-21	8734.1		
2020-01-22	8663.9		
2020-01-23	8403.5		
2020-01-24	8447.1	8445.4309	1.6691
2020-01-25	8353.7	8432.5887	-78.8887
2020-01-26	8621.6	8421.9215	199.6785
2020-01-27	8912	8440.2654	471.7346
2020-01-28	9393.7	8440.0775	953.6225
2020-01-29	9304.2	8429.8125	874.3875
2020-01-30	9512.7	8422.3948	1090.305
2020-01-31	9367.4	8429.6923	937.7077
2020-02-01	9410.6	8436.939	973.661
2020-02-02	9353.1	8423.8084	929.2916

Over a short duration, Bitcoin demonstrated a substantial positive deviation. This phenomenon can be construed as the impact of the COVID-19 outbreak on the Chinese market exerting a significant influence on the Bitcoin market, thereby rendering Bitcoin a short-term safe-haven asset.

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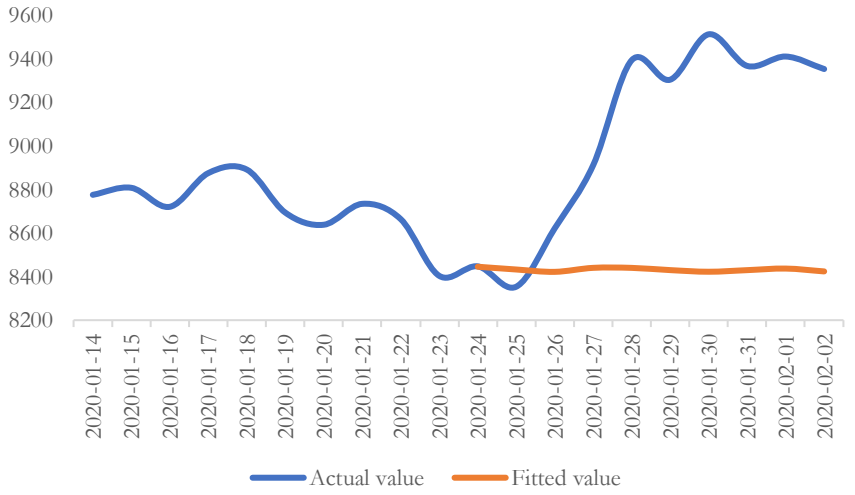

Figure 2: Actual value and fitted value, daily.

Photo credit: Original.

Based on the analysis of weekly data, the price of Bitcoin exhibited a rapid decline after a brief period of upward movement, subsequently plummeting significantly below the projection derived from a hypothetical scenario devoid of the pandemic. This phenomenon can be attributed to the global dissemination of the pandemic, which incited pervasive sentiments of financial apprehension across the market.

Table 4: Actual value and fitted value, weekly.

	Actual value	Fitted value	Difference
2019-11-17	7352.6		
2019-11-24	7599.9		
2019-12-01	7543.2		
2019-12-08	7100.8		
2019-12-15	7166.4		
2019-12-22	7334.4		
2019-12-29	7369.8		
2020-01-05	8013.8		
2020-01-12	8891.5		
2020-01-19	8353.7		
2020-01-26	9410.6	8536.637	873.963
2020-02-02	9877.2	8557.7516	1319.448
2020-02-09	9901	8408.6676	1492.332
2020-02-16	9662.4	8578.8397	1083.56
2020-02-23	8557.3	8668.8379	-111.538
2020-03-01	8919	8625.9771	293.0229
2020-03-08	5218.2	8743.0495	-3524.85
2020-03-15	6201.8	8850.0219	-2648.22
2020-03-22	6249.3	8758.4699	-2509.17
2020-03-29	6881.6	8834.3187	-1952.72

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During the period from February 1, 2020, to April 1, 2020, the NASDAQ Composite Index experienced a decline of 32.6%, diminishing from 9838.37 to 6631.42 within a span of six weeks; concurrently, the Dow Jones Industrial Average Index descended by 38.1%, declining from its zenith of 29409.09 to 18213.65 within the same temporal framework.

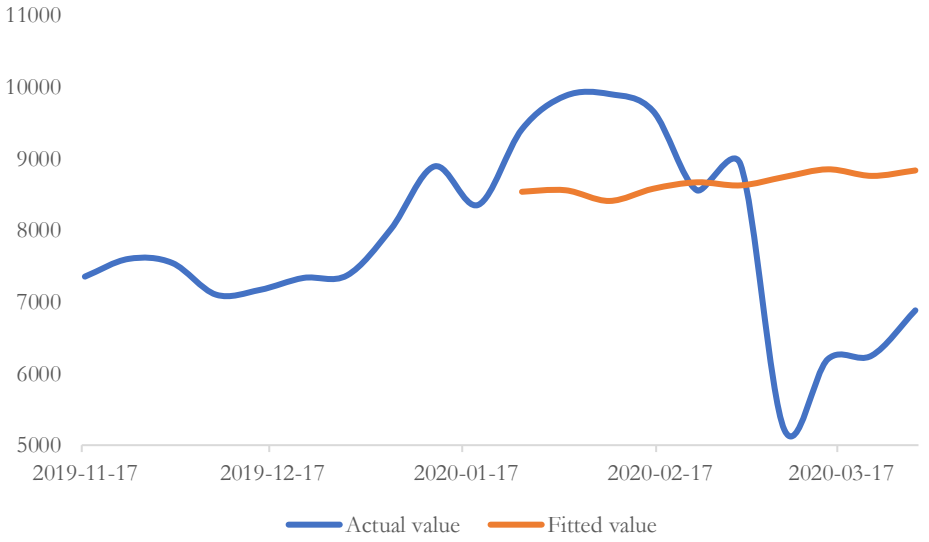

Figure 3: Actual value and fitted value, weekly.

Photo credit: Original.

Throughout this interval, the U.S. stock market encountered four circuit breaker occurrences, concomitant with substantial capital withdrawals. Against this backdrop, Bitcoin emerged as a conspicuous prospective investment target. However, it is imperative to note that Bitcoin's salient attribute of heightened volatility necessitates due consideration.

Table 5: Actual value and fitted value, monthly.

	Actual value	Fitted value	Difference
Jun-19	10745		
Jul-19	10088		
Aug-19	9623.9		
Sep-19	8331.1		
Oct-19	9185.6		
Nov-19	7599.9		
Dec-19	7208.3		
Jan-20	9367.4	7429.7914	1937.609
Feb-20	8557.3	7808.227	749.073
Mar-20	6427.7	7543.2945	-1115.59
Apr-20	8635.3	7631.4781	1003.822
May-20	9452.1	7067.5627	2384.537
Jun-20	9150.6	7208.748	1941.852
Jul-20	11350	6677.6886	4672.311

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Based on monthly data analysis, following the global financial panic that transpired between February and March 2020, Bitcoin's price exhibited a rapid surge, demonstrating a trend entirely contrary to the projected price based on the hypothetical scenario devoid of a pandemic. Moreover, compared to other traditional financial assets, Bitcoin's price was not subjected to sustained downward pressure. Instead, it displayed an exceptionally robust rebounding trend. This phenomenon effectively validates Bitcoin's capabilities as a diversified investment, a hedge, and a means of storing value. Moreover, the key distinction lies in Bitcoin's fixed total supply, which was established from its inception and remains unaltered over time. This stability enables Bitcoin to exhibit consistent characteristics when facing external shocks, in contrast to traditional currency policies, where central banks can employ measures like printing money to address crises. In conclusion, Bitcoin's ability to withstand risks and its attributes as a store of value and appreciating asset find robust confirmation in this event.

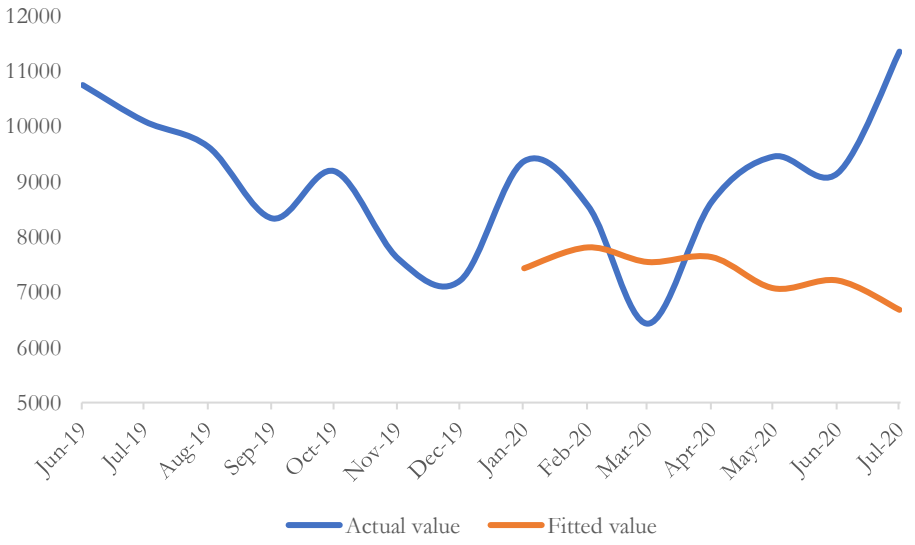

Figure 4: Actual value and fitted value, monthly.

Photo credit: Original.

4. Conclusion

The primary aim of this study was to explore the impact of the COVID-19 pandemic on the Bitcoin market, encompassing both short-term and long-term effects. Through a comprehensive analysis, this research aimed to provide insights into Bitcoin's response to the pandemic, its price dynamics, and its role as a safe-haven asset. Tshe study employed actual price data, empirical analytical techniques, and statistical modeling to unravel the intricate relationship between the pandemic and Bitcoin's behavior.

The investigation began by examining the volatility and price patterns of Bitcoin within different temporal scales—ultra-short, short, and short-medium term. The ARIMA modeling technique was leveraged to elucidate Bitcoin's responses to pandemic-induced events. The findings underscored the nuanced patterns in Bitcoin's behavior across varying timeframes. In the ultra-short term, swift and notable reactions to pandemic events were observed. Contrarily, the short-term analysis revealed Bitcoin's resilience and potential as a safe-haven asset, offering a hedge against market turbulence. However, the short-medium term exhibited challenges stemming from broader economic trends, indicating a complex interplay between Bitcoin and external factors.

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From the empirical outcomes, it was evident that the COVID-19 pandemic had immediate repercussions on Bitcoin's market dynamics. The paper's insights also extended to the broader implications of the pandemic on the global economic landscape. Amidst market turmoil, Bitcoin's behavior revealed its multifaceted role—both as a speculative asset and a potential safe-haven during volatile times. This duality suggested that while Bitcoin was subject to short-term market fluctuations, it had the potential to weather economic storms and emerge as a store of value in the long run.

Looking ahead, the research anticipated a continued discourse on market volatility and Bitcoin's status as a safe-haven asset. As global interdependencies increase and transformative technologies redefine industries, Bitcoin's role will continue to evolve. Just as the semiconductor industry needs to adapt and collaborate, the cryptocurrency sector will also have to navigate challenges through cooperation and innovation. In a world where uncertainties and disruptions are constant, both industries can thrive by actively responding to challenges, enhancing competitiveness, and seeking strategic partnerships to pave the way for a resilient and prosperous future.

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