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Bitcoin Price Bubbles and The Factors Driving Bitcoin Price Formation

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ABSTRACT

Bitcoin, one of the most discussed events of recent times, is the first cryptocurrency to be released. Bitcoin has the biggest market capitalization in the cryptocurrencies, and it is a decentralized payment tool that cannot be controlled by any government institution. Cryptocurrencies operate on top of a decentralized network, recording and verifying transactions using Blockchain. Many bubble price formations occurred in financial markets throughout history. Cryptocurrency markets are prone to manipulation because they are not connected to any center. This study aims to to investigate the bubble formations in Bitcoin (BTC) US Dollar price for the period of 11 December 2017 - 31 July 2023, and determine the main financial variables affecting Bitcoin prices. ARDL Bounds test proves the cointegration between Bitcoin price and dependent variables. Error Correction Model determines a positive connection between BTC and the Nasdaq100 index. A daily change in the Nasdaq100 index leads to a 0.58% increase in BTC price. The model captures also a negative relationship between the Volatility Index, USD Index and BTC price. No long-term relationship emerges in the results. In the long run, unique and different variables shape BTC price formation.

Keywords: Cryptocurrency, Bitcoin, Price Bubble, Financial Modeling, ARDL Model.

JEL Classification Codes: E40, G12, C32, G17

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INTRODUCTION

In parallel with financial globalization, banks and financial market firms are looking for new methods and/or ways to perform payment transactions more effectively and with lower costs in the national and international systems. Recently, they have had an intense interest in cryptocurrencies after Blockchain technology, a new and alternative payment system. This technology can be used in many areas such as, utility exchange, energy trading, automatic invoicing for electric vehicle charging stations etc. Blockchain technology offers cross-border payment systems instead of interbank systems. Thus, cryptocurrencies such as Ripple and Stellar put some new models into service. These cryptocurrencies are solutions for performing transactions across all currencies (Treleaven et al. 2017).

The first emergence of cryptocurrency was the publication of Nakamoto's article "*Bitcoin: A peer-to-peer electronic cash system*" (2008), and the first Bitcoin was released on January 3, 2009. There is no clear information about whether Nakamoto is the only one behind this new currency or whether he used his real name. Since the resources of the system are open-coded, the software developers constantly strengthen the system and additions are made to improve the usage area of the system. The most prominent point of the system is that money transfers may be made without the need for any intermediary institution or payment instrument (Greenberg, 2011). Cryptocurrencies are the mechanisms that provide an end-to-end (peer-to-peer) payment system without the need for a financial intermediary. The price of cryptocurrencies is determined through a security algorithm. Cryptocurrencies has many advantages such as low transfer costs, high efficiency, and alternative financial solutions for the markets. They also lead to many problems, such as energy costs, environmental pollution, volatility, and security issues. The absence of a traditional basis in the price valuation of cryptocurrencies allows the formation of volatility in the cryptocurrency market, which is highly sensitive to psychological variables such as vogue, speculative and/or manipulative activities, economic morale, fear of missing the opportunity (Shahzad et al., 2022).

The Internet age, along with financial innovation and other developments, has given rise to an entirely electronic alternative currency based on a transaction-friendly algorithm for instant transfers and a peer-to-peer

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mechanism that allows for creating transparency and storing transaction history. Due to its advantages and innovations, Bitcoin, the flagship cryptocurrency that started trading in 2009, is the most popular and most traded decentralized free cryptocurrency today. Bitcoin has been widely accepted as a currency compatible with current technology, providing fast, reliable and low-cost transfer. Bitcoin (BTC) was first introduced in 2009 as a cryptocurrency and is the cryptocurrency market leader in terms of market capitalization.. The adoption of Bitcoin as a means of payment has increased the interest in itself. Specifically, Bitcoin was issued to trade goods within a network of buyers and sellers that recognize it as a means of payment. Also, Bitcoin, which offers money and investment opportunities as a different option, operates outside of central financial institutions. BTC is a solution to optimize transactions by reducing costs and partially eliminating the need for financial intermediaries. Bitcoin transactions proceed in the Blockchain system, a database that provides encrypted transaction tracking. This system is similar to an accounting ledger and records each transaction. This system verifies payments between parties using methods such as asymmetric encryption, point-to-point network connection and proof of work.

Bitcoin was launched as 0.004 US Dollars in May 2010. Bitcoin has led to the emergence of different cryptocurrencies such as Ethereum, Cardano, Dogecoin and Ripple. Bitcoin price has risen sharply during the COVID-19 era. According to "www.coinmarketcap.com", one of the essential platforms in the crypto money market, as of August 29, 2023, 9.354 different cryptocurrencies are on trade, and the global crypto market value is 1.05 Trillion USD. Figure 1 shows the Bitcoin prices in US Dollars from the period of 11 December 2017 – 31 July 2023.

Bitcoin is not universally accepted as a medium of Exchange, although many companies nowadays accept it as a payment method (de la Horra et al., 2019). Yermack (2013) also point outs that Bitcoin is an investment tool or a speculative asset rather than a currency. Bitcoin price is highly correlated with its trading features, and macroeconomic events have no effect on BTC price. Therefore, Bitcoin has no chance of being included in risk management process, and Bitcoin holders has diffuculties to obtain hedge positions. Risk and volatility are the two main disadvantages encountered using Bitcoin. Although Bitcoin is limited in quantity, its constant increase in demand is the biggest reason for the fragility seen in prices. The high volatility in Bitcoin prices is its main drawback, which has led to criticism as to whether it is a currency or not. The main reason for this disadvantage is that this market is far from regulation and has low liquidity problems.

The fact that Bitcoin has no central control and is far from regulations has led to it being open to speculative movements, and the predictability of the course of price movements has been a subject of constant research. Bitcoin price and price bubbles in BTC price studies come to the fore in recent years. Ample studies on the Bitcoin and price formation appear in the academic literature. Demand and supply are essential factors in BTC price formation. The arrival of new information positively affects the price of Bitcoin, and increases the trust of BTC investors. Cryptocurrencies do not generate cash flow. Bitcoin investors adjust prices according to behavioral biases (Smales, 2022). Cryptocurrencies generally do not serve as legal tender or as an ordinary and official medium of exchange. Therefore, cryptocurrencies offer an ideal environment to test speculative behavior (Geuder et al.,

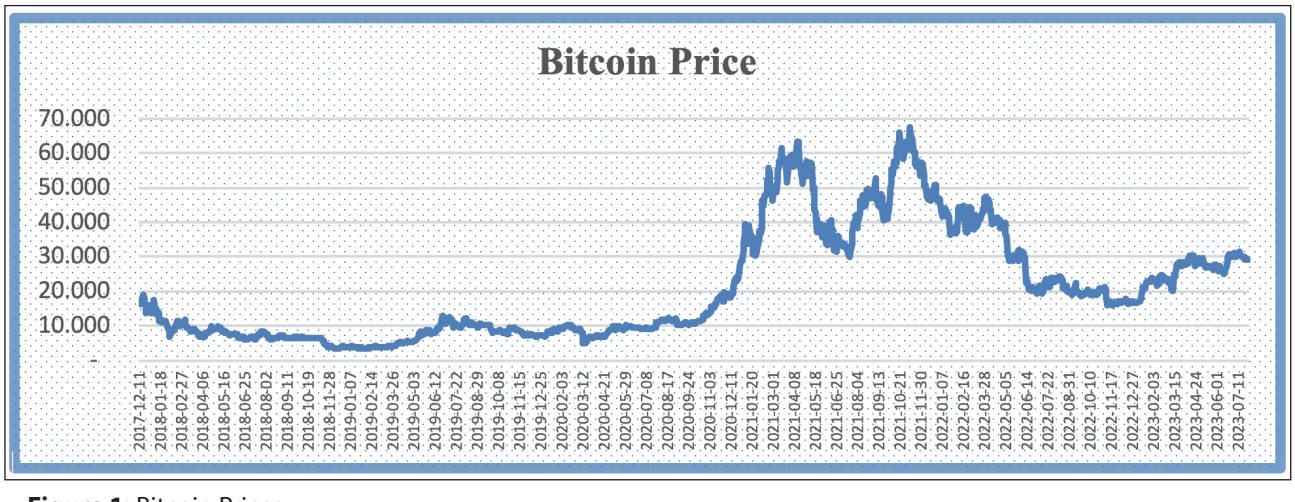

Figure 1: Bitcoin Prices

2019). The main feature distinguishing crypto money markets from others is that the participants are primarily investors with no or minimal investment history, and this situation makes the market psychology phenomenon much more critical than other asset markets. Also, these investors are much more inclined to act irrationally than other market investors.

Despite the diversity of cryptocurrencies, Bitcoin has arguably been the most used currency in the world. It is a well-known fact that the abundance of liquidity brought about by the monetary expansion and negative real interest policies of the developed countries after the 2008 financial crisis and the coronovirus case pushed asset and cryptocurrency prices up. In fact, many economists frequently warn investors about asset bubbles. This study considers these warnings, and aims to examine the bubble formations of the Bitcoin price for 11 December 2017 - 31 July 2023. In addition, the second aim is to determine the main financial variables affecting Bitcoin prices.

LITERATURE REVIEW

Digital currencies propose a move away from the established design of financial system infrastructures; technological solutions and information systems such as cryptographic algorithms provide decentralized organization, transparency and operational security. These currencies oppose traditional monetary systems that are centrally coordinated and less transparent (Bartos, 2015). Cryptocurrencies like Bitcoin appear to be viable competitors for central bank fiat currencies, posing a challenge to central banks. Central banks have begun to develop payment and clearing processes using blockchain technology and to issue their own digital currencies. A Central Bank Digital Currency (CBDC) is an digital form of central bank money that can be exchanged in a decentralized manner. Transactions with this currency occur peer-to-peer, that is, directly between the payer and the payee, without the need for an intermediary (Bech & Garratt, 2017). CBDCs are digital assets issued by a central authority, usually issued and regulated by a government and managed by a central bank. Unlike decentralized cryptocurrencies like Bitcoin, CBDCs are centralized, state-owned, and legal tender.

Helmi et. al, (2023), investigate the impact of CBDC news on financial and crypto markets with Primiceri's (2005) TVP-VAR model to analyze time-varying data from January 2015 to December 2021. The vector of endogenous variables in the VAR model are the Central Bank Digital Currency uncertainty index, cryptocurrency policy uncertainty index, S&P 500 index, VIX, and Bitcoin price. TVP-VAR analysis prove that responses to CBDC news varied over time. CBDCU shocks effect on financial markets are more prone during COVID-19.

According to Nakamoto (2008), Bitcoin takes place in people's daily life today. This article is a manifesto against the traditional financial system after the Global crisis. The answers to questions such as which financial assets drive the value of Bitcoin or which commodity and/or exchange rate affects the price have been a matter of curiosity. Pioneering studies are theoretical concerns in general. Ample academic studies on Bitcoin take place in recent years. Empirical studies started to emerged with the BTC trading on the Chicago Options Exchange.

The velocity of Bitcoin in circulation, the price of gold, and the deprecation of the Venezuelan currency (demonetization) affect the price of Bitcoin as the market declines (Bouoiyour and Selmi, 2017). Equity market returns, exchange rates, oil yields, FED and ECB (European Central Bank) fund rates and internet have no effect on Bitcoin return. Internet search volume and gold price changes determine changes in BTC price (Panagiotidis et al., 2018). In the framework of GARCH using hourly data, BTC trading volume and speculative demand drive BTC price (Ciaian et al., 2018).

Classical economic theories can not explain Bitcoin's price formation because the cryptocurrency market does not include the essential features of the money market. Therefore, there is no effect of macroeconomic factors on BTC price formation. (Vaddepalli and Antoney, 2018). Similarly, Bitcoin has no macroeconomic fundamentals, and "*rather it acts as a speculative bubble*" (Yermack 2014; Bugan, 2021; Li et al., 2021; Altunöz, 2023). Speculative transactions determine the Bitcoin price, and BTC price does not react to the economic fundamentals. The changes in the United States money supply affect Bitcoin price in the short run, (within 4 day lags), while US fund rates negatively affect (within a lag of 5 and 6 days). Also, Bitcoin price actively responds to volatility in the foreign exchange market with significant coefficients at different lags (Li and Wang, 2017). Its technology is the main factor in the formation of Bitcoin prices. The Global economic climate has absolutely no effect on price. Bitcoin is not a tool as a risk insurance against global recessions (Goczek and Skliarov, 2019).

Meegan et al. (2017) examines whether Bitcoin behaves similarly to traditional currencies. Monetary policy is as an external factor with GARCH model. The implemented policies significantly affect Bitcoin returns, but Bitcoin does not behave exactly like a traditional currency. Almansour et al (2021) conducte ARCH and GARCH analyses based on daily data for the period 2010-2020. The analyses reveal that cryptocurrencies play an important role in predicting future volatility. Moreover, past volatility of cryptocurrencies has an impact on current volatility. Wang C. (2021) analyze the daily closing prices of Bitcoin between 2013 and 2020 with ARCH and GARCH models. The GARCH(1,1) model shows that Bitcoin's returns and volatility tend to cluster in certain periods and form a continuing process, although it decreases over time. Also, Bitcoin has the potential to be a safe instrument that can absorb financial risks and contribute to investor portfolios.

The changes in Bitcoin affect other cryptocurrencies in the long term through NARDL analysis with data from January 2015 to March 2020 (Gonzalez et al., 2020). The impact of uncertainty on the crypto market with volatility models for the period January 2018 - November 2022 is a new study by Höl (2022). Höl (2022) uses the Global Economic Policy Uncertainty Index and geopolitical risks and Twitter-based uncertainties as representatives of market uncertainties. Uncertainties have a positive and significant impact on Bitcoin volatility.

Bubbles, in the simplest way, may be defined as the systematic deviation of an asset's market price from its fundamental value (Kyrazis et al., 2020). The bubble formation means that asset prices are moving away from market fundamentals. Geuder et al. (2019) point out that investors theorize that a cryptocurrency with limited supply will create a higher price in the future, ultimately creating a speculative bubble. Li et al. (2021) determined speculative bubbles using the GSADF model in the period of 2011 and 2020. Diniz et al. (2022) identify the existence of bubbles for cryptocurrencies with the GSADF test. Diniz et. al., (2022) identify the existence of bubbles for cryptocurrencies with GSADF test. Işıldak (2022) investigates the bubbles in cryptocurrencies using SADF and GSADF tests with daily Bitcoin prices between June 2019 - 2022. SADF test detects 6 balloons. GSADF test determines the presence of 13 balloons. Altunöz (2023) determines continuous speculative bubble pricing between 01.01.2017 and 01.01.2020 by GSADF. The much higher price bubble occurs in Ethereum and Bitcoin according to Ripple.

Li et. al. (2019) observe six bubble burst in republic of China and five burst in U.S cryptocurrency market using GSADF methodology. Wang et al. (2020) determine a relationship between BTC price and stock market indices. S&P 500 and Dow Jones indices are statistically significant on Bitcoin price. Prabhune et. al. (2023) point out that "*Efficient Market Hypothesis is not valid in Bitcoin market*". Nasdaq daily returns drive BTC price using the ARDL bound test from 2017 to 2021. Aththanayake and Nanayakkara (2023) indicate that Nasdaq-100 index affects positively and significantly BTC price in long and short term at the the period of January 2018 and September 2022 with ARDL bound test. Akkaya and Tuna (2023) investigate the connection between 8 stock market indices and BTC price in the period January 2016 - May 2022, and conclude that in the short run Nasdaq 100, Dow Jones index and Nikkei225 lead to changes on the Bitcoin prices.

Table 1: Variables

Abbrevation	Variable
BTC	Bitocoin US Dollar price
BRENT	Brent oil barrel price
DAX	Germany Frankfurt DAX index
EUR-USD	Euro/US Dollar Rate
GOLD	Gold Ounce price
NAS100	Nasdaq 100 index
NIK225	Japan Tokyo NIKKEI 225 index
SP500	S&Poors 500 index
USDIX	US Dollar Index
VIX	Volatility index

METHODOLOGY

The first purpose of the study is to examine the bubbles in the US Dollar price of Bitcoin (BTC), a cryptocurrency, in the period of 11 December 2017 - 31 July 2023. Also, paper aims to display the international financial variables driving the BTC prices. Table 1 shows variables added to the model. Data were obtained from yahoofinance.com and the Federal Reserve website. Bitcoin's first trading date on the Chicago Booard of Option Exchange is December 11, 2017. Thus, December 11, 2017 is the first date.

The GSADF (Generalized Supremium ADF) test is generally preferred and used to determine the presence of bubbles in financial markets. There may be difficulties and inconsistencies in the detection of balloons due to the low power in the SADF test. This problem is a major disadvantage to analyze long-running time series or rapidly changing variables where multiple vigorous periods are suspected. To overcome this weakness, they proposed a generalized supADF (GSADF) alternative test. The GSADF test carries on the idea of repeatedly applying a right-tailed ADF test. The alternative new test expands the data set to a broader and more flexible range. Rather than fixing the first observation, GSADF test expands the data set range by changing both the beginning and the end points within an appropriate flexible window range. Phillips et al. (2015) define GSADF statistic as the upper value of the statistical sequence expressed as follows:

$$GSADF(r_0) = \sup_{r_1 \in [0,\, r_2 - r_o]} \left\{ \sup_{r2 \in [0, r0,1]} ADF_{r2}^{r1} \right. \quad (1)$$

This study applies ARDL (Autoregressive Distributed Lag) Model to determine the long-term relationship of international financial variables affecting the BTC price. The ARDL bounds test is a method that has been frequently used in time series analysis in recent years, apart from the cointegration methods proposed by Engle-Granger and Johansen (Pesaran et al., 2001). This method has many advantages. In the cointegration approach, all the variables must be of the same order, but this method can also be used if the variables are stationary of different degrees. It is also not necessary to perform unit root tests of the variables beforehand. Another important advantage is that the ECM (Error Correction Model) is obtained simultaneously with a simple linear transformation. If the data used in time series analysis belong to a limited period, there is a risk of non-cointegration if all data are I(1). The ARDL model long-run equation is in the simplest form as shown below:

$$\Delta Y_t = \beta_0 + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta x_{t-i} + \beta_3 Y_{t-1} + \beta_5 x_{t-1} + \mu_t \quad (2)$$

RESULTS

Bitcion's price is highly correlated with the S&P500 (0.8777) and Nasdaq100 (0.8764) indices. The Nikkei (0.8567) and gold (0.6331) prices follow these two variables. Bitcoin's price is negatively correlated with Dax (-0,5437) and the US Dollar Index (-0.1576) (Table 2).

The GSADF test determines the bubbles in Bitcoin's price between 11 December 2017 and 31 July 2023 (Table 3).

A bubble formation has emerged in Bitcoin's price since the Chicago Booard of Option Exchange started trading (Figure 2). The bubble in the price arises sharpely in the COVID-19 era. With the end of the pandemic, the bubble in the price decreased, but increases also in 2023.-

After determining the bubbles in the BTC price from December 11, 2017, to July 31, 2023, the international financial factors affecting the Bitcoin price and the bubbles will be determined. ADF (Augmented Dickey-Fuller) test results show that there is a structural break in BTC price (Table 4).

Structural break occurs between 27.01.2021 and 15.09.2022 (Figure 3). The structural break coincides with the period of the Covid-19 outbreak. In this period, the price has seen 66,000 US Dollars.

Table 2: Correlations

	DAX	EUR-USD	GOLD	NAS100	NIK225	BRENT	SP500	USDIX	VIX
BTC	- 0.5437	0.2664	0.6331	0.8764	0.8567	0.3667	0.8777	- 0.1576	0.2084

Table 3: GSADF Results

	t-statistic	prob. *
GSADF	-1.3208	0.0000

* % 95 significancy

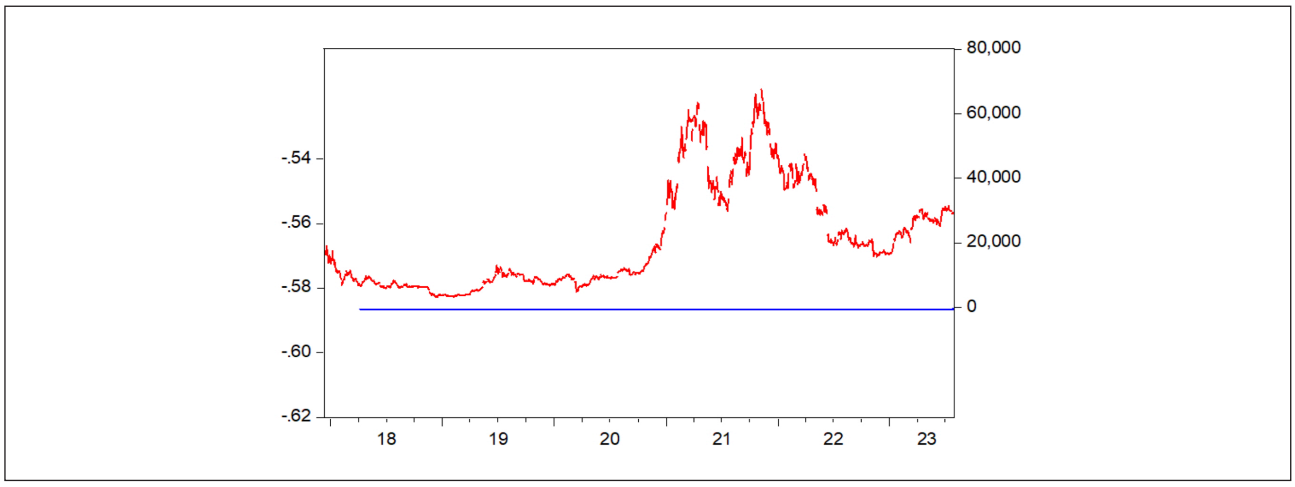

Figure 2: Bitcoin GSADF Graph

Tablo 4: ADF Structural Break Test Results

	t-statistic	prob. *
ADF	-2.9033	0.7374

* Vogelsang (1993) value

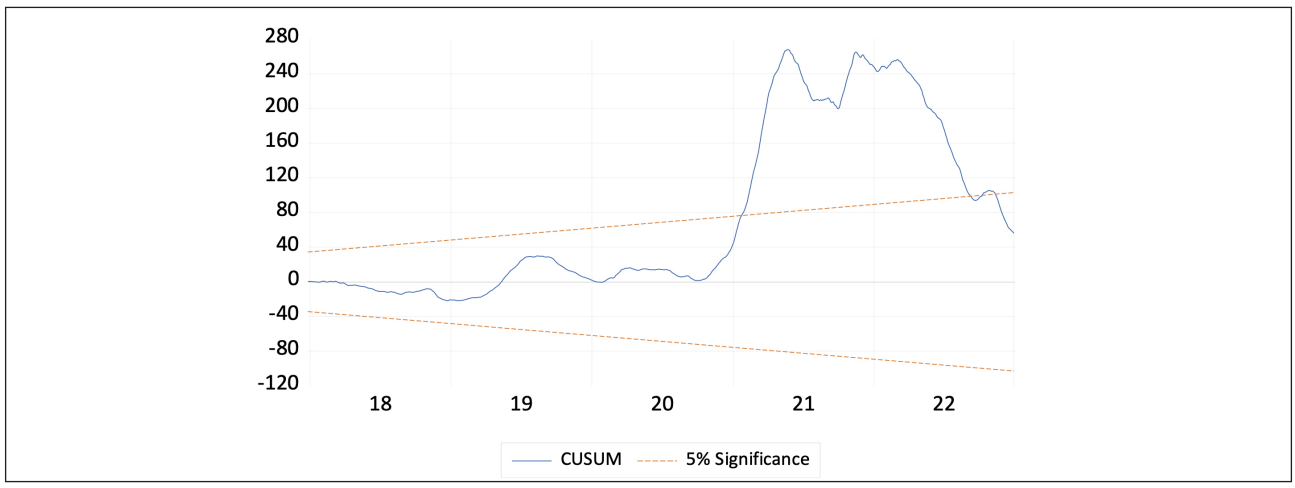

Figure 3: Bitcoin ADF Test Graph

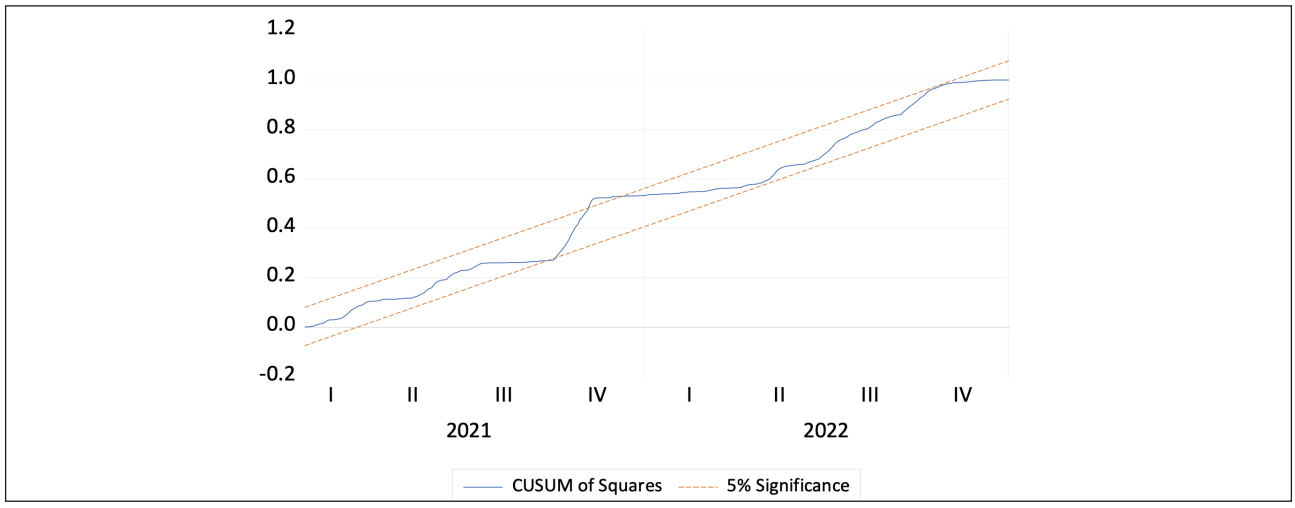

Figure 4: CUSUM Test Graph

Table 5: ADF Results

variable	t-statistic	prob.	1. diff.	prob.
BTC	- 1.3668	0.5999	- 3.8826	0.0000
BRENT	- 1.6181	0.4730	- 3.8063	0.0000
DAX	- 1.6044	0.4801	- 4.1199	0.0000
EUR-USD	- 1.6312	0.4663	- 3.7780	0.0000
GOLD	- 1.2120	0.6713	- 3.9154	0.0000
NAS100	- 1.0745	0.7278	- 4.2597	0.0000
NIK225	- 0.8025	0.8177	- 3.8352	0.0000
SP500	- 1.3260	0.6194	- 4.2303	0.0000
USDIX	0.4601	0.8138	- 3.6897	0.0000
VIX	- 1.5833	0.1068	- 4.7488	0.0001

Table 6: Zivot & Andrews Test Results

Variable	Test Statistic	Zivot ve Andrews Test
BTC	-39.9710***	0.0000
GOLD	-39.1300***	0.0000
BRENT	-37.3590***	0.0000
EUR-USD	-38.3230***	0.0000
USDIX	-37.7290***	0.0000
VIX	-5.3530***	0.0000
NAS100	-45.9040***	0.0000
NIK225	-38.7750***	0.0000
SP500	-40.7340***	0.0000
DAX	-42.3030***	0.0000

***, **, * represent significance at the %1, %5, %10 level of significance respectively.

To correct the structural break, the COVID-19 dummy variable was used between 27.01.2021 and 15.09.2022, and the structural break disappeared (Figure 4).

It is necessary to determine whether time series used in economics and finance studies are stationarity or not. In this respect, this study applies to Dickey and Fuller's (1979) Augmented ADF test. Results prove that the variables contain unit roots. They become stationary using the first (-1) difference. (Table 5).

Ziwot-Andrews (1992) unit root test includes structural changes occurring in level, slope and both slope + level (regime). If the t-statistic is smaller than the Ziwot-Andrews critical value, the basic hypothesis indicating the existence of a unit root is rejected. When accepted, it indicates that the series is trend stationary under structural breaks and does not contain a unit root.

According to Table 6, the hypothesis containing the existence of a unit root is rejected, that is, there is no unit root under structural breaks due to using logarithmic returns.

The appropriate F-tests or information criteria should be selected to determine the optimal lag length for cointegration analysis of the time series. According to the smallest value of Akaike Information Criteria (AIC) and Final Estimation Error (FPE), the lag lenght is three (3) (Table 7).

ARDL Bounds test determines the relationship between Bitcoin price and variables (Table 8). F statistic on Table 8 confirms the cointegration relationship among all variables.

The parameters reflecting the long-term relationship will be estimated for the ARDL model. No long-term relationship emerges in the results. (Table 9). Thus, unique and different variables determine BTC price formation in the long run.

We use the ARDL Error Correction Model (ECM) to estimate short-term relationships between variables. The ECM coefficient is negative and significant. Table 10 presents short-term estimate results. Error Correction Model determines a positive and significant connection between BTC and the Nasdaq100 index. The Nasdaq100 index leads to a 0.58% increase in BTC price. Also, ECM coeeficient is negative and model captures the inverse connection between USD Index, VIX and BTC prices.

Table 7: Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-64087.49	NA	2.35	98.31	98.34	98.32
1	-41349.68	45092.01	1.96	63.58	64.02*	63.75
2	-41042.06	605.33	1,42	63.27	64.10	63.58*
3	-40920.05	238.20	1.38*	63.23*	64.46	63.69
4	-40833.36	167.94	1.40	63.25	64.88	63.86
5	-40744.29	171.16	1.43	63.27	65.29	64.03
6	-40659.05	162.50	1.46	63.29	65.71	64.20
7	-40567.63	172.87	1.48	63.31	66.12	64.36
8	-40480.50	163.44*	1.51	63.33	66.54	64.53

* lag

Table 8: ARDL Bound Test Results

variable	coefficient	std. error	t-statistic	prob.*
BTC(-1)	0.9764	0.0058	167.0483	0.0000
DAX	0.0631	0.0349	1.8056	0.0712
DUMMY	216,6258	179.6615	1.2057	0.2281
EUR-USD	1009.7690	2484.9100	0.4063	0.6845
GOLD	-279.1507	333.1234	-0.8379	0.4022
NAS100	0.5766	0.2099	2.7478	**0.0061**
NAS100(-1)	0.0774	0.2729	0.2835	0.7768
NAS100(-2)	-0.5423	0.1985	-2.7313	**0.0064**
NIKKEI	0.0413	0.0308	1.3399	0.1805
BRENT	-2.0955	3.7719	-0.5556	0.5786
SP500	-0.1054	0.3726	-0.2827	0.7774
USDIX	-207.8039	83.6358	-2.4846	**0.0131**
USDIX(-1)	203.0727	79.7682	2.5458	**0.0110**
VIX	-43.6380	16.0412	-2.7204	**0.0066**
VIX(-1)	50.4646	16.2364	3.1081	**0.0019**
C	-2482.4870	5759.0750	-0.4311	0.6665
R-squared	**0.9954**	Prob (F-statistic)		**0.0000**

Table 9: ARDL Long-term Estimates

variable	coef.	std. error	t-statistic	prob.
DAX	2.6729	1.5642	1.7089	0.0877
DUMMY	9172.5990	6987.8050	1.3127	0.1895
EUR-USD	42756.7100	103648.8000	0.4125	0.6800
GOLD	-11820.1000	13999.8000	-0.8443	0.3987
NAS100	4.7327	3.8419	1.2319	0.2182
NIKKEI	1.7493	1.2604	1.3879	0.1654
OIL	-88.7313	157.5221	-0.5633	0.5733
SP500	-4.4614	16.0578	-0.2778	0.7812
USDIX	-200.3320	1244.7370	-0.1609	0.8722
VIX	289.0570	255.7632	1.1302	0.2586
C	-105116.1000	240242.5000	-0.4375	0.6618
	value	significancy	I(0)	I(1)
F-statistic	1.9871	10%	1,76	2,77
k	10	5%	**1,98**	**3,04**

Table 10: ARDL Short-term Estimates

variable	coefficient	std. error	t-statistic	prob.
D(NAS100)	0.5766	0.2068	2.7883	**0.0054**
D(NAS100(-1))	0.5422	0.1912	2.8363	**0.0046**
D(USDIX)	-207.8039	78.8055	-2.6369	**0.0085**
D(VIX)	-43.6380	15.7429	-2.7719	**0.0057**
CointEq(-1)*	-0.0236	0.0048	-4.9037	**0.0000**
F-Bounds Test				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	**1.9871**	**10%**	**1,76**	**2,77**
k	**10**	**5%**	**1.98**	**3,04**

CONCLUSION

Innovations are the most important driving force of the knowledge or digital economy. Countries and systems with thriving innovation policies are progressing rapidly in many areas. Financial innovations speed up transactions and provide many advantages, such as offering alternatives to products and processes. The innovations and financial instruments of the future are exciting. However, the complexity of financial innovations may increase risk and uncertainty.

The adventure of money has continued to improve over the centuries, and with the Bitcoin article by Nakamoto in 2008, it became the first cornerstone of a new era. Bitcoin, an important financial innovation and a decentralized payment tool that cannot be controlled by any government organization, has entered people's daily lives. Specialists have expectations for the creation of an innovative monetary system that is integrated with the positive aspects of Bitcoin, such as the facts that transactions can be carried out between two parties with a peer-to-peer network architecture without the need for any intermediary, money can travel around the world in a very short time with a single click, these transactions have no cost, and it is a system that can be used at any time.

The creation of Bitcoin is realized with a distributed network based on blockchain technology. Bitcoin has led to the development and proliferation of cryptocurrencies and blockchain technologies. Today, Bitcoin is recognized as one of the most valuable cryptocurrencies worldwide. With the spread of Bitcoin around the world, its usage areas in our social life have also started to increase. Some companies trying to turn this situation into an opportunity, have started to accept payments via Bitcoin. Cryptocurrencies are likely a powerful exchange element. However, whatever the outcome, Bitcoin has been a source of inspiration with Blockchain technology and the understanding of financial freedom that forms the basis of the idea of cryptocurrency.

This study analyzes the bubble formations in the price of Bitcoin between 11 December 2017 and 31 July 2023 using GSADF test. GSADF test proves bubbles in the BTC price throughout all period. This result is consistent with Altunöz (2023) and others. The second aim is to identify the international variables driving the BTC price using the ARDL model. ARDL bound test indicates a cointegration between all variables. ARDL bound test indicates a cointegration between all variables. ECM proves the short-term relationship between Nasdaq100, USD Index, VIX and Bitcoin. Nasdaq100, USD Index, VIX canalize the Bitcoin (BTC) price in the short term. Hovewer, ARDL model can not determine relationship in the long-term. Short-term findings are consistent with Aththanayake & Nanayakkara (2023) and Akkaya & Tuna (2023).

BTC investors shoul be careful. This study advices short position due to bubble in the Bitcoin price since December 2017. It is also recommended to be ready for speculations and bear market in Bitcoin transactions, which is a high-risk asset, especially since the US Federal Reserve (FED) will continue to increase interest rates, and interest rates will remain above 4% until the autumn of 2024. In addition, Bitcoin investors should follow Nasdaq 100 Index and USD Index carefully, and may take position according to the sudden changes in these indices.

In future studies, intraday data and other macroeconomic variables would be useful. It is also recommended to test bubbles and variables with advanced models such as Favar, Svar, nonlinear models, artificial neural networks, etc.

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