

The Cryptocurrency Market and the Financial Stability

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Abstract. *The fast development of the cryptocurrencies has brought to the attention of the authorities and researchers the importance of studying the risks associated with this category of assets. One of the main directions of analysis was the study of the correlations between the crypto-market and other traditional markets in order to assess the impact on financial stability. In the last 2-3 years, more and more studies have showed increasing correlations between the traditional markets and the crypto-market, which could generate some risks to the financial stability. We applied a novel methodology, based on TVP-VAR model, to study the correlations between Bitcoin and three other traditional assets, respectively gold, S&P 500 and EUR/USD from 01/01/2015 to 01/01/2023. We proved that the correlations between traditional assets, such as equity (S&P 500), respectively commodity (gold) and Bitcoin have increased significantly. However, other assets, such as the exchange rates are not correlated with cryptocurrencies and the correlations in the other way, from Bitcoin to gold, respectively S&P 500 are still very low. Thus, our findings indicate that, at this moment, the crypto-market poses risks to the financial stability, but because of the fact that the correlations are still only unidirectional (from traditional assets to cryptocurrency), the crypto-market could now just amplify the risks to the financial stability originating from the traditional markets.*

Keywords: crypto, financial stability, correlations, gold, S&P500, EUR/USD

Introduction

In recent years, the importance of cryptocurrencies has grown significantly. More and more investors, both retail and institutional, have paid attention to this category of assets and have included cryptocurrencies in their portfolio. As a result, the total market cap of cryptocurrencies has increased quickly, reaching a 3 trillion \$ all time high in November 2021. In March 2023, according to Coinmarketcap.com, the total market capitalization of cryptocurrencies was less than 1 trillion \$.

The growth of the cryptocurrencies relevance and the risks associated with trading this type of assets have brought to the attention of the authorities and researchers the importance of studying the correlations between the crypto-market and other traditional markets in order to assess the impact on financial stability. In the last 2-3 years, there have been published a large number of studies on this topic, by both researchers and international institutions, such as the International Monetary Fund, European Central Bank or Financial Stability Board.

In this paper, we applied a novel methodology to study the correlations between Bitcoin (the cryptocurrency with the highest market capitalization) and three other traditional assets, respectively gold (the most traded commodity), S&P500 (the most traded index) and EUR/USD (the most traded currency pair).

We proved that the correlations between Bitcoin and some traditional assets have increased in the analyzed interval (01/01/2015 - 01/01/2023), which shows that cryptocurrencies are becoming an increasingly greater risk to financial stability.

Our paper is structured in 5 chapters, as follows. In the next chapter, we present a literature review on the subject of cryptocurrency market and financial stability. In Chapter 3, we explained the methodology that we applied to study the correlations between Bitcoin and the other analyzed assets. Next, in Chapter 4, we discuss the results that we obtained by applying the methodology mentioned above, while in the last chapter we draw the conclusions.

Literature review

The literature on the subject of cryptocurrencies has had a similar evolution to the one of the market, respectively a fast development in the last five to ten years. Recently, more and more studies have focused on the characteristics of cryptocurrencies and, in particular, on the correlations between this category of assets and the traditional assets (such as commodity, equity, currencies etc.). However, until two to three years ago, the researchers didn't identify significant correlations between cryptocurrencies and traditional assets that would support a possible impact of the crypto-market on the financial stability.

Corbet et al. (2016) studied the correlations between three cryptocurrencies (Bitcoin, Ripple, Litecoin) and other traditional assets (US indexes for equity, exchange rates, gold price and volatility) from 2013 to 2017. They showed that cryptocurrencies are highly connected to each other but they are disconnected from traditional assets. Because of these characteristics, the authors concluded that cryptocurrencies could offer diversification benefits especially for short investment horizons investors.

Dyhrberg (2016) examined, using daily data from 07/19/2010 to 05/22/2015 and applying GARCH models, the characteristics of Bitcoin. He showed some similarities between Bitcoin, respectively gold and US dollar, which indicates hedging capabilities for Bitcoin. Moreover, Dyhrberg argued that Bitcoin can be classified somewhere between gold, as a medium of exchange and US dollar, as a store of value.

Bouri et al. (2017) analyzed the characteristics of Bitcoin and the correlations of this cryptocurrency with other traditional assets, such as stock market indexes, bond indexes, exchange rates, oil and gold. They proved, using daily and weekly data from 07/18/2011 to 12/22/2015, that Bitcoin is a good diversifier for most of the analyzed assets and, in just a few cases, can have hedge and safe haven properties.

Selmi et al. (2018) compared the roles of Bitcoin and gold as a hedger, a safe haven or a diversifier against extreme oil price movements. The analysis covered the period ranging from 09/13/2011 to 08/29/2017. The authors showed that both Bitcoin and gold could serve as a hedger, a safe haven or as a diversifier. However, the roles of each of the analyzed assets are sensitive to market conditions. Moreover, they showed that Bitcoin and gold, but not oil, are safe haven assets during periods of political and economic turmoil.

Kliber et al. (2019) studied, using a stochastic volatility approach, the main role of Bitcoin in a portfolio, respectively if it is a safe haven, a hedge instrument or a diversifier. They studied the properties of Bitcoin by referring to the evolution of the economic situation in some countries, such as Japan, China, Venezuela, Estonia and Sweden. The conclusions showed that Bitcoin has different properties depending on the economic situation. Thus, according to the authors, Bitcoin is a diversifier in China and Japan, a safe haven asset in Venezuela and a hedger in Estonia and Sweden.

In the last 2-3 years, more and more studies proved that cryptocurrencies and traditional assets are more correlated, which increased the risk associated with crypto-market on the financial stability.

Wang et al. (2020) analyzed the connections between Bitcoin and the stock market, proving the existence of some correlations between the cryptocurrency and some equity indexes, such as S&P 500.

Charfeddine et al. (2020) analyzed the correlations between four cryptocurrencies (Bitcoin, Ethereum, Ripple and Bitcoin Cash) and gold, oil, respectively S&P 500 from 09/01/2015 to 10/01/2018. Using GARCH models, the authors proved the existence of time varying dependence between the analyzed assets. In addition, they showed that the correlations mentioned before are sensitive to external shocks, proving that structural changes in the parameter of dependence could appear after some events, such as the Brexit referendum.

Wang et al. (2022) studied the risk contagion effects between the US stock markets and the crypto-market. To do so, they used a GARCH model and daily data on Nasdaq, Dow Jones, S&P 500, Bitcoin and Ether from 03/2017 to 04/2022. The authors found that there is an asymmetric contagion effect between the analyzed markets which is more significant in the lower tail. Moreover, they stated that, in the future, the price change of the cryptocurrencies can be an indicator for predicting the price fluctuation of the traditional assets and can also reflect the development of high-tech industry.

Cao&Xie (2022) analyzed the correlations between the crypto-market and China's financial market from 08/07/2015 to 09/30/2022. They proved that the risk spillover from the crypto-market to the financial markets is strong, while in the other direction, the risk spillover is very weak. Moreover, the authors showed that the negative volatility dominates, and that there are significant differences between the risk spillover effects of positive and negative volatility.

Some of the most important international financial institutions also showed that cryptocurrencies and traditional assets are more and more correlated and have warned about the implications on financial stability.

In October 2021, Jon Cunliffe, Deputy Governor for Financial Stability of Bank of England, stated that cryptocurrencies, both backed (stablecoins) and unbacked, began to connect to the financial system. Moreover, he claimed that, because of the increasing correlations, the financial stability risks would not be limited for too long, so there is a need for bringing the crypto-market within the regulatory perimeter (Bank of England, 2021).

The Financial Stability Board issued (February 2022) an assessment about the risks to financial stability caused by cryptocurrency. The international institution stated that cryptocurrencies could represent a threat to global financial stability due to a combination of factors, such as the increasing interconnectedness with the traditional markets and their structural vulnerabilities. The Financial Stability Board also asserted that the direct connections between crypto-market and traditional markets are limited, but they have grown rapidly and, if the trajectory of growth is maintained, it could have implications for financial stability (Financial Stability Board, 2022).

The European Central Bank released a similar report (May 2022), which concluded that cryptocurrencies would pose risks to financial stability if the trends of increasing correlations between crypto-market and traditional markets continue. In addition, the institution stated that the systemic risk would increase in line with the level of interconnectedness between the above mentioned markets, so creating a regulatory framework is more and more important (European Central Bank, 2022).

The European Securities and Markets Authority also published (November 2022) a report on the risks of cryptocurrencies for financial stability, stating that cryptocurrencies entail numerous risks because of their volatile growth cycles and the lack of regulations, which could become relevant for financial stability. However, until the date of the report, The European Securities and Markets Authority didn't identify spillover effects from the crypto-market to the traditional markets or the real economy (European Securities and Markets Authority, 2022).

Methodology

We collected daily data on Bitcoin, gold, EUR/USD and S&P 500 from 01/01/2015 to 01/01/2023. The data were downloaded from Yahoo Finance using a Python library called *yfinance*¹. The symbols for the assets are BTC – USD (for Bitcoin), GC=F (for gold), EURUSD=X (for EUR/USD) and ^GSPC (for S&P 500). After removing days with no data (closing price) for all four assets, there remained 1008 observations left.

Table 1. Descriptive statistics

<i>Variables</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Skewness</i>	<i>Kurtosis</i>
Bitcoin	13357.8004	16335.8090	1.4917	1.1266
EUR/USD	1.1283	0.0540	-0.2650	0.0732
Gold	1462.9874	273.3798	0.4280	-1.3732
S&P 500	2983.1244	812.8947	0.5809	-0.8768

Source: Authors' own research.

After that, we studied the correlations (in both way) between Bitcoin and the other three analyzed assets. To do so, we applied the TVP – VAR model in accordance with the methodology developed by Chan&Jeliazkov (2009). Starting from Vector Autoregressive (VAR) model, which is used mainly for macroeconomic analysis, Chan&Jeliazkov developed a new model, called time varying parameter vector autoregressive (TVP – VAR), in which the regression parameters follow a random walk. Because of that, the model developed by Chan&Jeliazkov allows the analyzed economic indicator to evolve differently over time, which facilitates the studying of structural correlations between variables and their evolution in time. The efficiency of the TVP-VAR in identifying the correlations between economic variables has been proven in several studies, such as Chan&Jeliazkov (2009) or Nakajima (2011). We applied the model in *Python – Jupyter Notebook*, using some functionalities of the *statsmodel*² library. A similar methodology to the one that we used to study the correlations between Bitcoin, respectively gold, S&P 500 and EUR/USD was used by Cao&Xie (2022) in order to analyze the volatility connectedness between five cryptocurrencies (Bitcoin, Ethereum, Ripple, Dogecoin and Litecoin) and the main China's financial assets in different periods, including the COVID – 19 pandemic.

Next, after consulting some of the crypto-specialized websites and blogs (*Appendix*), we selected ten of the most important events that affected the crypto market. The selected events are the following:

E1 – 06/03/2016 – After the collapse of Mt. Gox (a Japan-based company that was once the largest cryptocurrency exchange in the world) in 2014, Japan was the first country to introduce, in June 2016, regulation on cryptocurrencies. The cryptocurrencies were officially recognized as a means of payment and were brought under Financial Services Agency supervision (*Skalex, 2018*).

¹ Library documentation available at: <https://pypi.org/project/yfinance/>.

² Library documentation available at: <https://pypi.org/project/statsmodels/>.

E2 – 12/18/2017 – Chicago Mercantile Exchange (CME), the largest futures exchange in the world at that time, launched Bitcoin futures, one week after Chicago Board Options Exchange did the same. The decisions of both exchanges were a proof of bitcoin maturity, indicating an extension of the crypto-related products (*Cheng, 2017*).

E3 – 03/11/2020 – The World Health Organization declares COVID – 19 a Pandemic

E4 – 05/11/2020 – The last halving of Bitcoin. Halving is the event after which the reward for mining Bitcoin is cut in half. It is one of the most important moments in Bitcoin evolution, generating a reduction of the Bitcoin inflation and pushing the price upward (*Conway, 2022*).

E5 – 12/22/2020 – The Securities and Exchange Commission (SEC) filed an action against two executives of Ripple Labs Inc. and the company, alleging that the creator of XRP cryptocurrency (Ripple Labs Inc.) raised more than 1 billion \$ in an unregistered security offering. The court verdict in this case (which is still open in January 2023) will decide if cryptocurrency (including Bitcoin) is security or commodity (*George, 2023*).

E6 – 02/19/2021 – After an increase of over 360% in six months, the price of Bitcoin was around 54,000 \$, which resulted in a total market capitalization of 1 trillion \$, being the first time when Bitcoin surpassed this value. At that moment, the total market capitalization of Bitcoin was greater than the one of Tesla and half of the one of Apple (*Pound, 2021*).

E7 – 09/07/2021 – El Salvador was the first country in the world to adopt Bitcoin as legal tender. The president of El Salvador justified the decision by saying that it will help the citizens to save 400 million \$/ year on commission and promised 30\$ of Bitcoin for each user (*Renteira&Esposito, 2021*).

E8 – 09/24/2021 – The People’s Bank of China (China’s central bank) stated that all crypto-related transactions are illegal. According to the institution, the measure was adopted to prevent the risk associated with this category of assets, respectively to maintain social stability and national security (*Yu&Wallace, 2021*).

E9 – 10/05/2022 – The members of the Committee of the Permanent Representatives agreed upon the text of the first European Union’s crypto legislation (MiCA - Markets in Crypto Assets regulation). This was one of the first procedural steps for adopting the law, which could enter into force in April 2023, after the European Parliament vote (*Singh, 2023*).

E10 – 11/11/2022 – FTX, once the second-largest crypto exchange in the world, having assets in the range of 10 billion \$ to 50 billion \$, filed for bankruptcy protection. On the same day, Bankman – Fried, the FTX CEO, resigned. The problems for FTX started (on 02/11) when Coindesk (a crypto-specific news publication) revealed that a FTX affiliated company (Alameda Research) held a 5 billion \$ position in FTT (the token of FTX) and not in fiat currency (*Reiff, 2023*).

Next, we studied the dynamics of the correlations (in both ways) between Bitcoin and gold, respectively S&P 500 around the selected events. We computed the mean of the values of the coefficient’s correlations (which are the outputs of TVP – VAR model) in three time intervals (7 days, 14 days and 30 days), before and after the events.

Lastly, we identified jumps in the value of the correlations between Bitcoin and gold, respectively S&P 500. We did this in order to identify the periods in which the correlations between the analyzed variables registered a high change in value in a short period of time. To identify jumps appearance, we applied the Lee&Mykland (2008) test, adjusted by Lee, Naranjo& Velioglu (2018). Lee and Mykland developed a methodology to identify jumps appearance by using the properties of Gumbel distribution. They designed the test for 5 minutes data. Subsequent, Lee, Naranjo and

Velioglu adjusted the Lee and Mykland test for daily data (changing the value of a variable – K – from 10 to 16).

Results and discussions

As you can see in *Figure 1*, the correlations between S&P 500, respectively gold and Bitcoin have increased significantly in the last 8 years (the analyzed interval), while the impact of the evolutions in EUR/USD market on Bitcoin has remained almost null.

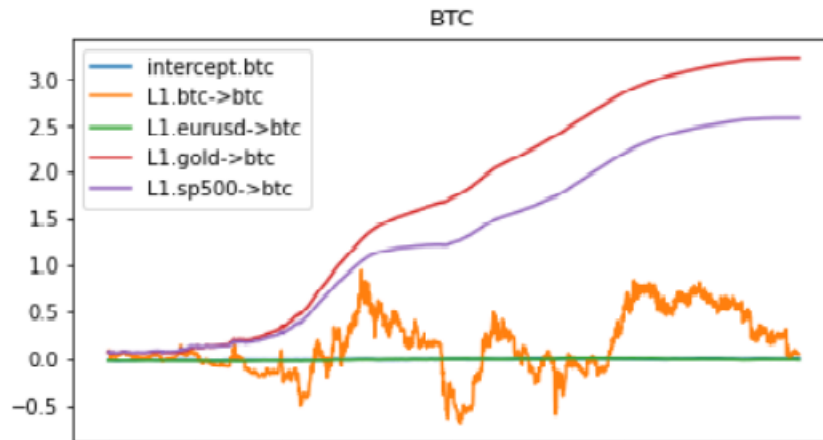


Figure 1. Correlations between the analyzed variables and Bitcoin

Source: Authors' own research.

The coefficients of correlations in the other direction (from Bitcoin to S&P 500 and gold) have remained, however, very low (*Figure 2* and *Figure 3*), which indicates that the shock propagation channel is still only from traditional markets to the crypto-market.

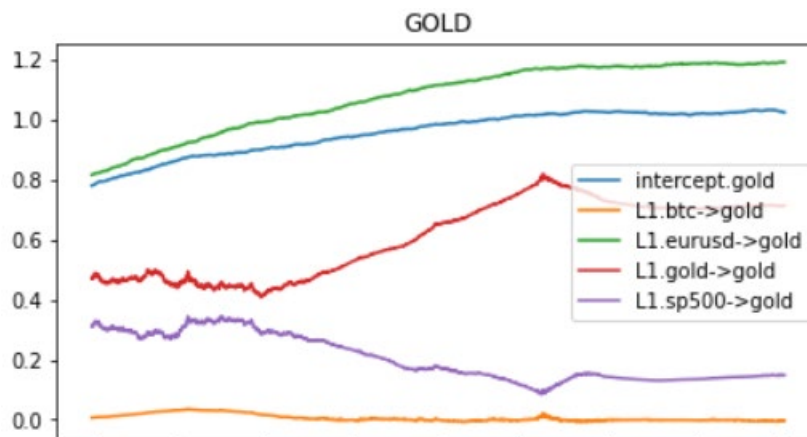


Figure 2. Correlations between the analyzed variables and gold

Source: Authors' own research.

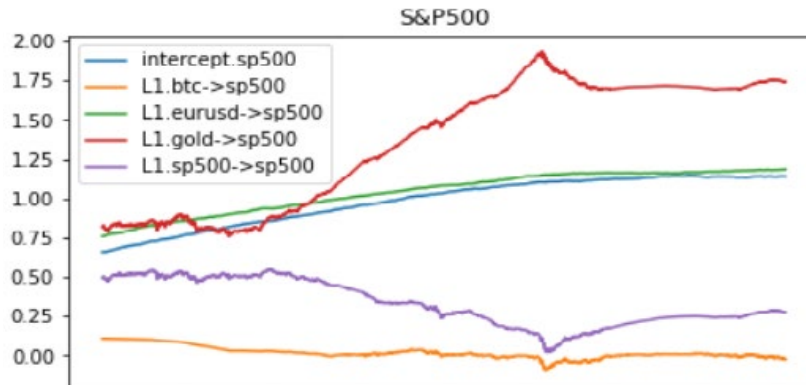


Figure 3. Correlations between the analyzed variables and S&P 500

Source: Authors' own research.

A yearly analysis of the evolution of the correlation's coefficients (*Table 2*) confirms the aspects mentioned above. Thus, the value of the correlation's coefficients for gold to Bitcoin, respectively S&P 500 to Bitcoin has increased, in the last 8 years, from 0.0746 to 3.2084, respectively from 0.0858 to 2.5668. However, the values of correlations coefficient for Bitcoin to gold, respectively S&P 500 are close to zero and sometimes even negative. In addition, we can observe that Bitcoin and EUR/USD are not correlated (regardless of the direction of correlations that you analyze).

Table 2. The correlation's coefficients

Correlations	2015	2016	2017	2018	2019	2020	2021	2022
GOLD → BTC	0.0746	0.1952	0.7993	1.5508	2.0146	2.5743	3.0298	3.2084
S&P 500 → BTC	0.0858	0.1764	0.6558	1.1833	1.4626	1.922	2.3959	2.5668
EUR/USD → BTC	-0.0245	-0.0273	-0.0215	-0.0126	-0.0087	-0.0044	-0.0073	-0.0122
BTC → GOLD	0.0188	0.0281	0.0052	0.0004	-0.0027	0.0001	-0.0011	-0.0027
BTC → S&P500	0.0977	0.0400	0.0097	0.0161	-0.0017	-0.0339	0.0046	-0.0039
BTC → EUR/USD	0.0003	0.0003	-0.0001	-0.0001	0	-0.0001	0	0

Source: Authors' own research.

Next, we wanted to analyze if the correlations are influenced by certain crypto relevant events. The results (*Table 3*) showed that the value of the correlation's coefficients (for gold, respectively S&P 500 to Bitcoin) followed the trend described before, even after the events. So, in the case of all ten events and all time intervals (10 days, 14 days, 30 days), the mean value of the correlation coefficient was higher after the events than before.

Table 3. Impact of the analyzed events on the correlation's coefficients

Events	GOLD → BTC						S&P 500 → BTC					
	Mean - 7 days		Mean - 14 days		Mean - 30 days		Mean - 7 days		Mean - 14 days		Mean - 30 days	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
E1	0.1642	0.184	0.1593	0.1922	0.1551	0.1965	0.1515	0.1682	0.1476	0.1750	0.1451	0.1785
E2	1.2864	1.311	1.2725	1.3231	1.24	1.3472	1.0524	1.0711	1.0417	1.0796	1.0162	1.0963
E3	2.3821	2.3925	2.3744	2.4022	2.3569	2.4213	1.7292	1.7355	1.7237	1.7438	1.7112	1.7616
E4	2.4816	2.4987	2.4715	2.5068	2.4512	2.5259	1.8192	1.8364	1.8096	1.845	1.7898	1.8645
E5	2.836	2.8506	2.8288	2.8578	2.812	2.8727	2.1927	2.2077	2.1854	2.2153	2.1675	2.2315
E6	2.909	2.9204	2.903	2.9257	2.8891	2.9376	2.2707	2.2828	2.2644	2.2886	2.2492	2.3015
E7	3.0821	3.0885	3.0798	3.0917	3.0715	3.0987	2.4508	2.4567	2.4479	2.4597	2.4403	2.4665
E8	3.0940	3.1	3.0908	3.1030	3.0834	3.1099	2.4618	2.4678	2.4589	2.4708	2.452	2.4773
E9	3.2276	3.2283	3.2272	3.2288	3.2261	3.2295	2.5842	2.5846	2.5837	2.5848	2.5828	2.585
E10	3.2303	3.2296	3.2301	3.2297	3.2293	3.2299	2.5852	2.5845	2.5852	2.5845	2.585	2.5844

Source: Authors' own research.

By analyzing the distribution of the jumps in the value of the correlation's coefficients (Table 4), we can observe a high density of them in the first part of the analyzed time interval (2015 and 2016). After, between 2017 and 2022, the number of jumps was significantly lower, which indicates a trend of progressive growth (without numerous spikes) in the value of correlation's coefficient. One of the jumps, both in the case of gold to Bitcoin and S&P 500 to Bitcoin took place less than 30 days after one of the ten analyzed events.

Table 4. Number of jumps in the value of the correlation's coefficients

<i>Correlations/ No. jumps</i>	<i>2015</i>	<i>2016</i>	<i>2017</i>	<i>2018</i>	<i>2019</i>	<i>2020</i>	<i>2021</i>	<i>2022</i>
GOLD → BTC	9	7	0	1	0	0	0	1
S&P 500 → BTC	7	10	0	2	0	0	0	0

Source: Authors' own research.

Conclusion

Along with the fast development of the cryptocurrency, there has been an increase in the interest of academics and international institutions on the properties and characteristics of this category of assets. More and more studies have proved recently that the correlations between traditional markets and the crypto-market have increased, which could generate risks to financial stability.

Our findings are related to the ones before, showing that the correlations between Bitcoin and traditional assets, such as equity (S&P 500) and commodity (gold) have increased significantly (the propagation channel is from traditional assets to Bitcoin). However, there are still some traditional assets, such as exchange rates that are not correlated with cryptocurrencies. Moreover, the impact of the evolution in the crypto-market on traditional markets is still very low, the values of correlation's coefficient being close to 0.

Therefore, the results indicate that, at this moment, the crypto-market poses some risks to the financial stability, taking into consideration the increasing correlations with traditional markets. However, because of the fact that the correlations are still only unidirectional (from traditional assets to cryptocurrency), the crypto-market could now just amplify the risks to the financial stability originating from the traditional markets. Our findings have implications on regulatory aspects, proving the importance of creating a legal framework for the cryptocurrencies in order to manage the associated risks.

Appendix

List of specialized websites used for selection of the most representative events that affected the crypto market:

<https://www.sygna.io/blog/japan-crypto-regulation-history-2014-2020/>

<https://www.wsj.com/articles/eu-sets-first-rules-to-regulate-cryptocurrencies-11656682089>

<https://www.investopedia.com/cryptocurrency-regulations-around-the-world-5202122>

<https://99bitcoins.com/bitcoin/historical-price/>

<https://medium.com/blockchain-blog/a-brief-history-of-bitcoin-432a8d44b0f3>

<https://decrypt.co/5347/11-most-defining-moments-bitcoin-history>

<https://economictimes.indiatimes.com/markets/cryptocurrency/the-year-that-was-for-crypto-10-era-defining-events-that-changed-investor-sentiment-for-the-better/articleshow/88558122.cms>

<https://blog.kryll.io/22-key-dates-in-the-history-of-bitcoin/>

<https://www.forbes.com/sites/bernardmarr/2017/12/06/a-short-history-of-bitcoin-and-cryptocurrency-everyone-should-read/?sh=5ae96b6e3f27>

<https://guardian.ng/technology/tech/the-idea-and-a-brief-history-of-cryptocurrencies/>

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