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on the topic: «**HOW ELON MUSK'S STATEMENTS IN SOCIAL MEDIA MOVE
CRYPTOCURRENCY MARKET**»

на тему: «**ЯК ТВЕРДЖЕННЯ ІЛОНА МАСКА У СОЦІАЛЬНИХ МЕРЕЖАХ
ВПЛИВАЮТЬ НА РИНОК КРИПТОВАЛЮТ**»

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Introduction

Late 2020 and early 2021 became the time of explicit growth and abnormal returns on the cryptocurrency market. Market capitalization of all crypto assets was \$190 bln in January 2020 and turned to \$2 500 bln in May 2021. There were multiple reasons for market acceleration, but one of them attracted attention of the authors of this paper: the impact of Elon Musk's posts on Twitter on cryptocurrencies.

Motivation for this research lays in the fact that during past year the whole crypto market grew more than 1000% and millions of investors are engaged in pursuit of making a good investment on relatively new market. It is important for investors to understand what causes movements on the market and how.

Our research is based on statistical determination of growth or decline of selected cryptocurrencies caused by Elon Musk's posts.

This thesis's aim is to provide methodology and recommendations for traders, small and big investors, institutional investors, etc., using which it would be possible to gain benefit from the market momentum caused by public figures' publications.

Object of this paper is cryptocurrency market

Subject is determination of the impact caused by Elon Musk's posts on Twitter regarding Bitcoin and Dogecoin cryptocurrencies.

Keywords: Blockchain, Cryptocurrency, Event Studies, Abnormal Returns, Abnormal Trading Volumes, Elon Musk, Twitter, Market Inefficiency, Bitcoin, Dogecoin.

Chapter 1. Theoretical basis of thesis

There were 4 main assumptions made to explain what causes growth of this market.

1. Evolution of crypto exchanges. Which made possible for uneducated and unprofessional investors to enter this market, deposit their savings and buy assets in a matter of minutes.

2. Unexperienced retail investors filled the market and they are in the chase of fast returns. These investors gather information from the social media

3. Market Efficiency Hypothesis does not work on the actual crypto market. Broadly speaking, MEH (Market Efficiency Hypothesis) states that market accepts new information instantly and it is reflected in prices at once. ^[8] However, further research in this thesis proves existence of inefficiency in the market.

4. Events and news are the fundamentals of this market. For a traditional investor value is a result of a strong financial performance of the company or country (if investor considers governmental bonds or currency). For example, traditional investor can make decisions based on the Discounted Cash Flow model, Multiples Analysis, Major Indicators for a particular industry (P/E, EPS, assets turnover, etc.), but investor, who considers cryptocurrency as a target investment is left with a few options to determine fundamental attractiveness of an asset. Throughout history, inception of demand started from belief of something is important for society and can bring value for individuals. The more value it brings – the higher the price is. On cryptocurrency markets this belief is represented by statements from government, businesses and influential people ^[18]. That's why the major

part of this thesis is dedicated to investigate influence of the “events” for the cryptocurrency market.

As a consequence, unprofessional investors react on catchy statements, which leads to appearance of abnormal returns (either positive, or negative). To better understand the impact of events event study methodology was utilized.

1. Evolution of information distribution on stock markets, sources of trend determination and new market forces

Throughout the history major news providers has evolved in parallel with technological advancements: 100 years ago a major provider of the most recent data was radio, access to which was limited, currently all the news could be reached through the phone connected to the Internet. More than 4.66 bln people are users of the Internet, 4.15 bln of which are active mobile social media users. Penetration rate in Northern America is 90% ^[1, 2]. Lag between an event and reaction shortens due to speed of how information is spread, it creates new opportunities for economists to explore new market conditions, determine new models of supply and demand momentum and predict short-term, mid-term trends.

Evolution of brokerage services led to uprise of “easy to use” platforms, as for example, Robinhood which allows to buy and sell stocks in a matter of a few clicks on a smartphone. It provoked emergence of new market forces, retail investors, whose size became significant enough to create big trading volume, which is reflected in price fluctuations. Hence, a lot of economic studies appeared to determine the new interconnections on the market.

2. Development of social media and its effect on the financial markets.

Social media became one of the most important sources of financial information. A lot of academic studies discovered significant impact of global market sentiment and mass known individuals' publications on stock market prices and trading volume volatility. Social media platforms have become an essential part of each one's life, they allow people to share information, ideas and experiences: it includes sharing of financial thoughts and decisions made. There is a sustainable growth of social media coverage through the US population. Dynamics of growth is shown on *the chart 1*. Facebook is an ultimate leader. This social media platform has direct impact from fashion trend setting to political views. It is proven that by analyzing Facebook profiles and using manipulative social media marketing tactics, it is possible to make inception of political views and consequently bring candidates to victories ^[3].

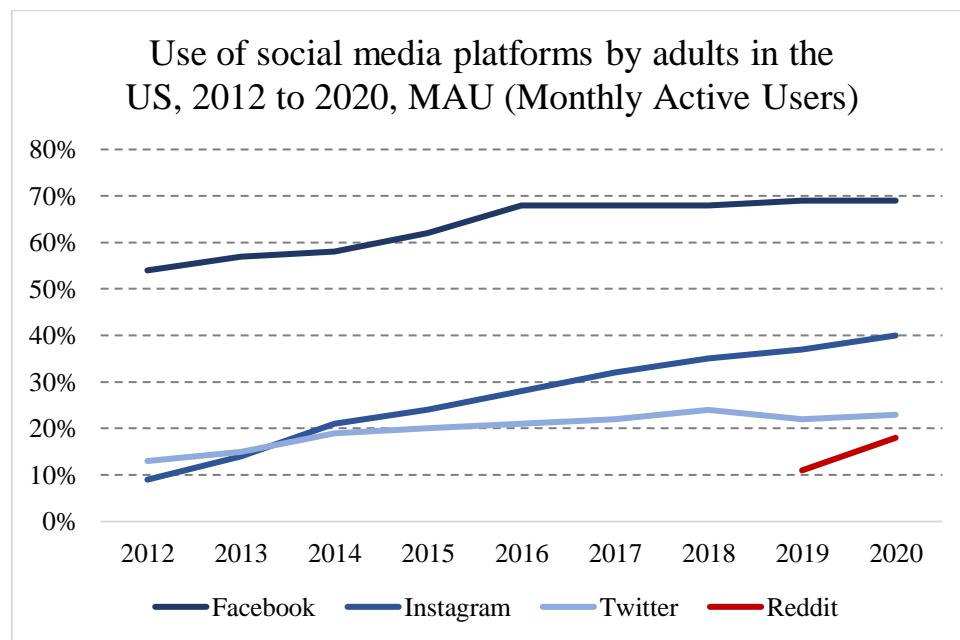


Chart 1. Use of social media by adults in the US, 2012 to 2020

Source: Pew Research Center (2021) ^[4]

In parallel, with audience growth, there is a growth of an average daily hours spent with social media. *Chart 2* displays this uprising trend. If in 2008 average American has spent up to 3 hours a day surfing social networks, in 2018 he spends more than 6 hours a day.

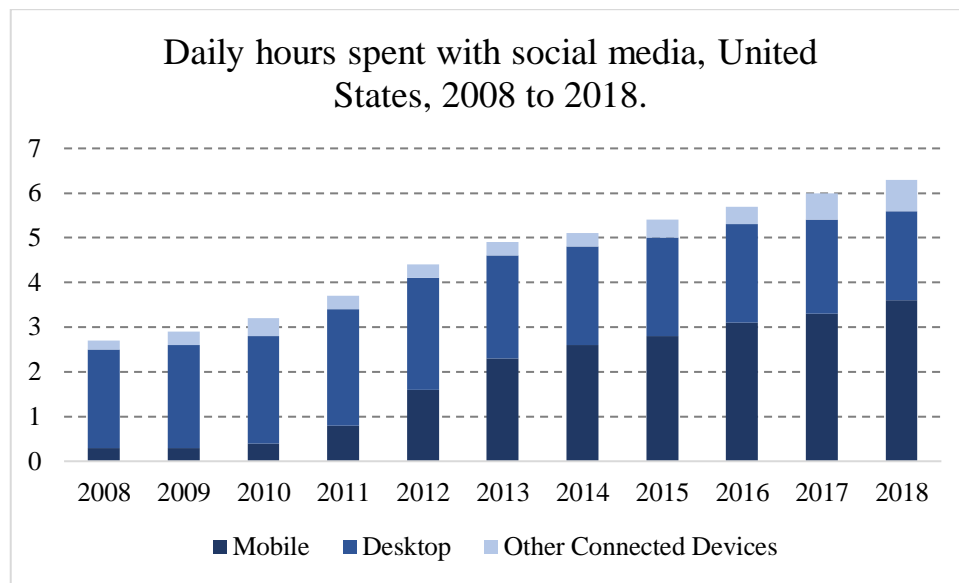


Chart 2. Daily hours spent with social media, United States, 2008 to 2018

Source: BOND Internet Trends (2019) ^[5]

Combination of users' growth on social media platforms and increase in their average daily hours spends reveals power which this communicational channel has. Public figures, such as Elon Musk, can dictate rules to the market. His statements on Twitter can move stock as well as cryptocurrency markets. There are multiple examples of his statements moving Bitcoin, Dogecoin, Tesla prices and trading volumes. Detailed exploration of the following topic will be included in further chapters of this thesis.

Through multiple social media platforms Twitter appeared to have the most significant impact on the financial markets. Moreover, each year the number of publications which include citations from this platform is continuously growing: in 2015 there were 216 publications, in 2019 this number increased to 816. ^[9] Studies conducted on the Twitter basis vary from prediction of price movements based on up-to-date social sentiment ^[10] to impact of particular posts on the market momentum ^[11].

2.1 Twitter

Twitter is an American microblogging and social networking platform for public self-expression and conversation in real time. Twitter allows people to consume, create, distribute and discover content and has democratized content creation and distribution. Through Topics, Interests, and Trends, the company helps people discover what is happening live. Communication goes through micro-blogging profiles. Posts in profile are called “tweets”. Tweets were originally restricted to 140 characters, but was doubled to 280 in November 2017. Short length of the posts allows subscribers of a blogger to receive information in a matter of seconds. This factor is crucial for understanding the impact Twitter has on the financial markets.

In 2013 the Security Exchange Commission (SEC) equalized information posted on Twitter with an official distribution channel for company-shareholders communication. If the Security Exchange Commission finds a violation in the posts of founders, top-management, official representatives, etc. it can sue the company or an individual. For instance, on the 7th August Elon Musk has posted: “I am considering taking Tesla private at 420\$. Funding secured. Shareholders could either sell at 420 or hold shares and go private”^[12]. Prices on Tesla’s stock reacted simultaneously, raising to 372\$ per share (10% below acquisition price), thereafter Tesla has made an official post that the company does not consider going public anymore. It reversed upside movement of the stock price. The SEC put restrictions on the company:

- Forced out Elon Musk as a Tesla inc. chairman.
- Elon Musk paid a \$20 million fine to the SEC.
- Tesla inc. paid a \$20 million fine to the SEC.

- Musk bought \$20 million in Tesla inc. stock to cover losses of his company.
- Tesla inc. appointed two new independent directors to the company's board.
- Elon Musk agreed to have his tweets reviewed by Tesla's in-house counsel.

This example reveals relevance of the Twitter for financial markets. This thesis was inspired by market reaction on tweets of publicly known individuals. There were multiple studies conducted to investigate impact of tweets on stock and commodity prices and volumes, however there is a small number of papers dedicated to the influence of posts on cryptocurrency market.

3. Cryptocurrency market

3.1. History of cryptocurrencies and actual market state.

Cryptocurrency is a type of electronic money. A unit of measurement is a coin that is protected against falsification based on encrypted algorithms. Cryptocurrency is issued online and is not linked to regular currency, or the state monetary system. Main feature of cryptocurrencies is a decentralization. The first time, the term "cryptocurrency" began to be used was in 2009, after the emergence of the "Bitcoin" payment system. Bitcoin is a representative of the whole cryptocurrency market created by an anonymous who calls himself "Satoshi Nakamoto". On October 31st Satoshi posted the first ever whitepaper (document, which explains mechanisms of a cryptocurrency) of Bitcoin. Satoshi and his team opposed existing financial system and claimed it to be inefficient due to the need of a third party in transactions and, hence a room for unwanted fraud actions from these third parties. In the introduction of his paper Satoshi states the general principles of future currency

Team of Satoshi proposed currency as an open-source code independent of centralized policies and free from the control of any authorities. Until 2013 the software of almost all cryptocurrencies was based on the Bitcoin system code. A few different projects, as for example Litecoin, were just using modified code, but generally remained fundamentally

the same. In July 2013, new platforms appeared that supported various features beyond the currency possibilities – trading platforms, shops, crypto-infrastructure projects, and so on. Crypto industry accumulated critical number of projects and recognition from 2013 to 2017. Since 2017 industry faced steep growth. As for 20th of May 2021 there are at least 9 961 projects and 381 crypto exchanges ^[14]. Dynamics of the industry is visualized on the *chart 3*.

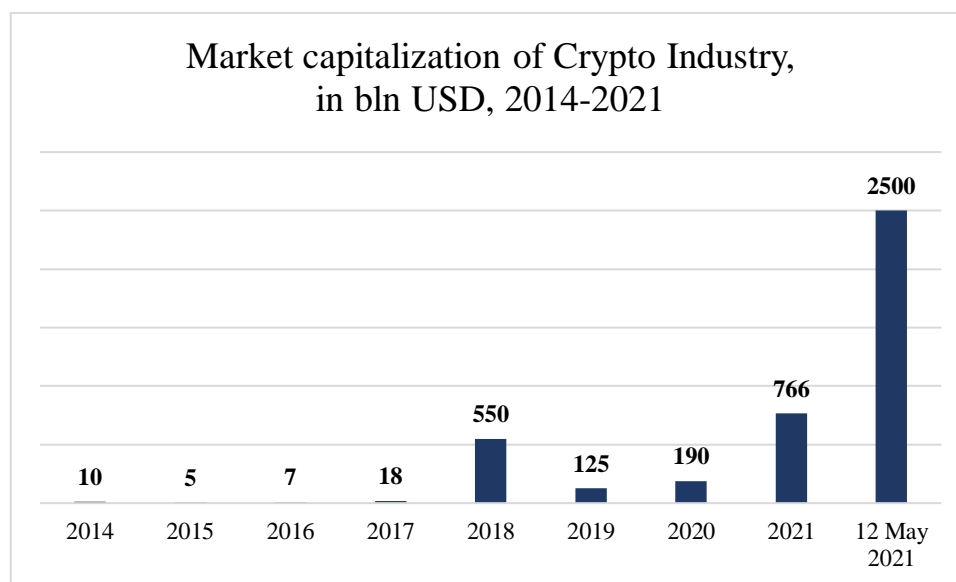


Chart 3. Market capitalization of crypto industry in bln USD, 2014 to 2021

**As for the 1st Jan of a year*

Source: Coinmarketcap ^[14]

\$2.5 trillion capitalization can be compared to 7,15% of the whole S&P 500 index size. Therefore, it is important for individual investors to keep an eye on the cryptocurrency market and find ideas of investing and portfolio diversification regarding this market. There is a need for the government and companies to understand the changes and innovations in the crypto market. In 2021 market approached to reality as never before. Two most referred examples of this year (yet) are: the most expansive digital art piece sold for \$70 million through one of the most prestigious auction houses “Christie’s” ^[15]. Transaction used NFT-technologies ^[16] (smart encryption to prove ownership rights for digital assets). Another example is Tesla buying Bitcoin for \$1.2 bln ^[17]. This event is

considered to boost price of the cryptocurrency from \$32 000 to \$47 000 in a matter of 2 weeks. Tesla's purchase of Bitcoin and its atypical for traditional markets growth was the reason for further investigation of how the value of crypto assets is calculated. This event leads to decomposition of 4 main hypothesis, which explain the abnormal growth:

- **Evolution of cryptocurrency exchanges.** Simplification of the registration process, depositing and withdrawal for investors.
- **Unexperienced investors filled the market.** Investors, who haven't had investment experience (especially in cryptocurrencies) are making not rational decisions.
- **Market Efficiency Hypothesis, which does not work on current market.**
- **Abnormal reaction to news from government, businesses and influential individuals.**

3.2 Cryptocurrency exchanges and unexperienced investors

Crypto market was not able to offer user-friendly trading platforms to buy/sell coins up until 2013, when Coinbase ^[19], the first popular and globally spread cryptocurrency exchange platform appeared. Only in early 2017 this platform received allowance to offer brokerage services for other cryptocurrencies except Bitcoin, which are Ethereum, Litecoin and others ^[20]. Also, in the year 2017 the most popular crypto-exchange platform Binance appeared ^[21]. This year was accounted for the first boom in cryptocurrency market (*see chart number 3*). It leads to a hypothesis that the wider advertised market is and the more convenient trading platforms are, the more price growth and trading volume market can expect. Touching advertisements, Coinbase had allocated for selling and marketing expense \$24 mln in 2019, \$57 mln in 2020 and \$117 mln in the first quarter of 2021. In 2021 alone the company has spent more than during past 2 years ^[22].

There is an assumption that crucial impact to the recent spike in parallel with marketing, was contribution of new trading instruments, which are derivatives, mainly futures. Futures

allow to leverage your position. During spikes as well as crashes, futures accelerate the movement. It is one more supportive angle of view that explain abnormal returns once event (as ex. Elon Musk's tweet) occur. On *charts 3 and 4* there is growth dynamics of Open Interest on Bitcoin Futures and Bitcoin price itself. It can be visually seen that there is a correlation.

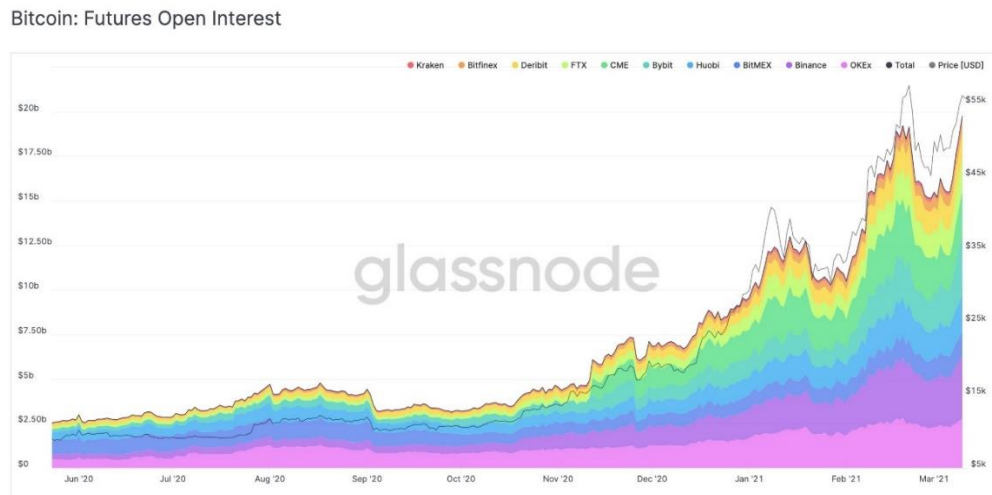


Chart 3. Open Interest on Futures. 2020-2021.

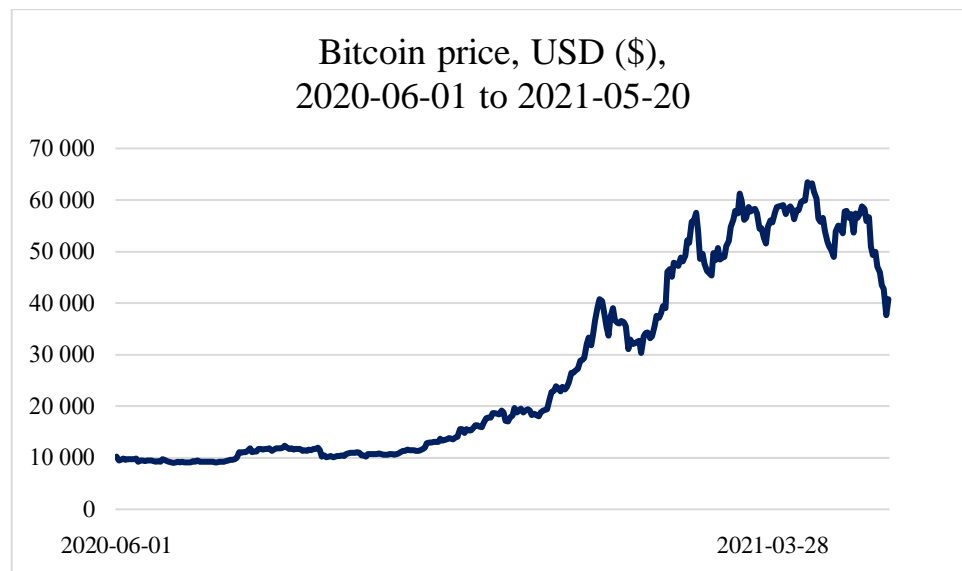


Chart 4. Bitcoin price from 01-06-2020 to 20-05-2021

Source: Glassnode ^[24]

Futures allow traders to leverage their positions by more than a hundred times ^[23]. For instance, new trader can deposit 1000\$ to his account, go to “futures” section, select “bitcoin”, press on 125x leverage and press buy. In that moment his position will be as high as \$125 000. It also means that less than 1% of upper movement doubles his initial investment of 1000\$, however if price goes in opposite direction – it forces position to be closed losing all the money.

In addition to this, there is a large number of new traders, who came to the market and whose decisions could be beyond the adequate risk management strategies. Crypto exchanges do not share direct data about their traders, but it is possible to determine their characteristics by using indirect methods. Two approaches were used. Frankly speaking blockchain infrastructure allows to track all the transactions were ever made through it. Ethereum was taken as an example. It is possible to see the average amount of money on addresses (accounts) at any moment of time, also there is a possibility to see for how long assets linked to a particular address stay. If number of accounts with medium amount (below 50 000\$) increases and time of holding an asset shortens, it means that new investors came to the market. *Chart 5* represents number of accounts by its size.

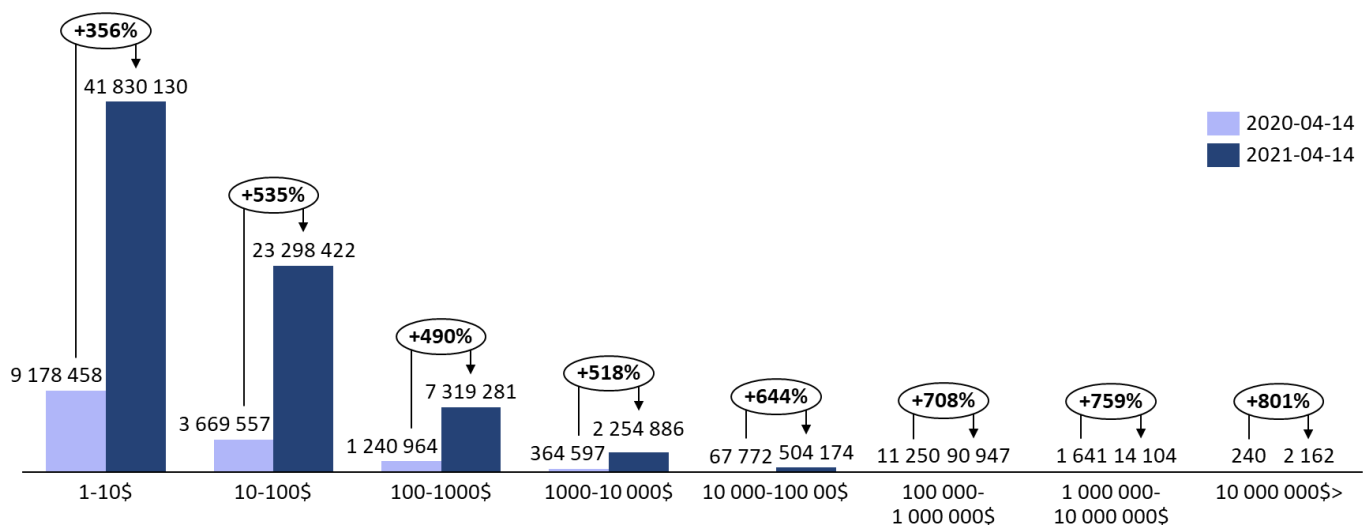


Chart 5. Distribution of Ethereum accounts by size

Source: Glassnode

To determine for how long coins stay within one account there was used HODL methodology represented by Glassnode. HODL Waves present a macro view of the age distribution of the coin supply and provides insight into changes to this age distribution arising from holding and spending behavior. The metric bundles the coin supply into categories depending on age, and presents it in colour bands with a thickness proportional to the total coin supply. HODL Waves thus provide a macro view of both the age distribution of the existing supply, and of changes to this distribution as coins mature and are spent. Changes in coin maturity as a result of spending or accumulation behavior will be reflected in changes in HODL Wave band thicknesses over time. ^[25] *Chart 6* represents HODL Waves of Ethereum during past years. Currently 50% of all Ethereum was purchased during past year, 42% during past 6 months, 23% during past 3 months.

On 14th of April 2020 Ethereum price was 160\$ on 14th April 2021 it surged to 2430\$. 1500% growth. Return rate during past year might be a catalyst of the movement.

Psychological biases, push people to focus only on the companies which they have already heard of and which have high media and social attention, including high trading volumes and abnormal one-day/one-week returns. ^[6]

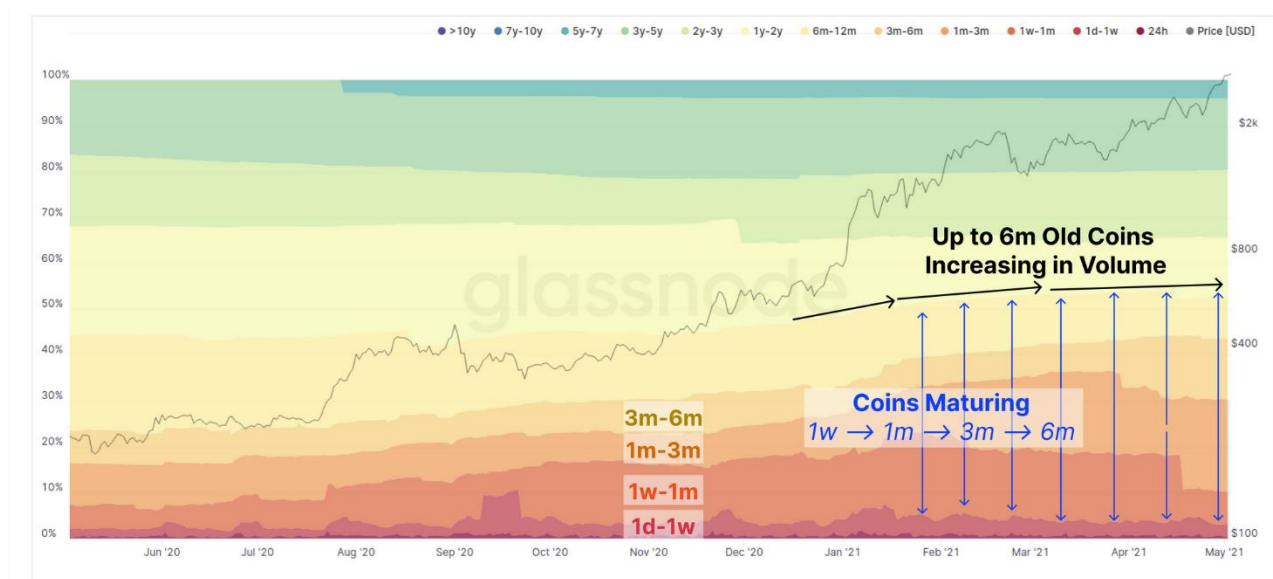


Chart 6. HODL Waves Ethereum

Source: Glassnode

Wide popularity and immaturity of investors push Ethereum and other cryptocurrencies to show abnormal returns and irrational investors' behavior. Amateur traders might miss important technological advancements of assets by non-reaction on complicated news, but rapidly to buy or sell, if news were easy to interpret, as easy as, "One word: Doge" from Elon Musk's Twitter ^[26]. Actual market has created new type of public financial authorities, whose main pronounced feature is in their audience: consolidated equal minded retail investors, who react on the statements made by these authorities in social media simultaneously, creating abnormal trading volumes and price spikes. ^[7] It results in denial of Efficient Market Hypothesis ^[8]. To investigate impact of inefficiency there was decided to use "Event Studies".

4. Phenomena of an "event" and market inefficiency. Event studies.

The event study methodology is commonly used to estimate abnormal reaction on certain announcement and tests how quickly new information is interpreted by the market.

4.1 Definition of the event

In context of this thesis, events are posts by Elon Musk on Twitter regarding Bitcoin and Dogecoin. Recent activity of Mr. Musk provoked big movements on the cryptocurrency market. For example, on 29th January 2021, Bitcoin surged from 32000\$ to 38000\$ in a matter of couple hours. On that day Elon Musk has changed his bio (*the first statement user see, while opening someone's profile*) to "#Bitcoin". His posts have such level of disruption, because they are not pre-planned. Crypto Community cannot prepare and overthink his news, so it starts abnormal selling or buying.

In this study, there will be 4 events review regarding Bitcoin and 4 regarding Dogecoin. All the events happened in 2021. Some of them had positive impact, some negative.

4.2 Event window

To measure the impact of the event it is required to select a “window” – timeframe of the observed event. It can be as long as months ^[27] or as short as days or event hours ^[28]. For this thesis it was decided to partially look up an approach from Lennart Ante “How Elon Musk’s Twitter activity moves cryptocurrency markets” ^[29] in that thesis the researcher takes time interval of 600 minutes preceding an event and 360 minutes after an event. This timeframe allows to determine micro-term movements. In this thesis we observe 720 minutes preceding an event and 600 minutes after it. This timeframe was selected to expand observing period and give better insight on the event reactionc.

4.3 Data

Data was collected from Binance crypto exchange, which is the largest exchange to the date of this thesis publication. It has 362 different crypto assets on it. On 24th of May there were \$66,8 bln traded through spot and \$127 bln through derivatives (mainly futures), it is 8,35% of the \$1,529 trillion market cap of crypto assets ^[30].

To extract data there were used 2nd parties data providers. “Cryptodatadownload”, which gave access to Bitcoin 1 minute and 1 hour data in “.csv” format and “Coinapi.io” for Dogecoin, which allowed to extract same timeframe data through Python in “.csv” format.

Data consists of open, close prices, trading volumes and dates.

4.4 Methodology and literature overview

Event studies is a popular method of measuring impact of specific events. The main aim of the study is to provide better insight on the inefficiency of traders’ behavior once unpredicted event occur. According to the Efficient Market Hypothesis, all the information

should be absorbed by market in the shortest time periods, however event studies give prove that in some situations this Hypothesis is neglected. The main idea is to compare returns or trading volumes of stocks/commodities/crypto assets, etc. before the event and after it. If overviewed instrument shows significant abnormal behavior, hence it means that traders and investors are biased by the event and keep buying or selling much more active comparatively to normal market circumstances.

Methodology used in this thesis was inspired by Lenart Ante's publication ^[32] regarding influence of Elon Musk's posts. Major part of posts happened during December 2020 and January 2021.

This thesis took the methodology provided by Lenart Ante, but projected it on other events, the ones, which happened during January 2021 – May 2021.

3.4.1 Calculating Cumulative Abnormal Return

Abnormal Return is the difference between the expected return and the actual return on an investment. Abnormal returns may be either positive or negative; indeed an abnormal return may be negative even if the actual return is positive.

$$R_{abnormal} = R_{actual} - R_{normal}$$

R_{actual} is a mean of returns of the window after the event.

R_{normal} is a mean of returns of the window before the event.

Window is a timeframe in which event is observed. Window before the event is marked as “-n to 0”, window after the event “0 to n”. Windows can vary depending on the timeline: from minutes to days. In this thesis we analyze short-term influence based on the 700 minutes before the event and 600 after.

Cumulative Abnormal Return is a sum of abnormal returns during specific period of time. For example, 0 to 15 minutes after the event.

$$\sum_{i=1}^N AR_i = CAR_i$$

To test the result there is t-test used.

$$t\text{-coef} = \frac{CAR_i}{\sigma AR}$$

4.4.2 Calculating Cumulative Abnormal Trading Volume

Cumulative Abnormal Trading Volume is calculated in the same way, with only exception of how abnormal return is calculated. Campell and Wasley, 1996 ^[33] strongly recommend to use log-transformed returns:

$$V_{it} = \log \left(\frac{n_{it} + 0,000255}{S_{it}} * 100 \right)$$

where n_{it} is the number of coins traded for the cryptocurrency i on day/hour/minute t and S_{it} is the outstanding coins of crypto asset i on the trading day.

Chapter 2. Observation of the selected events. Statistical overview.

This chapter describes narrative, context and time behind the events, reaction of public and investors, observes events from statistical perspective: price and trading volume changes. Events relate to Tweets of Elon Musk regarding Bitcoin and Dogecoin.

1. Observed Events

For this section there were 8 events selected. 4 events regarding Bitcoin and 1 regarding Dogecoin. All events happened in the first half of 2021. Basically, events are Elon Musk's tweets. Below is table 1, which gives brief explanation of the events sense and time.

Table 1. *Six events that gave impetus to the crypto market, because of Elon Musk's tweets or Tesla inc. statements*

Event	Asset Mentioned	Date	Time	Statement
1	Bitcoin	29.01.2021	8:30	- Elon Musk changed his Bio* on Twitter to "#bitcoin"
2	Bitcoin	08.02.2021	12:30	- Tesla disclosed information, where the company admitted buying \$1,5 bln worth of Bitcoin
3	Bitcoin	24.03.2021	7:02	- Elon Musk tweeted that it just became possible to buy a Tesla car for Bitcoin - Elon Musk tweeted that Tesla doesn't accept
4	Bitcoin	12.05.2021	22:06	Bitcoin payments any more and that company is concerned by dirty energy consumption of the Bitcoin
5	Dogecoin	01.04.2021	13:25	- Elon Musk tweeted that "SpaceX is going to put the Dogecoin on the Moon"

2. Context of the events and statistical analysis

This section gives statistical perspective of the events regarding Bitcoin and Dogecoin. Key areas are: how fast public reacted on the event (using 1m data), what were the consequences of events during mid & short term, overview of price and trading volume changes.

2.2.1. Bitcoin

Event number 1:

This event occurred due to change in Elon Musk's bio on Twitter. He has put “#Bitcoin” there. “-120-0” represents 2 hours before the event “0-320” 5 hours 20 minutes after the publication. During the first 30 minutes price surged from \$32 000 to \$37 000, which is ~16% growth. Thereafter price stabilized and was traded in \$36000-\$38000 price zone. *Chart 7* represents the dynamic.

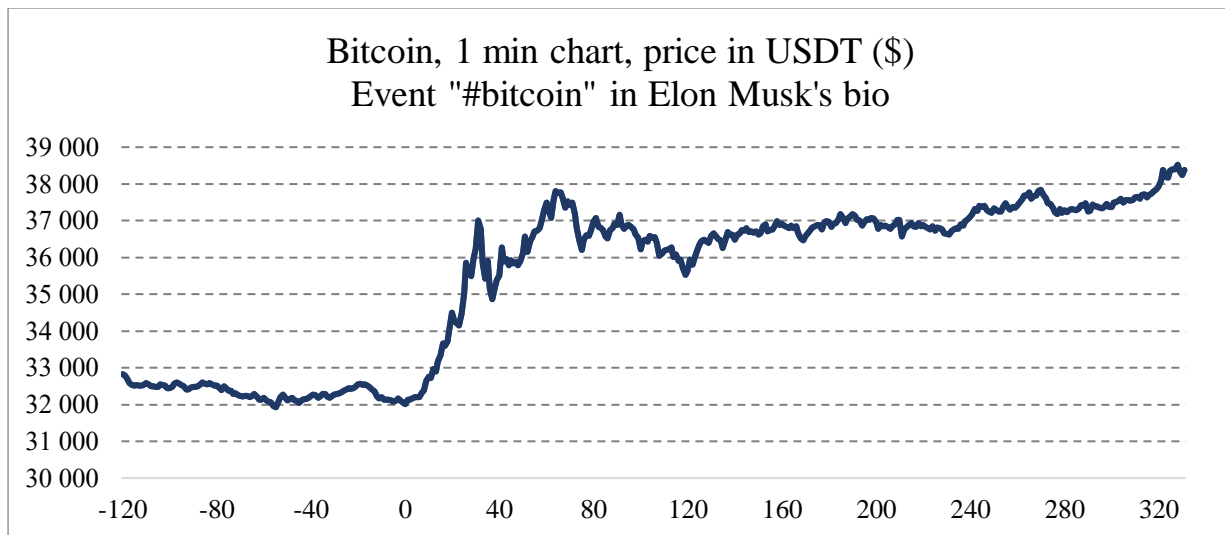


Chart 7. Bitcoin price, 1 min chart

Source: Binance

Insightful observation was found in deep zoom in to the price behavior. On the *chart 9* it can be seen that reaction on event came with a delay of at least 7 minutes, thereafter the first significant buy happened after 19 minutes, \$45 million. Abnormal trading volume could be seen during 0-80 window (*see chart 8*).

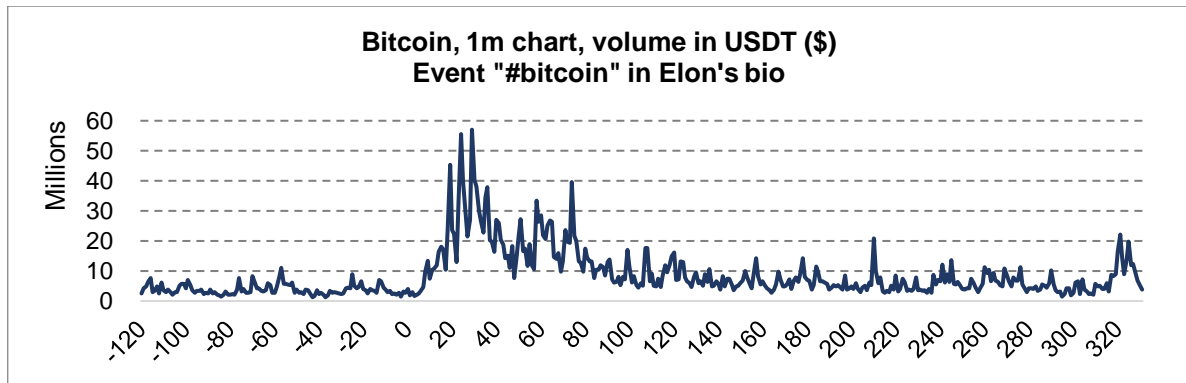


Chart 8. Bitcoin trading volume

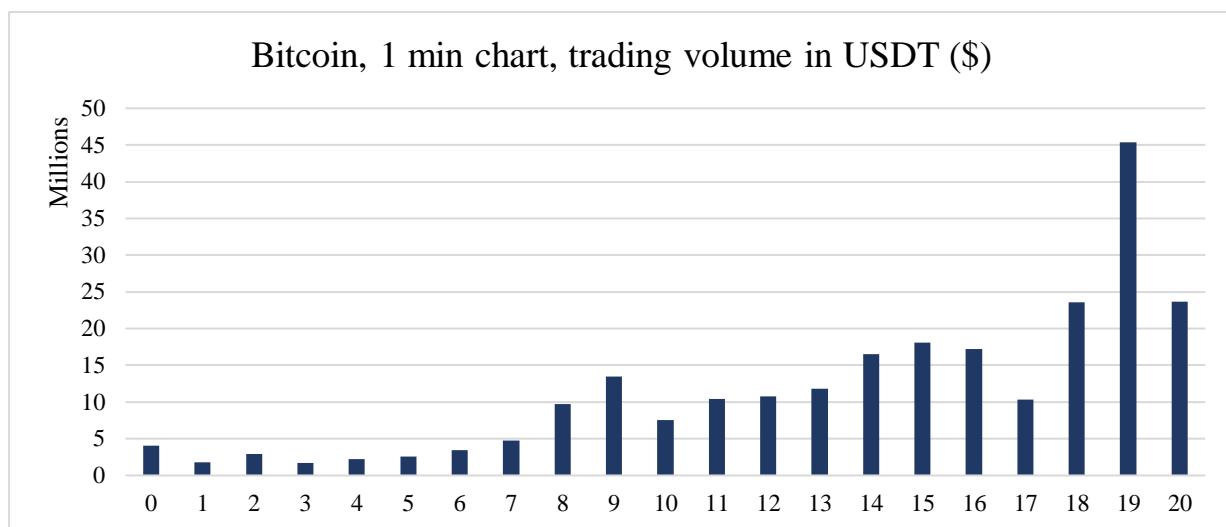


Chart 9. Bitcoin trading volume change (Binance)

Event number 2:

This event is a disclosure of annual Tesla inc. report, which was introduced to public at 12:30 of February 2021: *“In January 2021, we updated our investment policy to provide us with more flexibility to further diversify and maximize returns on our cash that is not*

required to maintain adequate operating liquidity. As part of the policy, which was duly approved by the Audit Committee of our Board of Directors, we may invest a portion of such cash in certain alternative reserve assets including digital assets, gold bullion, gold exchange-traded funds and other assets as specified in the future. Thereafter, we invested an aggregate \$1.50 billion in bitcoin under this policy and may acquire and hold digital assets from time to time or long-term. Moreover, we expect to begin accepting bitcoin as a form of payment for our products in the near future, subject to applicable laws and initially on a limited basis, which we may or may not liquidate upon receipt.”^[17]

Price reacted with growth from \$39 000 to \$43 000 during the first 30 minutes. Then on the minute 57 there was a peak of \$44 860, which is 15% growth from the moment of publication. Afterwards price stabilized in \$43 000 - \$44 000 range. Dynamics is represented on the *chart 10*.

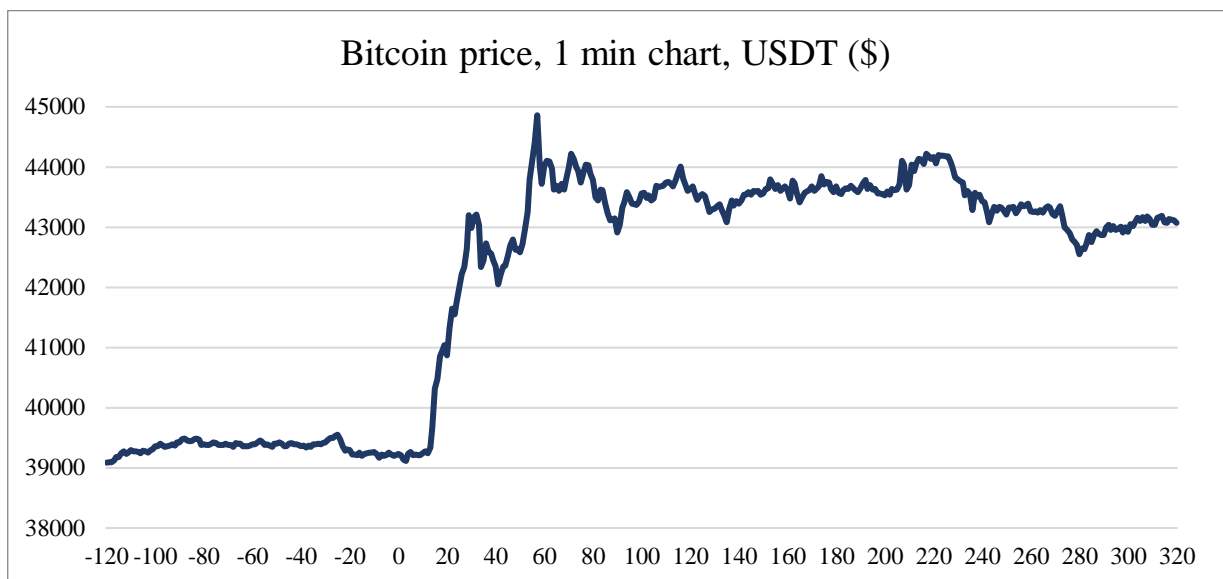
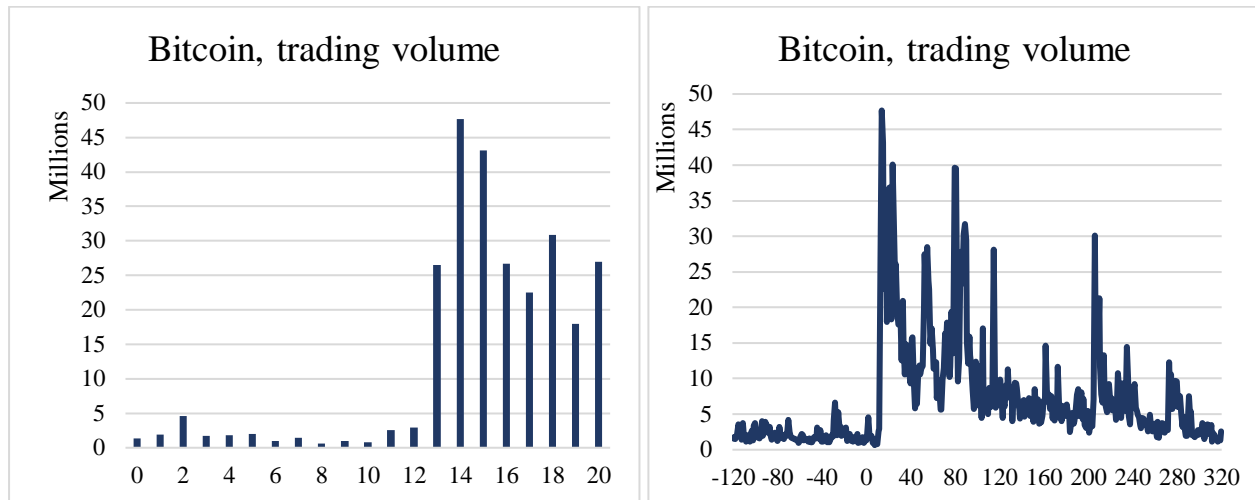


Chart 10. Bitcoin price, 1 min chart (Binance)

Event: “Tesla bought \$1,5 bln worth of Bitcoin”

Again there is a lag in a market reaction. On the *chart 11* the first major buy happened only 13 minutes after the announcement. *Chart 12* shows that abnormal trading volume could be seen even 200 minutes after the event.



Charts 11 and 12. Bitcoin trading volume, 1 min chart (Binance)

Event number 3:

Elon Musk has posted on Twitter: “You can now buy a Tesla with Bitcoin”. \$54 600 to \$55 000 during the first 30 minutes. Reaction on this event was much more weaker then on previous two. However, after 5 hours price climbed to \$57 000, 4% of growth. *Chart 13* represents the dynamics

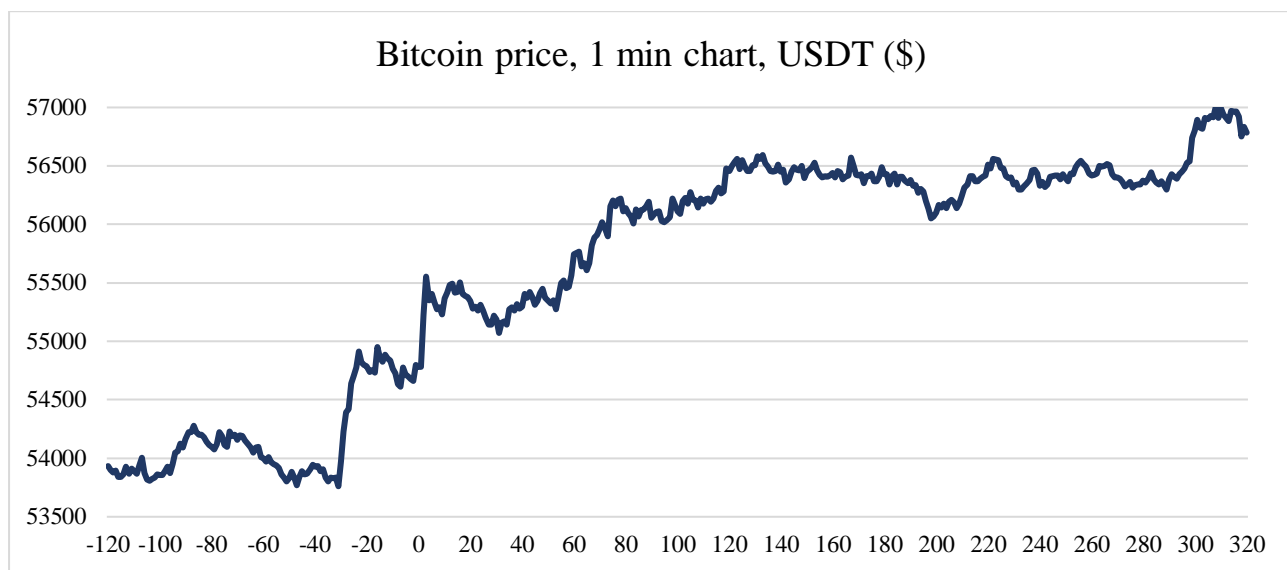
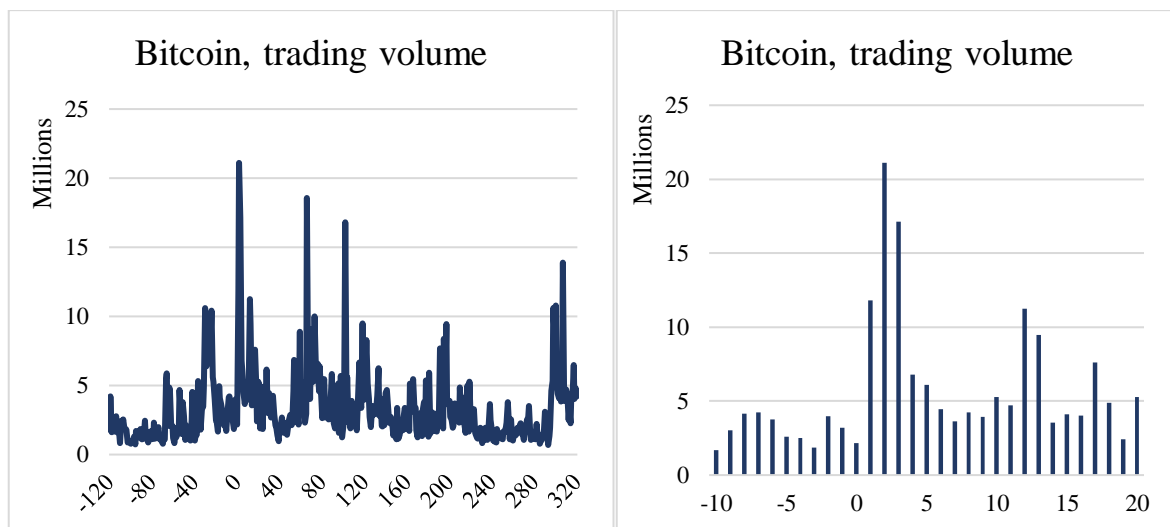


Chart 13. Bitcoin price, 1 min chart. “You can buy Tesla for Bitcoin”

There is an assumption that such weak reaction could be a cause of adaptation of the market to Elon Musk’s posts. Moreover, high trading volume appeared once Elon’s tweet came public, however there used to be a lag between post and reaction before. Probably, explicit reaction was a cause of absolutely new information: good attitude of one of the richest people in the world towards the Bitcoin.



Charts 14 and 15. Bitcoin trading volume, 1 min chart (Binance)

Event: “You can buy Tesla for Bitcoin”

Event number 4:

The last event regarding the Bitcoin is recent Elon Musk's post on Twitter regarding concerns of Bitcoin energy consumption and Tesla's suspension of the Bitcoin usage. Direct quote: "Tesla has suspended vehicle purchases using Bitcoin. We are concerned about rapidly increasing use of fossil fuels for Bitcoin mining and transactions, especially coal, which has the worst emissions of any fuel. Cryptocurrency is a good idea on many levels and we believe it has a promising future, but this cannot come at great cost to the environment. Tesla will not be selling any Bitcoin and we intend to use it for transactions as soon as mining transitions to more sustainable energy" ^[31].

In authors opinion this event represents the power of social media, Elon Musk and crowd. During the first 2 hours price has fallen on 16%. Trading volume had reached its peak after 2 hours, which untypical, because as usual price peaked once a post was published. *Chart 16* represents the dynamics of the Bitcoin.

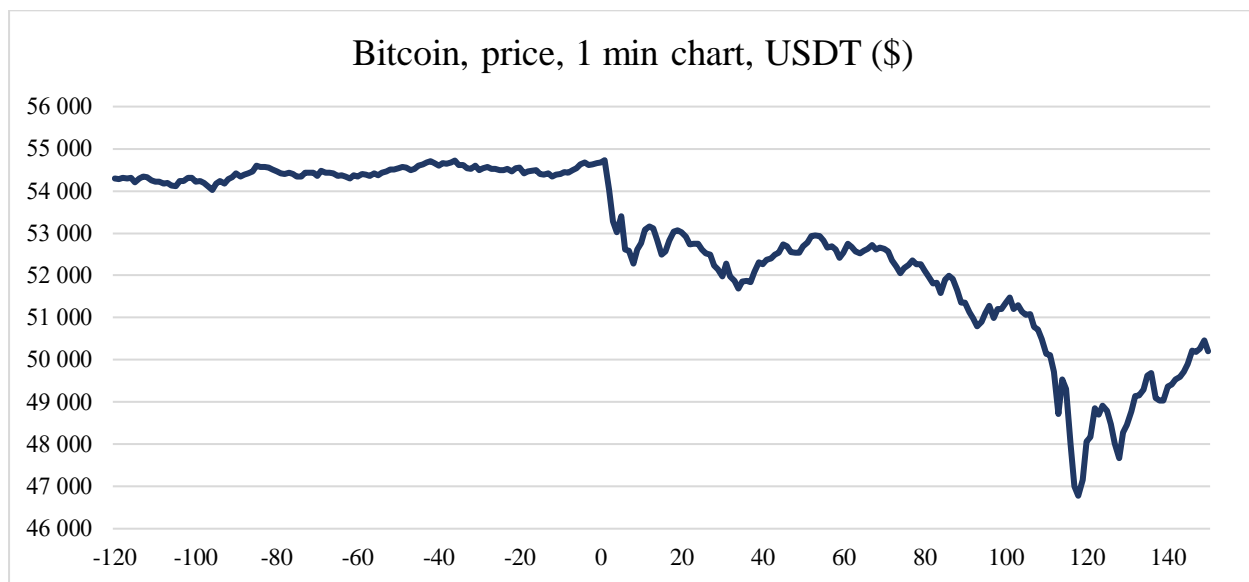
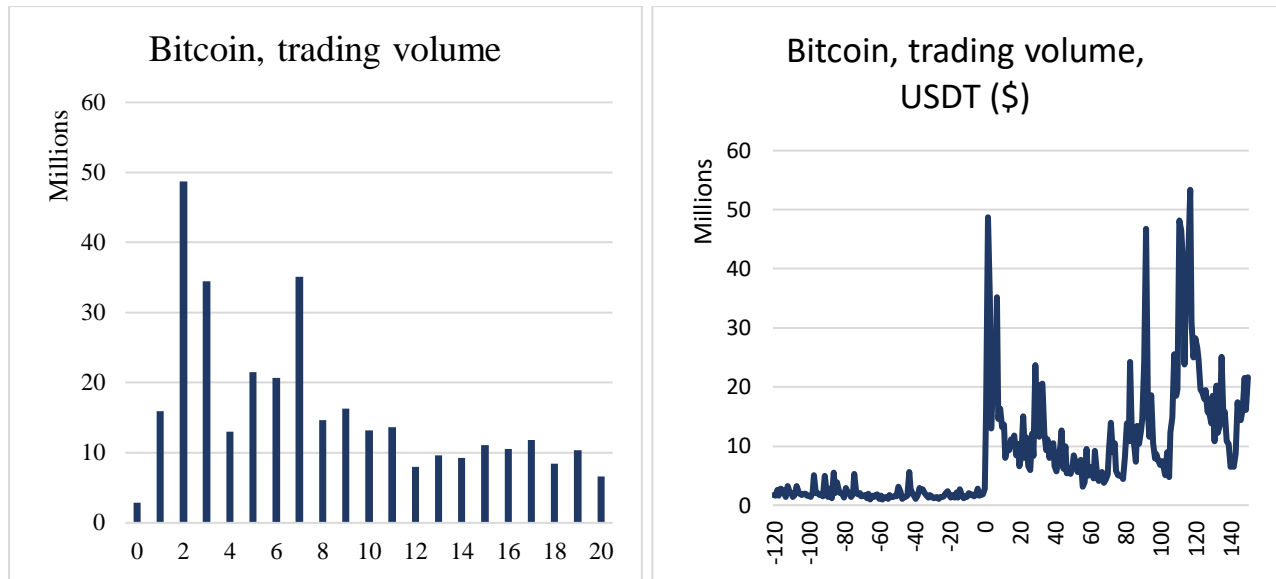


Chart 16. Bitcoin price, 1 min chart, USDT (\$)

Event: "Tesla doesn't accept Bitcoin anymore"

At the second minute after the publication trading volumes has reached one of the highest values, 50 million USDT during one minute of trading. This event was new and unexpected for the market, because investors and traders used to think that Elon Musk has very positive outlook on cryptocurrencies.



Charts 17 and 18. Bitcoin trading volume

Event: “Tesla doesn’t accept Bitcoin”

2.2.2. Dogecoin

Event number 1:

This event happened on the first of April 2021. Elon Musk tweeted “SpaceX is going to put a literal Dogecoin on the literal Moon”. Price at point “0” was \$0,054 per Dogecoin after 73 minutes price peaked at \$0,07. It is 30% growth. Due to lower market capitalization it might be easier for traders to push price of assets fast.

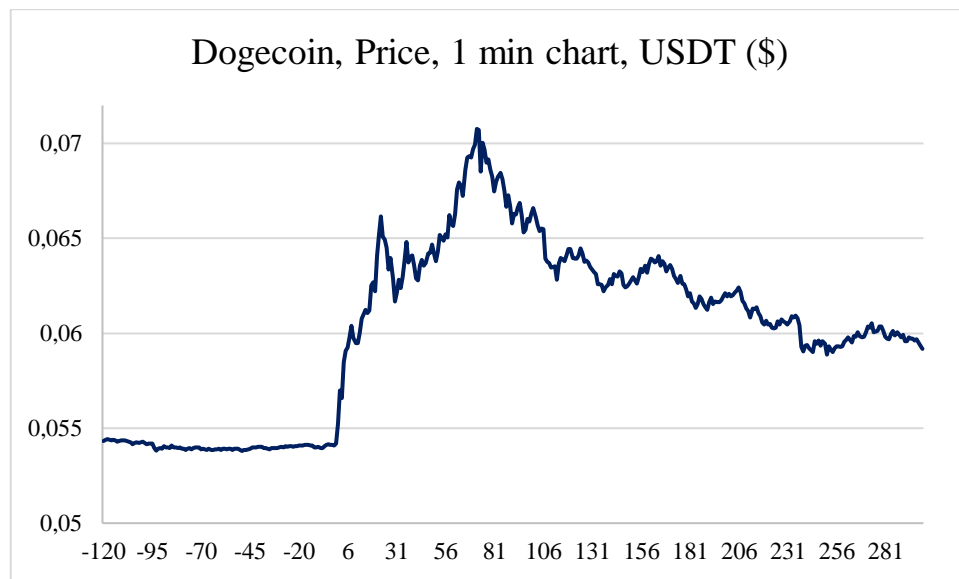


Chart 19. Dogecoin price

Event: “Dogecoin on the Moon”

There are abnormal trading volumes since the first minute of the event. Probably market figured out the impact Elon Musk has on cryptocurrencies and some traders might have created trading bots with language recognition, which react momentarily at news.

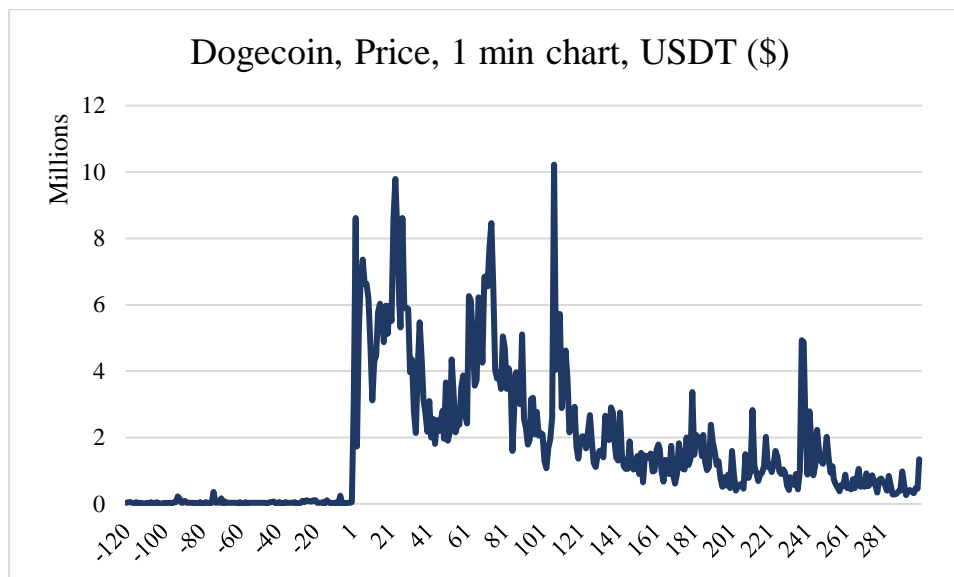


Chart 20. Dogecoin volume

Chapter 3. Event study

Elon Musk's posts has shown significant impact on the prices of underlining assets. Majority of the events demonstrated high abnormal values. The most impactful event was caused by change of Elon Musk's bio. **Cumulative abnormal return in the window 0 to 360 peaked at 19,3%** during this event. It shows that market was unprepared for such news, because windows closer to the event (0 to 15, 0 to 30, 0 to 60, 0 to 120) has shown less percentage.

Publication regarding the possibility of purchasing Tesla using Bitcoin has shown the least impact on the trading volumes and price. It can be explained by the fact that market has already understood attitude of Elon Musk, and positive publications about Bitcoin are no longer shocking.

Significant abnormal trading volumes ($t\text{-stat} > 2$) could be seen during window 0 to 30 in the events "Twitter bio change", "Tesla doesn't accept Bitcoin", "Tesla bought Bitcoin". The highest spike in trading volume was caused by Tesla's annual report, where they stated purchase of the Bitcoin.

Results of the research are stated in the *Table 2*.

Possible advancements to the model could be implemented by changing time datapoints from 1 min to 5 min, because 1 min could be noisy enough to distort the results (especially regarding Cumulative Abnormal Returns)

Table 2. Event study. Bitcoin

Event	Twitter bio change			Tesla doesn't accept Bitcoin		Tesla bought \$1.5 bln of Bitcoin		You can buy Tesla using Bitcoin	
Crypto	Bitcoin			Bitcoin		Bitcoin		Bitcoin	
	Window	CAR	CAV	CAR	CAV	CAR	CAV	CAR	CAV
Event	0 to 15	4,0%	21,6%	-3,6%	44,7%	2,8%	78,3%	1,1%	-2,9%
	0 to 30	12,4%	28,2%	-4,1%	42,6%	9,2%	51,7%	0,7%	-7,6%
	0 to 60	16,1%	9,0%	-2,2%	12,8%	11,6%	23,0%	1,7%	-35,6%
	0 to 120	11,2%	-29,6%	-9,3%	17,7%	10,7%	-25,6%	2,9%	-55,6%
	0 to 360	19,3%	-102,6%	-4,0%	-5,5%	9,4%	-153,2%	3,6%	-211,7%
	0 to 600	10,8%	-112,8%			11,8%	-210,2%	1,5%	-361,3%
T-stat	0 to 15	13,02	2,20	-8,11	4,10	13,38	5,96	8,86	-0,18
	0 to 30	40,65	2,88	-9,37	3,90	44,38	3,94	5,47	-0,47
	0 to 60	52,75	0,92	-5,01	1,17	55,95	1,75	13,18	-2,21
	0 to 120	36,73	-3,02	-21,11	1,62	51,47	-1,95	22,86	-3,45
	0 to 320	63,14	-10,47	-9,16	-0,51	45,57	-11,67	28,06	-13,15
	0 to 600	35,43	-11,51			57,14	-16,01	11,93	-22,44

On the first April (April Fools Day) Elon Musk made a publication regarding the launch of Dogecoin on the Moon. Context of this post is ironic and humorous, however reaction was intensive, showing significant cumulative abnormal return at the rate of **18,5%** in 0 to 60 window and cumulative abnormal trading volume at **32,73%** during the first 15 minutes of trading. Results are displayed in the *Table 3*.

Table 3. Event study Dogecoin

Event	Dogecoin to the moon		
Crypto	Dogecoin		
	Window	CAR	CAV
Event	0 to 15	12,18%	32,73%
	0 to 30	12,78%	28,59%
	0 to 60	18,50%	16,30%
	0 to 120	15,64%	-2,33%
	0 to 360	5,07%	-60,01%
T-stat	0 to 15	28,27	5,41
	0 to 30	29,68	4,73
	0 to 60	42,94	2,69
	0 to 120	36,30	-0,38
	0 to 360	11,76	-9,92

Elon Musk's posts about Bitcoin has significant impact on the other cryptocurrencies (*see table 3*). Projecting his tweets regarding this cryptocurrency can be extrapolated on the whole cryptocurrency market in general. To prove this statement there was Regression made. Impact of Bitcoin on 3 major cryptocurrencies are displayed in the *Table 4*. Regression has shown strong influence on the Ethereum and Litecoin, R-square of 0,835 and 0,899 respectively. However, impact on Cardano was less significant, R square of 0,56. Potentially investor can make regression for all the cryptocurrencies he is willing to observe and extrapolate tweets of Elon Musk on the selected assets.

Table 4. Regression

Bitcoin to Ethereum		<i>Bitcoin to Litecoin</i>		<i>Bitcoin to Cardano</i>	
Multiple R	0,914	Multiple R	0,948	Multiple R	0,749
R Square	0,835	R Square	0,899	R Square	0,561
Adjusted R Square	0,835	Adjusted R Square	0,899	Adjusted R Square	0,560
Standard Error	352,26	Standard Error	24,552	Standard Error	0,230
Observations	510	Observations	510	Observations	510

Conclusion

This thesis investigated the impact of Elon Musk's post on the cryptocurrency market, which is more than one trillion dollars in size, and was rapidly disrupted by single public figure. Thesis makes an attempt to quantify the impact regarding two cryptocurrencies: Bitcoin and Dogecoin.

The first chapter was dedicated to provide an explanation of the reasons why in the current conditions cryptocurrency market is highly liquid and volatile. Primer triggers might be seen in the social media development, new investors with psychological biases towards the market, wide derivative market, which is multiple times bigger than the spot one, and allows to leverage the position by more than 100 times. Also, the first chapter gives methodology on the execution of the research provided in the Chapter 3.

The second chapter denotes the cryptocurrencies, which are Bitcoin and Dogecoin, provides detailed analysis of Elon Musk's posts and market reaction on them. Some posts triggered ~15% growth of the Bitcoin during the first hour after the publication. Also, there was discovered that there used to be a time lag in market reaction for a new type of publications. Examples are: “#Bitcoin” in Elon Musk's Twitter bio and annual report of Tesla, where the company confessed buying \$1,5 bln Bitcoins. Time lag was 8 and 12 minutes respectively, however, market reaction on the following tweet about possibility of buying Tesla for the Bitcoin was instant, demonstrating trading volume spike at the first minutes after the event.

The third chapter introduces Event Study. It strengthens hypothesis of Elon Musk's impact and quantifies it. It shows that the impact of his posts is significant for the Bitcoin and Dogecoin. Also, it provides a linear regression of the Bitcoin's impact on other crypto assets, which allows to extrapolate Elon Musk's posts on the whole market in general.

Understanding of the impact of Elon Musk's posts might allow traders and investors to react quickly to changed market conditions, since there is a 15 minute window to react on it and either to buy or sell assets depending on the attitude of the publication of Mr. Musk.

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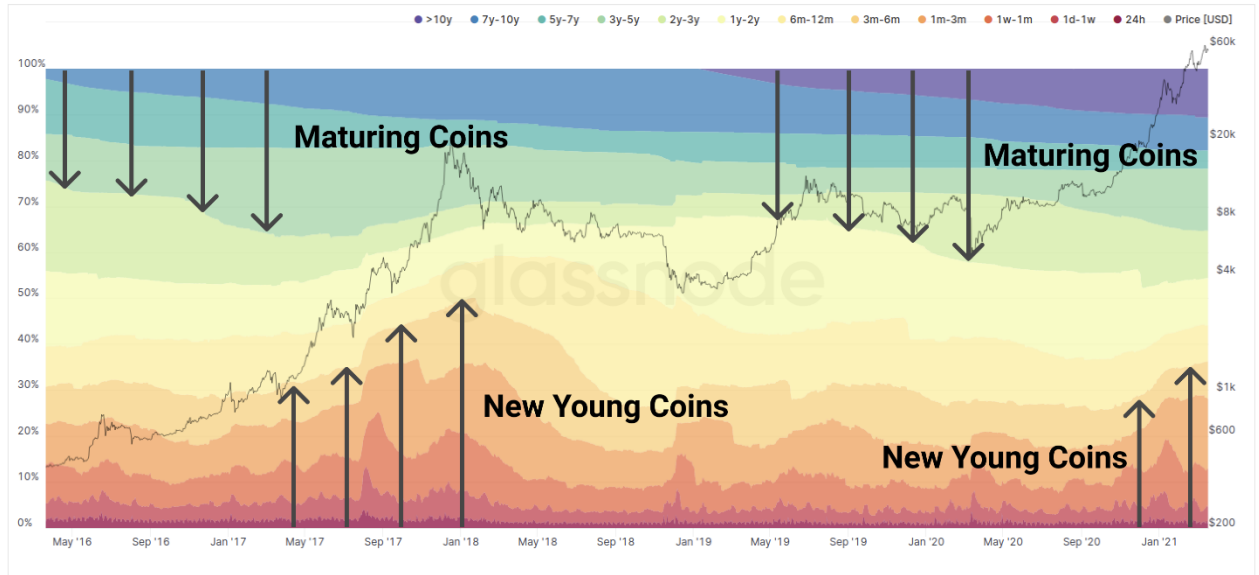
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Appendix

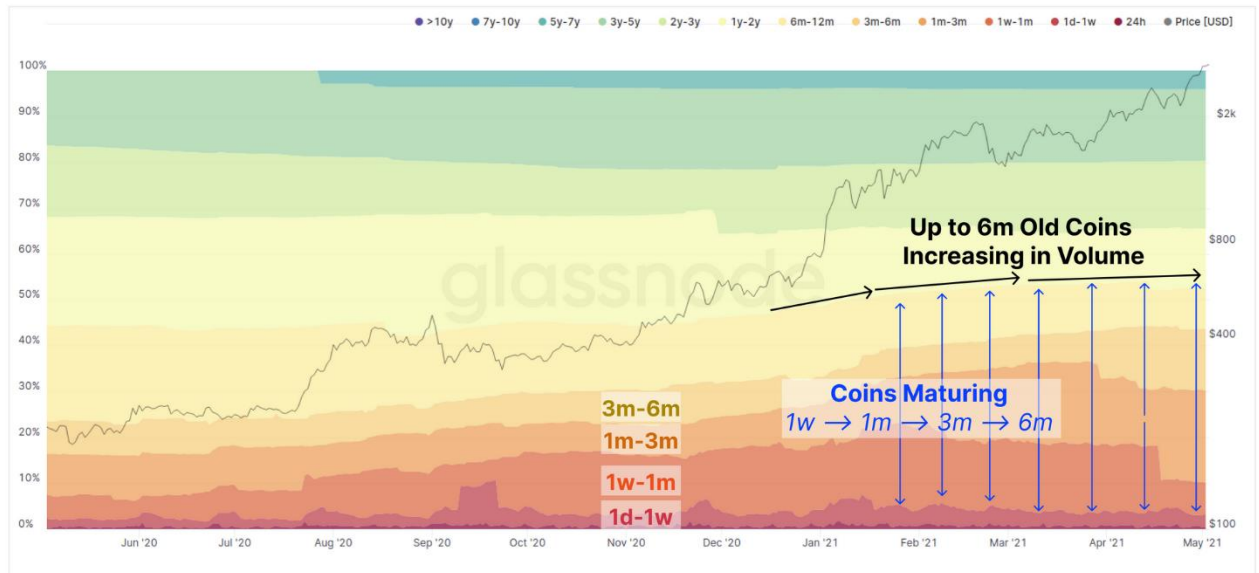
Bitcoin: HODL Waves



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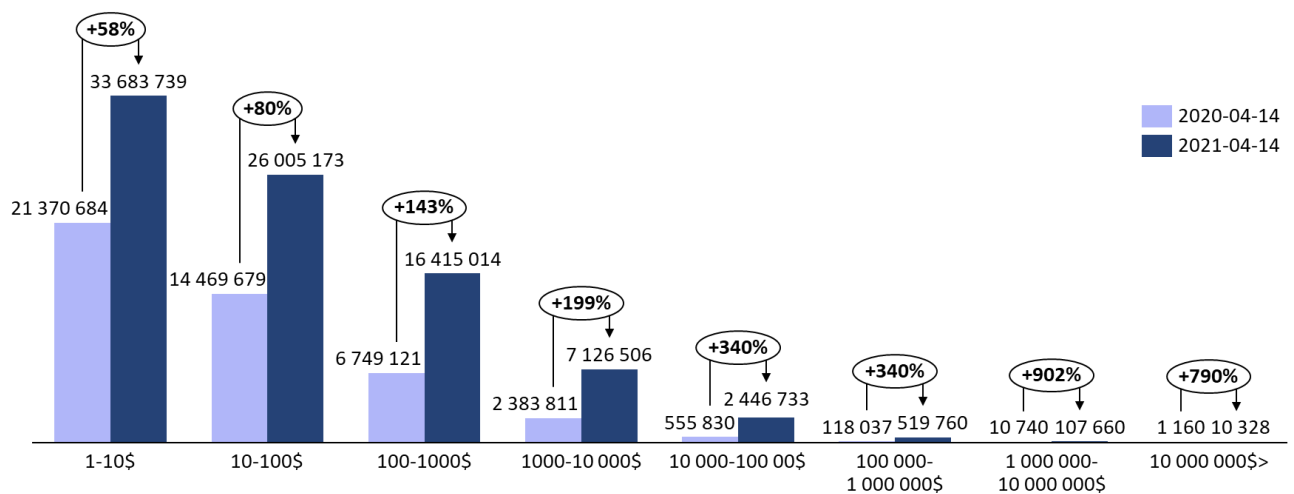
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Ethereum: HODL Waves



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Bitcoin accounts by size

Source: Glassnode

Regression Statistics	
Multiple R	0,914
R Square	0,835
Adjusted R Square	0,835
Standard Error	352,26
Observations	510

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	319590753,6	319590753,6	2575,60535	4,5307E-201
Residual	508	63034541,69	124083,7435		
Total	509	382625295,3			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	-171,819666	24,50356414	-7,012027518	7,52217E-12	-219,9604651	-123,678867	-219,9604651	-123,678867
7200,85	0,044219169	0,000871306	50,75042217	4,5307E-201	0,042507361	0,045930977	0,042507361	0,045930977

Influence of Bitcoin on Ethereum

Regression Statistics	
Multiple R	0,948
R Square	0,899
Adjusted R Square	0,899
Standard Error	24,552
Observations	510

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	2727303,523	2727303,523	4524,46924	4,0624E-255
Residual	508	306217,1751	602,7897148		
Total	509	3033520,698			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95,0%	Upper 95,0%
Intercept	10,87998441	1,707869693	6,370500312	4,22609E-10	7,524627158	14,23534167	7,524627158	14,23534167
7200,85	0,004084889	6,0729E-05	67,26417501	4,0624E-255	0,003965578	0,0042042	0,003965578	0,0042042

Influence of Bitcoin on Litecoin

<i>Regression Statistics</i>	
Multiple R	0,749
R Square	0,561
Adjusted R Square	0,560
Standard Error	0,230
Observations	510

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	34,34756681	34,34756681	648,7927756	7,87361E-93
Residual	508	26,8938937	0,052940736		
Total	509	61,24146051			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95,0%</i>	<i>Upper 95,0%</i>
Intercept	0,083581508	0,01600541	5,222078587	2,58495E-07	0,052136564	0,115026453	0,052136564	0,115026453
7200,85	1,44964E-05	5,69126E-07	25,47141095	7,87361E-93	1,33783E-05	1,56146E-05	1,33783E-05	1,56146E-05

Influence of BTC on ADA