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AVAILABILITY OF RSI IN BITCOIN TRANSACTIONS: A REVIEW FROM THE PERSPECTIVE OF BEHAVIORAL FINANCE

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Abstract: *BITCOIN has a different criterion than traditional systems that pay in states' currencies. This payment system is a complex scheme designed to facilitate the transfer of value between the parties. In this study, firstly, brief information about technical analysis, BITCOIN and behavioral finance is given. Then, in the literature part of the study, studies on BITCOIN prices in the context of behavioral finance and technical analysis are given. In this study, it is examined Relative Strength Index (RSI) availability in Bitcoin transactions and evaluate in the context of behavioral finance findings. For describing the risk of trading in Bitcoin, were chosen Value at Risk (VaR) ratio. In application part of the study it is supposed 1 Bitcoin "Buy" orders were opened when RSI was under 30 and closed when RSI was above 70. And also, 1 Bitcoin "Sell" orders were opened when RSI was above 70 and closed when it was under 30. All obtained data from trades was used for revealing results on accuracy, total profitability. Positive trades were divided by total trades and multiplied by 100 for calculation of accuracy. Period of research is 2015-01-01 till 2019-08-31. As a result of the study we see the effects of biases in Bitcoin transactions. It is observed the examples of conservatism, over and underreaction, status quo effect and loss aversion. And also it is determined in this study that RSI works better in stable market when traders play safer. In other words, RSI works better when conservatism wins over overreaction.*

Keywords*: Relative Strenght Index, Bitcoin, Behavioral Finance*

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INTRODUCTION

Technical analysis enables the future inferences from the past movements of prices in the markets. With technical analysis, trends in prices and formations formed by price movements are examined and market corrections and reverse price movements are predicted. Besides, important indicators such as RSI are used in technical analysis. It is thought that the findings in the field of behavioral finance may contribute to the estimations obtained from technical analysis and indicators and make them more meaningful. In terms of behavioral finance, investors are adversely affected by cognitive biases and cannot rationally use existing knowledge (Thaler, 1993). The results of empirical studies supporting behavioral finance show that investors behave irrationally. Efficient Market Theory states that stock prices reflect all the information available at a given moment. This theory is based on the idea that it is impossible to estimate prices since prices reflect all the information about stock. In behavioral finance, rational and non-rational expectations of returns are emphasized. The same can be said for technical analysis (Papathanasiou, Vasiliou & Eriotis, 2015).

Behavioral finance literature has focused on two main market anomalies. These are over and under reaction. Barberis et al. (1998) link these two findings to human psychological biases (conservatism and representativeness), which have caused investors to misrepresent a series of news such as earnings announcements (Wu, Wu & Liu, 2009). Barberis et al. (1998) suggested that investors do not know that earnings show a random walk. They argue that earnings depend either on an average returning regime (where investors react slowly to earnings announcements and are conservative) or on a prone regime (where investors anticipate past earnings trends and show representativeness). These two behavior biases include momentum predictability and reversal of trends (Wu, Wu & Liu, 2009).

Barberis et al. (1998), the investor falls into two jurisdictions: conservatism and / or representativeness bias. In the model; underreaction is explained by conservatism and overreaction is by representativeness bias. Underreaction, in the model, occurs when investors believe that if profits change in one direction, they will return to average. The overreaction occurs when investors believe that a trend has started after several repeated surprises in the same direction (Demir&Songur, 2011).

The bias of conservatism may contribute to the gradual adjustment of prices and the emergence of the trend as investors gradually take into account new information. On the other hand, representativeness causes investors to believe that the market will be established in the future based on a small and often inaccurate

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data sample. When investors later realize that prices are overreacting, corrections reverse the initial and erroneous trend.

Homo-economicus, which is the basic assumption of classical and neo-classical economics, defines the rational individual who pursues the maximization of benefit or profit (Akyıldız, 2008). Homo-economicus is defined as an individual trying to maximize his wealth within the framework of his material means (cited in: Akyildiz, 2008). Rational choice theory assumes that individuals have complete and transitive choices and argues that individuals will act instrumentally rationally to fulfill their preferences (Lecouteux, 2016). As stated by Lecouteux (2016), many empirical studies have shown that the choices that individuals make with their choices deviate considerably from the assumptions of rational choice theory (Kahneman and Tversky, 2000; Frederick, Loewenstein&O'Donoghue, 2002; Camerer, 2003). The common result of these studies is that real people - unlike filling the neoclassical economic models of rational Homo Economicus - often make mistakes and therefore do not act in their own interests (O'Donoghue& Rabin, 2003; Thaler&Sunstein, 2008; Ariely, 2008; Lecouteux, 2016).

The idea that prices formed in financial markets are affected by the psychological and behavioral characteristics of financial market investors has started to be expressed more in the last 10-15 years. Behavioral Finance has been gaining ground in the academic field since the 1970s. This process has accelerated since the 1990s. In 2002, the Nobel Prize received by Daniel Kahneman for his contribution to the field of behavioral finance has attracted much more attention to this field. Finally, in 2017, Richard Thaler, another behavioral financier, was also awarded the Nobel Economics Award for his work in the field of behavioral finance, and a new stepping stone has emerged to increase the number of studies in behavioral finance. Behavioral finance is a new approach that draws attention to the difficulties (rational investor paradigm) faced by traditional approaches to solving problems that arise mainly in financial markets.

We can indicate that with the studies in the academic field, the logic of homo psychologicus is replaced by the logic of homo economicus. Studies have shown that the predominant factors determining individual behavior are very diverse and sometimes they are intellect, sometimes habit, sometimes imitation, and sometimes social norms (Akyildiz, 2008). This suggests that behavior in real life involves a multidimensional optimization and that it is not possible to formulate psychological processes. From this, it becomes clear that human beings can be defined as "homo-psychologicalus" (psychological human), rather than "homo-economicus (Akyildiz, 2008).

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Psychology literature is extensive and continues to expand day by day. The literature on human psychology and behavior suggests that most people, including investors, have significant constraints in their cognitive decision-making processes and therefore tend to develop behavioral biases that can significantly affect individuals' decisions (Azouzi&Jarboui, 2012). Therefore behavioral finance argues that some events taking place in financial markets can be better understood by models where financial actors are not assumed to be fully rational (Vasiliou, Eriotis, Papathanasiou, 2008). Behavioral Finance also argues that in an economy where rational and irrational actors interact, irrationality can have a significant and long-lasting impact on prices. Studies conducted in the field of behavioral finance have yielded findings to explain how certain investor groups behave, and in particular, what investment instruments their portfolios prefer, and how they transact over time (Vasiliou, et al., 2008). Behavioral finance shows that if there are deviations from basic financial market values due to the transactions of irrational actors, rational actors will be ineffective in correcting this. However, as in technical analysis, there are expectations for trend returns in behavioral finance models (Vasiliou, et. al., 2008).

This article contributes to the current literature as follows: a) Examining the relationship between Behavioral Finance and Technical Analysis. b) Investigation of the extent to which Bitcoin market is affected by investor behavior. c) Investigating the performance of the RSI indicator in the Bitcoin market. d) Contributing to the literature on Behavioral Finance and Technical Analysis.

The purpose of this study is to explain the behavioral drivers which affects Bitcoin price and to find evidence of such affection by using tools of Technical Analysis. Firstly, in Section 1, we examined the existed literature of researches on crypto currencies market. In Section 2, we calculated the Bitcoin risk levels and identified riskiest time periods. Then, the returns of investing in Bitcoin were calculated by using Relative Strength Index and modeling 16 different scenarios. All results are presented in this section. So, Section 3 concludes.

LITERATURE REVIEW

Behavioral finance has emerged with the idea that people are not always rational in their investment decisions. It focuses on logical errors that are constantly made by investors. Investors tend to make mistakes in some cases. Individual investors have difficulty in making decisions in uncertain situations and correctly evaluating relevant information (Küçük, 2014: 8). Therefore, behavioral finance

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has determined the tendency of investors to make mistakes and tried to explain the irrational behaviors that occur in the market (Öztopçu&Aytekin, 2017).

In the literature, it is seen that investor behavior is mostly examined through stock investments. However, the fact that cryptocurrencies have not fallen off the agenda for a long time in recent years and the effects that they have or could have on the economic and financial system cause interest to shift towards this area.

In one of these studies, Bukovina&Marticek (2016) examined the relationship between investor sentiment and Bitcoin prices. In this study, it is investigated how Bitcoin prices are affected by comments made through a social network. According to the results of the study, the sensitivity of Bitcoin explains only a small part of the volatility. Mai et. all (2018) examined the dynamic interactions between social media and the monetary value of bitcoin. They found that bull market shipment is associated with higher future bitcoin values. In addition, messages related to tweets have a stronger impact on future bitcoin value. Their findings generally indicate that social media sensitivity is an important factor in determining the valuation of Bitcoin, but shows that not all social media messages have an equal effect.

When the literature is examined, it is seen that the studies examining the findings of behavioral finance together with crypto currency are quite limited. In the current studies, it is seen that the over and under reaction hypotheses in the crypto currency market are mostly investigated.

Jakub (2015) investigated whether Bitcoin price complies with the effective market hypothesis. As a result of this study, Bitcoin price was found to act in accordance with the effective market hypothesis and react to information disclosed to the public immediately. In his research in Pakistan, Khan (2019) examined the impact of biases on those who make investments in digital / crypto currencies. As a result of the study, it was determined that investors act with bias and heuristic while investing in digital currencies.

Caporale&Plastun (2018) examined the overreaction in crypto currencies. As a result of the analysis, they detected overreaction anomaly in crypto currencies. They also investigated whether these price movements could be used to make a profit and showed that after extreme reactions, a strategy based on counter-movements is not profitable, that the inertia-based seems profitable, but produces results that are not statistically different from random ones. Therefore, they con-

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cluded that the excessive reactions detected in the crypto currency market cannot be used for profit and cannot be seen as evidence against the Efficient Market Hypothesis (EMH).

Chevapatrakul&Mascia (2018) tried to detect the presence of overreaction in the Bitcoin market. According to the findings of the studies, the Bitcoin market is overreacting. Traders are overreacting on the days of sharp drop in Bitcoin prices and market rally weeks.

Some of the studies in the literature are focused on the interaction between behavioral finance and technical analysis. Many studies have been conducted combining the behavioral finance discipline with technical analysis. Martin (2008) state that in line with the basic assumptions about investors, the profit making approach also differs. Fundamental analysts assume that investors are actually rational and financial markets are efficient. In contrast, technical analysts tend to believe investors' illogicality and rationality.

Behavioral finance models show that if technical analysis strategies are prepared on the basis of noise or other models and are not prepared according to information such as news or basic factors, technical analysis profit can be obtained even in the long term (Shleifer and Summers, 1990). Nebesnijs (2012) conducted a comprehensive literature review on market efficiency, behavioral finance and technical analysis. In his study, it was shown that the price movement following the price cut showed a non-random price behavior that could help systematically produce alpha in some currency pairs.Caginalp et al. (1998) found that investors were affected by price movements. Lachhwani et al. (2013) found that in the long and short term, the Relative Strength Index (RSI) provides a higher profit compared to other trading strategies such as buy and hold (B&H).Papathanasiou et al. (2015), examined the possible presence of behavioral factors on the stock exchanges of PIGS (Portugal, Italy, Greece and Spain). As a result of the study, they found that the buy and hold strategies overcame the market and that Fama's (1965) efficient market hypothesis in the weak form was not valid. Vasiliou et al. (2008) applied the Methodology of Technical Analysis to Behavioral Theory on high-capital firms traded on the Athens Stock Exchange. As a result of the study, in behavioral and technical theory, they found a combination between basic (rational) and psychological-emotional (irrational) factors. In addition, there was a strong time-based increase in the performance of trading rules. Therefore, there is the existence of behavioral theory for the high capital companies of the Athens Stock Exchange.

METHOD AND FINDINGS

Value at Risk: For describing the risk of trading in Bitcoin, were chosen Value at Risk (VaR) ratio. VaR concept has few different approaches to calculate it. According to Abad et al (2013) VaR estimation could be performed by using tree types of methods: (i) Non-parametric methods; (ii) Parametric methods; (iii) Semi-parametric methods. All these methods have different approaches. Future in this article, the Historical simulation approach (Non-parametric method) was used to calculate the data of Bitcoin from January 2016 till September 2019. Calculations of VaR were composed by recommendations of Basel Committee on Banking Supervision (2017). VaR data shows the size of invested capital which could be lost in next 10 days with possibility of 99 %.
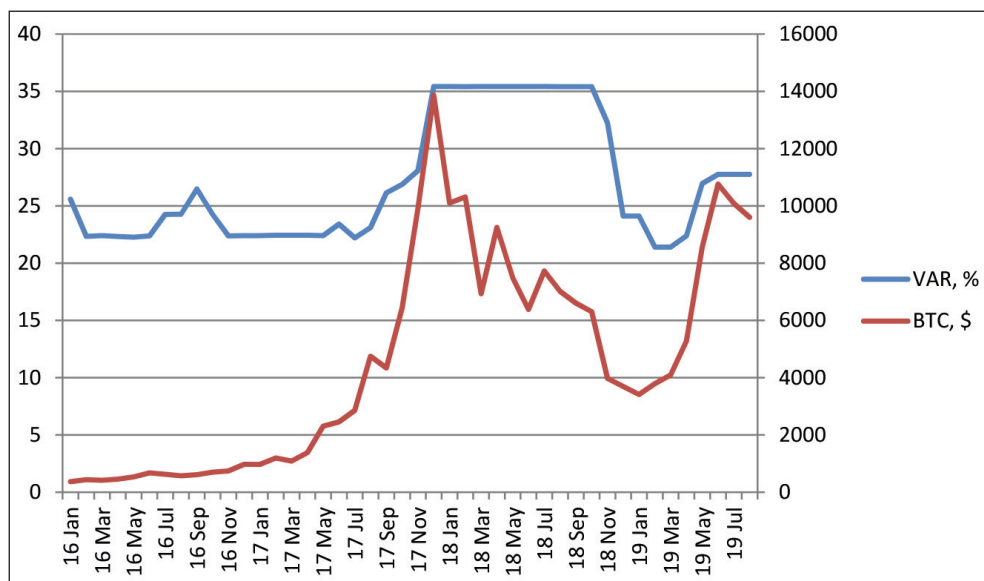
Figure 1. Dynamics of Bitcoin price and Value at Risk

Source: authors

As shown in the chart (Fig. 1), Value at Risk of Bitcoin is always higher than 20 % in period from January 2016 till September 2019. For comparison with other financial assets, we could say that Bitcoin is 8 times riskier than SP500 and Gold (Stavroyannis, 2017) and 10 times riskier than usual currencies (Bartkus, 2019). If we look closely, VaR of Bitcoin left stable below 25 % in period from beginning of 2016 till September 2017 with two small jumps. First jump was calculated in January 2016 when one of Bitcoin's developer Mike Hearn went out from Bitcoin. The price of this cryptocurrency felt down by 18 % (Charles, Darne

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2019). Another jump of Bitcoin's Value at Risk to zone over 25 % happened in September 2016. Increased risk was effected by the theft of 120 000 Bitcoins (value $72 million at the time) from Bitfinex in August 2016 (Reuters). In the end of October 2017, it was period when VaR stayed over 25 % more than one month. Perhaps, it was the signal that overreaction takes preference over other behavior. In next two months this ratio jumped over 35 % and price of Bitcoin reached its peak – near 20 000 $ for 1 Bitcoin. This price and risk's level was the peak of overreaction by investors. In next month, the wave of more conservative Bitcoin owners, possibly, decided that it is the time to take the profit. They started to sell this assets. Herewith, the selling affected fast declining Bitcoin's market value. In another few months, one part of overreacted Bitcoin buyers had changed their behavior to "assets protection status". They sold their Bitcoins with some losses and left the market. Other part of initially overreacted buyers is still keeping this cryptocurrency with thoughts to do it "till the end", i.e. they believe that the price will rise again in the future. If not, they agree to lose everything. Perhaps, this behavior is one of factors which determine the current price of Bitcoin which didn't fall less than 3000 $.

In spring of 2019, Facebook's cryptocurrency Libra sparked new life in cryptocurrency market. Once again, the value of Bitcoin jumped 4 times from 3000 $ to 12 000 $. The rising VaR (from 21 % till 28 %), perhaps, shows that overreaction are back in this market and there could be another financial bubble.

Relative Strength Index: The original RSI was developed by W. Wilder in 1978 for trading stocks in The New York Stock Exchange. Since that, the index has become widely used and now, every trading platform has integrated it inside theirs charts. Index calculation splits into two formulas. First of all, the Relative Strength has to be calculated:

$$RS = AUP / ADP \tag{1}$$

Where, RS ‒Relative Strength;
AUP ‒ average gain of UP periods during the specified time frame;
ADP ‒ average gain of DOWN periods during the specified time frame.

W. Wilder recommends use 14 days periods. According to him, on day 15 and more, the price changes in unpredictable way for RSI. Till that, the oscillator's indication goes ahead of price line and that's very important for trader who wants to forecast the price of securities.

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Future, this research was based on these observations: imaginary 1 Bitcoin "Buy" orders were opened when RSI was under 30 and closed when RSI was above 70. Imaginary 1 Bitcoin "Sell" orders were opened when RSI was above 70 and closed when it was under 30. All obtained data from trades was used for revealing results on accuracy, total profitability. Positive trades were divided by total trades and multiplied by 100 for calculation of accuracy. Period of research is 2015-01-01 till 2019-08-31.

Table 1. Main conditions for opening and closing the trading order

Entering LONG position	Exiting LONG position	Entering SHORT position	Exiting SHORT position	Position's amount
RSI<30	RSI>70	RSI>70	RSI<30	1 Bitcoin

Source: authors

The usage of 1st approach RSI (30/70) on trading of 1 Bitcoin suffered losses in every scenario despite the accuracy was equal or over then 50 % (Table 2).

Table 2. Results obtained with daily RSI trading scenarios on 1st approach (30/70)

Scenario	Trades	Accuracy, %	Total return, $
D6	46	50.00	-2741
D8	32	50.00	-7069
D10	23	47.80	-6847
D12	19	73.68	-417
D14	15	60.00	-1396
D16	10	60.00	-3422
D18	7	71.43	-1043
D20	3	66.67	-5217
D22	3	66.67	-5217

Source: authors

The best results were reached from 12 days (D12) scenario with 73.68 % accuracy and -417 $ loss. Classical W. Wilder's setup gave 60 % accuracy and -1396 $ on balance. The biggest losses of all scenarios were suffered at the period of Bitcoin price bubble from October 2017 till November 2018. This period synchronizes with grown up VaR ratio also. In the case, any trade would not be made when VaR stays over 25 % longer than 2 months the results of trading would be much better, i.e. 2nd approach excludes impact of overreacted investors (Table 3).

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Table 3. Results obtained with daily RSI trading scenarios on 2nd approach (30/70)

Scenario	Trades	Accuracy, %	Total return, $
D6	29	48.28	-2766
D8	22	50.00	-26
D10	16	43.75	-1565
D12	13	76.92	1946
D14	11	72.73	2620
D16	6	66.67	76
D18	4	75.00	-32

Source: authors

In the 2nd approach the trading with classical RSI setup (D14) showed good result on total return (2620 $) with the condition - stay away from trading when VaR over 25 %. The accuracy of trades reached highest result near 77 %. Closest scenarios (D12 and D16) were profitable also. This could prove that RSI works better in stable market when traders play safer. In other words, RSI works better when conservatism wins over overreaction.

CONCLUSION

In this study we see the effects of biases in Bitcoin transactions. According to the analysis, Bitcoin, the developer's departure from Bitcoinand the stolen 120 thousand Bitcoin reduces the value of Bitcoinby 18% and increases the value at risk (VaR) by 25%. At the end of October 2017, the VaR value for Bitcoinremained above 25% for more than a month. Over the next two months, this rate has risen to over 35%, and the price of Bitcoinhas reached its peak (1Bitcoinhas risen to around $ 20,000). In addition, the highest losses are seen when VAR exceeds 25%. This is a typical example of conservatism and underreaction. The status quo effect can also be addressed. Bias to preserve the status quo, in other words, to prefer the current situation, is also a result of indulgence. People resist change, because they fear the regret that may arise if the active steps change the status quo. Therefore, they tend to preserve what is currently owned (Bayar, 2011). All 9 scenarios of Bitcoin trading with RSI suffered losses in conditions when we "blindly" followed the signals to "Buy" or "Sell". In next approach, RSI indications weren't follow in periods when investing risk get over 25% and RSI with classical setup showed positive return and 72.73% accuracy of trades. The results could link to idea that rapidly rising risk level indicates establishing of the overreaction in the crypto currency market. Herewith, the using of RSI on

Bitcoin prices can be useful when conservative investors dominate in the market. Compared to other financial assets, Bitcoin is 8 times more risky than the SP500 and gold (Stavroyannis, 2017) and 10 times more risky than normal currencies (Bartkus, 2019). Despite this, Bitcoin continues to be preferred by investors. The price is quite high. Here is the value or confidence that Bitcoin really has. There are quite a number of factors that shape investor behavior. Perhaps the most important of these is the psychological characteristics of investors and their reactions to the news in the markets. Recent global economic crises have shaken people's confidence in the countries' currencies and precious metals. Here we see a typical risk and loss aversion behavior. In this way, people prefer digital currencies that they know much less about, but rely on the people they trust with which they tend.

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