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"The disposition effect in stocks versus bitcoin"

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Abstract

Cryptocurrencies have become a hot topic in finance: its price swings have gathered attention from investors therefore they have become an appealing asset to hold alongside other financial instruments. Despite this, do cryptocurrencies reflect the same investment behavior as seen in other assets? This paper aims to study irrational behavior with a focus on the disposition effect in stocks and Bitcoin. Is there a disposition effect in cryptocurrencies and, if so, how different are the effects between the two assets? The findings suggest there is disposition effect in Bitcoin, but it is stronger for stocks.

Keywords: Disposition effect; Bitcoin; Investor behavior; Prospect theory

1. Introduction

On the 17th of June 2019, Bitcoin hit $9,000 and it appears to have, arguably, gathered new interest from investors with the news of Facebook's new cryptocurrency and the interest of more companies accepting cryptocurrencies as method of payment. In the beginning of this year, Bitcoin was priced at around $3,700 therefore representing an increase of 143% in 6 months but the volatility of this asset was best shown in 2017 where it had an increase of 1400% ($1000 to $14000 on a year basis).This helps to show how volatile Bitcoin is but also the prospect of returns on investment in such a small time frame might propel new investments in this class of assets from experienced investors and not so experienced ones.

Cryptocurrencies, such as Bitcoin, are digital currencies which use cryptography to create and manage digital financial transactions and these have gathered much attention due to regular debates on tv networks and growing discussion on social media. The increase in Bitcoin's popularity alongside a potential fear of missing out on a good investment have raised demand for the asset and, consequentially, its price. In the acclaimed book, "Thinking, Fast and Slow", Daniel Kahneman (2013) writes there are two operating system in the brain: System 1 and system 2. The former acts in an automatic, instinctive, unconscious manner whereas the latter is slower, deliberate and rational. Due to the larger physical toll on the individual by system 2 and/or limited knowledge, time or information ("bounded rationality"), most decisions can be influenced by different cognitive biases thus causing suboptimal (irrational) decisions in terms of expected utility.

The goal of this paper is to use the findings of behavioral economics to understand whether, in fact, investors are more irrational investors towards Bitcoin versus stocks. Specifically, does the disposition effect also holds for Bitcoin as it does for stocks? If so, what is the difference, in magnitude, of the disposition effect between the two assets? In order to capture

the potential difference in rationality towards the different assets, cognitive biases such as the disposition effect, mental accounting and sunk cost effect are the ones studied.

The structure of this paper is as follows: First, I review the literature on cognitive biases and consequences on investment behavior and present a brief description of Bitcoin and what potentially drives its price. Second, I present the data and methodology used to gather the results. Third, the findings are presented and discussed. Lastly, the conclusion outlines the evidence gathered and suggestions for future study on the matter.

2. Literature Review

Simon (1986) displays some aspects on how neoclassical economics (hereafter standard theory) diverges from other social sciences in the rationality assumption: the agents are rational regarding their environment in the present (and future) and they are consistent with this behavior throughout time. This rational agent[1] is considered as a highly intelligent and organized individual (Simon, 1955). Consequentially, the individual will take the optimal decision thus maximizing expect utility. Nevertheless, there are real-life examples in which behavior does not follow along the lines of standard theory[2]. As a result, behavioral economics has set a theoretical framework of cognitive biases and heuristics which describe the "rationale" behind the deviations from the best or optimal decision by the agent.

In this paper, three cognitive biases will be studied: Disposition effect, mental accounting and sunk cost effect. In a nutshell, the disposition effect is the tendency investors have to realize gains quicker than realizing losses ("selling winners and holding losers"); mental accounting,

[1] The rational agent also knows the probability of every outcome; has no struggle on sorting lotteries of outcomes and is perceived as selfish and emotionless.
[2] See Thaler (1999).

resembling formal accounting, is the setting money into categories in which money will be spent for a specific purpose and will not be fungible across categories and sunk cost effect is the propensity of past outcomes influencing today's decisions (these will be explained, in depth, in this section).

2.1 Disposition effect

In Baker and Nofsinger (2011), Markku Kaustia highlights the costs from this recurrent type of behavior: First, investors end up paying more in taxes (in terms of capital gains) than they should. Second, a reliance on the purchase price over financial decisions might also result in non-optimal behavior. The disposition effect is a trading behavior well documented and reviewed by many scholars throughout the years however its root causes are still to be agreed upon[3].

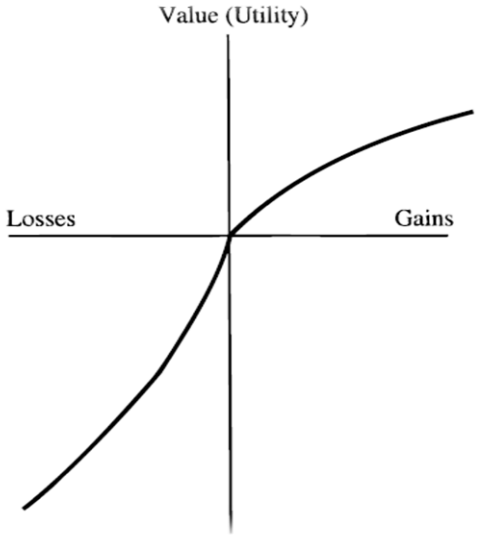
One of the most prominent papers in the literature about the disposition effect is the one from Shefrin and Statman (1985). In this paper, the authors recognized that investors display the disposition effect which contradicts the optimal route for individuals to minimize tax costs: with no transactions expenditures, subjects should sell their asset whenever it turns a "loser" and if, there are transactions expenditures, selling "losers" ought to increase, consistently, throughout the year hitting a maximum in December (Constantinides, 1983). Therefore, they argued certain factors might explain the investors' behavior: regret; self-control; mental accounting and prospect theory.

Prospect theory, as presented by Kahneman and Tversky (1979), is a theory of decision-making between different alternatives when faced with uncertainty and is a response to some issues not displayed or clarified by standard theory. It explains that individuals will maximize

[3] Hens and Vlcek (2011) present possible causes: belief in mean reversion prices; taxes or transaction costs; private information and prospect theory.

their welfare according to a S-shape value function. Instead of levels of wealth, this value function considers gains and losses, depending on a reference point (for many investors, the purchasing price is used as reference point). The new value function is concave on the gains side and convex on the losses dimension. Finally, is also steeper for losses than for gains (reflecting loss aversion) as seen in Figure 1.

Figure 1- Prospect theory value function



Source: Odean, T. (1998)

These axioms are relevant towards explaining why the disposition effect exists and persists: Assuming the reference point as the purchasing price, if the stock is, now, priced below, the individual seeks more risk than before (since the individual is, now, on the convex part of the value function) so it will delay the sale of the stock (and vice-versa for the gain region). In addition, prospect theory suggests the tendency to sell an asset decreases as gains or losses move further away from the reference point.

Odean (1998) tested the disposition effect using trading data from an American brokerage firm with 10,000 accounts from 1987 until 1993. The data demonstrated there is disposition effect among investors and return momentum is significant (stocks' returns tend to follow the

past three to twelve-month past returns). Likewise, Chen, Kim, Nofsinger and Rui (2007) found that Chinese investors also display disposition effect behavior. Using trading records from a brokerage firm with, around, 45,000 individual accounts and 212 institutional investor accounts, the authors argue investors tend to behave with the mindset of dodging regret and following pride which might explain why investors quickly sell "winners" and delay selling "losers" (in other words, people exhibit loss aversion).

Not only with real-life investment data can the disposition effect be studied but also with a laboratory experiments (which are closely related to the methodology presented in this paper). Fogel and Berry (2010) surveyed 176 individuals and they found anticipation of regret may lead to disposition effect since 59% of respondents said the regret was larger for not selling a loser stock sooner compared to selling a winning stock too quickly. Weber and Camerer (1998) surveyed individuals to consider hypothetical investment actions regarding six stocks across fourteen periods and they concluded there is a disposition effect for different reference points (purchase price and price in the preceding period) although the effect tends to be lower with automatic sale at the end of the period meaning they are not as predisposed to buy back the stocks sold (the pride/regret of an investment is eliminated at the end of each period). The problem with hypothetical investment decisions may lead to biased or inconclusive results since respondents don't have any real repercussions for the decisions they take in the survey and small sample of respondents leads to a larger variance of results.

One principle of the efficient market hypothesis (EMH hereafter) is the unpredictability of stock prices in the future based on public information (Mullainathan and Thaler, 2000). However, there are studies contradicting this principle. De Bondt and Thaler (1985) showed people are inclined to overreact to important and unexpected news events in which individuals rely heavily on recent reports and undercut prior data (representativeness bias). If

there is overreaction, stock prices which are too high, eventually, will come down hence predictability on future prices.

On the other end of the spectre, Frazzini (2006) states the disposition effect can cause an underreaction to news events which, in turn, can lead to predictability on future prices. With a considerable number of investors exhibiting disposition effect, once good news is released, the stock would rise in price. Afterwards, those same investors would want to sell quickly (depending on the reference point) which decreases the price in the short term. If other investors predict this, they would want to buy when the price is lower thus, by increasing the demand for the stock, its price will rise again reflecting a positive price drift after the announcement (and vice-versa for negative news) resulting in price predictability. In sum, prospect theory has been a major factor, even though researchers might disagree on its extent[4], to explain the disposition effect.

2.2 Mental Accounting

According to standard theory, money is fungible: any monetary unit has the exact same value no matter where it comes from and can be used for several different expenditures. Nevertheless, individuals assign money to mental "categories" thereby violating the principle of fungibility (Thaler, 1985). This is called mental accounting: subjects tend to create categories in which money has distinct subjective value. Individuals might have budgets for different purposes (clothing; house bills; travel, etc.) and, when faced with a large expenditure, one would rather take money out of the clothing or travel account before taking from the house bills account therefore certifying money has different value across the several

[4] See Kaustia (2010), Barberis and Xiong (2006) and Dacey & Zielonka (2013).

mental accounts. A famous example of mental accounting is the theater ticket example[5] where having two different mental accounts can explain an outcome of a real-life situation.

There is also other unorthodox behavior called "house money effect": a willingness to take more risk with recent gains due to mental accounting. Thaler and Johnson (1990) postulate prior gains and prior losses can affect current choices (which also helps to prove there are sunk cost effects). In particular, a gambler experiencing a profit, will seek more risky behavior while playing with "house money" until the mental account of "house money" is zero whereas when given the ability to break-even after prior losses, individuals are more willing to take the risk with the goal of closing the mental account.

Kaustia (2010) found a spike in stock selling at zero capital gains which can be attributed, according to the author, to mental accounting. Investors might hold on to "losers" however when they break-even, they are ready to sell and close the mental account avoiding more future regret. Likewise, mental accounting is also featured in the model from Shefrin and Statman (1985): selling a stock at a loss generates regret and a realization of a bad investment decision thus leading to a delay of selling that exact stock and, consequentially, closing that mental account.

2.3.Sunk Cost Effect

Individuals are prone to let past returns/costs influence decisions made in the present whereas, according to standard theory, only incremental returns/costs shall impact decisions. According to Arkes and Blumer (1985), sunk cost effect is a continuation of a project after several resources (effort, time or money) have already been allocated into it ("weekend ski trip" example demonstrates this effect)[6].There are several scenarios in every aspect of life which

[5] See Kahneman and Tversky (1984).
[6] See Arkes and Blumer (1985).

can easily depict how sunk costs influence decision-making: going to a football match while ill (thus risking a more serious health issue) due to the hefty ticket price, a poker player who takes in more risk when losing to try to regain chips, investing time and money into a business idea which has not flourished yet instead of moving on to other possible profitable idea, etc.

Often, challenging decisions consider not what to do in a specficic situation but about a course of actions across time. Staw (1981) gives several examples of cases about past events influencing today's decisions and, in many cases, there is a doubling down in money, effort or time into projects which are, arguably, non-optimal (the escalation effect). Therefore, he developed a descriptive model in order to be able to see, in hindsight, what caused the escalation effect with justifying previous decisions being one of the causes.

The author argues that personal responsibility is a driver in commiting to a non-efficient action. If an individual has the responsibility of an ongoing project and it has not been profitable yet, he might want to justify the initial decision by committing to pour in more funds into the project hoping it will payoff in the future. Given the onus is on the individual's side, one might commit heavily in a losing project because, otherwise, it would be an admission of guilt/judgement error which can have some relevant internal effects ("I made a mistake") and external effects ("That person might not be ready for a promotion").

Another argument used to try to explain the sunk cost effect is the certainty effect. People tend to prefer certain outcomes compared to likely outcomes and, on the other end, individuals tend to choose more unlikely outcomes with larger gains than other unlikely outcomes with lower gains (Kahneman and Tversky, 1979). This is shown in the Allais paradox[7] thus, an investor might be willing to direct more funds to an already "losing" project

[7] See Allais (1953).

because the possible payoff, in the future, is larger or equal to the sunk costs compared with the alternative of no more investment and a certain loss on the project.

Situations where committing to an inefficient course action in which the costs outweigh the benefits is the reason (considering prior information) why the sunk costs effect exists and it can only be eliminated if individuals are capable of identifying these beforehand (Arkes and Ayton, 1999). In sum, sunk cost effect, also known as the sunk cost fallacy, is displayed in many real life situations and can have major impacts in present and future prospects either for the regular household but also for relevant companies. A desire not to be wasteful; personal responsibility (leading to a justification action) and the certainty effect are used as arguments to explain decisions impacted by sunk costs.

2.4.Bitcoin

Bitcoin is a digital currency based on a distributed peer-to-peer network of computers allowing a public history about the electronic transactions between people across the world with no central authority supervising or directly affecting the system. The protocol can make transactions more efficient with lesser costs and time between users however it does not request some entity to verify users 'identity. Also, Bitcoin transactions are irretrievable, and Bitcoin can be used to buy/sell every type of product/service not looking out for its lawfulness (Böhme, 2015). Its complexity (in terms of the technology used), its use as a store of value or means of payment (currency) and the amount of reports of "crypto millionaires overnight" have raised a passionate debate about the value of Bitcoin in the last few years.

According to the EMH, established by the economist Eugene Fama, stock prices reflect all available information and they are promptly incorporated in prices through fully rational investors, therefore only through luck and inside information, can "one beat the market".

Moreover, in this theory, a fundamental or technical analysis on a company's stock does not help to predict future price because the random walk hypothesis is used, in EMH, to describe the pattern of future stock price (Konstantinidis, 2012).

Is Bitcoin, also, an asset which falls inside the directive of EMH? Bartos (2015) studied if Bitcoin follows the EMH and he found that, indeed, Bitcoin follows EMH. Bitcoin price does react on public announcements: The price rises if there are any good news released and vice-versa for the decrease in prices. In addition, supply and demand forces are the driver of price. Finally, the number of searches and macroeconomic data (e.g. stock indexes, commodity prices, etc.) do not affect, significantly, bitcoin price which helps to show that speculative investment is not the one to blame regarding bitcoin's price volatility. In addition, comparing volatility in stocks versus cryptocurrencies, Baur and Dimpfl (2018) find positive news shocks generates greater volatility than for negative shocks contrasting with the case of stocks. In this case, the "culprit" may be the "fear of missing out". In spite of this, Bitcoin was one of the two cryptocurrencies (out of twenty) which reflect the stock asymmetrical volatility (this can be explained by a larger presence of informed investors) and one of the reasons for the asymmetrical volatility in stocks is the loss aversion so disposition effect arises.

In contrast, Bukovina (2016) finds that sentiment (variable used to assess if speculative investment is a driver of Bitcoin's price volatility using data from several Reddit forums) is a significant factor affecting Bitcoin price (especially in periods with large volatility). Furthermore, one of the factors which could explain the volatility is the spread of information specifically in major news outlets, discussion forums and other social media, Calderón (2018) highlights that Bitcoin might be a self-fulfilling prophecy: with volatility, prices can increase which can attract more investors with high or low degree of understanding of the underlying asset because of a constant presence of news/debates about Bitcoin in many platforms. Seeing

the rise in price, new investors want to get in displaying a sentiment of "fear of missing out", price rises again, etc.

Nevertheless, since it has been difficult to put a real value on Bitcoin, its volatility which can bring large profits in the short term and its complexity, might lead investors to rely on unfounded or biased information from other individuals which might lead to suboptimal outcomes in terms of utility. Moreover, there is a small number of papers regarding disposition effect in cryptocurrencies which does not help in establishing a significant record of this effect in these types of currencies.

3. Methodology

As seen above, the disposition effect (the main behavior to be studied), in stocks, has been identified by several reports but not as much in cryptocurrencies therefore this paper aims to bridge the gap between the number of studies about the disposition effect between stocks and cryptocurrencies. In order to capture the disposition effect in stocks and Bitcoin, two questionnaires were created. Both surveys were distributed online to respondents without any exclusion criteria in terms of age, gender, education, nationality, etc. Bitcoin and Microsoft stock were chosen as variables due to their popularity with the public (Microsoft stock was the representative agent for the class of stocks).

Each survey had 29 multiple choice questions where the first survey (hereafter, the "up" survey") had 41 respondents whereas the second survey (hereafter, the "down" survey) had 46 respondents. The former had a response rate of 76% and the latter a 62% response rate due to incomplete surveys which were not considered into the results section. Both surveys are equal except for the questions intended to study the disposition effect.

Here are some relevant questions towards studying the disposition effect:

“Imagine you have invested $1000 worth of Microsoft stock. One month passes and now the stock is valued at $1010. Now choose one of the following:”

A. Sell the stock and take this gain of 1%
B. Hold it for one more month with a 50/50% chance of additional 1% gain or a loss of your original gain (value returns to $1000)

“Imagine you have invested $1000 worth of Bitcoin. One month passes and now your Bitcoin is valued at $1010. Now choose one of the following:”

A. Sell Bitcoin and take this gain of 1%
B. Hold it for one more month with a 50/50% chance of additional 1% gain or a loss of your original gain (value returns to $1000)

“Imagine you have invested $1000 worth of Microsoft stock. One month passes and now the stock is valued at $990. Now choose one of the following:”

A. Sell the stock and take this loss of 1%
B. Hold it for one more month with a 50/50% chance of additional 1% loss or a gain of your original loss (value returns to $1000)

“Imagine you have invested $1000 worth of Bitcoin. One month passes and now your Bitcoin is valued at $990. Now choose one of the following:”

A. Sell Bitcoin and take this loss of 1%
B. Hold it for one more month with a 50/50% chance of additional 1% loss or a gain of your original loss (value returns to $1000)

These questions, with the goal of studying the disposition effect, were inspired by Shefrin and Statman (1985). The first two are found in the "up" survey and the last two in the "down" survey. These belong in a series of similar questions (within the surveys) where the only different aspect from question to question is the value of the asset. In other words, the questions have the same layout, but the assets will have 5%, 10%, 20%, 50% increase/decrease in value, according to the survey they belong to[8]. Finally, the reason for the two surveys (instead of one) was to make sure respondents were not influenced by both the upward and downward trend. In other words, the same respondent, after answering about an upward trend, might be influenced or, at least, think twice about responding to the downward trend and, consequentially, alter the results based on previous deliberations.

4. Results

The "up" survey had 51% male respondents, most of the subjects were in the 25-34 age bracket (19) and most had, at least, a university diploma (31). In addition, 41% had invested in classic financial assets (stocks e.g.) before but only 17% have, previously, invested in cryptocurrencies. The "down" survey had 47% female individuals, most of the subjects were, also, in the 25-34 age bracket (19) and 74% had, at minimum, one university diploma. Furthermore, 50% claimed they had bought classic financial assets whereas only 11% had purchased a cryptocurrency before.

In this section, the findings from the surveys are displayed. Table 1 and table 2 show how many respondents (in absolute and percentage terms) chose to sell the respective asset versus holding it one more month given a different gain in %.

[8] See appendix for a full display of both surveys.

Along these lines, Table 3 and table 4 are equal but for different losses in %. An important point should be highlighted beforehand: The reference point is assumed to be the purchase price ($1000).

4.1."Up" Survey

Table 1 – Microsoft stock

	1%	**5%**	**10%**	**20%**	**50%**
Sell the stock	5 (12%)	7 (17%)	14 (34%)	18 (44%)	29 (71%)
Hold for one more period	36 (88%)	34 (83%)	27 (66%)	23 (56%)	12 (29%)
Total	**41**	**41**	**41**	**41**	**41**

Table 2 – Bitcoin

	1%	**5%**	**10%**	**20%**	**50%**
Sell Bitcoin	9 (22%)	12 (29%)	21 (51%)	20 (49%)	30 (73%)
Hold for one more period	32 (78%)	29 (71%)	20 (49%)	21 (51%)	11 (27%)
Total	**41**	**41**	**41**	**41**	**41**

As seen in table 1, 12% of the respondents chose to sell the stock at 1% profit whereas, with 50% profit, 71% stated they would sell the stock. The largest leap in the willingness to sell between the joint profit classes is 100% from 5% to 10% profit level. Table 2 shows, with a 1% profit in Bitcoin, 22% chose to sell the asset and with a 50% gain, 73% said they would sell their stake in Bitcoin. The largest increase, in the willingness to sell Bitcoin, is 75% from 5% to 10%. There is an interesting pattern to be discussed in the data: The tendency to sell the asset, for all possible gain percentages, is higher for Bitcoin compared to the case of the stock.

This might be attributed to a lower knowledge on Bitcoin (only 17% survey respondents had invested in cryptocurrencies which, arguably, tells this population sample might not be as educated Bitcoin) or to a, relatively, larger volatility in Bitcoin price specially during the last two years: the price might decrease rapidly, in the future, therefore there is a higher urge to sell the asset (compared to a more classical financial asset such as stocks).

4.2. "Down" Survey

Table 3 – Microsoft stock

	1%	**5%**	**10%**	**20%**	**50%**
Sell the stock	3 (7%)	2 (4%)	3 (7%)	5 (11%)	8 (17%)
Hold for one more period	43 (93%)	44 (96%)	43 (93%)	41 (89%)	38 (83%)
Total	**46**	**46**	**46**	**46**	**46**

Table 4 – Bitcoin

	1%	**5%**	**10%**	**20%**	**50%**
Sell Bitcoin	8 (17%)	9 (20%)	12 (26%)	11 (24%)	10 (22%)
Hold for one more period	38 (83%)	37 (80%)	34 (74%)	35 (76%)	36 (78%)
Total	**46**	**46**	**46**	**46**	**46**

With a 1% decrease in price from the reference point, only 7% respondents chose to sell the stock whereas a very significant number chose 93% to hold the asset for one more period, as seen in Table 3. For the largest decrease in price, 17% of the subjects were willing to sell the stock and the largest increase, in the willingness to sell the Microsoft stock, was registered as 66% from 10 to 20 % profit.

Table 4 shows for, the initial loss of 1%, 17% selected the option "sell Bitcoin" instead of holding it for more one month whereas, with a 50% loss, 22% chose to sell Bitcoin.

The largest increase (25%) was registered from 5% to 10 % loss. There is also a pattern to reckon here: for every loss percentage, there is a larger tendency to hold the asset for one more period in stocks rather than Bitcoin. Again, the volatility associated with cryptocurrencies might play in the decision on selling the asset sooner than later: Dacey & Zielonka (2013) argued, under high volatility, the disposition effect works well in the case of gains but not for losses. On the losses side, investors are less willing to hold an asset which is known to have a large volatility. If one assumes Bitcoin behaves as a high volatility stock in just as described in Dacey & Zielonka's paper, it is then plausible to explain the difference in the pattern above described.

4.3 Disposition effect

Table 5 – Disposition effect in Microsoft stock

Selling the stock	**1%**	**5%**	**10%**	**20%**	**50%**
Upward trend	12%	17%	34%	44%	71%
Downward trend	7%	4%	7%	11%	17%
Total	**46**	**46**	**46**	**46**	**46**

Table 6 – Disposition effect in Bitcoin

Selling Bitcoin	**1%**	**5%**	**10%**	**20%**	**50%**
Upward trend	22%	29%	51%	49%	73%
Downward trend	17%	20%	26%	24%	22%
Total	**46**	**46**	**46**	**46**	**46**

In tables 5 and 6, lies the answer to one of the main questions in this paper: the disposition effect, the tendency to hold on to "losing" assets and eagerness to sell a "winning" asset holds for Bitcoin? The propensity (this data is displayed in the first four tables) to sell the stock in the upward trend is higher than the propensity to sell in the downward trend for every profit

percentage which suggest disposition effect occurs . The same situation is demonstrated with the case of Microsoft stock. These results resemble the findings of Shefrin and Statman (1985), Odean (1999) or Fogel and Berry (2010) therefore further solidifies the existence of this investment behavior in stocks and, also, gives a stronger background for the case to be made about the disposition effect in cryptocurrencies since the effect is not as well documented as in the case of stocks.

After documenting about the presence of the disposition effect in both assets, the other question left unanswered was: How different is the disposition effect between Bitcoin and stock? The answer to this question can be seen in the next table:

Table 7 – Magnitude of the disposition effect (in pp.)

	1%	**5%**	**10%**	**20%**	**50%**
Stock	+5	+13	+27	+33	+54
Bitcoin	+5	+9	+25	+25	+51
Total	**46**	**46**	**46**	**46**	**46**

The values, in this table, were computed as follow: picking the results from tables 5 and 6, the difference between the upward and downward trend, for each asset, was computed for every profit percentage. For instance, the (+) 54pp in stock is the result of the difference between 71% (upward trend) and 17% (downward trend). At the 1% level, the disposition effect has the same weight however, for every other profit, the disposition effect is stronger with the stock compared to Bitcoin. Furthermore, the difference in the magnitude of the disposition effect between the two assets is not extreme as the maximum discrepancy is 8 percentage points at a 20% profit level.

It is important to notice this paper have some limitations. The sample for both surveys was, relatively, low compared to surveys or experiments with real financial data from other papers

in this topic and the answers to hypothetical investment questions present in the surveys might not be as definitive data since choosing between speculative options and real financial transactions can be two relevant distinct scenarios and individuals might alter their behavior.

4. Conclusion

This paper had the goal to study irrational behavior in cryptocurrencies and stocks. Specifically, whether the disposition effect existed in Bitcoin alongside with stocks and, if so, how different the effect's impact would be between the two assets? Some cognitive biases were explored, in depth, in order to understand why investors display behavior which prevents them from maximizing utility (disposition effect; mental accounting and sunk cost effect however the first is the main focus of this paper). Using two surveys, the variables used to study the existence of the tendency to delay selling a "losing" asset and the desire to quickly sell a "winning asset" were Bitcoin and Microsoft stock. In the case of the cryptocurrency, the results show the disposition effect occurs (as well in the case of stocks) and, consequentially, it was possible to assess the magnitude of the effect in both assets.

The results showed the disposition effect is stronger in stocks than in the case of Bitcoin. This finding might correlate with an idea written above: investors are aware of Bitcoin's larger volatility therefore they exhibit more self-control. They sell Bitcoin faster if the price goes up or down which one could argue they are not as ready to take a chance with Bitcoin as they are with stocks. They might feel more regret, specially, holding on to Bitcoin with a negative profit not only due to loss aversion but also because they knew the probabilities of suffering a loss, on average, were higher for Bitcoin than with stocks (Bitcoin's mental account can be "closed" sooner and, consequentially, a more meaningful sunk cost effect does not happen because the escalation effect is shut down sooner).

In addition, the loss realization in Bitcoin might not be as hurtful as in stocks so it's easier to let go and admit it was a bad investment. Prospect theory asserts that losses are, approximately, twice as painful as gains are and, arguably, emotions play a part in investment decisions which might lead to even more undesired outcomes so investors can always learn and improve. In sum, one should behave in the following manner: an investor, holding Bitcoin, should sell it as if he was holding stocks in the gains region and a stockholder should sell stocks, in the losses region, as if he was holding Bitcoin.

Given there is not enough literature, relatively, about this effect in cryptocurrencies, supplementary studies with Bitcoin but possibly with alternative coins, are recommended as well as studies with large population samples to add robustness to the results found in this paper (if, surely, they tend to suggest what I found in this study).

References

Allais, M. (1953). Le comportement de l'homme rationnel devant le risque, critique des postulats et axioms de l'ecole americaine. *Econometrica, 21,* 503-546.

Arkes, H. & Ayton, P. (1999). The sunk cost and concorde effects: are humans less rational than lower animals? *Psychological Bulletin, 125,* 591-600.

Arkes, H. & Blumer, C. (1985). The psychology of sunk cost. *Organizational Behavior and Human Decision Processes, 35,* 124-140.

Baker, H. & Nofsinger, J. (2011). *Behavioral finance: Investors, corporations and markets*. New Jersey, NJ: Wiley.

Barberis, N. & Xiong, W. (2006). What drives the disposition effect? An analysis of a long-standing preference-based explanation. *National Bureau of Economics Research*, Working paper 12397.

Bartos, J. (2015). Does Bitcoin follow the hypothesis of efficient market? *International Journal of Economic Sciences, 4.* 10-23.

Baur, D. & Dimpfl, T. (2018). Asymmetric volatility in cryptocurrencies. *Economics Letters, 173,* 148-151.

Böhme, R. & Christin, N. & Edelman, B. & Moore, T. (2015). Bitcoin: Economics, technology and governance. *Journal of Economic Perspectives, 29,* 213-238.

Bukovina, J. & Martiček, M. (2016). Sentiment and bitcoin volatility. *Mendelu Working Papers in Business and Economics, 58,* 1-12.

Calderón, Obryan P. (2018). Herding behavior in cryptocurrency markets. Working paper

Chen, G. & Kim, K. & Rui, O. (2007). Trading performance, disposition effect, overconfidence, representativeness bias and experience of emerging market investors. *Journal of Behavioral Decision Making, 20,* 425-451.

Constantinides, G. (1983). Capital market equilibrium with personal tax. *Econometrica, 51,* 611-636.

Dacey, R. & Zielonka, P. (2013). High Volatility Eliminates the Disposition Effect in a Market Crisis. *Decyzje, 20,* 5-20.

De Bondt, W & Thaler, R. (1985). Does the stock market overreact? *The Journal of Finance, 40,* 793-805.

Fogel, S & Berry, T. (2010). The disposition effect and individual investor decisions: The roles of regret and counterfactual alternatives. *The Journal of Behavioral Finance, 7,* 107-116.

Frazzini, A. (2006). The disposition effect and underreaction to news. *The Journal of Finance, 61,* 2017-2046.

Hens, T. & Vlcek, M. (2011). Does Prospect Theory explain the disposition effect? *Journal of Behavioral Finance, 12,* 141-157.

Kahneman, D & Tversky, A. (1979). Prospect Theory: An analysis of decision under risk. *Econometrica, 47,* 263-292.

Kahneman, D & Tversky, A. (1984). Choices, values and frames. *American Psychologist, 39,* 341-350.

Kahneman, D. (2013). *Thinking, fast and slow*. New York, NY: Farrar, Straus and Giroux.

Kaustia, M. (2010). Prospect theory and the disposition effect. *The Journal of Financial and Quantitative Analysis, 45,* 791-812.

Konstantinidis, A. & Katarachia, A. & Borovas, G. & Voutsa, E. (2012). From efficient market hypothesis to behavioral finance: Can behavioral finance be the new dominant model for investing? *Scientific Bulletin – Economic Papers, 11,* 16-26.

Mullainathan, S. & Thaler, R. (2000). Behavioral economics. *National Bureau of Economic Research,* Working paper 7948.

Odean, T. (1998). Are investors reluctant to realize their losses? *The Journal of Finance, 53,* 1775-1798.

Shefrin, H. & Statman, M. (1985). The disposition to sell winners too early and ride losers too ling: Theory and evidence. *The Journal of Finance, 40,* 777-790.

Simon, H. (1955). A behavioral model of rational choice. *The Quarterly Journal of Economics, 69,* 99-118.

Simon, H. (1986). Rationality in psychology and economics. *The Journal of Business, 59,* 209-224.

Staw, B. (1981). The escalation of commitment to a course of action. *Academy of Management Review, 6,* 577-587.

Thaler, R. (1985). Mental accounting and consumer choice. *Marketing Science, 4,* 199-214.

Thaler, R. & Johnson, E. (1990). Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management Science, 36,* 643-660.

Thaler, R. (1999). The end of behavioral finance. *Financial Analysts Journal, 55,* 12-17.

Weber, M. & Camerer, C. (1998). The disposition effect in securities trading: An experimental analysis. *Journal of Economic Behavior & Organization*, *33*, 167-184.