# Disrupting Money: Psychological Factors of Investment Biases in Cryptocurrency

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***Abstract* – The presence of cryptocurrencies as means of trading and investing has presented new opportunities to make profits. Unfortunately, investment bias becomes a phenomenon that accompanies investing behavior for many people which actually results in losses and regrets. This study uses a narrative review method to identify cognitive, affective, and contextual factors that correlate with investment biases in cryptocurrency. The results of the review indicate that a number of factors - i.e. self-affirmation, anticipation of postdecision dissonance, fear of missing out (FoMO), overconfidence, perception of the investment process and regulation - play a pivotal role in explaining investment biases in cryptocurrency.**

***Keywords* – investment, bias, digital money, cryptocurrency, psychological factor, disruption.**

## 1. Introduction

In the midst of the rapid technological advancement, there is a whole digitized transformation in the world of money and finance.

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In the midst of the rapid technological advancement, there is a whole digitized transformation in the world of money and finance.

Chuen et al. [1] referred to cryptocurrency as a subset of digital currency that uses a highly integrated blockchain technology with its maximum capacity, amid tight security systems, and rapid settlement.

With the significantly emerging cryptocurrency market since the first release of Bitcoin as the pioneer of cryptocurrency, Hileman and Rauchs [2] argued that there has been more flexibility in the financial industry as there is more blurred lines between virtual exchange and the use of traditional wallet because both has provided better utilization for wide range of functions.

In comparing cryptocurrency with other forms of investment such as gold, people tend to perceive that cryptocurrency, such as Bitcoin, is actually having more practicality because it comes with the blockchain that continuously develops the digital technology in a positive pattern for the future, which elevates digitalization in the financial system. Baur et al., as cited in Andrianto and Diputra [3], also found out that Bitcoin's return and correlation are highest with 7.6% amongst the other sixteen assets such as stocks, bonds, energy, currency, and metals. From these data, it can be concluded that cryptocurrency may have a great utility and bigger return of investment compared to other forms of investment.

### *1.1. The phenomenon of cryptocurrency*

According to Hileman and Rauchs [2], there are four key cryptocurrency industry sectors, namely exchanges, wallets, payments, and mining sectors. On the exchanges sectors, cryptocurrencies are used as the instrument of purchasing, saling, and trading. Specifically, several risks are created as a result of wide arrays of transactions which cryptocurrency exchanges facilitate.

For example, risks can arise from the decentralized exchange of Bitcoin that is not supported by any institution that should have been responsible for regulating the quality and the transaction of the currency, as stated by Abraham et al. [4]. Meanwhile on the wallets sectors, cryptocurrency has a digital program with the use of private and public cryptographic keys management, helping the users to store, send, and receive cryptocurrencies [2]. Furthermore in the payments sectors, cryptocurrency has a primary function in facilitating payments along with the highly integrated blockchain system, but Steinmetz et al. [5] mentioned that currently, cryptocurrencies are not extensively used as a means of payment because users tend to maintain the way they usually pay goods and services with fiat currencies, especially with the fact that Bitcoin is more widely used as the users' speculative assets rather than for payment instrument. However, currently there are still a few countries and shops that accept cryptocurrency as a form of payment, therefore the usage for payment is limited. On the mining sector of cryptocurrency, Hileman and Rauchs [2] explained that individuals as well as organizations are able to process their transactions and obtain rewards and transaction fees through the use of the blockchain as the global ledger that is responsible for enumerating the large number of hashes to look for added valid blocks.

Overall, in between those cryptocurrency industry sectors, the exchange sectors have contributed largely to the increasing phenomenon of investment in cryptocurrencies, in which it is estimated by Burniske and White [6] that 54% Coinbase users use Bitcoin for investment. Additionally, investments are seen by the economist as a stimulus for creating highly potential economic growth despite the high rates of fluctuations and volatility. It means that although investing in cryptocurrency could be risky, it may contribute to further economic growth for the people.

Specifically in Indonesia, recently the use of cryptocurrency has emerged more significantly compared to the previous years. Although since 2014 Bank Indonesia has not legalized cryptocurrency as Indonesia's currency for payments of goods and services, cryptocurrency that is used as assets which are traded in the Crypto Asset Physical Market are legal. In Indonesia, the law for cryptocurrencies is regulated in Badan Pengawas Perdagangan Berjangka Komoditi (Bappebti) No. 7 Year 2020 [7]. Therefore in 2021, there were 13 lists of legal cryptocurrency exchanges that have the right to open domestic operations and released 229 legal crypto assets to trade on exchanges. In addition, as of July 2021, it is recorded that there are 7.4 million Indonesians who own cryptocurrency, in which there is an increase of 85% compared to 2020 that were only 4 million owners.

As a result of this significant increase of cryptocurrency users in Indonesia, there are also a higher number of new cryptocurrency trading platforms in Indonesia that has been registered in Badan Pengawas Perdagangan Berjangka Komoditi (Bappebti), namely Indodax, Tokocrypto, Zipmex, Idex, Pintu, Luno, Koinku, and many more. With the availability of various cryptocurrency trading platforms in Indonesia, Millennials until Generation Z dominates the use of cryptocurrency for investment. This is in accordance with Tokocrypto's data which found out that currently, there are 66% cryptocurrency investors that are aged 18 up to 34 years old [8]. Furthermore, these investors usually read news, articles, and publications everyday regarding crypto assets and blockchain, such as from Coindesk, Cointelegraph, and Coinbase.

### 1.2. *Cryptocurrency as a form of investment*

In general, investment refers to a current commitment over an asset or instrument with expected benefits that can be obtained in the future. Additionally, investment comprises the involvement of risk and uncertainty about the future revenues that determine whether the investors are willing to invest [9]. There are various investment behaviors, such as how investors conduct research, gather information, analyze, define, understand, review several procedures, and make a decision for investment.

Different from fixed capital such as money, gold, and properties, it seems that cryptocurrency as one of investment instruments engages more potential investors even though Bouri et al., as cited in Yousaf et al. [10], argued that the market of cryptocurrency is immature and usually excoriated as high-risk and inefficient. Specifically, the immature market refers to the current cryptocurrency investors who are mostly still in the young age amongst different cultural backgrounds and the new blockchain technology that is somehow still questionable from the security aspect [11]. Despite this, it is estimated that there is an increase of 189% compared to 2019 in the total cryptocurrency users globally that reached 101 million as of September 2020 [5]. It means that with the possible threat that may present by investing in cryptocurrency, people will still take the risk to invest in cryptocurrency.

Additionally, Steinmetz et al. [5] also mentioned that socioeconomically, there is a high association between knowledge and ownership of cryptocurrency and male as well as young age users. This statistical data is supported by some literature mentioned in Xi et al. [12] which shows that while making financial decisions, on average, men tend to obtain a higher risk tolerance than women because they easily make investing decisions daily and become more active investors.

It also can be analyzed from the current situation which seems that young investors from the millennials are owning and investing on cryptocurrencies as their way to create wealth and grow assets, which Frank [13] specifically mentioned that there are accurately 83% of millennial millionaires who invest on cryptocurrencies.

On top of that, Garnett [14] explained that investing in cryptocurrency include several steps, such as choosing the type of cryptocurrency exchange, funding the cryptocurrency, deciding the type of cryptocurrency that is willing to be invested, buying the chosen cryptocurrency, and storing the cryptocurrency in the best and safe digital wallet. In the last step, investors may also choose how they should manage their cryptocurrency asset, which is either to hold their cryptocurrency over a long period of time or perform trading by buying and selling cryptocurrency through the cryptocurrency exchange. Thus, investing in cryptocurrency involves a complex decision-making process, which may include investment biases. This present study aims to identify the factors that might correlate with the processes.

## 2. Methods

This present study used a narrative review method by entering the keywords ‘investment behavior’ AND ‘investment bias’ AND ‘Cryptocurrency’ in the search engines Google Scholar and Google.com. The retrieval results on the search engine are selected based on the potential wealth of information and the credibility of the data source. Furthermore, thematization was carried out based on these results. The results of the research and discussion are presented in the following sections.

## 3. Factors affecting investment behavior in cryptocurrency investment

With the complexity in cryptocurrency, it is necessary to address both the psychological and non-psychological factors to see how these affect individuals’ investment behavior in cryptocurrency.

### *3.1. Psychological factors that affect investment behavior in cryptocurrency*

Responding to the robust phenomenon of cryptocurrency, there are several reasons that underlie why investment behavior of cryptocurrency users are increasing, especially in the young investors. By using the realm of the sociopsychological aspects, Abraham et al. [4] explained that there are some sociopsychological factors that affect individuals to invest in cryptocurrencies.

First, it is believed that cryptocurrencies are symbolic instruments for individuals to express their freedom and opposition against authority and monetary policy. This can be seen through the way blockchain that supports cryptocurrency actually affects the traditional or conventional money as well as several economic policies made by the government. Second, there is also a certain level of psychological excitement that may seem to appear in individuals to use cryptocurrencies as a new method of exchange, specifically for investments, despite the risks that they will face in the future. It means that cryptocurrencies’ existence may encourage them psychologically through having a whole new experience in the digital currency, thus increasing the needs to invest in an unusual way.

Sauer et al., as cited in Abraham et al. [4], also mentioned that the use of cryptocurrencies reflects the new way of everyday life that is getting more integrated with virtuality. In other words, the emergence of technology in the financial sector of cryptocurrency psychologically triggers individuals to be curious in using it, thus investing in it. Specifically, it is portrayed that Indonesians are highly interested in investing in cryptocurrency because most see the value from the asset, in which most are seduced by the “wealth” displayed on social media after other investors are buying cryptocurrency assets. Meaning, Indonesians are inclined to invest in cryptocurrency due to their initial positive perspective and expectation regarding the financial benefits and values that are highly needed by them as individuals.

On the other hand, there are also some negative psychological factors that affect investment behavior in cryptocurrency, in which the most common one is Fear of Missing Out (FoMO). This phenomenon occurs when individuals are investing in cryptocurrency even if they do not have an enough understanding or knowledge about it. This may be triggered by the fact that they are buying other people’s stories that have made success in receiving a huge return of investment through investing in cryptocurrency. This also suggests that if there are more individuals with FoMO over cryptocurrency, it means that a high number of investors arise as a result of their way to reduce the fear of being missed out on a good financial opportunity. FoMO acts as the main factor which boosts global demand for Bitcoin through creating speculative views of how Bitcoin brings rewards for the investors and causes individuals to prevent them from missing out [15]. Aside from FoMO, Fear, Uncertainty, and Doubt (FUD) also become the negative psychological factors in cryptocurrency investments. FUD arises when there is negative news regarding cryptocurrencies’ regulations or unwanted information about blockchain.

In contrast with FoMO, through the presence of FUD amongst investors, it is more likely that the investment behavior in cryptocurrency is lower in order to prevent the unwanted loss or risk that will be obtained if they maintain investing in it.

### *3.2. Non-psychological factors that affect investment behavior in cryptocurrency*

Aside from explaining the underlying psychological factors at the individual level, there are also non-psychological factors. For instance from the financial perspective, cryptocurrency is seen as the best investment option for millennials as well as Gen Z in order to generate more income in the long run, rather than other forms of investment such as properties and gold. It is because millennials and Gen Z do not have to put in a huge amount of money as the initial step of investing in cryptocurrency, meanwhile they have to afford much on investing in properties and gold as both of these investments have a direct link to the fiat currency. It means that it is a great deal for the young generations to generate more income for the future, further affecting them to choose to invest in cryptocurrency rather than other forms of investments.

Another one is the cultural factors that exist as the predictors of the intentionality of individuals' behavior to invest in cryptocurrency. Pakrou and Amir, as cited in Abraham et al. [4], explained that the cultural factors include the investors' education, opinion, consciousness, and confidence. These cultural factors are highly important as the cultural differences that exist in different countries are responsible as well for the technological advancement that is needed for the penetration of cryptocurrency.

Aside from that, Caporale and Kang [16] found out in their research result that countries with high financial conscientiousness and social stability, such as in the US, tend to have a higher number of investors in Bitcoin because there are much better investment strategies that are designed based on the advanced analytical skills of the individuals on gaining a wider scope of education and understanding of the financial market. Statistically speaking, this is also because there is a long history of high trading volume in the US Bitcoin market as the US dollar is the most suitable national currency that supported the exchange [2].

## 4. Consequences of investing in cryptocurrency

In every investment, there must be some consequences faced by investors. The following is an explanation of the positive and negative consequences of investing in cryptocurrency, both psychological and non-psychological ones.

### *4.1. Positive consequences of investing in cryptocurrency*

The presence of cryptocurrency itself will certainly have consequences. For instance, in some countries that allow the use of cryptocurrency for products and services payments are giving huge benefits for retail's business operations. For instance, retail players in some countries can use blockchain incentive programs such as through *WishKinish*, in which they can provide customers with crypto-based incentives without being affected by the volatility of cryptocurrencies. It means that this type of incentive helps retailers to have more opportunity to gain more loyal customers through using the advancement of blockchain in their business. In addition, there is also positive financial consequence from the investment in cryptocurrency, in which the presence of blockchain along with its innovation for data storage and transmission helps changing the existing financial system and the FinTech industry, thus helping to optimize fully the financial infrastructure to be operated in a more effective method [17]. Therefore, it means that the use of blockchain may cause a higher motivation for market intermediaries - such as insurance and pension companies, banks, stock exchanges, and many more - to be more competitive among others in optimizing the digitalization in their systems, leading to a more integrated world with the advanced technology.

Psychologically, the positive consequence of cryptocurrency also applies when the investors are perceiving that investing in cryptocurrency is a game. Through this way of thinking, it helps investors to be actively competing with each other in building their portfolios, thus stimulating their ability in forming effective strategies to gain all of the maximum profit of their investment. Additionally, according to Knight [18], once investors maintain their investment activity as a game, this allows the cryptocurrency investors to put aside their emotion of trading, that will prevent them from making a quick decision to input or withdraw assets within a short period of time, and assess critically the information through the digital system. Knight [18] also mentioned that while investing in cryptocurrency, investors are demanded to creatively solve problems due to its uncertainty characteristics and they should be able to understand the connection of events logically, in which this is referring to the various factors that affect the ups and downs of cryptocurrency. Overall, it can be concluded that cryptocurrency subconsciously helps individuals to have a better skill in analyzing, forming predictions, making decisions, controlling their emotion, and solving problems when it comes to taking care of their cryptocurrency that they have invested.

### *4.2. Negative consequences of investing in cryptocurrency*

Although there is a wide range of usefulness of blockchain technology in this digital currency that forms opportunities in transforming several industries, cryptocurrency is very volatile as it is highly affected by various factors - trends, politics, policies, wars, business, microeconomics, and many more. Furthermore, there are also some extraordinary problems that may arise due to the cryptocurrency markets, such as the hysterics made by social media influencers as well as rising scam projects due to lack of regulatory surveillance. Thus, one of the negative consequences that are rooted from these is that investors are investing cryptocurrency in an uncertain and risky situation, in which their rate of returns can sometimes be lower than predicted. This cryptocurrency's volatility is causing investors to be completely manipulated against their will because they may lose the real value of the cryptocurrency due to the inability to control the volatility.

In addition, the blockchain's security is also very vulnerable as it is susceptible to attacks and hacks from unauthorized or illegal parties up to 51 percent, in which this is due to the immature characteristics of the blockchain technology [17]. This statistical data supports what Smutny et al. [19] has argued, in which they stated that cryptocurrency is somehow associated with criminal activities such as theft of cryptocurrencies, tax evasion, and money laundering.

On top of that, due to the high risk characteristics of cryptocurrency, it can negatively affect the investors' psychological state. Brunton [11] explained that investors may not fully have trust in blockchain because it highly relies on the computing mechanism of blockchain that links between anonymous parties. As a result, investors are prone to experience psychological discomfort such as thinking a worst case scenario of experiencing loss after deciding to invest in a specific type of cryptocurrency. Stress may also arise when the value of the cryptocurrency that they invest suddenly drops, leading to a possibly higher difficulty level in reaching a greater rate of return. Lastly, it is also very likely that the investors' self-esteem may be affected negatively when they continuously compare their cryptocurrency portfolio and investment performance with other investors.

## 5. Investment biases in cryptocurrency

With these various consequences of investing in cryptocurrency, it is important for the investors to maximize the accuracy of the investment behavior and prevent future threats from the risk that cryptocurrency may create in their investment.

However, as individuals, investors are prone to investment biases that may block them from obtaining the maximum benefits that they should have gained from investing.

In general, biases refer to the prejudice that affects individuals in making decisions due to the misplaced psychological belief [20]. It means that biases refer to the errors that are found in judgment, influencing how individuals make interpretations. Specifically, investment biases refer to the deviations of rationality which affect individuals' way of interpreting the available information for investing [20]. In addition, investment biases cause illogical and irrational decisions, thus negatively affecting the investment behavior in investors. Similarly, even with sufficient information, the presence of investment biases causes investors to have not all completely rational decisions [21]. Jain and Jain [22], para. 2, also argued that while investing, investment biases "act as a roadblock in attaining financial freedom and addressing life goals". Overall, investment biases are the subjective way individuals interpret the available information which forms irrational investment decisions and affect investor behavior.

There are several aspects of investment biases, namely herding bias, availability bias, loss aversion bias, confirmation bias, and hindsight bias [20], [23]-[25]. Herding bias, also known as herding effect, is the investment behavior in which individuals follow what others are doing because they make decisions based on the social perception [20]. Herding bias was initially identified by Shiller as well as Kahneman and Tversky, as cited in Zahera and Bansal [24], and became a popular research because investors are dependent on the collective information instead of their own objective analysis. Omane-Adjepong et al. [26] found out that there was asymmetric herd behavior in cryptocurrency, which indicated that individuals react collectively along with the high risk and consequences in the information efficiency. This relates to what Calderón [27] believed that herding is due to the ability of investors to process information only based on limited resources and they only have weak prior knowledge, so they rely on other people to evaluate cryptocurrencies. In addition, in the cryptocurrency markets, herding behavior is present and affects the price of cryptocurrency, in which this may trigger volatility in cryptocurrency as well. Herding bias has caused investors to decide irrationally through imitating other people's judgments, causing volatility in cryptocurrency and therefore should be more prevented.

Availability bias occurs when individuals make decisions based on the first thing that comes to their mind.

This is in accordance with Alrabadi et al. [28] which explained that availability bias causes decision makers to rely on the readily available knowledge, which allows them to easily recall the similar information that they have. The more recent the information, the easier for individuals to remember and therefore is more accessible for making judgements [20]. Availability biases are highly affected by the information's frequency, extremity, vividness, and negativity, which then cause investors to lose their objectivity and form incorrect investment decisions [25]. With the news and trends of cryptocurrency that are continuously evolving at a fast pace, there should be more recent information that will be perceived by each investor. For instance, there have been so many news articles and public opinions which portray negative information once there is a major drop of a cryptocurrency type, along with the language of hysterics. This, of course has affected many readers including investors and triggered them to form irrational decisions on their investment, such as impulsive withdrawal, eventually causing them to be blocked from having high financial returns. Therefore, it is important to take a greater look at the availability bias that may be present in the investors.

Loss aversion bias is the individuals' preferences in avoiding losses, because Kahneman and Tversky, as cited in Banerji et al. [20], discovered that the pain of loss is twice as great as the pleasure of gain or profit. In other words, this bias causes individuals to be more focused on the potential loss rather than the satisfaction that they get from a profit. Especially when making investment decisions on cryptocurrency that is highly volatile and risky, individuals tend to be more sensitive to the potential losses that they will experience, thus affecting how they may behave differently in investing in it. With cryptocurrency's volatility that may lead to further fall due to the microeconomic environment of high inflation, the risk of loss for cryptocurrency may be higher, thus may trigger loss aversion bias.

Confirmation bias was described by Dickens, as cited in Zahera and Bansal [24], as the bias that presents when individuals rely on their preconceived impression, causing them to adjust available information to suit their belief or opinion. Banerji et al. [20] also mentioned that this leads investors to ignore the relevant information and favor more towards their own opinion, thus causing irrational decisions and behavior. This can be explained through Oberstadt [29] who argued that confirmation bias helps to strengthen individuals' hopes or beliefs by confirming their positive thoughts and opinions, even when the reality or the actual situation does not align with their opinion.

Especially with the cryptocurrency's volatility that is easily affected by various factors, confirmation bias should have a large impact on how investors make judgment on their decisions, thus can make mistakes on the evaluation of cryptocurrency, further negatively affecting their behavior in investing in it.

Last but not least, hindsight bias, according to Mirae Asset [25], is a type of bias that causes investors to overestimate their predictive abilities due to the fact that they make decisions based on their previous experiences that have resulted in high investment returns. Zahera and Bansal [24] explained that this bias also lets investors believe that some events can be predicted in a reasonable way. Banerji et al. [20] also explained that this leads to individuals to believe in their predicted outcome of investment while there is no objective reason. For instance, in cryptocurrency, because there have been previous events of highs and lows in the prices, investors may have their own way to perceive, either positive or negative, and affect the outcome on how they make investment decisions. Thus, this bias should be investigated more because the volatility characteristics of cryptocurrency may trigger individuals to not be ready for the unexpected outcomes, especially during the major drop of cryptocurrency. Investors with a high level of hindsight bias will tend to be not ready with the unexpected outcomes of future investment.

## 6. Cognitive, affective, and contextual factors of investment biases in cryptocurrency

Considering the investment biases that might be experienced by investors which affect the decision-making of investors and their consequent investment behavior, it is important to outlook the underlying psychological explanation through theories. Nowadays, there are abundant theories and literature that support investment behavior, such as through the scope of *psychology of investing*. As a relatively new field that has been evolving rapidly recently, behavioral finance takes a great concern regarding the decision-making that is needed for economic aspects through cognitive psychology, economy, and financial theory. Ricciardi and Simon [30] explained that behavioral finance comprehends various disciplines from psychology, sociology, and finance. Behavioral finance basically explains the individual, group, and organization investors' underlying patterns in investment from psychological and sociological factors, in which this also includes how emotions and mentality affect the financial decision-making process.

This brief explanation of behavioral finance is in accordance with several academic scholars who explored behavioral finance.

Statman [31] believed that individual investors and portfolio managers are influenced by the financial decision-making process that includes the risk assessment (assessing the suitable level of risks) and the framing issues (information-processing and decision-making processes that depend on the presentation of the investment). Meanwhile, Olsen, as cited in Ricciardi and Simon [30], explained behavioral finance as the new school of thought that is useful for helping investors to create accurate final decisions for investing through analyzing the investors' systematic behavior. In addition, a portfolio manager called Russell Fuller, as cited in Ricciardi and Simon [30], believed that behavioral finance leads investors to be able to understand others' mental errors and misjudgments in investing, thus leading to a greater investment return.

Overall, it can be inferred that behavioral finance theory is in contrast with the traditional financial theories because behavioral finance theory focuses on how investing decisions are not merely based on rationality, but also on the internal aspects of humans. Therefore, individuals are not only responding to the available situations while investing, but there are also the cognitive and emotional aspects that influence them to invest. In the realm of psychology that revolves around behavioral finance, individuals' investment biases in cryptocurrency can be analyzed through cognitive, affective, and contextual factors.

### *6.1. Cognitive factors of investment biases in cryptocurrency*

As the underlying theory to support the cognitive factors of investment in cryptocurrency, there is the Cognitive Dissonance theory by Leon Festinger, as cited in Ploger et al. [32]. Festinger believed that individuals are experiencing both psychological and physiological tension and discomfort when they are faced with conflicting beliefs and when they behave that is not in accordance with their self-concept [32]-[33]. In other words, there is a high dissonance in individuals' cognitive elements. In relation with investment, Goetzmann and Peles, as cited in Ricciardi and Simon [30], also argued that dissonance may be experienced by the individual investors when they are about to decide which to buy, sell, or hold. Thus Aronson et al. [33] explained that there are three strategies to reduce the dissonance: (1) change the behavior that fits with the self-concept or dissonant cognitions; (2) change the dissonant cognitions to justify the behavior; and (3) add new cognitions through self-affirmation to justify the behavior.

Specifically in the last method that is through self-affirmation, individuals can take a greater focus to their positive attributes or the good qualities [33], so that they can reduce the dissonance by showing that their behavior is still reasonable with their personal goals and values.

This is in accordance with Taylor and Broffman [34] which explained that self-affirmation can protect individuals mentally through reducing the ruminative thoughts. Weller et al. [35] found out that individuals with high levels of self-affirmation are able to accept or tolerate situations with high uncertainty and are able to make risky decisions for potential gains. This is because highly self-affirmed individuals are able to look at the better aspects in them to lessen the thought of being threatened from uncertain situations and are able to have reduced stress reactivity by thinking that higher rewards will be gained from risky decisions. Additionally, Gu et al. [36] suggested in their study that self-affirmation may help individuals in coping with uncertainty through an early, positive cognitive processing. From these studies, self-affirmation may lessen the irrational thoughts that occur during the decision-making process of investors, which is during the times when investment biases occur. Therefore, with the uncertainty and risky characteristics of cryptocurrency investment, self-affirmation may positively predict individuals' investment biases in cryptocurrency.

Additionally, in the Cognitive Dissonance Theory, once the dissonance has successfully reduced cognitively, postdecision dissonance may happen too. Festinger, as cited in Stevick et al. [37], hypothesized that individuals' postdecision dissonance may arise after an important decision is made between several desirable choices. When postdecision dissonance appears, it may cause individuals to experience distress with the choices that they have chosen. Aronson et al. [33] explained that in order to resolve postdecision dissonance, it can be done through devaluing the unchosen alternatives while enhancing the positive aspects of the chosen one, in which this occurs in individuals' cognitive processes. Thus, this is believed to be useful to make individuals feel better and become more confident after making the chosen decision. A study conducted by Suzuki [38] found out that when individuals are provided with a larger choice set of projects, the expected output (their effort and performance) with the chosen project is higher than when they are provided with a smaller choice set of projects. This happens because there are larger dissonant signals from choosing a larger choice set, then causing individuals to suppress the dissonant signals more optimally. It means that the more choices, the higher the postdecision dissonance and the need to reduce it, eventually contributing to better output because the cognitive thoughts of focusing on the positive aspects of the chosen one are more enhanced rather than the alternatives. With the high number of available choices of cryptocurrency exchange and types of cryptocurrency, it is more likely for cryptocurrency investors to experience higher levels of postdecision dissonance after they invest.

Hence, this postdecision dissonance needs to be anticipated before they invest because investment biases in cryptocurrency may appear in individuals that affect how they make investment decisions over various types of cryptocurrency. Thus, it can be predicted that high levels of anticipation of postdecision dissonance will less likely form investment biases with the chosen cryptocurrency exchange and type of cryptocurrency.

### 6.2. *Affective factors of investment biases in cryptocurrency*

Aside from the cognitive factors, there are also affective factors which influence individuals' behavior in investing cryptocurrency. Affect is a component which is closely intertwined with two aspects, namely emotions and moods [39]. Emotions are the result into which individuals react over certain things, or in other words, emotions can be defined as a form of judgment. It is because emotions involve the feelings that individuals have toward a specific object or person. Meanwhile, moods refer to individuals' disposition which tends to appear in individuals in a conscious state that affect how they act and behave. Consequently, Robbins and Judge [39] mentioned that moods are unlike emotions, because individuals' moods do not appear due to a specific situation or problems like emotions.

Therefore, similar to what behavioral finance focuses on, it is important to comprehend investors' underlying affective aspect while investing in cryptocurrency because the availability of moods and emotions in humans may cause them to sometimes act and behave unconsciously with a limited level of rationality. The emotions of anxiety such as through FoMO and overconfidence have recently become the focus in various studies in explaining why and how people invest in cryptocurrency.

FoMO, as a type of anxiety, is one of the examples of affective factors of investing in cryptocurrency. FoMO is mostly found in investors who are investing in cryptocurrency because Kim et al. [15] showed that Bitcoin and share investors scored higher in FoMO scale when compared to non-investors because they have higher sensitivity to rewarding experiences, especially in the investment settings. Hayran et al. [40] also found out that FoMO is related to negative feelings such as regret, anticipated regret, envy, and social exclusion due to the higher needs to follow what others are doing. Furthermore, the presence of FoMO leads to a greater level of affective instability and impulsivity in the investors (Patterniti & Bisserbe, as cited in Kim et al. [15].

Therefore with impulsivity and negative affects that present in FoMO, it may lead to investment misbehavior which Mirae Asset [25] explained that this misbehavior causes investors to have a gap between investment return (return on portfolio at a period of time) and investor return (total inputs minus total outputs on investors' portfolio). FoMO may predict the presence of investment biases in investors as they may let the emotions of fear to be involved in how they decide and behave on their investment in cryptocurrency.

Another one, overconfidence, is also one of the affective factors that influence investors' investment behavior and becomes one of the focus topics from behavioral finance. Ricciardi and Simon [30] explained that overconfidence occurs when individuals' emotional condition allows them to overestimate their skills and overly predict their success in achieving their goals. Oskamp, as cited in Skala [41], also found out that the accuracy of one's potential lies far apart from the expressed judgment as the confidence increases. It means that individuals with overconfidence express judgment on themselves more rather than reflecting on their actual skills and ability. Thus, overconfidence is highly influential in investing because investment decisions on individuals can change significantly due to the presence of overconfidence. Barber and Odean, as cited in Ricciardi and Simon [30], found out that men generally have higher levels of overconfidence than women on investing and trading, which then resulted in men to obtain significant investment such as causing them to sell their investments during the wrong time and spend too much trading costs than women. Overconfidence may predict investment biases because individuals may form investment decisions based on what is believed will work out because of their own judgment on the confidence.

A theory called Social Exchange Theory may explain the underlying FoMO and overconfidence that may appear amongst cryptocurrency investors. George Homans, as one of the most influential figures of the Social Exchange Theory, focuses on reinforcement psychology and microeconomics through addressing social situations [42]. Homans, as cited in Cook and Rice [43], explained that Social Exchange Theory refers to the exchange of activity between at least two persons that could be tangible or intangible and more or less rewarding. Aronson et al. [33] also mentioned that Social Exchange Theory addresses the basic concepts including reward, cost, outcome, and comparison level.

With the presence of reward, it acts as the gratifying aspect that reinforces individuals to behave in a certain way so that it is in accordance with what others believe is advantageous [33], [43]. This reward concept is related to FoMO because nowadays, other cryptocurrency investors are displaying their wealth and positive gains from investing in cryptocurrency, thus this has become an important information that is perceived by individuals as rewarding. Eventually, this creates a feeling of excitement and positively reinforced individuals to follow what others are investing so that they will not miss out the opportunity to gain the rewards.

Meanwhile, overconfidence is more related with the concept of outcome in the Social Exchange Theory. For instance, Skala [41] argued that there is a relation between the confident judgments made by individuals and how the information that they gained from others support the form of judgment. Especially nowadays, there is abundant information that can be accessed easily through online articles, investment apps, and many more platforms that show the steps or tutorials to invest in cryptocurrency, even for beginners. It somehow increases the degree of how individuals are getting more persuaded to invest in cryptocurrency to seek benefits. With this vast amount of information that is gained socially from others. This helps them to confirm their confident judgment in achieving the desirable outcomes such as to create profits. Consequently, the tendency of making irrational investment decisions in cryptocurrency is higher because they focus more on the positive outcomes, even when it is not guaranteed that they will actually be able to successfully gain the desirable outcomes.

### *6.3. Contextual factors of investment biases in cryptocurrency*

Another factor of investors' investment behavior are the contextual factors. Sachdeva et al. [44] revealed that a few of contextual factors such as accounting information, self-image or firm-image coincidence, and neutral information are having the greatest influence in the decision-making process of investing. Meanwhile, Hamidon and Kehelwalatenna [45] found out that one of the contextual factors of investment on trading, namely stockbroker's recommendations, caused in lower investment performance because there was a lower level of financial returns once investors tried to invest by imitating on other investors' behavior whilst trading on stock broker's recommendations.

Additionally, in general, contextual factors refer to the environmental characteristics which influence individuals' behavior.

Specifically in the realm of investment, there is a term called "investment environment" which defines the aspects that encourage people to invest, as it relates to individuals' demand to receive higher investment returns while having a higher risk level of investment. Mehta [46] explained that there are seven factors of the investment environment, namely the available investments assets and vehicles, financial markets, the structure of the market, market intermediaries, investment process, regulation, as well as the economy.

The investment process includes the determination of the investors' risk profile and goals through their portfolio, the diversification of investors' assets or instruments, as well as the implementation of the investment strategy [46]. Specifically in the perception towards the investment process, investors should be able to recognize their investment goals and objectives in order to execute the most suitable investment strategy. This is in accordance with Saini et al., as cited in Sharma [47], which found out that investment instruments characteristics, creditability, convenience, and success factors were the most influential factors of investments' perception in elevating the investment process. In analyzing this, bottom-up processing can be used to explain the underlying psychological process towards these contextual aspects. Bottom-up processing was initially proposed by Gibson [48]; it is when sensory information is retrieved from the environment and further built into individuals' perception. In terms of investing, bottom-up processing involves focusing first on the characteristics of the investment instrument and finally perceived or judged by how well it may create financial benefits. This is in accordance with Hayes [49] which explained that bottom-up investing focuses on the fundamentals such as the investment instrument's revenue that it has created, thus affecting individuals to perceive differently. It can be concluded that individuals' perception towards the investment process highly relies on the notion of how well the investment instrument creates benefits, potentials, and success. Especially in cryptocurrency investment that is volatile along with the changing news and trends, these become the sensory information that will be retrieved by investors until they have their own perception regarding the cryptocurrency and the process of the investment that occurs. Thus, these perceptions will then trigger irrationality while investors are making decisions on cryptocurrency investments.

Meanwhile, the investment regulation includes the governmental laws and any other rules that determine how investors should act and behave while investing [46].

Specifically in top-down investing, Murphy [50] explained that it allows investors to analyze all of the macroeconomic factors that affect the investment instrument, such as the monetary policy, governmental taxes, and key regulations made by each country. In Indonesia itself, the Regulation [7] is used as the key regulation which stated a list of 229 legal crypto assets which are allowed for exchanges. However, with the news of ups and downs of cryptocurrency, these regulations may emerge over time, which then may affect how individuals interpret or make judgment of the new information regarding the regulation. Thus, perception towards investment regulation will be able to predict the investment biases from how investors make judgements on the available regulation.

## 7. Conclusion

This study concludes that there are three groups of psychological factors that explain investment biases in cryptocurrency. The three factors are (1) cognitive factors - which include self-affirmation, anticipation of postdecision dissonance, (2) affective factors - which include fear of missing out (FoMO), overconfidence bias, and (3) contextual factors - which include perception of the investment process and regulation.

For further research in the future, it is recommended to conduct empirical studies to investigate the weight of each predictor against investment biases - which include herding bias, availability bias, loss aversion bias, confirmation bias, and hindsight bias.

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