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QUALITATIVE STUDY OF HEURISTICS AND BIASES INFLUENCING CRYPTOCURRENCY INVESTMENT

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I hereby declare that I have compiled the thesis independently
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ABSTRACT

The purchase of cryptocurrencies as a form of investment by retail investors has gained popularity in recent years. However, studies on the motivations driving investors to adopt such risky investment products are scarce. This paper's aim is to study the way people make investment decisions regarding cryptocurrencies. By using a qualitative exploratory analysis, this thesis investigates the ways in which biases and heuristics known in the field of behavioural finance influence cryptocurrency investment. Data collected through in-depth semi-structured interviews with participants holding cryptocurrency investments at the time of the study was analysed using Applied Thematic Analysis, identifying four themes influencing cryptocurrency investment. The findings highlight the large role that the narrative of cryptocurrency projects play in the investors' assessment of risk, and the participants' reliance on heuristics to validate several aspects which influence cryptocurrency investing such as the level of due diligence needed and their reluctance to realise their current losses and gains.

Keywords: cryptocurrency investment, biases, heuristics, behavioural finance

INTRODUCTION

In 2008, the creation of Bitcoin was informed to the subscribers of The Cryptography Mailing List in an email by Satoshi Nakamoto, describing the innovation as "a new electronic cash system that's fully peer-to-peer, with no trusted third party" (The Cryptography Mailing List, 2008). Previous attempts at creating digital versions of money, like David Chaum's eCash, had been thus far unsuccessful (Tapscott & Tapscott, 2019, p.4), but Nakamoto (2008) proposed a fundamental innovation: Bitcoin was embedded with a consensus mechanism which solved the double-spending problem inherent to financial transactions without relying on a trusted intermediary. Instead, the "nodes" of the network would process the Bitcoin transactions and record them in a universal distributed ledger secured through cryptographic techniques known as the blockchain (Smith & Kumar, 2018).

The growing enthusiasm about cryptocurrencies as an investment can be understood in the context of the one hundred and twenty fold increase in value of Bitcoin over six years, from $500 in 2015 to over $60,000 in 2021 (Prasad, 2021 p.5). Unsophisticated early adopters of Bitcoin became millionaires in the process (Bishop, 2017), further propelling enthusiasm and consolidating a market for trading cryptocurrencies where new inflows of retail and professional investors could participate. The number of cryptocurrencies available increased in tandem, with Smith & Kumar (2018) estimating 1,560 cryptocurrencies in existence by 2018 and the capitalization of the cryptocurrency market reaching over $2 trillion in April 2021, with Bitcoin still maintaining the largest share (Jagtiani, 2021, as cited in Hackethal et al. 2022).

Scientific literature has only recently started to explore the relevance of cryptocurrencies in modern finance. The first studies made on the topic focused on Bitcoin, and over time expanded their scope of interest exploring different aspects of cryptocurrencies in general like the evolution of their price, volatility, market capitalization and their correlation to other commodities like gold, silver and oil (García-Monleón et al., 2021). By contrast, little attention has been paid to the reasons and motivations driving cryptocurrency investments - yet a better understanding of this phenomena is becoming increasingly important.

First, cryptocurrencies are becoming an increasingly common financial investment vehicle, and established financial institutions are adapting to this demand. For example, Mastercard launched the Crypto Source program to help other financial institutions provide cryptocurrency trading

capabilities to their customers (Mastercard, 2022). Second, the prices of cryptocurrencies are remarkably volatile, posing a risk to investors. Third, the technological developments propelled by the cryptocurrencies' threat of disruption, such as Central Bank Digital Currencies (CBDCs) covering both retail and wholesale payments, are the most important ones in recent financial history (Prasad, 2021 p.11-13).

The aim of this paper is to study the investing decisions people make with regards to cryptocurrencies. The research problem being addressed is the existing knowledge gap in our understanding of how these investing decisions are formed and influenced by biases and heuristics known in the scientific literature advanced by Kahneman & Tversky (1979) amongst other authors. By conducting an exploratory study, this paper attempts answering the following research question:

- In what ways do biases and heuristics influence investing in cryptocurrencies?

Previous studies on cryptocurrency adoption and behavioural biases have pointed out limitations and future lines of research on the topic. Stix (2021) mentions the existence of endogeneity problems when exploring the ownership and purchase intention of crypto assets from survey results. Given the complexity inherent to studying behaviour, Jain et al. (2015) points out the need for behavioural finance to focus on studying the individual investor on a cross-cultural and cross-sectional level. After studying Bitcoin investment motivations from a mixed method approach Mattke et al. (2021) suggests a future line of research exploring the motivations that drive continuous investment in cryptocurrencies among individuals.

Considering the purpose of this paper is to explore perceptions, motivations and the overall behaviour of individuals, the most appropriate methodology available is qualitative. Purposeful sampling is used to select individuals who hold cryptocurrency investments at the time of the study. Applied Thematic Analysis (Guest et al., 2011) on data collected through one-on-one semi-structured interviews is used to gather insights and answer the research question.

The rest of the paper is organised in three sections. The first section describes the literature reviewed. An overview of the technological advances underpinning the advent of cryptocurrencies is provided. Next, an explanation of the heuristics mapped in the field of behavioural finance is provided, along with some of its most known effects and the biases they cause. Finally, a review of recent studies on the motivations individuals have when engaging in cryptocurrency investment is provided. The second section describes the methodology, data

collection and data analysis methods used. The third section presents the results of the study and a discussion of the findings, with special emphasis on how the research questions were answered. Finally, conclusions are presented followed by the list of references to literature used.

1. LITERATURE REVIEW

This section provides a review of existing literature covering the main two aspects of the phenomena under study. The first section provides an overview of the technological aspect, discussing what cryptocurrencies are and how they work, the potential of blockchain technology and the characteristics that cryptocurrencies have shown when used as an investment vehicle. The second section provides an overview of the behavioural aspect, providing an overview of the biases and heuristics mapped in scientific literature which are known to affect decision making under uncertainty.

1.1 Technological innovations

Given the paper's aim to study the investing decisions people make regarding cryptocurrencies, it is important to have a high-level understanding of the technical details underpinning this technology and its characteristics. This contextualises the enthusiasm cryptocurrency investors have regarding this technology and pinpoint which of its characteristics influence them, and in what ways. When investigating the biases and heuristics associated with this phenomena it is of particular importance to be precise and make distinctions between the two different but related topics: cryptocurrencies, and the blockchain technology supporting it.

1.1.1 Cryptocurrencies

Smith & Kumar (2018) define cryptocurrencies as decentralised currencies using cryptography to secure and validate transactions. Although there are more than 1,700 different cryptocurrencies in existence as of May 2021 (Prasad, 2021, p.109), Bitcoin is by any measure the dominant one: it is the first cryptocurrency in existence, has the largest market capitalization and laid out the technical foundations on which most of the newer cryptocurrencies are based. Therefore it makes sense to focus on understanding Bitcoin first, in order to make sense of the entire cryptocurrency ecosystem later on.

It is important to point out that, besides the technical innovations that Bitcoin achieved, one of its most salient aspects is the ideology to which the project is advocated: the technology proposed is usually seen as a response to the growing distrust in financial institutions triggered by the 2008

financial crisis. Bitcoin's proposed peer-to-peer version of electronic cash is meant to work without any trusted third-party intermediary, replacing the role usually reserved to governments and institutions with cryptographic proof, achieved through the proof-of-work consensus mechanism embedded in the technology. Through the use of private and public keys when validating transactions, anonymity can be provided to the transacting parties, in contrast to the required levels of compliance transacting parties need to fulfil in order to access the services of an established financial institution. With a predetermined and fixed supply of Bitcoin encoded in the network, and issued gradually to the people validating transactions in the network as an incentive mechanism, it is impossible to debase its value through excessive supply (Nakamoto, 2008). By contrast, increasing or decreasing the money supply is a tool of monetary policy commonly used by governments and central banks to effect changes in the economy. These unique characteristics made Bitcoin the perfect embodiment of the existing zeitgeist at the moment of its launch.

Despite its growing popularity Bitcoin has failed to achieve many of its objectives: it lacks stable value as a currency, it falls short in processing capacity as a medium of exchange, it provides only pseudo-anonymity (as all transactions are traceable public information), it damages the environment due to the high electricity consumption needed to run the networks, among others (Prasad, 2021, p. 129-142). However, instead of discouraging cryptocurrency adoption, a wide range of alternative cryptocurrencies have been created aiming to address one or several of these limitations. A few examples of these new types of cryptocurrencies are in order.

To address the issue of its volatile value and its inviability as a medium of exchange, cryptocurrencies aiming to reduce price volatility through price diversification by holding a basket of assets, fiat currencies or commodities have sprung. These aim to maintain a par value with a specific fiat currency and are known as stablecoins (Prasad, 2021, p.155). To address the issue of privacy, new cryptocurrencies in public blockchains such as Monero and Zcash provide enhanced anonymity through advanced cryptography, protecting the identity of the transacting parties while still maintaining public records of the transaction (Chen & Bellavitis, 2020).

However, not all the newly created cryptocurrencies have the merits of attempting to improve the capabilities of previous ones. Increasingly, many cryptocurrency projects seem to have come into existence without any functional purpose, with valuations seemingly driven only by the willingness of cryptocurrency investors to acquire them. Prasad (2021, p.187-89) lists examples such as Jesus Coin and Dogecoin, among others. Jesus Coin's white paper proposed little more

than to "decentralize Jesus", yet this cryptocurrency reached a market capitalization of $20 million by February 2018. Dogecoin's market capitalization increased from below $30 million in 2017 to above $90 billion in May 2021, an astonishing three-thousand-fold increase in value in four years, prompted by Elon Musk's friendly tweets endorsing the coin - in spite of the fact that this cryptocurrency has minor transactional value and is based on an internet meme.

This phenomena sheds light on an ongoing issue regarding this technology: no consensus has been achieved regarding whether cryptocurrencies could effectively act as an instrument to store value. Studies made on Bitcoin (Baur et al. 2018) explore this question by investigating its usage and comparing its financial characteristics with that of other financial assets. Data usage shows that Bitcoin is used mainly for investment purposes rather than for transactions, while its correlation with other financial assets give it weak safe haven properties. If the demand for Bitcoin increases in the future while its supply remains fixed, the deflationary power of the cryptocurrency would further support the investment motivation. The findings proposed by Glaser et al. (2014) when investigating the user's intentions for exchanging domestic fiat currencies into Bitcoin aligns with this notion of the use of cryptocurrencies as an investment vehicle, primarily traded on exchanges as an asset class rather than used for transactions.

1.1.2 Blockchain technology

In business, trust is based on the expectation that the parties involved in a transaction behave honestly and fulfil their agreed commitments. Tapscott & Tapscott (2019, p.11) explain that in order to trust that a transaction will take place individuals have come to rely on third parties performing the enforcement of these agreed commitments. These third-party intermediaries, such as governments, financial institutions and other conglomerates, have in turn acquired the role of keeping and maintaining transaction records, enabling the performance of business operations that would not be possible without them.

The standpoint of the current paper's author is that, beyond all the technical innovations underpinning Bitcoin, the most important one is the creation of a viable decentralised mechanism for trust. Prasad (2021, p.129) points out that "whatever Bitcoin's eventual fate, the blockchain technology that underpins it constitutes a technological advance that will have a transformative effect".

To recap, all the technical elements which underpin Bitcoin where already existing technologies at the time of its launch: cryptographic systems for the issuance of private and public keys, Hash

functions and Merkle trees to synthesise and maintaining data integrity, and Distributed Ledger Technologies (DLT) to ensure the consistent replication of data across a network of nodes. What allows Bitcoin to process transactions without a trusted intermediary is the proof-of-work consensus mechanism (Nakamoto, 2008) through which, rather than having a single trusted third-party verifying transactions, all the nodes in the network are alerted of the transaction, participate in their validation through a process called "mining", and broadcast the valid transaction to the rest of the network. Validated transactions are grouped in "blocks" and appended to the existing public ledger of previous transactions, which is where the term "blockchain" derives its name from.

The potential of blockchain technologies then becomes the possibility of conducting transactions without any third-party intermediary to enforce them. This implies that **anything** which could be programmed into a transaction could take place through blockchain technology, which is where the promise of blockchain becoming the "Ledger of Everything" for the "Internet of Everything" in the physical world finds its roots. (Tapscott & Tapscott, 2019, p.7)

A step further in the potential of blockchain technology is the idea of Decentralised Finance (DeFi), which refers to the initiatives aiming to use decentralised blockchains solutions to provide financial services. Chen & Bellavitis (2020) describe five aspects of DeFi which hold its potential: decentralisation, innovativeness, interoperability, borderlessness and transparency. Decentralisation would reduce transaction costs due to the lack of intermediaries and the network effects created through the blockchain's increased adoption. Innovativeness would be fostered due to the blockchain's open source nature and the lack of a centralised controlling party restricting new developments. In comparison to traditional financial institutions, which tend to work in silos and with legacy technology, DeFi would allow capital and value to be transferred easily through its high interoperability and borderlessness given its distributed nature. Finally, DeFi's reliance on public ledgers and radical transparency would generate trust for the parties participating in a transaction.

1.2 Empirical studies on cryptocurrency investment

The existing literature on the characteristics of cryptocurrencies as an investment vehicle is limited. Most of the available studies on the topic focus on Bitcoin and use it as a proxy for the cryptocurrencies market in general. While it is useful to narrow down the focus of a study on the

most representative cryptocurrency in existence, more needs to be said about the nuances and differences amongst different types of cryptocurrencies given the complexities of this phenomenon. For example, the valuation model for cryptocurrencies proposed by García-Monleón et al. (2021) distinguishes between cryptocurrencies with redeemable value issued for the purpose of funding an Initial Coin Offering (ICO), single layer blockchain networks for the transfer of cryptocurrencies only and multilayer blockchain networks for the transfer of different types of information.

1.2.1 Cryptocurrency as an investment

The question of whether cryptocurrencies have intrinsic value is an open one, and lies outside the scope of this paper. In spite of being the most popular cryptocurrency, Bitcoin has been described as not having intrinsic value (Baur et al., 2018; García-Monleón et al., 2021) but the evidence provided is still contested.

Mattke et al. (2021) argues that Bitcoin "[have] unique characteristics that may motivate people to invest in it. In contrast to classic investments, a bitcoin investment is not associated with any person, organisation or intermediary, does not finance any venture, and individuals do not acquire a stake in a company or venture. Furthermore, the bitcoin price does not depend on traditional financial assets, such as stocks, and because of its volatility bitcoin does not fulfil the requirements of a currency. Those unique characteristics limit the transfer of knowledge from related research to the context of investing in bitcoin."

What has been established in existing literature and through the increased adoption of cryptocurrencies as an investment vehicle is its relevance as a financial tool. For example, futures contracts with Bitcoin as the underlying asset have been enabled in 2017 by the Chicago Mercantile Exchange (CME) Group and the Chicago Board Options Exchange (CBOE), legitimising the cryptocurrency market and extending its reach to institutional investors (Bouri et al., 2020). The Bitcoin tracker certificate, an investment product for retail investors which tracks the risk and return profile of Bitcoin, was "the most traded structured product at the Frankfurt Stock Exchange" (Hackethal et al., 2022).

Baur et al. (2018) has investigated Bitcoin's characteristics and describes it as a hybrid between fiat and commodity currency held mainly for investment purposes. Its historical returns and volatility make it unique and not comparable to any other asset, with a return's distribution showing large negative skewness and extreme kurtosis, which indicates a "great number of tail

events in Bitcoin returns." (Baur et al., 2018). It is argued that, due to its isolation from the current monetary system, Bitcoin could act as a safe haven against financial turmoil, in spite of its volatility. Its weak positive relationship with other assets gives Bitcoin properties as a diversifier (Baur et al., 2018; Bouri et al. 2017). Dyhrberg (2016) argues that Bitcoin's returns are uncorrelated to the assets in the Financial Times Stock Exchange (FTSE) Index on average, giving it hedge properties against it.

In summary, despite their speculative nature, the studies suggest a positive effect of holding cryptocurrencies as part of the investor's portfolio and point to its continued relevance in modern finance.

1.2.2 Cryptocurrency investors' characteristics

The most recently available study on the subject has been made by Hackethal et al. (2022), who sets to investigate the characteristics of cryptocurrency investors by analysing the use of cryptocurrency-related retail investment products offered by financial institutions in Germany, which are easier to access in comparison with acquiring the cryptocurrency asset itself and have the same underlying risk and return characteristics of cryptocurrencies. The findings indicate that cryptocurrency investors have a greater interest in their financial situation, trade more frequently, have higher use and login rates for online banking than non-cryptocurrency investors and, in some cases, have cryptocurrency as a significant fraction of their total portfolio investment, and actively manage it. The risky nature of cryptocurrency investment would suggest these investors are driven to invest by positive sentiment, have an overall gambling propensity, see trading as a form of entertainment and have preferences for stocks with lottery-type features. Kumar (2009) defines a lottery-type of stock as a low-priced stock with high idiosyncratic volatility and skewness, similar to lotteries in that they have low prices, low negative payoff and a very small probability of an extreme reward.

Hackethal et al. (2022) finds a correlation between the first cryptocurrency-related investment made and the subsequent increase in risk-seeking behaviour for both cryptocurrency and non-cryptocurrency types of investments in cryptocurrency investors. Additionally, and contrary to traditional portfolio theory, "[cryptocurrency investors] do not tend to reallocate their portfolio holdings toward safer assets as compensation for the high volatility of cryptocurrency securities. Instead, these [cryptocurrency] investors tilt their noncryptocurrency portfolio holdings toward assets with a higher risk profile." (Hackethal et al., 2022)

Gupta et al. (2021) studied through a fuzzy analytical framework in which order of priorities the intentions behind cryptocurrency investment are perceived by its investors. The following criteria is listed and defined in descending order of priority:

1) Social influence: a behavioural change caused due to social acts, like peer pressure.
2) Facilitating conditions: the extent of support provided for using a particular technology.
3) Perceived usefulness: the impression that a particular system's usage will be of benefit.
4) Financial literacy: the ability to understand and make sound financial decisions.
5) Performance expectancy: the expectation that the use of a technology will be lucrative.
6) Perceived trust: the confidence that a system will perform according to expectations.
7) Social support: the expectation that help will be obtained from society when needed.
8) Effort expectancy: the determination of the complexity associated with a process.

Having social influence as the most important criteria for the motivation to adopt cryptocurrency investment is aligned with the findings of Krafft et al. (2018) about the increased role of peer behaviour in cryptocurrency markets and the herd behaviour characteristics cryptocurrency investors possess suggested by Ballis and Drakos (2020).

Fujiki (2021) studies the characteristics of Japanese cryptocurrency owners by examining their level of financial literacy and experience holding risky financial assets. His findings suggest that cryptocurrency owners without investment experience in risky assets do not tend to hoard cash and have lower levels of financial literacy than those with that experience in risky assets.

Zhao & Zhang (2021) investigate the roles financial literacy and investment experience play in determining cryptocurrency investment in the United States. For financial literacy it is found that cryptocurrency investors, when compared to non-cryptocurrency investors, have higher levels of risk tolerance and subjective financial knowledge (i.e. the confidence an investor has in his own knowledge of financial issues) along with lower levels of perceived risk and objective financial knowledge (i.e. the actual level of knowledge of financial issues). Only subjective financial knowledge has a statistically significant association with investing in cryptocurrencies and is more important to predict cryptocurrency investment. For investment experience, it is found that cryptocurrency investors hold a larger amount of investments in risky assets when compared to non-cryptocurrency investors. These results indicate a robust positive relationship between financial literacy, investment experience and cryptocurrency investing. However, investment experience, particularly with risky assets, has a greater impact in cryptocurrency investment than financial literacy.

Stix (2021) reported similar findings when studying the ownership and purchase intention of cryptocurrencies in Austrian households. Owners and potential owners of cryptocurrencies have higher risk tolerance, financial literacy and are more likely to invest in other risky financial assets. Additionally, beliefs about the profitability of cryptocurrencies as an investment and its potential advantages for payments also significantly affect cryptocurrency adoption. These beliefs stand in contrast to the low actual use of cryptocurrencies as a payment method, but could be understood as the expectation that cryptocurrencies will be useful in the future rather than the present.

Mattke et al. (2021) studies the investment motivations of first-time Bitcoin investors and applies a mixed methods approach to identify relevant configurations of motivations. Through the first stage of the study, seven motivations driving investment in Bitcoin are identified and grouped:

- Relevant perceptions: 1) profit expectancy, 2) ease of bitcoin acquisition, and 3) support of bitcoin ideology.
- Personal factors: 4) investment skills, and 5) risk affinity.
- Regret sentiments: 6) anticipated inaction regret, and 7) experienced inaction regret.

In the second stage of the study, these motivations build the four configurations of motivations driving Bitcoin investors, and classifies them as a) the incompatible profit investor, b) the risk affine profit investor, c) the not-profit-driven ideological investor, and d) the experienced ideological investor.

1.3 Heuristics and effects

The aim of this paper is to study the investing decisions people make with regards to cryptocurrencies. In order to understand and contextualise how those decisions are made, literature on the field of behavioural finance relevant to this paper is presented as a starting point, and used as the framework through which to study the research question. Given that by conventional metrics cryptocurrency investment is inherently risky, it would be appropriate to approach the research question considering the biases and heuristics identified in the study of judgement under uncertainty (Kahneman & Tversky, 1974) and prospect theory (Kahneman & Tversky, 1979), as this critique of expected utility theory concerns itself with how people make choices under risky prospects.

In order to analyse the data collected with precision, it is important to have a few definitions of the terminology used in the discussion that follows. An effect is a cognitive operation performed by individuals intuitively, which could affect their judgement. A combination of one or several effects are generally present in the heuristics people use when making judgements. A heuristic is akin to "back-of-the-envelope calculations" (Shefrin, 2002, p.14) which individuals use when making judgements and often gives them the right answer to difficult a question. A bias is a deviation from the right answer to such a question, in a particular direction.

The **substitution effect** (Kahneman, 2012, p. 97-99) can be defined as the operation of answering a difficult question ("target question") with the answer to an easier question ("heuristic question"), a function which the intuitive judgement system performs without the individual's awareness.

The **certainty effect** (Kahneman & Tversky, 1979) takes place when individuals overweight outcomes that are considered certain relative to outcomes that are considered probable. When individuals are faced with evaluating two similar prospects offering a positive outcome, and one of them has a 100% certainty of being realised while the other is only probable, that is to say, has a probability of being realised of less than a 100%, individuals tend to choose the one with the certain outcome over the probable one, even if the probable prospect has a larger expected value than the certain option. On the other hand, when both options are probable, individuals tend to prefer the prospect with the higher probability of being realised, even if it offers a smaller expected value in comparison. Finally, when both options are probable but the positive outcome has only a very small probability to occur, individuals tend to favour the prospect offering the largest gain.

The **reflection effect** (Kahneman & Tversky, 1979) takes place when individuals reverse their preferences towards a risky prospect depending on whether a probable gain or a probable loss is involved. When the prospects offered involve a probable gain individuals show risk averse preferences and choose the prospect with the highest probability, even if the other prospect provides the same expected value. However, when the prospects offered involve a probable loss of equal magnitude as the prospect involving a gain, individuals show risk seeking preferences, often choosing the prospects with higher probabilities but lower expected value (Kahneman & Tversky, 1979). The only exception to this pattern of behaviour occurs when the probabilities of a gain or a loss involved are very small, more in the realm of possibility than probability (Tversky & Kahneman, 1986).

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The **isolation effect** (Kahneman & Tversky, 1979) describes a cognitive process through which individuals simplify their choices between two different prospects by disregarding their commonalities and focusing on the components that distinguish them. Given that prospects can be decomposed in more than one way between common and distinctive components, different preferences can be elicited, even though the prospects remain the same.

When an individual is faced with the prospect of making a choice, the decision frame (Tversky & Kahneman, 1981) through which the prospect is presented may elicit different or even contradictory preferences for the same prospect, as any prospect can be framed in more than one configuration, something known as the **framing effect**. For example, framing one prospect as a gamble in which an individual has a probability of gaining and a probability of losing elicits less favourable responses than a prospect of the same expected value which frames the probability of losing as a participation cost instead (Kahneman, 2012, p.364). It is known that a narrow decision frame (Kahneman & Lovallo, 1993) makes individuals approach decision problems in isolation with respect to other related choices, or future opportunities to make similar decisions.

Slovic et al. (2000) defines affect as either a feeling state (e.g. happiness, sadness, etc) or a quality (e.g. goodness, badness, etc) associated with a stimulus. In people's minds, objects and events are tagged with a certain degree of affect, composing an affective pool. The **affect heuristic** takes place when people refer to this affective pool in the process of making judgements, and their emotions towards the object being judged guide their evaluations of its risks and benefits. This heuristic explains the commonly known inverse relationship between perceived risk and perceived benefit: individuals tend to evaluate an activity they like as low risk and high benefit, while the reverse evaluation is attributed to an activity disliked. While the conclusions this heuristic provides can be refined through the input of new information, it is likely that the new interpretation will also be subject to the heuristic: "Your beliefs, and even your emotional attitude, may change (at least a little) when you learn that the risk of an activity you disliked is smaller than you thought. However, the information about lower risks will also change your view of the benefits (for the better) even if nothing was said about benefits in the information you received." (Kahneman, 2012, p.103)

Generally speaking, frequent events are easier to recall than rare events, in the same way that likely events are easier to imagine than unlikely ones. When an individual estimates the likelihood of an event by assessing the ease with which instances or mental associations to such an event are carried out, the **availability heuristic** (Tversky & Kahneman, 1973) is effectively

being used. As the reasons due to which an individual could have ease of retrieval for certain events are not necessarily related to the event's actual frequency or likelihood, using the availability heuristic necessarily affects the perceived likelihood or frequency of the event, leading to systematic biases.

When events are perceived as unique with no relevant past history to evaluate their likelihood, individuals resort to constructing scenarios, that is to say, "stories that lead from the present situation to the target event" (Tversky & Kahneman, 1973) and through evaluating the plausibility of such scenarios they determine the likelihood of the rare event. When complex events are involved, it is suggested that only the simplest and most available scenarios are likely to be considered. As a result, for scenarios that are difficult to imagine the event is deemed impossible or highly unlikely, while for scenarios that are easier to imagine or more compelling the event is seen as probable. It is known that once an uncertain event has been interpreted in a certain way, it is very difficult for individuals to be able to see it in a different way afterwards, which could inhibit the emergence of other scenarios that, although difficult to imagine, could be probable. This in turn could lead to systematic biases in which risks difficult to imagine while constructing scenarios are simply considered impossible, grossly underestimating the real risk related to a rare event. Conversely, risks which are easier to imagine could also overestimate the real risk related to a rare event. (Tversky & Kahneman, 1974)

The **representativeness heuristic** (Kahneman & Tversky, 1972) takes place when individuals judge the probability of uncertain events by the degree to which the event's characteristics resemble the essential properties of its parent population and the salient features of the process by which it is generated. While examining instances of this heuristic, Kahneman & Tversky (1974) find that individuals are largely insensitive to a different set of conditions which should have a major effect in their judgement. For example, even when explicitly indicated, the prior probabilities of the outcomes under evaluation are neglected in favour of judging by representativeness. Similarly, the sample size from which individuals are asked to make a judgement is ignored when using the representativeness heuristic, which goes against the fundamental notion in statistics that the size of the sample affects the probability that the sample in question is similar to its population parameter. In a similar way, the degree of confidence with which individuals make predictions is also affected by representativeness. Even if the individual is made aware of the limited predictability or weak reliability of the information used to elaborate such prediction, the illusion of validity "produced by a good fit between the predicted outcome and the input information" (Kahneman & Tversky, 1974) remains unaltered.

Misconceptions of chance like the Law of Small Numbers (Tversky & Kahneman, 1971) are also a result of this heuristic, according to which individuals' intuitions about random sampling conform to the belief that the "law of large numbers applies to small numbers as well" (Tversky & Kahneman, 1971).

Prospect theory (Kahneman & Tversky, 1979) emerges as an alternative theory of choice in light of the consistent violations to expected utility theory that individuals making decisions fall for. The certainty effect, the reflection effect and the isolation effect are a few of the many cognitive processes individuals resort to when making decisions, something the theory of expected utility does not accommodate for. The main contributions of the theory can be summarised in the following main points (Kahneman, 2012, p.281-284):

- Individuals evaluate prospects relative to a neutral reference point, the state relative to which gains and losses are measured. When the outcome is above the reference point, the change is considered a gain. When the outcome is below the reference point, the change is considered a loss.
- Diminishing sensitivity applies to the evaluation of the changes of wealth. Changes in wealth of the same magnitude have a greater impact if they take place near the reference point than if they happen further away from it.
- Loss aversion is experienced by individuals when comparing losses to gains. When individuals face mixed prospects involving the opportunity for gain and the risk of a loss, losses are perceived stronger than gains, in a ratio ranging from 1.5 to 2.5. In other words, a loss identical in magnitude to a gain is perceived almost twice as strongly.

Prospect theory, however, has flaws of its own. It does not accommodate for the role of regret, disappointment, or the anticipation of disappointment in the evaluation of uncertain prospects. While several alternative theories incorporating these characteristics add a more realistic set of assumptions, they have not been as influential as prospect theory given their increased complexity but otherwise less usefulness. (Kahneman, 2012, p.287-288)

2. DATA AND METHODOLOGY

As the knowledge gap being addressed relates to how investing decisions are formed and influenced through known biases and heuristics, this paper extends the contributions made by Mattke et al. (2021) in the context of Bitcoin investment and build upon the relevant perceptions mapped in their study as the starting point from which to study the research question. Bitcoin is the most prominent cryptocurrency in existence and has the highest market capitalization in the cryptocurrency market. Therefore, it would be reasonable to conjecture that findings related to it could be valid for the larger set of cryptocurrencies in existence.

2.1 Research methodology

While quantitative methodologies relying on statistical analysis are more common in finance research, there are limitations to this approach that need to be considered for the present paper. Cryptocurrency investment is a domain in modern finance where the availability of datasets is severely limited. Stix (2021) cautions about the low number of observations regarding owners of cryptocurrencies and non-owners with awareness of cryptocurrencies in the dataset he studied. The pseudo anonymity provided by cryptocurrencies and decentralised nature of blockchains tend to compound these data availability problems "mainly due to a lack of systematic data collection and costs associated with identifying users." (Yelowitz and Wilson, 2015, as cited in Hackettal et al., 2020).

The research aim is to explore the behavioural aspect of how investing decisions are made. Given the complexity of the phenomena under study and the aforementioned limitations, a qualitative methodology is be used to answer the research questions. A qualitative methodology provides the advantage of exploring complex phenomena in detail, while also incorporating factors that quantitative methodologies generally neglect or ignore, such as the role of context and meaning in the data collected.

2.1.1 Methods of data gathering

For the purpose of studying the research question and having an in-depth understanding of the perceptions cryptocurrency investors have, the most adequate data collection method available is qualitative, semi-structured, one on one interviews. This type of interview requires to have an a priori outline of the topics and issues to be investigated, but still leaves room for the researcher to vary the wording or order of the questions during the interview if necessary. "The major advantage is that the materials are somewhat systematic and comprehensive, while the tone of the interview is fairly conversational and informal." (Eriksson & Kovalainen, 2016, p.94). Open-ended questions which require a more developed and nuanced answer than closed-ended questions are used (Collis & Hussey, 2014, p.133).

The biases and heuristics concerning the research questions are generally a form of intuitive judgement of which individuals are, for the most part, unaware (Kahneman 2012, p.21-24). Therefore, it is not possible to approach them directly or ask the participants to explain their perceptions about it. Instead, it is imperative to elicit answers from participants regarding their motivations to invest in cryptocurrencies and, from these responses, use an inductive approach to address the research question. For this purpose, the following motivations driving Bitcoin investment identified by Mattke et al. (2021) are taken as the starting point from which to elaborate the interview questions and categorise the responses: 1) profit expectancy, 2) ease of acquisition, 3) support of ideology, 4) investment skills and 5) risk affinity. Each motivation is assigned a question and, from the responses, the ways in which the effects and heuristics listed in the literature review are present and affect the investor's decisions is analysed.

The structured part of semi-structured interviews consists of two baseline questions asking participants directly about their motivations for investing in cryptocurrencies (e.g. "why did you decide to invest in cryptocurrencies?"). The questions on the semi-structured part of the interviews were based on the motivations identified by Mattke et al. (2021) regarding Bitcoin investment and other questions meant to elicit responses regarding investors' preferences between different prospects, as suggested in the reviewed literature. The full list of questions used is provided in the Appendix 1.

Each semi-structured interview aimed to last 20 minutes. The interviews were conducted in full through online video conferences, as this option provided the most flexibility for participants. In order to generate data that can then be analysed, the interviews were transcribed verbatim and

studied according to the analysis method selected. A temporary electronic access link to the interviews' full transcription is available in the list of references.

2.1.2 Methods of data analysis

An Exploratory Analysis is used as the analytic approach given the content-driven nature of the data generated and the lack of a priori assumptions or formulated hypotheses regarding the phenomena studied.

The analysis method used is Applied Thematic Analysis (ATA) (Guest et al., 2011). In contrast to Qualitative Content Analysis, which can concern itself with the quantification of the data under study, ATA provides a purely qualitative and nuanced account of the data studied and is considered as a "flexible and useful research tool, [which] provides a rich and detailed, yet complex, account of the data." (Braun & Clarke, 2006, as cited in Vaismoradi et al., 2013) While ATA synthesises different branches of qualitative approaches and procedures such as grounded theory, positivism, interpretivism and phenomenology, this paper's analysis method leans towards an interpretivist philosophical position, which is generally less concerned with measurement or quantification of data but rather focused on the meaning interpreted within the discourse (Guest et al., 2011, p.14-15).

2.2 Sampling criteria

Given that the biases and heuristics listed in the literature reviewed are generally applicable to the individual's decision making across different age groups and demographics, the main criteria used to select participants for the interviews is their current use of cryptocurrencies as an investment vehicle. For the purposes of this paper, it is not relevant what specific type of instrument an investor uses to invest in cryptocurrencies (e.g. purchasing a token related to a blockchain project, purchasing and owning the cryptocurrency directly, purchasing a retail investment product offered by a financial institution, etc) but rather their continued participation in this type of investment.

Purposeful sampling was used by this paper's author to approach the initial interview participants face-to-face during an educational event organised in Tallinn by a prominent cryptocurrency exchange platform during March 2023. A set of screening questions were asked

in order to determine which participants in the event would qualify for this study, and to subsequently request their participation.

The sample size in qualitative research is usually determined by the point at which saturation is achieved, that is to say, "the point in data collection when no additional issues or insights are identified and data begin to repeat so that further data collection is redundant, signifying that an adequate sample size is reached." (Hennink & Kaiser, 2022) It is suggested that saturation can be achieved from a set of between nine to seventeen interviews (Hennink & Kaiser, 2022). While the point of saturation is the main reference on which the adequate sample size is considered, as a baseline, this study aimed at interviewing at a minimum nine participants.

A snowball sampling technique was used to recruit more participants, by asking the participants initially contacted face-to-face by the author to suggest people in their network of contacts who could be contacted for the purposes of this study. A description of the participant's sampling demographics is in order.

- Number of participants: 7
    - Male participants: 4
    - Female participants: 3
- Age cohorts (Dimock, 2019):
    - Generation Z, 11 to 26 years old as of 2023: 3
    - Millennials, 27 to 42 years old as of 2023: 4
- Professions stated:
    - In the Financial Technology sector: 3
    - In professions related to Information Technologies: 4

While the sample size of nine interviewees initially set was not reached, saturation in the data collected was already present given the consistency of the themes appearing in the participants' responses. Therefore, it was considered that seven in-depth semi-structured interviews would be sufficient to conduct the exploratory analysis aimed in this thesis.

It is important to note that this study makes no claims of statistical representativeness or significance regarding the data collected for this study, given the non-probabilistic nature of the sampling technique used and the qualitative nature of the study. Also, no incentive was offered for participation in this study, monetary or otherwise.

3. EMPIRICAL ANALYSIS

Guest et al. (2011, p. 250-251) advises authors of qualitative studies to be reflexive on how their presence in the study may have affected the data collection process. In the present study the main challenge during the interviews conducted was enabling the continued openness of the participants in spite of some conflicting preferences becoming apparent during the course of the interviews, something which would usually make participants more reserved in their responses. The measures taken to minimise this effect were to switch between questions on different topics, so that participants would switch their focus to a different area of interest.

In order to discover the underlying themes in the data collected, the coding of the interviews' transcriptions considered the tips suggested by Ryan and Bernard (2003, as cited in Guest et al., 2011, p. 66). Looking for concepts and specific words repeating most often throughout the transcripts gave the first clue to the codes identified, while metaphors and analogies used by participants provided more content and robustness to the codes, eventually generating the themes identified in the data. For example, participants often used the term "risk" or "risky" to refer to the inherent volatility of cryptocurrencies, the types of returns to be expected and when characterising it as an investment. Therefore, the code "risk" was used to identify these instances.

Participant 5: *"I think that is, it's a good investment, but it's a very high risk investment."*

Participant 6: *"But I guess, depending on the project… there's also a potential to have like, much higher returns than a normal investment. So essentially, it's way more risky"*

Participant 7: *"crypto in general I would describe the person that is a degenerate person, kind of high risk person, a person that likes to go around and try new stuff and fail and try more new stuff and be risky and, actually, a hustler…"*

The beginning and ending point for each segment of text being coded was identified by the author while reading the text, which is a commonplace approach to text segmentation in qualitative studies (Guest et al., 2011, p.51). As a rule of thumb, the text segmented included only enough context to ensure the meaning of the segment would remain legible. The codes identified in the data are provided in Table 1.

Table 1. Codes and descriptions

Code	Description
Analysis	Used for discussions of the research or investment analysis an investor makes when considering cryptocurrency purchase. This can include statements about their level of knowledge and references to the valuation of an investment.
Gambling	Used for discussions of gambling practices. This can include statements about the lack of value in some cryptocurrency projects and references to uninformed investors and quick profits.
Timing	Used for discussions of how time can affect an investment. This can include statements about short and long term horizons, market cycles, financial bubbles and arbitrage opportunities.
Risk	Used for discussions about the volatility and riskiness of an investment prospect. This can include statements about the potential for returns and losses and references to safety or danger when evaluating an investment prospects.
Safe bet	Used for discussions about cryptocurrency as a safe investment.
Scam	Used for discussions about scams or criminal activity related to cryptocurrencies. This can include statements about bad actors.
Decentralised	Used for discussions about the decentralised feature of cryptocurrencies and blockchain. This can include statements about lack of intermediaries, resilience or boundaries in general.
Promise	Used for discussions about the future potential of cryptocurrencies and blockchain in general. This can include statements about usability, adoption and references to uncertainty.
Success over profits	Used for discussions about the success of a cryptocurrency project being not necessarily correlated to returns on the investment made. This can include statements about adoption and coming to life.
Tech behind	Used for discussions about the underlying technology supporting cryptocurrencies. This can include statements about blockchains.
Ease of use	Used for discussions about the degree of ease with which investing in cryptocurrencies can be made.
Ownership	Used for discussions about the investor's level of control over their investments. This can include references about responsibility.
Tangible	Used for discussions about forms of investments perceived as more tangible. This can include references to real estate, dividends, accessibility or the physical aspect of an investment.

Source: Author

3.1 Themes and results of coding

In total, thirteen different codes were used for categorising the data in the transcripts. Although initially more codes were considered for categorization, the focus of the coding was kept around the participants' motivations for cryptocurrency investment and their perceptions around this particular type of investment. For example, initially a "regulation" code was created to categorise references made to how the regulatory environment around cryptocurrencies might affect its adoption in general. It was considered this particular code, while useful in a broader context, would be out of the scope of the thesis' focus, and it was therefore eventually removed. The codes used were grouped around four main themes, described in Table 2.

Table 2. Themes and codes

Theme	Codes
Financial knowledge	Analysis, Gambling, Timing
Level of risk involved	Risk, Safe bet, Scam
Narrative of cryptocurrencies' potential	Promise, Decentralised, Success over profits, Tech behind
Perception of investment	Tangible, Ownership, Ease of use

Source: Author

While all themes emerged from the data after several readings of the transcripts, the one emerging with most prominence was the "narrative of cryptocurrencies' potential". This theme groups discussions about the future promise of the technology advanced by cryptocurrencies, their decentralised nature and, interestingly, the idea that the long term success of a cryptocurrency project is not necessarily correlated the investment generating returns for the investor, something akin to the findings made by Mattke et al. (2021) when referring to the not-profit-driven ideological type of investor. There's a strong component of uncertainty in the theme in general, but this is particularly noticeable in the discussions coded as "promise", where the beliefs of the investors in the potential of the cryptocurrency space gaining relevance in the future is perceived as difficult to envision.

Participant 1: *"Then again, as it has a lot of potential like, new, a lot of new like, projects will appear… To be honest, I cannot even like, fully comprehend like, the extent of how like… this technology can like, shape the future, so…"*

Participant 5: *"even people who are very deep into it, like, very knowledgeable in crypto, they still don't know what crypto will be in… 5, 10 years from now… what it's gonna be like the main use of crypto and how it's gonna be used. Yeah."*

The codes related to the overarching idea of the importance of knowledge in the context of cryptocurrency investing were grouped under the theme of "financial knowledge". Discussions about the type of research made when considering an investment prospect, references made to gambling within the context of investing and the overarching idea of investors being able to time the market were constantly mentioned during the discussions. It is particularly noticeable how participants made strong remarks about the difference between investing in cryptocurrencies and gambling with cryptocurrencies, perceiving the latter somehow negatively and showing some aversion to being identified as gamblers - a term used instead to describe uninformed investors buying cryptocurrencies with the expectation of achieving quick profits.

Participant 1: *"[when asked about the preferences between two risky prospects] that's like purely gambling, which it's not something that I'm really like, eh… I don't usually do, like I don't… [chuckles]… I don't particularly like gambling my money away, that's not the point of investment."*

Participant 3: *"If you have a doge coin, for example, eh, it's really popular but, but there isn't really a project behind it. You can make money from it, but it's more about gambling than it is like, ahm, calculating, thinking."*

Participant 7: *"Like, I have a really clear line between gambling and actually investing with research. And I never gamble."*

The investor's different perceptions when describing their investments was grouped in the "perception of investment" theme, which is the broadest theme in the study as it encompasses a diverse range of perceptions, which are not necessarily correlated. It is of note that the physical aspect of the investments described by the participants seemed to reflect a degree of safety. For example, investments in real estate or cryptocurrency projects which involve the use of machinery was perceived as being a more real, and therefore safer, investment. In the case of participants who incurred losses with cryptocurrency investments, their interests seemed to shift

towards non-cryptocurrency investments providing dividends, which could reflect the need for a more immediate form of investment return.

Participant 4: *"[when considering future investment prospects] I think I would invest it… mostly into… ah, dividend, ah… stocks? Or ETFs [Exchange-Traded Funds]? Not crypto (…) I want to get dividends."*

Participant 5: *"[describing a cryptocurrency project] it has an infrastructure purpose, right? It's a proof of, ah… work. So you put computers, you have computers that are hosting, ah, you know, services (…) So it's not, ah, just exchanging currencies, or whatever. It's just… it's proof of work, so, that's, that's what I like about it, so it feels a more of a secure [chuckles]…"*

Participant 7: *"Yeah, for me like, diversification, like, out of cryptocurrencies will happen in maybe real estate at some point (…) that's a safer investment I guess."*

The theme labelled "level of risk involved" grouped the participants' perceptions of risk, danger and safety related to cryptocurrency investment. The discussions covered mainly topics related to volatility and the potential for returns and losses, with references to scams and criminal activity when describing the danger aspect of it. While the level of risk in cryptocurrency investment was acknowledged by all participants to a similar degree, it is noteworthy that, for some participants, investing in stocks of regular companies or in the most popular cryptocurrencies can be considered a safe form of investment.

Participant 2: *"Well, the problem with crypto is that, ah, cryptos involve everything related to crypto, meaning, everything like shitty coins or scam coins that basically don't do anything, basically it's a random token to make money."*

Participant 4: *"[describing cryptocurrency characteristics] potentially like a good backup investment as well."*

The themes mapped provide the basis on which the research question can be explored. In what ways the heuristics and biases known in the behavioural finance literature affect cryptocurrency investment is considered under each theme separately where possible.

3.2 Discussion of findings

Cryptocurrency investment as perceived by the investors has been so far investigated. The four themes identified in the data are used as the starting point from which to explore how the investor's perceptions of cryptocurrency investments fit what is known in behavioural finance to influence an individual's decision making.

In the theme of "financial knowledge" a discussion point often referred to is the ability of the investor to time the market and being able to profit from the swings in price, with references to the cyclicality of events in financial markets. This is reflected in the level of confidence investors expressed when assessing the probability of their investments eventually providing a return, or going back to its previous peak.

Participant 1: *"Ahm, I expect in the next few years, to go back potentially again, to like, 4[00%] to 500% profit… I'd say at the moment, ahm, besides, the the crypto-cyclical highs and lows, there is, like other micro economic aspects that might heavily influence the market"*

Participant 6: *"it usually just off something like 4 year cycles where it like starts, and gets very popular, it goes really high up, and then it just crashes, and then repeats that every 4 or 5 years essentially."*

These perceptions are influenced by the availability heuristic (Tversky & Kahneman, 1973), with investors assessing the likelihood of their cryptocurrency investment providing a return or going back to its previous peak by recalling previous instances in which cryptocurrency investments reflected these expectations - or, more precisely, the ease with which these instances can be recalled or imagined. It is important to note that the strength of the investor's previous experience with cryptocurrency investment might make it difficult to consider scenarios beyond the ones provided by direct experience, which could lead to a bias of underestimating emerging risks out of them being difficult to imagine.

When explaining the motivations to invest in cryptocurrencies, some of the arguments provided by participants in this study made references to the due diligence made when considering this type of investment. This was explained mainly in terms of risk and reward rather than any specific investment indicators or valuation methodologies, which stands in stark contrast to the myriad of indicators and methodologies available when evaluating non-cryptocurrency investments such as purchasing stocks in publicly listed companies (e.g. Price to Earnings ratio).

This lack of specific valuation methods could be related to the unique characteristics of cryptocurrency projects, which could in turn contribute to an illusion of understanding (Kahneman, 2012, p. 199-201) in which a compelling narrative makes up for the complexity involved when evaluating a prospect.

Participant 7: *"So you have to actually do your proper research and risk assessment. And see, like, 'if this can give me these returns'"*

Participant 1: *"once you have enough knowledge, and you're okay with the knowledge that you have, and you say "okay, with this knowledge, I'm okay to like, invest this amount of money, and I'm okay if I lose it" then that's probably a good ratio that you can check like…"*

A role could also be attributed to the degree of subjective financial knowledge the investor has, which has an important association with cryptocurrency investment (Zhao & Zhang, 2021). Additionally, the due diligence considerations mentioned earlier could also be influenced by the affect heuristic (Slovic et al., 2000), in which the risk involved with a prospect is evaluated mainly with regards to how much the investor likes it or dislikes it, which is a serious error given that these considerations should not have influence over an investment assessment. One participant described their cryptocurrency investments in the following ways.

Participant 5: *"basically, by reading the white papers, ah, it's something interesting to me that the project itself, ah, what they were doing, and what they were, ah, you know, trying to achieve (…) I check the company, and if the company represents ah, something that I'm interested in, then I will invest in that company."*

Participant 5: *"And it's also decentralised, right? It's not only Amazon who has access to that, is not only, you know… it's cheaper as a service, and it's a… it's a… the idea is cool behind it."*

In the theme of "level of risk involved" the perceptions investors had regarding risk were explored. As reflected in the codes used, these varied from the most extreme form of perceived risk, in which criminality and scams were discussed, to the most extreme form of perceived safety, in which, paradoxically, cryptocurrency investment and investments in the stock of publicly listed companies were perceived as safe. One explanation for considering stock market investing and cryptocurrency investment as safe could be that these instances correspond with what is known in behavioural finance as the framing effect (Tversky & Kahneman, 1981) in which the decision frame from which a prospect is evaluated influences the perception and choice an individual makes. Considering stock investing from the decision frame of

cryptocurrency investing, in particular after experiencing losses, might make regular types of investments such as purchasing stock of publicly listed companies to be perceived as safe. Similarly, considering investing in the most popular cryptocurrencies (e.g. Bitcoin, Ethereum, Ripple, etc) from the decision frame of the riskiest forms of cryptocurrency investment (e.g. Non-Fungible tokens) could cause these popular cryptocurrencies to be perceived as safe. Considering the lack of consensus and contested evidence regarding the intrinsic value of cryptocurrencies in general, perceptions of safety relating to this type of investment could be considered as biassed towards underestimating their intrinsic risk.

Participant 5: *"I invested in those [Bitcoin and Ethereum] because they are the basis for most of the other cryptos. So, it felt like a safe bet."*

Participant 7: *"I would put like around [$]5[000] or $2,000 into kind of a… very low risk investment like Bitcoin."*

In between the two extremes described, discussions of the risk involved in cryptocurrency investment focused mostly on the potential rewards that this type of investment could provide, matching it with different levels of intensity, as in the following descriptions.

Participant 4: *"well, cryptocurrency investment is very risky. It's not a guarantee, it's very stressful [chuckles]... but it's like, high-risk-high-reward type of investment."*

Participant 2: *"No investment is a safe investment, but the like, ah, this is a very very flat to… It it's highly highly risky so… what they say, you need to put money that you are willing to lose."*

When asked to evaluate cryptocurrency and non-cryptocurrency investments in terms of their investment characteristics the participants' focus considered primarily differences in the level of risk involved with each option, with cryptocurrency investments considered as the more risky, and also elaborated on explanations over the potential of cryptocurrencies in the future. The consistent disregard of the commonalities shared by both prospects, such as considerations about capital at risk in both cases, could be explained by the isolation effect (Kahneman & Tversky, 1979) through which individuals simplify their evaluation of prospects by focusing solely on the characteristics that distinguish them and ignoring commonalities or other relevant information.

In the theme of "narrative of cryptocurrencies' potential" the discussions centred mostly around the promise of cryptocurrencies becoming something of importance in the future. The participants' continued cryptocurrency investment is supported by their reluctance to realise

current gains or losses, and their perceptions point to more than one interpretation. In the context of stock market investing, the disposition effect (Shefrin & Statman, 1985, Odean, 1998, as cited in Kahneman, 2012, p.344-345) has documented instances in which the investors' decisions with regards to what stocks to sell and what stocks to keep are biassed in the direction of the emotions elicited by each choice, disregarding more relevant information such as the financial prospects involved. Therefore, a stock that is considered a winner is sold early to realise profits and feel the pleasure of a gain, while a stock that is considered a loser is kept for longer to avoid the unpleasantness of a loss. The participant's explanations for not realising losses in the context of cryptocurrency investing can be explained as an instance of this effect. Explanations made references to the potential of cryptocurrencies but also to time considerations, something also explored in the previous theme.

Participant 2: *"[when asked about reasons stopping the participant from selling the cryptocurrency investment at a loss] Because it's already in minus. So, what I have to lose? you just wait…"*

Participant 4: *"[when asked about reasons stopping the participant from selling the cryptocurrency investment at a loss] From discontinuing? Ahm… It is a small enough amount that I could afford to lose. But it's a good amount to see what happens with it without taking on too much risk."*

While the investor's reluctance to realise losses might be explained by the disposition effect, an explanation to the investor's reluctance to realise gains, especially considering the magnitude of the gains involved, is less clear. Two possibly related explanations are explored.

First, according to prospect theory (Kahneman & Tversky, 1979) the reference point, that is to say, the "earlier state relative to which gains and losses are evaluated" (Kahneman, 2012, p.281) plays a large role in the evaluation of financial outcomes. Considering that the previous peak of Bitcoin, and the cryptocurrency market in general, was reached in the second half of 2021 (Prasad, 2021 p.5) and the references participants made to market cycles, it is possible that the previous record highs in cryptocurrency valuations are considered as the reference point from which to these investments are evaluated. From such a reference point, realising investments that have experienced considerable gains but are still below the previous peak in valuation would still be perceived as a loss. Therefore, due to loss aversion, realising financial gains is avoided.

Second, the uncertainty component referenced in the participant's discussions, coupled with the lack of regular investment indicators for cryptocurrencies, seem to bias the investors' perceptions towards evaluating risk by relying primarily on the coherence of the narrative with which a cryptocurrency project is envisioned. The confidence of the participant's in the eventual rise in value of the cryptocurrency market could therefore be grounded on an illusion of validity (Kahneman, 2012, p.209-212). "Subjective confidence in a judgment is not a reasoned evaluation of the probability that this judgment is correct. Confidence is a feeling, which reflects the coherence of the information and the cognitive ease of processing it. It is wise to take admissions of uncertainty seriously, but declarations of high confidence mainly tell you that an individual has constructed a coherent story in his mind, not necessarily that the story is true." (Kahneman, 2012, p.212).

When the motivations for investing in cryptocurrencies were asked directly, the responses provided by participants conformed largely to an instance of the substitution effect (Kahneman, 2012, p. 97-99). The target question seemed to be answered with a response to a simpler heuristic question relating not to motivations for investing in cryptocurrencies but rather to what characteristics of cryptocurrencies participants liked the most. The following are examples of the responses to the structured part of the interviews, in which the motivations for investing in cryptocurrencies were asked directly:

Participant 2: *"But to looks like, especially some of the initial cryptocurrencies, they look interesting, the idea, especially Bitcoin, Ethereum like the... The technology behind looked interesting"*

Participant 3: *"Ah, I decided to invest in them mainly because of their decentralisation… So, they are decentralised, and there are no intermediaries."*

Finally, the importance of the success of a cryptocurrency project regardless of the final state of the investment made in it was also mentioned during the participants' discussions.

Participant 3: *"Well, for me, a successful investment… for me personally, I would say that when I see the project that I invested in, ah, really succeeding, because behind every cryptocurrency is a project, and when I see the project really like come to life and and start gaining attraction."*

Participant 5: *"So, I would say that, this is my main project and this is a project that, regardless whether I get my money back (...) it will be a successful investment if the project, or when the project actually manage to get like, proper traction"*

The apparent disregard for profit expectancy as the main motivation for investing in cryptocurrencies aligns with the findings from Mattke et al. (2021) in the configuration of motivation classified as the not-profit driven ideological investor, and could be considered an instance of the affect heuristic (Slovic et al., 2000) in which the investors' emotional attitudes towards the prospect being evaluated plays a large role, and in this particular case, seem to override profit considerations.

CONCLUSIONS

Since its inception in 2008, cryptocurrencies have gained attention from the public, the media and, increasingly, both retail and institutional investors. The first and most popular cryptocurrency in existence, Bitcoin, can be used to exemplify the current state of the cryptocurrency market. Bitcoin's valuation peaked during the second half of 2021 (Prasad, 2021 p.5) but, as of this writing, Bitcoin's valuation remains at approximately a third of its peak value. This means that investors who entered the cryptocurrency market purchasing Bitcoin during the second half of 2021 have either sold at a loss in the time since, or are currently keeping their investments with a paper loss of approximately 65% of the value of the original amount invested. Findings by Auer et al. (2023) support this intuition by revealing that over 70% of retail investors have likely lost money in their cryptocurrency investment at the time of their article's publication. Moreover, scrutiny over the blockchain transactions shows that "as prices were rising smaller users were buying Bitcoin, while the largest holders (the so-called "whales") were selling – making a return at the smaller users' expense." (Auer et al., 2023).

This dynamic of smaller, mostly retail investors, shouldering losses when entering the cryptocurrency market is not uncommon and highlights the need to better understand the motivations that drive people to these type of investments, especially where no commonplace valuation indicators are available, as in the case of most cryptocurrency projects.

In this paper, the ways in which biases and heuristics influence cryptocurrency investment have been investigated. By using a qualitative methodology, in-depth semi-structured interviews were conducted with participants currently holding investments in cryptocurrencies. The data generated was analysed by using Applied Thematic Analysis (Guest et al. 2011) and four underlying themes relevant to the investors' motivations for cryptocurrency investing were revealed: financial knowledge, level of risk involved, narrative of cryptocurrencies' potential and perception of investment. From these themes the ways in which biases and heuristics known in behavioural finance influence cryptocurrency investment were investigated.

Instances of the availability heuristic (Tversky & Kahneman, 1973) were identified where participants' expectations of market cycles and their ability to time it was discussed. This heuristic might bias the investor's perceptions in the direction of underestimating the risks associated with cryptocurrency investment out of the difficulty to envision the risks associated with it, the ease with which instances of the investment reaching new heights can be recalled, or

a combination of both. Discussions of the due diligence required to invest in cryptocurrencies referred mostly to the level of knowledge to be had on the prospects of risk and reward involved rather than specific valuation indicators. This simplification can be considered the result of a combination of influences, such as the level of subjective financial knowledge, the affect heuristic (Slovic et al., 2000) and an illusion of understanding (Kahneman, 2012, p. 199-201) on the part of investors, which could bias them towards over relying on compelling narratives instead of more relevant financial indicators.

The framing effect (Tversky & Kahneman, 1981) influenced the level of risk with which stock investing and, in some instances, cryptocurrency investing, was perceived by the participants. Stock investing was perceived as safe from the decision frame of cryptocurrency investing, and in turn, cryptocurrency investing in the most popular cryptocurrencies was perceived as safe from the decision frame of investing in the riskiest cryptocurrency-related investments available, such as Non-Fungible Tokens. The isolation effect (Kahneman & Tversky, 1979) was present when participants evaluated cryptocurrency and non-cryptocurrency types of investment, by consistently disregarding both prospects' commonalities and focusing only on their differences. When participants were questioned directly on their motivations to invest in cryptocurrencies, instances of the substitution effect (Kahneman, 2012, p. 97-99) were noticed, as participants seemed to address the target question (e.g. "why did you invest in cryptocurrencies?") with the response to an easier and related heuristic question (e.g. "why do you like cryptocurrencies?"). The investors' disregard for profit expectancy in support of the narrative of cryptocurrencies' future potential is supported by the affect heuristic (Slovic et al., 2000), as emotional attitudes seem to override profit considerations.

Continued cryptocurrency investment was supported by the reluctance of the participants to realise both losses and gains. The tendency of investors to avoid selling poor-performing stocks at a loss is known in behavioural finance as the disposition effect (Shefrin & Statman, 1985, Odean, 1998, as cited in Kahneman, 2012, p.344-345) and could explain the investors' reluctance to realise losses in their cryptocurrency investments. The reluctance to sell cryptocurrency investments that have experienced extreme returns is more elusive to explain, and two lines of reasoning are provided. First, it is possible that these investments consider the latest peak in the cryptocurrency market valuation as the reference point from which gains and losses are evaluated. In line with prospect theory (Kahneman & Tversky, 1979) evaluating a paper gain from a reference point which makes the investor perceive it as a loss makes the investor loss averse and therefore realising the paper gain is avoided. Secondly, it is possible that

the coherence of the narrative of cryptocurrencies' potential is being used as a proxy for evaluating risk and be grounded on an illusion of validity (Kahneman, 2012, p.209-212).

While the results of this paper are consistent, the findings proposed need to be interpreted with care. It is important to note that, due to the non-probabilistic sampling technique used and the qualitative methodology applied this study makes no claims of statistical significance or representativeness. In other words, the findings presented cannot be used to make statistical inferences about the broader population of cryptocurrency investors. Instead, the themes emerging from analysing the data and the concepts explored can be extrapolated to investigate similar phenomena or processes. For example, future research studying investment motivations could take into consideration by what cognitive mechanisms the narrative of a project in itself can affect the investors' preferences towards it.

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APPENDICES

Appendix 1. Screening and interview questions

The following screening questions were posed face-to-face to participants at an educational event organised in Tallinn by a prominent cryptocurrency exchange platform during March 2023. If the answer to both questions were affirmative, the participant was invited to take part in the study:

1. Are you interested in cryptocurrency investing?
2. Do you currently invest in cryptocurrencies?

The following interview questions were asked from participants who answered affirmatively to both screening questions and were willing to have a 20 minutes interview with the author.

Demographic data:

1. Year of birth
2. Field of occupation/ profession

The structured part of the interview was based on the following questions:

3. Why did you decide to invest in cryptocurrencies?
4. What characteristics of cryptocurrencies convinced you to purchase them as an investment?

The semi-structured part of the interview was based on the five motivations identified by Mattke et al. (2021) regarding Bitcoin investment, together with questions suggested in the reviewed literature to elicit responses regarding the participant's risk preferences:

5. What would you estimate is the probability that this will be a successful investment?
   a. How did you come up with that number? Walk me through your thought process.

6. What would you estimate is the proportion of successful crypto investors from the total number of crypto investors in existence?
   a. How did you come up with that number? Walk me through your thought process.

7. What expectations do you have of this investment? At what point would you consider this a successful investment?

8. How do you usually acquire cryptocurrency for investment purposes?

9. Do you believe cryptocurrencies are important? Why do you believe that?

10. If cryptocurrency investing would be a character, how would you describe this character?

11. If on your deathbed someone would tell you that you'd have made 2% higher returns by investing in an ETF [Exchange-Traded Fund] instead of cryptocurrencies, would you still invest in cryptocurrencies today?

12. How would you compare crypto investment to other types of investment?

13. Imagine you get €10,000 right now, what would you do with it?

14. What would you estimate is your current percentage of gain or loss in your cryptocurrency investment?
    a. What's stopping you from increasing your cryptocurrency investment?
    b. What's stopping you from discontinuing your cryptocurrency investment?

15. Given two prospects, which one would you prefer?
    a. An investment that gives you an annual return of 6% with certainty?
    b. A cryptocurrency investment that gives you an annual return of no less than 6%, with 50% probability?

16. Consider a 50-50 gamble in which you can lose €1,000. What is the smallest gain that makes this gamble attractive?

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