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WHY ARE IRRATIONAL DECISIONS MADE?

Distortions, heuristics and neurofinance

Andrea Pelei – Dr. Petra Benedek[1]

ABSTRACT

The objective of this study is to analyse how emotions, cognitive distortions and social impacts shape financial decisions questioning the traditional view suggesting people act rationally. While classical theories emphasise logics and expected outcome, behavioural economics and neurofinance have demonstrated that decisions are also impacted by mental shortcuts, emotional distortion or even evolutional aspects. The study discusses concepts such as bounded rationality, the prospect theory, as well as a wide range of cognitive distortions due to information overload, emotional reasons or afterthought. In the analysis, the distortions are classified into four main categories: distortions caused by limitations of cognitive capacity, distortions originating from emotions and psychological inclinations, distortions changing past events and distortions shaped by social dynamics. Distortions are not *ad hoc*; they are conscious and find their origins in how information is processed. To understand them may help both individuals and organisations to make better financial decisions. Improved awareness may lead to better judgement and more stable long-term financial results.

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1 *Andrea Pelei* PhD student, Budapest University of Technology and Economics, Faculty of Economics and Social Sciences, Chair of Management and Business Studies. Email: apelei@edu.bme.hu.

Dr. Petra Benedek senior lecturer, Budapest University of Technology and Economics, Faculty of Economics and Social Sciences, Chair of Management and Business Studies. Email: benedek.petra@gtk.bme.hu.

1 INTRODUCTION

To maximise profit, enterprises particularly financial enterprises accelerate the process of decision-making focusing on short-term advantage. Meanwhile considering mid and long-term risks might suffer, so their behaviour starts to be similar to that of an irrational consumer. The lesson to be drawn is that the background of financial decisions made by enterprises can be best understood if behavioural science, and psychology is applied. (Fömötör et al., 2017, 155).

The science of behavioural finance tracing back decision makers' irrational behaviour to cognitive traps evolved in the 1980s. It has been followed by research in neuroscience, which has gone a step further to state that such types of cognitive distortions are defined by (neuro)biology and the characteristics of human evolution lurk in their background. In other words, the mistakes occurring when making financial-investment decisions are, in fact, unavoidable (Du, 2022).

In the study the authors investigate how emotions and cognitive patterns affect financial decisions, questioning the traditional concept suggesting that people always act rationally. They present and compare the most significant results of behavioural economics and neurofinance to shed light on how mental shortcuts and bias may lead to wrong decisions. The objective of the study is to help people and organisations to understand those effects, to make better decisions and to incorporate the relevant knowledge into their financial decision-making and business practices.

Chapter two of the study presents the theory of bounded rationality, *chapter three* is about heuristics and distorted decisions, and *chapter four* deals with prospect theory. *Chapter five* is a presentation of distortions most typical in financial decisions; *chapter six* is a summary of the key findings of neurofinance. *Chapter seven* focuses on the differences between the risk attitudes of men and women, while *chapter eight* covers the financial decisions of enterprises from the aspect of behavioural economics and neurofinance. Finally, the study is complete with a summary of the distortions affecting financial decisions and further lessons drawn.

2 BOUNDED RATIONALITY

Decision making is uncertain because decision makers do not necessarily know all the alternatives available at a given moment. In many cases, their preferences are not unambiguous either while the expected outcomes are almost always foggy. According to the theory of bounded rationality developed by Herbert Simon (1982), decision makers basically intend to make rational decisions; however, the impressions received from their environment via different channels and – even

more – the boundaries of their own cognitive abilities hamper or even stymie their efforts to make the optimal decisions. At the same time, the theory does not question the basics of classical economics, i.e., individuals will always make decisions keeping their self-interest in mind, although they may be willing to compromise if it is advantageous both for themselves and the other party (Milgrom–Roberts, 2005).

In practice, decision makers are forced to accept a "satisfactory" decision or one that is "good enough" compared to their needs or expectations, while in many cases even that is difficult to achieve. If the cost of obtaining the minimum information necessary for a decision exceeds the expected profit, you have rational ignorance (Johnson, 1999).

Various factors can hinder obtaining the necessary information, such as the limitations of time available to prepare the decision, the difficulty of communication among those authorised to make the decision, or if the information relevant to the decision could not be identified or the proper conclusions could not be drawn (March, 2000).

3 HEURISTICS, DECISION MAKING BIASES

Decision makers strive to bridge the gap caused by cognitive limitations. The techniques applied are termed simplification procedures. They include editing, partition and heuristics. Editing means that decision makers reduce complex problem sets into a manageable size alongside a few considerations. During partition a problem is broken down into smaller units using the assumption that if a solution is found for the parts, it will also be valid for the whole problem (Sterbenz, 2007).

Heuristics is a set if simple rules to make decision-making more effective, which is especially important if either time or information is limited. Heuristics is worth interpreting as "the rule of thumb" or "shortcuts", since a solution reached in that way is not guaranteed. They should be accepted with reservation as they can lead to distortions (Gigerenzer, 2004).

Tversky and Kahneman (1974) have identified several kinds of heuristics. One for instance is *representativeness* when the probability of a given outcome is defined by the extent of 'A' being similar to 'B'. Decision makers do not care about the size of the sample but make their decision based on the "law of small numbers". *Availability* defines the probability of an event based on examples that come to a decision maker's mind first due to their extremity or triviality. *Adjustment from an anchor* is typical for cases when the probability of the occurrence of an event must be given numerically, and the answer is affected by an internal (existing knowledge, assumptions, etc.) or external factor: a person adjusts from an an-

chor to make a potentially wrong or at least inaccurate decision as a result of the method (Farkas, 2021).

In *affect heuristics* a person makes a decision while affected by their emotions: if they associate positive emotions to something, they are prone to underestimate the relevant risks while overestimating the advantages. This can also work vice versa in the event of negative emotions. According to *expert heuristics*, people consider the opinion of supposed 'experts' of a given topic to be more reliable. *Fluency heuristics* is based on the perception that pieces of information that are easier to understand or sound better may seem to be more credible, while *authority bias* makes one believe that people who use objective/scientific terms have more credibility (Slovic et al., 2002; Hamar, 2013).

Heuristics can be divided into many more categories. In most cases they might be sufficient to make an "acceptable" decision, however, decision makers should be aware that applying them may lead to traps of decision-making, to false or even clearly irrational consequences (Du, 2022).

4 PROSPECT THEORY

A rational, sufficiently informed decision maker keeping his own interests in mind (*homo oeconomicus*) will make decisions under risk based on the usefulness of the different outcomes (Schmeidler–Wakker, 1987). As opposed to the theory of expected usefulness, Kahneman and Tversky's *prospect theory model* (*Prospect Theory,* 1979) points out that people in strained circumstances do not make rational decisions in most cases. According to the authors' theory supported by experiments, in an uncertain situation individuals respond to loss or profit asymmetrically when making decisions. They do not consider loss or profit in their absolute sense but compare them to their specific circumstances (wealth, expectations, etc.), i.e., to some point of reference. Because of its psychological impact, loss is perceived to be higher than profit of the same measure. The theory suggests people are prone to overestimating events of low probability while underestimating those of higher probability (Kahneman–Tversky, 1979). Further, if they must choose between certain profit and risky profit yielding higher gains, people usually opt for the lower but certain profit (risk aversion). On the other hand, if they face a loss, people will often prefer a risky option to certain loss even if the expected value of the risky option is worse or equal, which is a certain type of risk taking. (Kahneman–Tversky, 1979).

Kahneman and Tversky have coined the term *decision frame* to describe decision makers' knowledge relevant to a given decision-making situation, which includes their ideas on alternatives of decision, potential outcomes and any fac-

tors of uncertainty. That set of knowledge is highly subject to a decision maker's preliminary skills, experience, personality, ideology and appreciation of values, but it also depends on how a given decision-making situation is expressed. Accordingly, ideas i.e., the decision frame itself can be manipulated simply by how the questions relevant in a given situation are expressed, i.e., the *framing effect* (Kahneman–Tversky, 1984).

Although Kahneman and his colleague never stated that people would be unable to make rational decisions, critics of their prospect theory have argued the findings under laboratory conditions have not provided proof as to how decisions are made in reality. However, other researchers have come to results similar to those of Kahneman's (for instance, Kachelmeier–Shehata,1992; Lieder et al., 2017), and everyday experience also supports the theory of expected usefulness cannot explain decision makers' behaviour in a significant number of cases (Farkas, 2021).

One should note that the prospect theory and Neumann–Morgenstern's theory of expected usefulness differ from each other in several aspects. The most important difference lies in the fact that while the traditionally accepted theory makes statements with decision makers' total wealth in mind, Kahneman and Tversky's (1979) theory analyses financial decisions from the aspect of gains and losses starting out from a subjective point of reference. It can explain why an individual behaves differently if the outcome appears to them a loss or gain even if their total wealth will not suffer. It is because people make more efforts to avoid a loss than to reach a gain of the same measure. The phenomenon called *loss aversion* helps understand a number of financial anomalies that may seem irrational if analysed from the aspect of expected usefulness.

Empirical research has also verified that particular aspect of the prospect theory. For example, Barberis and Huang's (2001) model, on the one hand, illustrates how loss aversion may distort individuals' attitude to profit and risk. On the other hand, it provides proof that investors make their decisions as per the prospect theory at portfolio level rather than analysing the shares within a portfolio. In other words, investors are not so much worried about portfolio fluctuations than about the fluctuations of certain shares. The model also proves Tversky and Kahneman's (1974) theory according to which individuals – seemingly irrationally – decide about their investments in comparison to some points of reference.

By introducing the concept of *myopic loss aversion,* Benartzi and Thaler (1995) applied computer simulation (Monte Carlo) to analyse portfolio risk and profit trying to find an answer to the contradiction termed *equity premium puzzle* i.e., why the stock market – compared to the bond market – offers higher profit although households invest much less into stocks. So, the researchers were trying to find a solution of a financial problem applying the prospect theory. They have found if investors assess their portfolio at short intervals (annually) exhibiting behaviour

of loss aversion, they will buy proportionally fewer stocks. In their case, the point of reference is short-term profit, and they will make their investment decisions accordingly.

Such research is apt to verify the prospect theory. It proves that individuals – in a significant part of the cases – do not make decisions based on rational considerations but under the effect of cognitive distortions.

5 SPECIFIC DISTORTIONS CHARACTERISTIC OF FINANCIAL DECISIONS

Heuristics have been inevitably incorporated in decision makers' mindset to help simplify decision-making processes via cognitive patterns. In some cases, they can lead to correct decisions, but individuals typically judge the outcome, so they might act based on the same heuristics the next time while it – due to the difference in the circumstances – will not produce the expected outcome. Researchers have described several cognitive distortions at variance with rational decision-making that are particularly characteristic of financial decisions. According to psychological studies, the number of cognitive distortions may be as high as a hundred and eighty, twenty to thirty of which may play a part in financial-investment decisions (Sibony, 2021).

Loss aversion bias is a basic principle of the prospect theory: people usually perceive losses to be bigger than profits of the same size. It can explain why a person will keep a loss-making investment or why they will opt for a secure but less profitable investment instead of an insecure one promising higher profit (Kahneman–Tversky, 1979).

In this regard, *regret aversion bias* describes a phenomenon when the mind ignores reality, the unfavourable trends of reality to protect people from pain. Since investors perceive loss as pain, they strive to avoid risky products. An example: an investor has made two investments, one of them performs well, the other is loss making. The rational action in such a case would be to close down the latter, but – as it has been pointed out by several studies – most investors will close down the profit-making deal only to avoid admitting having made a bad investment decision with the other one (Odean, 1998).

Representative bias means a decision maker will decide on the experience gained from a similar event in the past, but they fail to consider that the probabilities of the past are no longer valid for the new situation: they will buy a given stock simply because its price has increased while several factors can influence if the given price increase will be lasting or not (Tengfei Zhang, 2022).

Confirmation bias is a phenomenon when a decision maker searches for or considers the pieces of information that support their assumptions only and omits other information that might be contrary to their convictions or may suggest their decision was not correct (Chen Chu Xin, 2019).

Hindsight bias is when an individual thinks – in hindsight when the outcome of a decision has come to light – he knew in advance what will happen. It can lead to the mistaken consequence that the occurrence of the given event was evident and calculable (Fischhoff, 2003). Hindsight bias may also occur because investors and stockbrokers often do not know or do not want to acknowledge that you cannot foresee how certain financial processes evolve. They are particularly unwilling to accept it if their predictions sometimes become true (Pezzo, 2011).

Narrative fallacy is based on the fact that the human mind can process reality easier in the form of stories; thus, it may assume the presence of cause and effect even if the events were actually caused by accident. That is the reason why stock market news and analyses are so popular. Investors are curious to learn what has caused the recent fluctuation or why the stock market is having a boost. Meanwhile they forget that experts also make guesses only and give their explanations in hindsight when the story is over (Shiller, 2017). It was found during research conducted between 1998 and 2012 on a sample of seven thousand that the reliability of stock market analyses is 48 percent on average. Less than six percent of the analysts reached a hit rate higher than that (70 to 79 percent) while the hit rate of two thirds remained below 50 percent (Bailey et al., 2017).

Overestimation of the present or *recency bias* also frequently appears with financial decisions: a decision maker pays attention to current or recent events but fails to take into account past occurrences. Barber and Odean (2011) have pointed out an average investor will monitor recent price changes and tries to come to assumptions regarding the future on that basis, or they will invest in currently popular instruments promising short-term profit rather than choosing some longer-term investment.

However, both short-term and longer-term data can mislead investors to make decisions on the basis of long-term data series. The phenomenon is described as *start date bias,* which can be illustrated well by the evolution of the US stock market index. Using a longer timeframe such as a hundred years for a basis, you can find that profits fluctuated between –47 percent and +46 percent, while the volatility of a one-year investment period was 9+ to –10 (Sackett, 1979; Analysis centre, 2023).

Bubble bias causes a similar effect. A textbook example is offered by investments based on the analysis of the gold price going back fifty to sixty years (Analysis centre, 2023). The gold price produced an increase of 1900 percent from 1970 to

1980, and a somewhat lower increase of 600 percent from 1972 to 1974. If you only consider the former figure, you can get a 6 percent annual real profit, but you only get 3 percent if you also consider the price movement in the bubble period (Fazekasné–Pivarcsi, 2017).

You could speak of *ludic fallacy* if laws created in the theoretical realm are applied to real life situations. Taleb (2010) has illustrated the situation with the classical coin toss. In his example, there were ninety-nine heads already. The question is what the chances are for the hundredth toss. Uncle Tony using his common sense says the chance of another head is less than one percent, as ninety-nine heads could only occur if somebody was cheating. Dr. John, on the other hand, thinks there is a 50 percent chance of another head. In this case, Dr John committed the mistake of *ludic fallacy,* because he applied in his answer what he had learnt academically. Uncle Tony, on the other hand, could step out of academic knowledge and found an "out-of-the-box" solution to the problem.

The Dunning–Kruger bias has been described by David Dunning and Justin Kruger following several decades of empirical research. According to them, the majority of investors believe they are expert stock market players or highly overestimate their knowledge after having read a few analyses and articles. As for average investors, it is the more typical the less actual knowledge of the given topic they have. The phenomenon is a direct consequence of *illusory superiority*, a cognitive distortion: people are prone to overestimate their abilities compared to others having identical skills or abilities. Such unjustified optimism is doubly harmful: on the one hand, it can lead to bad decisions (not only in the area of finances), on the other hand, it prevents decision makers from recognising their limitations and acknowledging their own responsibility for the bad decisions they have made (Kruger–Dunning, 2000).

Excessive optimism (*optimism bias*) has a similar basis. Such cognitive distortion is present in everyday life too: people are usually overtly optimistic regarding their outlooks in life, or the correctness of their decisions. The same can be observed in relation to investment decisions: average investors are prone to assume they will make a profit by reaching a higher yield than that suggested by analyses and will never make a loss. In practice it all leads to underestimated risks and setting up a portfolio that is much riskier than what they can afford. Excessive optimism can not only be found with starter investors: a study by McKinsey Group points out experts can also overestimate expected gain, and the volume of economic growth, etc., in many cases (Sharot, 2012).

Mental accounting describes the mental process connected with finances when revenues from different sources and costs occurring under different titles are categorised ("booked") in our mind. People typically manage revenues from investments or stocks separately and are willing to risk the amount easier forgetting

that the money, in fact, is not in any way different from what they have earned from work. According to Thaler (1999), portfolios paying dividends are extremely popular because investors are prone to regard dividends received regularly (annually or quarterly) as windfall, or disposable income. In fact, had they invested into stocks not paying dividends, they would have gained just as much, only they would not have received it immediately, but it would have been built into the price. Thaler points out that some companies abuse such cognitive distortion when they suggest stability by regular dividend payments. However, the strategy has a contrary effect on stability in the long run: if the profits were spent on improvement, investors would also be better off, because a decline (lower price) may occur after some time (Thaler, 2008). Financial institutions offering many different sub-accounts marked with the most diverse target labels also make use of the bias resulting from mental accounting because it suggests that certain amounts depending on their origin can be spent easier (Zhang–Sussman, 2018).

Survivorship bias is another cognitive trap you can find in everyday life. It says that you can avoid making mistakes if you analyse your successful decisions only. The mental distortion here is evident because you fail to consider the unsuccessful cases. Just think of the fact that books about successful enterprises can easily fill a whole library while there are few works on the mistakes committed by successful entrepreneurs and even fewer on how and why unsuccessful ones have failed. Fama and French (2009) analysed survivorship bias in the case of investment funds. According to their famed paradigm *luck versus skill,* investors cannot be certain whether their results are the outcome of luck or knowledge or skills. The authors analysed over three thousand active investment funds. They have found many where outstanding results were clearly the outcome of professional skills. However, they have also found that investment funds kept a low-profile regarding items of information that would bring to life if success was the result of luck or their skills. So, not only investors but, in fact, experts cannot select a reliably successful fund manager either (Pástor et al., 2015).

It seems obvious nowadays, in the age of investment advice offered by experts and self-proclaimed experts on the most diverse sites of social media that you listen to / read others' experience before making a financial decision. *Bandwagon effect* is the phenomenon when somebody decides because others have decided in the same way. You can speak of *herding bias* if an investor decides following other investors' example. While in the former case an individual is motivated by the feeling of "I belong to the winning team", in the latter, the attitude "I don't want to be out" is decisive (Bauer–Kolos, 2017; Honti, 2024).

FOMO, i.e., *fear of missing out* is based on a similar idea. It describes the fear you may feel regarding finances that you will be left out of some excellent investment opportunity many others have already made used of hopefully making big profits

(Wiesner, 2017). In all three cognitive distortions you have to consider the strong distortion effect of the social media. *Event media-driven buying pressure* is the name of the phenomenon when the price of a stock or some product soars simply because the media deals with it. It has a ripple effect: the more often the topic is mentioned in the news, the more investors want to buy the product, which makes the price rise. When the information has reached all potential buyers and there are no more people who would buy the stock because of the news, the price rise stops. The phenomenon is related to the heuristics of availability discussed above: people are more likely to decide based on easily accessible information, and the news appearing on social media sites are exactly like that (Barber–Odean, 2008).

6 NEUROFINANCE

According to the principles of traditional economics, individuals can make rational decisions. On the other hand, behavioural economics has found evidence to prove that decisions are affected by *a priori* assumptions and cognitive distortions. *Neurofinance* goes into further, and – combining economic theories with the findings of schools of psychology and the results of neurology – investigates what kind of brain structures start operating when financial decisions are made and what sort of neurological processes are in the background of heuristics and mental traps (Miendlarzewska et al., 2017).

It is a young field of research. It uses varied means: the electrical activity of neurons are measured in different decision-making situations applying functional magnetic resonance *(fMRI)* and electro-encephalography *(EEG).* The experiments are supplemented with physiological tests, such as monitoring heartbeat, fluctuations of hormone levels, changes in skin conductivity or eye movements (Cohen, 2005). The tests themselves are not suitable for conclusions to be drawn; they are supplements to experiments where researchers investigate brain activity using transcranial magnetic stimulation *(TMS).* The application of TMS uses the assumption that when behavioural or decision-making changes occur if a certain brain area is stimulated, the part of the brain in question may play a part in the process investigated (Poldrack, 2006). To confirm the cause-and-effect relationship, researchers add tests on brain-damaged patients and by the provision of neurotransmitter manipulating medication to the TMS method (Miendlarzewska et al., 2017).

Researchers in neurofinance assume there are evolutionary reasons of how people respond to situations requiring financial decisions. The human mind has been optimised for survival learning two interrelated but contradictory mechanisms: one is to get a reward and the other is to avoid punishment. Both can be inter-

preted in the context of financial decision-making, as earlier decisions are more probable to be repeated if they were followed by a profit in the past. However, money is a special reward from the aspect of evolution (at least compared to food and reproduction that are primary rewards), as it is not necessary for survival. Money is a secondary reward only representing a value because of its connection to the primary rewards. Although money as a secondary reward triggers similar brain mechanisms, they will not necessarily lead to similarly good decisions just because of its less valuable nature. Thus, due to neurobiological reasons, the brain is not particularly smart when financial decisions are made (Odum, 2011).

Odum (2011) conducted empirical research to analyse how *delay discounting* functions. The concept describes the phenomenon, which can also be observed in the field of financial decision-making, when people underestimate the value of future reward compared to present gains. Such behaviour can often lead to impulsive decisions: an individual will opt for a lower but immediate reward instead of a higher one to be obtained later. Delay discounting is genetically coded; however, individuals can be trained to opt for rewards that come later but are higher with the help of a method applied in behaviour therapy and in operant conditioning termed *fading procedure*. Odum's research (2011) has underlined how the evolutionary development of the human brain can influence financial decision-making.

Researchers (for instance, Preuschoff et al., 2006) have used fMRI to prove the activity of certain brain areas when assessing risky financial situations: the activity was moderate with risk-averse subjects, but it was much stronger with risk-seekers (Rudorf et al., 2012). Other researchers have recognised that risk-taking willingness can be predicted to a certain extent based on the data measured at rest (Gianotti et al., 2009).

The application of the latest fNIRS-based technologies has boosted neurofinance research. Functional near-infrared spectroscopy (NIRS, fNIRS) is an imaging procedure that – unlike fMRI – tests brain microcirculation in the capillaries rather than in the blood veins allowing in that way to monitor neural response in real time. Using the method you can observe brain areas (for instance, the insular cortex) that are mainly active in situations with an uncertain outcome. Applying the fNIRS technology, Çakar et al. (2024) analysed haemodynamic responses measured in certain regions of the pre-frontal cortex of respondents considering different offers of consumer loans with the help of machine learning algorithms (CatBoost, Extreme Gradient Boosting etc). They could prove activity in certain parts of the dorsomedial frontal lobe, such as in the pre-frontal cortex (dmPFC) and in the ventromedial prefrontal cortex (vmPFC) that play a part in emotional assessment and decision-making. Both play a part in how you relate to other people or to different situations. The researchers have found the blood supply of the

areas is higher when people have positive feelings about a certain loan product: for instance, if they feel it is reliable and matching their needs, or if they think it is less risky. The inter-disciplinary approach used by Çakar et al. (2024) is an example of how science can be made help understand or even support financial decisions.

All in all, it should be noted that research into neurofinance is still in its infancy. No counterargument has been offered yet to its main weakness, i.e., most tests have only been made under laboratory conditions. A test by Lo and Repin (2002) is one of the exceptions: they placed biofeedback units on the bodies of professional securities traders, so they could follow the changes of pulse, blood pressure, body temperature etc. during trading time, i.e., in real time.

Nevertheless, the importance of neurofinance cannot be questioned, since by confirming the findings of behavioural economics it contributes to reiterating the questions relating to traditional theories arguing the rationality of decision makers and helps interpret (or even predict) the operation of heuristics and cognitive distortions (Miendlarzewska et al., 2017). Another aspect might be that economic research (including behavioural economics) focuses on the western societies, while (neuro)biology-based research is independent of culture, or social environment, so it should also be successfully applicable in the developing countries (Hedden et al., 2008).

7 DIFFERENCES IN MALE-FEMALE RISK ATTITUDES IN FINANCIAL DECISION-MAKING

According to research in behavioural economics and neurofinance, women and men respond to financial risk differently and in some cases make decisions by different heuristics (Malhan–Vij, 2024). Abouzari et al., (2016) have found proof that not only financial logic, but also neural variations linked to gender differences can play a decisive role with stock market deals (particularly if they are about buying, keeping, or selling stocks).

Authors of several studies have analysed the part played by testosterone and cortisol in men's financial decisions and they have verified the assumption that high testosterone levels increase risk-taking willingness. Coates and Herbert (2008) have found the connexion is more expressed in the case of stock market traders of more experience or who have specialised in high-volume transactions.

It is a generally accepted view that women are typically more risk averse compared to men and that they seem less confident regarding financial issues. Research by Charness and Gneezy (2012) among young and (financially) not highly trained women has confirmed the statement, but they could not draw valid conclusions for professional financially qualified women. Feng and Seasholes (2008) believe

men are more likely to buy riskier stocks. According to another research (Miendlarzewska et al., 2017), no difference in risk taking willingness can be proved between female and male investment fund managers.

Risk tolerance is an individual's willingness to accept insecurity or a potential negative outcome when a decision is made (for instance, a small enterprise is launched using personal savings). Risk aversion is a strategy or mindset when individuals or undertakings prefer minimising insecurity and potential loss. For instance, you are risk averse if you decide to keep your savings on a low-interest rate bank account rather than investing into stocks – you prefer stability to the options of insecure profit. In other words, risk tolerance measures the ability of risk taking while risk aversion is the strategy of risk reduction. Fehr-Duda et al. (2006) have pointed out that women are usually less optimistic regarding the probability of high profits and they are less risk tolerant against loss than men. However, such behaviour is not equal to higher risk aversion.

The risk-averse behaviour of financially non-professional women can be explained using both biological and social reasons (Felton et al., 2003). The biological explanation says the reason lies in the genes and hormones defining gender (Kuhnen–Chiao, 2009), and also because men have become risk-takers out of necessity during evolutionary development (Dekel–Scotchmer, 1999). According to social reasoning, it is simply about the fact that women act in line with the gender role and social expectations learnt since childhood; they are more careful and responsible particularly if their decisions may affect others (for instance, members of their families) (Wood–Eagly, 2012).

It should be underlined that gender-specific differences in risk attitude have no absolute validity; financial qualifications and professional experience may level them off. Miendlarzewska et al. (2017) state all the above reiterate that financial awareness and the education targeting it can contribute to more rational and balanced decision-making irrespective of gender.

8 CORPORATE FINANCIAL DECISIONS FROM THE ASPECT OF BEHAVIOURAL ECONOMICS AND NEUROFINANCE

The most well-known studies of behavioural economics and neurofinance including Tversky–Kahneman (1974, 1979), Thaler (1980, 1999), Odean (1998), Barberis–Huang (2001), Benartzi–Thaler (1995) quoted above primarily analyse decisions by individual investors. There are, however, studies focusing on undertakings. This is all the more justified as you can see basic differences between individual and corporate level decision-making although corporate decisions are also made by individuals.

Graham and his colleagues (2013) analysed if there are clear differences between financial decisions made by companies operating in the United States and those operating in other countries in the world. They have asked thousands of CEOs to complete psychometric tests to reveal their main personal features and attitudes. They have concluded that CEOs in the US are more optimistic and willing to take risks than non-professionals or CEOs in other countries. The study has also made it clear a CEO's overconfidence / optimism does have an impact on the financial-investment decision of their enterprise. It has also proved decisions made by CEOs also display certain cognitive distortions (for instance, excessive optimism), which will distort corporate decision-making just as much as individual decisions do.

Kádár et al., (2023) investigated the process of lending from the aspect of financial institutions assuming the operation of the lending market is not necessarily perfect, so seemingly irrational decisions may be behind lending in many cases. Their questionnaire-based test involved twenty-six bankers – risk analysts and loan officers. The study verified the assumption that cognitive distortions particularly anchoring, risk and loss aversion, overconfidence and representativity also characterised the decisions made by bank officers.

The research is important because it helps recognise, understand, and correct – if necessary – the mechanisms of cognitive distortion in the background of financial decisions not only at individual but also at corporate level.

9 SUMMARY

In traditional economics the impact on investment decisions by emotions and cognitive patterns is neglected; no appropriate answers are given to the question why irrational financial decisions are made by individuals in some cases. This study is a summary of the most significant findings of behavioural economics and neurofinance.

Table 1 is a display of the theories and cognitive distortions affecting financial decision-making identified by behavioural economics and neurofinance and analysed in detail in this study. The related statements are brief summaries of the different heuristics, so the Table provides a quick overview of the emotional and psychological factors that may affect consumers or decision-makers.

Table 1
A summary of the theories and heuristics discussed in the study

Theory/heuristics	Source	Related statement
Bounded rationality	Simon, H., 1982	Individuals may be "diverted" at decision making by their bounded cognitive abilities
Editing, partition	Sterbenz, 2007	Breakdown of complex problem sets into smaller units
Representative bias	Tversky–Kahnemann, 1974	Decision-making pattern: how much is 'A' similar to 'B'
Availability	Tversky–Kahnemann, 1974	Assess phenomenon from extreme/trivial example
Adjustment from an anchor	Tversky–Kahnemann, 1974	'Anchor' – initial value affects estimation
Affect heuristics	Slovic, 2002	Emotions affect decision
Expert bias	Slovic, 2002	Decisions affected by views of persons believed to be experts
Fluency bias	Slovic, 2002	Information easily available seems more credible
Authority bias	Slovic, 2002	Persons using scholarly terms seem more credible
Prospect theory	Tversky–Kahnemann, 1979	Individuals rarely make rational decisions in critical situations
Loss aversion	Tversky–Kahnemann, 1979	Individuals perceive loss to be bigger than profit
Regret aversion bias	Odean, 1998	Brain neglects unfavourable occurrences
Connectivity bias	Tengfei Zhang, 2022	Individuals decide based on an earlier case
Confirmation bias	Chu Xin, 2019	Individuals decide on information supporting their assumptions
Hindsight bias	Fischhof, 2003; Pezzo, 2011	Individuals assess occurrences evident in hindsight
Narrative fallacy	Shiller, 2017	Decision based on totality of occurrences
Recency bias	Barber–Odean, 2011	Decision made based on current/recent occurrences
Start date bias	Sackett, 1979	Selection of start date of analysis affects findings
Bubble bias	Analysis centre, 2023	Investors overestimate instruments, so a financial bubble arises

Theory/heuristics	Source	Related statement
Ludic fallacy	Taleb, 2010	Theoretical rules applied to real situations
Illusory superiority	Kruger–Dunning, 2000	Individuals are prone to underestimate their knowledge/abilities
Optimism bias	Sharot, 2012	Individuals are overly optimistic regarding correctness of their decisions
Mental accounting	Thaler, 1999	Individuals mentally categorise their revenues from different sources
Survivorship bias	Fama–French, 2009	Individuals believe mistakes can be avoided if successful decisions only are used for decision-making
Bandwagon effect	Bauer–Kolos, 2017	Individuals make specific decisions because others have done the same
Herding bias	Bauer–Kolos, 2017	Investors follow other investors' decisions
Fear of missing out	Wiesner, 2017	Individuals are afraid to miss an opportunity already used by others

Source: own design

The cognitive distortions in the Table can be grouped in many ways depending on the emotional, cognitive patterns or social effects exercising their influence on decision-making. Standardising the phenomena may help their recognition and understanding, which might have special value for corporate decision makers.

Part of the heuristics arise because of the limitations of cognitive capacity: individuals are unable to analyse/interpret all available information, so – using some rules of thumb – they will unconsciously simplify information processing. Bounded rationality (Simon, 1982), editing (Sterbenz, 2007), representativity, availability, adjustment from anchoring (Tversky–Kahneman, 1974), fluency heuristics (Slovic, 2002), and mental accounting (Thaler, 1999) belong to the group.

The second group comprises heuristics based on emotions and psychology such as affect heuristics, expert heuristics, illusory superiority (Slovic, 2002), loss aversion, regret aversion, excessive optimism (Tversky–Kahneman, Odean, Sharot), as well as narrative fallacy (Shiller, 2017), recency bias (Barber–Odean, 2011) and fear of missing out (Wiesner, 2017). In these cases, rational decision-making is distorted by emotions, wishes and fears.

The third group of heuristics includes phenomena where the interpretation of decisions or the decisions are distorted in hindsight either because subjective elements have been dominant in the process or because individuals neglected statistical probabilities. Examples include hindsight bias (Fischhof, 2003; Pezzo, 2011), confirmation bias (Chu Xin, 2019), connectivity bias (Zhang, 2022), start date bias (Sackett, 1979), and mismanagement of potential risk (Taleb, 2010).

The fourth group covers distortions caused by social effects such as expert heuristics, illusory superiority (Slovic, 2002), survivor bias (Fama–French, 2009), bandwagon effect and herding bias (Bauer–Kolos, 2017). In these cases, individuals assume that others (experts or people assumed to be experts or the community) can make better decisions.

While all the above heuristics may occur with financial decisions, some of them are particularly typical of the stock market or the market of loan products. Examples include the prospect theory (Tversky–Kahneman, 1979), as well as starting date bias (Sackett, 1979), bubble bias (Analysis centre, 2023), illusory superiority (Kruger–Dunning, 2000), excess optimism (Sharot, 2012), or fear of missing out (Wiesner, 2017). Such phenomena may lead to decisions neglecting market rationality.

Some financial institutions and investment advisors are clearly aware that individuals do not always or exclusively make decisions on the basis of expected usefulness, and they may be derailed from an optimal response by certain heuristics, or cognitive distortions. Still, such information may not be said to be generally known.

Consumers and corporate decision makers should be made aware of those phenomena – may be as part of financial training, which could help them to make more informed decisions and to avoid manipulative techniques trying to make use of cognitive mistakes. Such knowledge is not only useful for small investors; organisational structures can also be set up more effectively if you understand what kind of prejudice and erroneous assumptions influence your decisions.

The findings of behavioural economics can be incorporated into the decision-making process of work organisations improving in this way the quality of decisions and reducing undesirable subjective influence and, eventually, incompetence.

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