

Role of Cognition in Financial Decision Making

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1. Introduction

The human brain is a complex machine. Surprisingly, this focal organ of the nervous system, weighs about 20 pounds and devours a good 20 percent of the fuel taken by the body, generating enough energy to keep a light bulb burning. This complex structure, made up of thousands of neurons, is not only responsible for complex cognitive decision making mechanisms of the human beings but, also for the generation of various sentiments and emotions. For millions of years, human brain has remained a mysterious riddle for the mankind, until the advent and advancements in the field of Neurosciences. Neuroscience is a field that studies neurons and neural circuits in detail. However, the study of such complex yet, the driving force of human beings must not be restricted to the field of sciences only.

Traditional finance has often overlooked the human aspect to the mechanism of financial decision making. While Behavioral Finance is gaining momentum and has some ground breaking contributions to its credit, Neurofinance still remains in the field of infancy.

Neurofinance is a blend of Neurology, Psychology and Finance that attempts to explain why investors behave the way they do, what prompts a certain behaviour, what psychological and physiological factors interplay leading to a certain kind of behaviour and reactions occurring there from. In short, Neurofinance explains the reasons of market anomalies as well as an interesting interplay of cognition and emotion. Stock markets have become a giant casino where traders are buying and selling non-stop, driven by a motive to earn more and more. It is the field of Neurofinance that helps us ascertain what prompts the behaviour of these masterminds.

In 1970, Fama proposed the theory of 'Efficient Markets'. The theory states that the asset prices reflect all the publicly traded information and that there is almost no chance of traders buying underpriced and selling overpriced. However, this theory majorly stands on the assumption of 'rationality', assuming that the investors will behave rationally in all circumstances, which does not hold true (Sapra & Zak, 2011). The Efficient Market Theory also assumes that, if in case some investors are irrational, their activities will be nullified or arbitrated by their rational counterparts (Tseng, 2006). The theory, therefore, assumes that almost all the investors display a constant level of risk aversion and time consistency, which is unrealistic. Human beings are always subject to irrational biases such as heuristic simplification, overconfidence, loss aversion, status quo and framing effects, just to name a few (Sapra & Zak, 2011). The financial bubbles and crisis experienced by the world are also a guiding proof that human beings do not always behave rationally and that they are fallible (Coates et al., 2010).

According to Simon (1982, vol. 2, p.408), "Rationality denotes a style of behaviour that is appropriate to the achievement to the given goals, within the limits imposed by given conditions and constraints. Theories of rational behaviour may be normative or descriptive, that is, they may prescribe how people or organisations should behave in order to achieve certain goals under certain conditions, or they may purport to describe how people or organisations do, in fact, behave." However, it is hardly possible for the traders or investors to stay rational in a marketplace that is most of the times in frenzy. Therefore, the concept of 'bounded rationality' swept in. The following quotation is from Simon (1997, vol. 3, p. 291):

"The term 'bounded rationality' is used to designate a rational choice that takes into account the cognitive limitations of the decision maker, limitations of both knowledge and computational capacity. Bounded rationality is a central theme in behavioural approach to economics, which is deeply concerned with the ways in which the actual decision making process influences the decisions that are reached."

Considering these limitations, Lo (2005) formulated the theory of Adaptive Markets. This theory postulates that the investors are not always rational and take decisions based on hit-and-trial methods. Also, the traders tend to make mistakes on trading floor, learn from them and strategize accordingly the next time. While traditional finance refutes the possibility of human aspects in its concepts and theories, Neurofinance goes a step ahead in embracing these aspects to ascertain anomalous market and investor behaviour. Stock markets, particularly, are an interesting arena to study the implications of human conduct or behaviour.

The objective of the present paper is to identify the psychological and physiological factors involved in investment decisions taken up by the traders. Taking account of the scant but breath taking work in this field, a humble attempt is made to understand the impact of psychological factors while making investment decisions.

2. Theoretical background of the study:

While Neurofinance is a new field, Behavioural finance and Behavioural Economics are relatively much matured fields of research. Many theories in Behavioural Finance and Behavioural Economics have demonstrated how the traders and investors, even the most experienced ones are susceptible to taking irrational decisions due to cognitive or emotional influences and biases. Tversky and Kahneman's Prospect Theory (1979) is an example for the same. The theory posits that losses loom larger than the profits for people, meaning thereby that the people tend to feel higher morose and sadness on losing the money, than the happiness they receive on gaining it. The ongoing debate between the rationalists and behaviourists have intensified after the emergence of

Neurofinance. The rationalists believe that there is no influence of emotions or cognitive biases in the process of financial decision making. On the other hand, the behaviourists believe that the process of financial decision making is surely driven by investors' emotions, cognitive biases and other psychological and physiological factors.

Herbert Simon, in his work entitled "A Behavioural Model of Rational Choice", stated that human beings do possess certain cognitive limitations, which become evident during the process of investing. He propounded the term "satisficing" meaning that human beings often take good decisions, instead of taking 'optimal decisions', as stated in the Expected Utility Theory. As discussed earlier, the 'Efficient Market Theory' is a complete rationalist theory, defying the fact that human beings are not always rational and they are bound to make mistakes. The traditional finance is built up on rationalist theories and conceptualizations. However, with the advancement in technology and inquisitiveness of the researchers, behaviourist notions are entering the field of finance, making a room for more logical and realistic theories and assumptions. It is imperative to mention here that while conducting the review, it was observed that contribution to the field of Neuroeconomics is still present but, in the field of Neurofinance the contribution is very scarce, intensifying the need of research in this area as well.

3. Objectives of the study:

The objectives of the present paper are:

1. To identify the psychological and physiological factors affecting the process of financial decision making by the investors; and
2. To review studies demonstrating the interplay of cognition and emotions during the process of financial decision making.

4. Anatomy of Human Brain:

While the study of human brain is extremely intricate, sophisticated, elaborate and complex, an attempt is made here to elaborate its relevant parts for our discussion. The Central Nervous System of the human beings consists of the brain and spinal cord. Covered by the Cortex, which is approximately the size of 4 big sheets of paper, it consists of incalculable brain cells called neurons.

In the most basic terms, the human brain can be divided into three parts viz, the Forebrain, the Midbrain and the Hindbrain, each part specialised to perform a specific function.

The Forebrain is the most evolved part of the human brain, responsible for the generation of emotions as well as the most sophisticated cognitive mechanisms that cannot even be performed by the supercomputers or other complex machines. The Forebrain consists of Cerebrum, the Limbic System and the Thalamus. Cerebrum determines the intelligence of a being. Divided into two hemispheres by Corpus Collosum, human brain consists of four lobes namely, the Frontal Lobe, Parietal Lobe, Temporal Lobe and Occipital Lobe. The Frontal Lobe, covered by the Pre-Frontal Cortex (PFC), is responsible for all cognitive processes happening in the human beings. Problem solving, decision making, sensory processing etc happens in the Frontal Lobe only. In short, is a place that commands processing and logic. The natural process of evolution has gifted the mankind with Pre-Frontal Cortex (PFC),

right behind our forehead that is most active during decision making. While the Parietal Lobe is concerned with perception formation, recognition, orientation and movement, the Temporal and Occipital Lobes are concerned with auditory and sensory processing respectively.

The Cerebrum is involved in cognitive mechanisms and the Limbic system in the Forebrain is responsible for regulation of feelings and emotions. The Limbic System consists of Hypothalamus, which releases hormones into the blood stream; the Amydala, which is responsible for the emotions of fear, anxiety, anger, violence and panic; the Hippocampus, which is responsible for converting Short Term Memory into Long Term Memory; and the Thalamus, which acts as a relay station for sensory information to the appropriate parts of the brain. The Hypothalamus, placed just below the Thalamus, connects the Nervous System and the Endocrine System through the Pituitary Glands. It is the interplay of the Cerebrum and the Limbic System of the brain that helps us take all kinds of decisions, whether financial or non-financial.

The second part of the human brain, which is the Midbrain, is located just below the Cerebral Cortex and above the Hindbrain. It controls reflex movements and hearing reflexes. The posterior part of the brain, which is the Hindbrain, consists of Cerebellum, Pons and Medulla Oblongata. While the Cerebellum controls and coordinates the movement, posture and balance of the body, Pons and Medulla Oblongata are responsible for controlling voluntary and involuntary movements of the body respectively.

Unsurprisingly, there is no specific 'financial centre' in the human brain. Therefore, the parts of the brain that we use for other activities are active during financial decision making also. The conscious part of the human brain can process upto 40 frames of information in a second, while the unconscious part of the brain can process upto 1.2 billion frames of information in just a single second. According to neurologists, major part of our decision making depends on the information we gather unconsciously. This holds true for trading decisions also that are to be taken quickly and impulsively many a times, owing to the hysterical and frenzy stock market conditions.

In 1759, Adam Smith authored an incredible book titled 'Theory of Moral Sentiments'. The book explains human beings as always struggling between the "impartial speculator" and the "passions". While the impartial speculator described the newly evolved Pre-Frontal Cortex (PFC), which has the capabilities to suppress the reptilian instincts of the human beings and are highly evolved for complex mechanisms, "passion" described the Limbic System of the human brain. According to Smith, it is the integration and interaction of both these regions that helps individuals take optimal decisions.

5. Experiments demonstrating the interplay of cognition and emotions during financial decision making:

Feelings and emotions are often seen as subcortical eruptions disabling reasonable and logical direction of conduct. However, certain researchers have defied this misconception and suggested that rationality itself would be directionless, if it is not tagged for emotional significance (Damasio, 1994; LeDoux, 1996; Loewenstein et. al.,2001).

Daniel Kahneman, an American Psychologist, who was awarded the Nobel Prize in Economic Sciences in 2002 for his exceptional contribution to the field of Neuroeconomics,

conducted numerous experiments to study the factors influencing financial decisions. He concluded that it is a strong misinterpretation that the decisions are made on just two quantitative variables of price and quantity. Rather, there are a whole lot of psychological factors and variables that influence the mechanism of financial decision making. These psychological factors of decision making hugely impact the micro as well as macro-economic variables and determine the performance of the economy as a whole.

An experiment conducted in 2017 at Gate Experimental Economics Laboratory, ranked amongst the top 5% institutes in experimental Economics by IDEAS field ranking, at Lyon, France, showed how the subjects in the experiment reacted during an intensified competition. A group of students were asked to become traders, where each volunteer had a portfolio of shares and a virtual sum of money on their computers. The volunteers were free to set their own prices based on the forces of demand and supply, while a reference rate was also arbitrarily set by the researchers. The competition intensifies when the researchers announce that the top three performing traders shall be entitled to a generous amount of bonus. As the competition escalated, the traders increased the value of their shares, purchased more shares, raised their prices and followed rising prices. Therefore, herding behaviour emerged during the experiment, creating a speculative bubble. The study showed how the traders respond amidst the competition due to a reward that augments their brain activity and the number of neurons firing per second. Hirshleifer, et al. (1992) also observed this characteristic of 'local conformity' amongst human beings as they tend to mimic each other in a particular setting.

Yet another experiment conducted at Gate Experimental Economics Laboratory examine the psychological and physiological reactions in the body during the economic and financial decision making process. The participants were given a sum of money virtually and an option was provided to either disclose it to Income Tax authorities or conceal it from them. To note the reactions in the body, electrodes are attached to the fingers of the volunteers to keep their perspiration under check. The electrodes measure the electrical changes in the surface of the skin before, during and after the experiment. The results of the experiment show that the volunteers who choose to evade the tax are the ones whose emotions overpowered them and they experience maximum sweating. It was concluded in the experiment that a more emotional trader exhibits a higher risky behaviour, with the intent and hopes of winning bigger each time.

Brugier, Quartz and Bossaerts (2010) studied how the Theory of Mind outperforms probabilistic reasoning. The researchers looked at brain imaging and observed that the traders who used the Theory of Mind outperformed in predicting future stock prices. these traders did not use the area of brain involved in probabilistic reasoning. Theory of Mind postulates that others might have believes, intentions, desires and perspectives different from one's own and that an individual must acknowledge this fact. The application of this theory made the trader act rationally and therefore, facilitated them to successfully predict future stock prices. The following table summarises the research works and experiments discussed herein:

Table 1: Summary of experiments demonstrating the interplay of cognition and emotion in financial decision making

STUDY CONDUCTED BY LABORATORY/RESEARCHER	YEAR	DISCUSSION
Gate Experimental Economics Laboratory, Lyon, France	2017	<ul style="list-style-type: none"> ➤ Experiment demonstrating 'herding behaviour' amongst investors in case of intensifying competition. ➤ Another experiment demonstrating how more emotional investors exhibit greater risk taking capabilities.
Brugier, Quartz and Bossaerts	2010	<ul style="list-style-type: none"> ➤ Traders applying Theory of Mind outperform the ones applying probabilistic reasoning.

6. Conclusion

Looking at numerous empirical evidences, it can be observed that cognitive and emotional procedures are basic and innate to all human beings and have their bearing on financial decision making too. For centuries, the traders, investors, finance professionals and academicians have taught and studied that financial decision making is a rational process. Traditional finance theorists have often ignored the fact that human beings are 'feeling beings' and that they are never

completely rational. From simplest to most complex decisions, every decision is impacted by behavioural biases and cognitive limitations. The emerging field of Neurofinance, which is a blend of Neurology and Finance, has helped bust various myths about human behaviour and further developments in this field will enhance put forth theories and concepts that may reshape finance, as a discipline. Therefore, it is important to know and understand the human being is a homo-sapien before being a homo-economicus.

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