INTERDISCIPLINARY APPROACH TO NEURAL NOISE AND PERCEPTION BIAS IN FINANCIAL DECISION MAKING

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ABSTRACT

The general goal of the interdisciplinary work refers to the research of complex experimental interactions and theoretical works on the subject of neural mechanisms in the perception of decision making; economic and perceptual decision making; high and low volatility bias of the investors perception, and the perception bias during the duration of the stimuli, according to the theory of subsequent effect. The work shows the complex interweaving of scientific achievements in the process of decision making. The given scientific and applicative research leads us towards understanding the levels of complexity of financial decision making with the principles of universality; spatial and temporal fluctuations of input in perceptual decision making (perception can be under the influence of attention and can surface subconsciously without conscious consciousness), possible extending of current results and models from two alternative choices and are they different in respect to spatial and temporal fluctuations (our capability of deciding can result from random fluctuations in the background of electric noise in the brain) effects on the results of decision making. The focus of this research paper is the analysis of testing the perception of investors which shows us the subsequent effect of volatility, which further indicates the twisted perception after prolonged exposure to extreme levels of volatility. This established framework can give us key insight in the domain of deductive reasoning. Bias in deductions is questioned using the VIX index

Key words:
Neural noise, Subsequent effect, Perceptual bias in decision making, Neuroeconomics, Neurofinance

1. INTRODUCTION

The interdisciplinary approach of the work to stand in a broader context to summarize the impact of the neural noise, perception bias and subsequent effect through contributions to neurophysiology / neuroscience as a center of research in understanding the research reaching the limits of separate items. Understanding outside the own discipline of science is a necessity. Despite today's information flow between disciplines scientific necessity lags (Gigerenzer / Selten, 2001). Our chosen approach interaction neurophysiology / neuroscience and neuroeconomics / neurofinance incentive review and continuation of further research. Of course this is not to be confused with scientific imperialism. The existence of controversy, in particular it relates to the economy and finance, where the human factor plays a significant role, despite the application of sophisticated technology, it is human nature unpredictable and unreliable. The question is how to build economic models on them, which are meaningful and coherent.

The aim was to investigate the effect of neural noise and perception bias of investors and the appearance of the subsequent effect through setting research questions; the extent to which the volatility of perception affects the decisions of investors and the extent to which we can summarize bias perception in the VIX index and in this context to explain the concept of volatility? The subject of research is the perception of investors showing subsequent effect volatility. McFadden (1999) points to the ubiquity of the perception of bias and should be respected as it explains many anomalies in behavior, and the history and past experience is more important in determining perception than what is allowed in traditional models. In the wake of McFadden analyze the latest research on the impact of the volatility of perception and distortion of asset prices. Research in the field of neurophysiology show that after long exposure to stimulus, perception bias creates the illusion of the opposite impulse. This bias subsequent effect illustrate documented research authors from Hurvich and Jameson, 1957, Barlow and Hill, 1963, Webster, Kapping, Mizokami and Duhamel, 2004 Rutherford, Chattha and Krysko, 2008. Subsequent effects occur within different time periods, a occur within a few seconds while others have a daily or monthly horizons (Delahunt, Webster, MA, Werner, 2004; Webster, McDermott and Bebis, 2007. from a theoretical point of Woodford, 2012, formally shows that the phenomenon of post-effect functions and values highlighted by Prospect theory (Kahneman and Tversky, 1979) which ultimately results in neural adaptation, the mechanism by which the brain increases the accuracy of perception subject to the limitations of processing capacity information.

Conducted testing (experimental work) perception of investors in the laboratory Payzan-Lenestour, Ballein, Berrada and Pearson (2014) shows the appearance of the subsequent effects that distort the perception of volatility using the VIX measures in shares of the S & P500. VIX is often called the fear index or the fear gauge. VIX

represents a measure of market expectations of volatility in the stock market during the next 30 days, which proves perceptual anomalies in the period volatility regime. Testing was conducted through a computer task designed to Bloomberg terminal displaying participant time series representing trajectories market index over a year on a daily frequency with reference to the perceived volatility of each trajectories. Results showed that the volatility trajectory always been 10%. But the perception of the participants was systematically varied from 10%. Perceived volatility is 32% higher after the extension (50 seconds) exposure to low volatility trajectory (2%), but after prolonged exposure to high volatility (45%) trajaktorija. Thus, the test is shown volatility subsequent effect that distorts the perception of volatility.

In assessing the realized volatility of assessors was used several times a coordinate grid (Zhang, Mykland and Ait-Sahalie, 2005) that provides a compromise between accuracy and simplicity. Low frequency evaluator is more accurate than Andersen, Bolersleve, Diaboldne and Labysove (2000) whose implementation is relatively simple. Empirical analyzes indicate nuanced prediction subsequent effect, therefore the perception of bias becomes stronger when exposed to stimuli very high / very low volatility. The perception of bias is having certain well-defined properties when they come to the sensory organs, but they are transduced and transmitted along paths that have multiples of synaptic workstations were also stronger when the stimulus intensity, and after more extreme levels of volatility. In accordance with the subsequent effect, the conducted research results showed no perception of bias threatening jumps in volatility that are not preceded by long-term exposure to very high / very low volatility, though you leaps comparable in magnitude to those that induce subsequent effect.

2. SCIENTIFIC AND THEORETICAL BACKGROUND

Explaining the occurrence of subsequent effect / theory of opponents process (Hurvich and Jameson, 1957 Hering, 1964 Griggs, 2009), evokes antagonistic association between pairs of neurons coding for an alternative presentation of incentives; for example, selective movement of the neurons encoding upwardly relative to downward, facial selective neuronal pairs encoding for happiness in regard to the expression of sad faces or male/ female traits. Subsequent effect arises from an imbalance between the characteristics of selective pairs of neurons. The application of the subsequent effects in the context of finance is based on the postulate of investor's perception of volatility, in a broader sense the volatility of time series as well as the variance of sequence numbers that include the variability pair of selective neurons. After long-term exposure to low levels of volatility, neurons signal low volatility, which will show the relative base activity compared to neurons that are encoded, looking for high volatility. The theory predicts biased perception of volatility.

Numerous studies in physiology, statistics, and behavioral tools enabled neuroscientists to establish strong ties between the behavior of individual neurons and perceptive experience. Development tools allowed us insights into the neural mechanisms of decision-making. Many decisions have significant biological and social effects, while others may have a more limited impact on our daily lives. Neural mechanisms of decision-making are an important subject of research in the field of cognitive and behavioral neuroscience. Studies include sensory discrimination tasks using visual movements that give a wealth of information about the nature of neural networks required to perform perceptual decision-making (Shadlen MN, 2007, Shalden MN Kiani, R. 2011. Salden MN, Newsome N.T, 1994).

At the core of decision-making are fundamental four processes of computation that are central to understanding the neural substrate of decision-making: the accumulation of evidence, forming a categorical choice, reward-based adaptation and stochastic properties of choice behavior (Wang, 2008). The question is why do we make incorrect decisions? The answer comes from the fact that the decision-making process is noisy (Knill and Pouget, 2004), indicating uncertainty. The noise in the nervous system can have multiple sources (Faisal et al., 2008), however uncertainty in making categorical decisions usually comes from the outside world or from internal insecurity. As the uncertainty in the overall decision-making process, it is assumed that the nervous system has a computer strategy and certain circles calculate the amount of uncertainty in the decision and take advantage of the calculation of the optimal motor and adjust behavior (Drugoeitsch et al., 2012, Cording, 2007). The natural environment is complex; one choice may bring more outcomes.

Perceptual decision making is one of the most important tasks performed by the brain. The brain has developed a sophisticated and fast decision-making mechanism from the outside world. Physical stimuli information may be delayed, or distort under the influence of down, efferent activity. The accumulation of these effects is the internal noise (Green DM, and includes stochastic nature of neuronal firing, the internal state of the organism (excited) or changes in attention. Percept or internal stimuli presented are imperfect representations of physical stimuli, and physical identical stimulation can cause variable perceptions. The mechanism decision-making must act on perceptual evidence available to achieve the objectives of the body. When the stimuli are at the upper limit, the behavioral decisions accurately reflect the characteristics of physical stimuli. The accuracy of the internal representation reduces the threshold by an external signal becomes weak. As the relative contributions of internal generation of noise increases the perception of decision-prone error.

The human brain has about 100 billion neurons, each of which sends thousands of signals every second other neurons. Understanding how neurons work individually or collectively it is important to know not only in the treatment of various diseases, but also in how financial decisions are made. Noise can be described as any change in neural activity in a way that does not depend on a task that the brain wants

to achieve (Xaq Pitkow, Rice University, Houston, Texas, 2015). Not only are neuronal responses noisy, but each neural noise is correlated with the noise in thousands of other neurons. This means that something that affects the output of one neuron that can be amplified to affect many others. These correlations are great difficulties to scientists in modeling small group of neurons in a way that will affect the person to reacts to a stimulus. Noise, a group activity of neurons in multiple brain regions are the base of making decisions. In the case of perceptual decision making, accumulation of the evidence over long periods could be achieved with relatively short memory properties. For example, discrimination movement in the dot task proves the direct direction of the field movement random dots with low coherence and a one-way and direct accumulation in a few seconds. In contrast, neurons that could be responsible for the variability in the time periods of several tens of milliseconds, indicating a kind of circle-type mechanism that could be the basis of accumulation.

Understanding bias seeks answers how fast the brain makes judgments, which are patterns that create assumptions and whether the brain self-adjust and correct our thoughts. Answers lie in the study of neural pathways that may offer clues to reduce prejudice and its effects. Neuroscientific research on neural foundations of bias and stereotypes are trying to identify how bias formed and affect behavior and how they can be regulated. The complex research process supports networks of neural structures in several regions of the brain. Perceptual decisions based on sensory information. They are a simple and frequency types of decisions that have been exposed by the people (Palmer, 1997), monkeys (Schall, 2003), rat (Kepecs et al., 2008), mice (Harvey, et al., 2012) and Drosophila (Zhang et al., 2007). So this is the beginning of the process of understanding the neural mechanisms that are specifically aimed at the behavioral origin. Even a simple behavior depends on the coordinated efforts across different areas of the brain. Different areas of the brain can implement various budgets or the same calculations can be arranged in various fields. Well, within a small area of the cortex different neurons have different morphology, connectivity patterns and properties of response depends on the position within the local micro-circuits. Therefore, within an area of the cortex different neuronal populations can implement a variety of budgets. At any given point of time, the external environment is a great unknown and performance requirements, which are based on a noisy sensory inputs. The behavior depends on the ability of fast and accurate decision-making between state process known as perceptual decision making (PDM; von Helmhotz, 1925, Tenenbaum and Griffths, 2001, Shalden and Newsome, 2001, Gold and Shalden, 2007). Various factors must be taken into account before making a decision. Decision-making variables represent the sum of the multiple choices of information (such as previous history, current emotional state, quantity and quality of available evidence, the value of each choice) and proper decision-making determines how and when the variable decision interpreted the arrival of a particular choice (Gold and Shalden, 2007) . Between the economy and perceptive

decision making, there is a visible defect in studies being conducted (Summerfield and Tsetsos, 2012, 2015). Example accumulation process perceptive decision can be explained by the dynamics of simple economic decisions (Krajbich and Rangel, 2011; Tsetos et al, 2012, Polania et al, 2014). While, robust biased decision-making in the context of the economic effect it was only recently discovered in perceptual decision making (Trueblood et al, 2013).

Financial decision-making is a complex area which is approached from different perspectives including comparisons of different scenarios and assessment of the perceived outcomes, different perspectives in multiple coordinate systems, allows us a deeper level of understanding of financial decisions, as well as insights that will change the way in time. The decision is the selection of the proposal or plan and the decision-making process includes the steps that lead to commitments that are often referred to deliberations among the options. Most decisions based on a variety of factors: prior knowledge regarding the relative value of the options, expected costs and rewards associated with a matrix of possible decisions and their outcomes, and other costs related to the collection of evidence (for example the cost of the elapsed time). As a rule, decision-making has a beginning and an end. For perceptual decisions, many complex factors are manifested in and through the personal perception that can be major obstacles in any decision-making process. The perception of bias seeks to disrupt lucid monitoring of the problem by introducing externalities which generally are not relevant to the decision; however, an individual can be biased by various factors structured prejudices.

3. THE METHODOLOGICAL FRAMEWORK OF RESEARCHING OBJECTIVES

The model is set up based on the detection of the regime volatility that induces subsequent effect. This framework can provide important insights into the domain of deductive reasoning. Belief bias in concluding examined by the VIX index. Deductive reasoning, we set up research framework emergence of subsequent effect that distorts market volatility index VIX.

A technical explanation of the volatility index (VIX) is a weighted measure that implies volatility to set up a real-time $ SPX and call options. Setting the calls are weighted according to the remaining time and the degree to which they are in or out of the money. From this he created a hypothetical option in cash with 30 days expiry period. In this way they are trying to set the value equal to the amount of dollars the current value of $ PX. This means that the VIX actually represents the implied volatility of a hypothetical option of setting / call $ SPX cash option value. In short VIX is a key measure of market expectations in the short term. VIX considered valuable barometer of investor sentiment and volatility. Many say that the VIX implied volatility, but it is very important to know that the VIX moves in the time of uncertainty and fear

and down in time greed and trust. Since the VIX moves in the opposite direction of the market it is possible to find out the expectations for the upcoming market trends by watching what happens to the VIX

Consideration empirical strategy allows measures VIX contains information on the perception of volatility investors through a model that incorporates the potential for bias in perception, because the theory subsequent effect gives clear guidance on the nature of prejudice and prediction that the focus of empirical research (Elise Payzan-Lenestour, Lionnel Pradier and Talis J. Putnins, 2015). Their tests show changes in the VIX when switching from a state or very high or very low volatility to the state of neutral volatility (neither high nor low). VIX found changes in the test cannot be attributed to changes in either the foundation or levels of risk aversion but is attributable to the effect of the subsequent effect. By inserting the subsequent effect as core attribution perception volatility through designed model provides scientific guidelines that are important for a deeper understanding of the economics and finance or space further study taking into account the scientific advances in neuroscience / quantum genetics, because regardless of the established models, they have to be rich and focus our thoughts and replace coherent approaches, many of the more remote areas of the current model, if we target a deep understanding of complex relationships, because the decision-maker is a mesh network of external and internal factors that are important for a comprehensive approach to understanding, however piecemeal approach regardless of the well-designed research undermines depth of market volatility.

Often economists cost assets are used together with models of determination by performing financial expectations. For example; Finance economists use federal funds future price for the measurement of expected interest rates (Krueger and Kuttner, 1995; Pakko and Wheelock, 1996). Similarly, much of the literature on fixed and target zones exchange rates used to measure the credibility of the exchange rate regime or predictions of their collapse (Svensson, 1991; Rose and Svensson, 1991, 1993; Neely, 1994). However helps measure of uncertainty associated with future property prices and their expectations. Since asset prices depend on the perceived volatility of the underlying assets, they can be used to quantify the expected volatility of asset prices (Zlatan and Rendleman, 1976).

The implied volatility requires assumptions about the statistical procedure governing. Changing the volatility in the market is a signal of change in the perception of risk participants in the movement of stock prices. The theme of the volatility is the subject of much scientific research. Many scientists observed changes in overall market volatility over time (Schwert, 1989, 1998), work Campbbelya et al (2001), locating idiosyncratic risk has increased over time (at company level) or the aggregate volatility remained stable from 1926 to 1997. Measuring volatility in various studies that were based on the standard deviation (Schwert, 1998) or the modified forms of the standard deviation (Schwert, Stambaugh, 1987) basically are based on realized

volatility. However, the VIX and VXO are options that imply volatility, so they give us a chance to look at the market volatility from the perspective of the future.

Indicative research backing the understanding of the meaning of changes in volatility in the works Granger and Ding (1996), Lobatto and Savin (1998); Diebold and Inoue (2001); Granger and Hyung (2004), however, though all of these studies go beyond focusing influence subsequent effect on asset prices leading to distortions of the VIX, as the perception of the average individual may be distorted, however sophisticated knowledge can enable visibility distortion.

Uncertainty is one of the most important changes facing companies in the financial area. This situation could have an impact on the variability of reported current income that reduces the ability of income anticipated future income. So volatility affects the empirical projections of future income to assess the company and the capital value to be analyzed.

Everyday life requires taking a series of decisions, be they large or small. Some are simple choices while complex elections seeking systematic approaches to decision making. The assessment of the existence and extent of the tendency of investors who are facing at the time of decision making leads us into the behavior biases as sample variations in judgment that occurs in certain situations which can sometimes lead to perceptual changes, incorrect judgments, illogical interpretation or irrationality.

Behaviors of investors sometimes are contrary to logic and reason whereby we have indicators of many prejudices that affect the decision-making process on investments. Emotional processes, mental errors, individual personality complicate financial decision-making, analysis of numbers, for the purchase of shares and other securities. Ignoring or inability to understand the perception of bias in decision-making can have an adverse effect on the performance of the portfolio. Behavior bias includes many species. So cognitive bias refers to the tendency to think and act in a certain way. Cognitive bias can be seen as rules or heuristics, which can lead to systematic deviations from the standard of rationality or until valid judgment. There is controversy whether some of the prejudices or irrational they result in useful positions behavior. Emotional bias results in feelings rather than facts, in fact there is some overlap between cognitive and emotional bias, and it is called the bias behavior. It is important knowledge and skills and awareness to avoid bias. Baker and Novsfinger (2002, 2010), Ricciardi (2008) Shares (2013), Parker (2013) and Seawright (2012) show us the behavior of investors and bias in the behavior and how to deal with bias. Representativeness; means investment as good or bad. A disposition effect; closely related to the aversion. Familiarity bias; overcoming the bias implies that investors spread their decisions on profit distribution expanding the portfolio diversification and risk reduction. Concerns; is linked to the fear of loss. Anchoring; occurs when an individual controls their cognitive decision-making process. Biased self-attribution; successful results are attributed to their own works, while poor results are attributed to external factors.

4. CONCLUSION

The interdisciplinary approach involves setting neuroscience and theories subsequent effect as the cause of biased perceptions in the activities and decision-making. Analysis of Psychology, Behavioral economics / finance, neurofinance indicates different cognitive limitations and biases that affect the perception of the behavior of individuals, departing from the traditional economic model of rational decision-maker. Market participants affect the overall market result. Observers are highly capitalized and sophisticated and relatively impartial arbitrators / speculators who manage to market outcomes in accordance with rational behavior or limits to arbitration or mass biased individuals that affect the cause of bias affecting the equilibrium price. Thus, studies show bias in individuals or bias has a significant impact on asset prices.

The problems and limitations inherent indicate the scientific necessity of linking scientific areas if we are to create a meaningful and coherent model. Within each national economy there are differences between the financial markets and the economy. Empirical Strategy on the perception of volatility investors measuring the VIX, which contains information on the perception of volatility inserting the potential for bias in the perception as a base subsequent effect gives us a partial insights about the nature of prejudice and prediction. The bias of the individual does not result from a lack of intelligence, but the question of the causes of the functioning of the perceptual system.

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