Neurofinance and Risk Tolerance by André Schiesser

Executive Summary

Investment suitability is the objective of good financial advisors. An investment has to be suitable in different regards, such as an investor's goals, risk capacity, and risk tolerance (Resnik, 2012). An investor's psychological risk tolerance, i.e. the willingness to take and endure risk, is probably the most difficult factor to assess during the advisory process. A wrong evaluation of his or her risk tolerance can have serious consequences for a client. For instance, an overestimated risk tolerance might result in an early liquidation of an investor's portfolio, especially during market downturns. Assessing risk tolerance is also of great importance for financial institutions. Besides the fact that customer satisfaction is vital, regulatory agencies oblige financial institutions to appropriately evaluate an investor's willingness to take risk (European Parliament and Council, 2004). However, the objective of finding a suitable portfolio is difficult to accomplish and depends on the tools as well as the abilities of an advisor. Financial advisors usually use standardized questionnaires, i.e. risk profilers, to assess an investor's risk tolerance. In practice, there is a vide variety of risk profilers differing in validity and reliability (Guillemette, Finke, & Gilliam, 2012). Rice (2005) shows that there is substantial variance across the recommended asset allocation of questionnaires. This implies that either advisors do not rely on their questionnaires, or that these questionnaires are not suitable to determine the risk tolerance of investors. The question arises whether there are other approaches to address this topic.

The innovative scientific field neuroscience has the potential to provide additional methods for the examination of an investor's risk profile. This discipline aims to contribute to a better understanding of financial decision-making. In order to gain insights, researchers examine decision-making at its origin, the brain. The discipline uses a wide variety of methods, e.g. functional magnetic resonance imaging (fMRI), which enable the recording of brain activity. Measuring brain activity could improve the understanding of risk tolerance. Furthermore, the direct measurement of physiological processes in the brain may be an indicator for investors' risk preferences and risk tolerance.

The objective of this thesis is to examine whether the methods of neurofinance, especially fMRI, make it possible to directly measure a person's tolerance of bearing risk. This thesis discusses the following research question:

> Is it possible to evaluate the psychological risk tolerance of an investor with the methods of neurofinance, and would an integration of these methods into the advisory process provide additional value?

In order to examine whether it is possible to determine the risk tolerance by using neuroscientific methods, this study investigates the following hypotheses:

Hypothesis 1: Individual differences in risk tolerance are associated with differential activity in the brain's valuation processing system.

Hypothesis 2: Individual differences in risk are associated with differential activity in the brain's risk processing system.

Hypothesis 3: Individual differences in risk tolerance are associated with differential activity in the brain's emotion processing systems.

This study finds some evidence for hypothesis 1. Individual differences in risk tolerance seem to be associated with different activity in a brain structure (i.e. the ventral striatum) which processes the expected value of an alternative. In other words, subject-to-subject differences in risk tolerance may be explained by individual differences in neural activity.

Furthermore, there is evidence for the hypothesis that differential activity in the brain's risk processing system is related to individual differences in the willingness to take and endure risk. An fMRI study by Rudorf, Preuschoff, and Weber (2012), for instance, examined the processing of risk during a simple card game and found that there are differences in brain activity between risk-averse and risk seeking individuals. More specifically, the neural response to high-risk trials is stronger in risk-avers individuals than in risk-seeking individuals. Under the assumption that individuals who perceive risk more intensely are less risk tolerance, the neural response to risk could indicate a person's tolerance for bearing risk. The direct measurement of neural activity might help to overcome disadvantages of risk profilers, like the discrepancy between communicated and actual risk preferences.

There is also evidence for hypothesis 3. Individual differences in risk tolerance are associated with different activity in emotion processing brain structures, such as the amygdala and the anterior insula. FMRI tasks related to emotions may have the potential to provide additional value to the advisory process. For instance, the amygdala reactivity to aversive stimuli is an indicator for the trait anxiety, which affects a person's willingness to take risk (Hariri et al., 2002). Determining a general trait of an investor has the advantage that it is more stable than other factors (e.g. risk preferences) depending on knowledge or state of mind and is thus more suitable to predict long-term behavior (Hare, 2012).

Based on these findings, this study concludes that neurofinancial methods have the potential to assess factors which influence an investor's risk tolerance. However, there are many aspects which require further research. For instance, the relationship between behavioral risk preferences and individual differences in brain activity is vague. Furthermore, there is additional research necessary to evaluate how the neural response to aversive stimuli affects an investor's risk tolerance. Another negative aspect is that current research particularly focuses on the identification of brain structures and their functions. In order to identify the functions of a brain structure, researchers often use average data across individuals and therefore neglect individual differences in neural activity. A deeper understanding of investors' willingness to take and endure risk requires further examination of individual differences. There are also open questions concerning the neuroscientific research method fMRI. For example, a study has shown that the activity of a single neuron does not necessarily lead to hemodynamic responses which can be measured by fMRI scanners (Logothetis et al., 2001).

There are many open questions as to how neurological activity and risk tolerance are related to each other, which limits a practical integration of neuroscientific methods into the advisory process at this time and with the current technological possibilities. However, this thesis argues that there is strong evidence that financial decision-making theory in combination with neuroscience has the potential to study and characterize important aspects of risk tolerance, especially with regard to emotion processing, risk preferences, and risk perception. Integration into the advisory process might be possible in the foreseeable future, especially if the technological advances remain as fast as they have been.

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