Chapter 16
Risk Perception and Management

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ABSTRACT

This chapter provides an exploration of the decision-making processes associated with risk perception and management through the lens of neuroscience and behavioural finance. Drawing upon neuroimaging studies and empirical research, it elucidates how individuals comprehend and react to risks in both financial and non-monetary contexts. A comprehensive literature review highlights the significant influence of emotional and cognitive biases, including loss aversion, overconfidence, and anchoring effects, on risk-related behaviours, evidenced by the activation of specific neural correlates such as the amygdala, prefrontal cortex, and striatum. Furthermore, the chapter discusses the role of cultural and social determinants—particularly collectivist orientations—on risk-taking behaviours and the variance in activity within the ventromedial prefrontal cortex. Consequently, a novel framework for risk management is proposed, tailored to align with human neurocognitive limitations.

1. INTRODUCTION

Risk is a dynamic phenomenon that has a significant place in financial decision-making processes and does not fit into the rational framework envisaged by traditional economic models. Behavioural economics filled this gap; Kahneman and Tversky's (1979) Prospect Theory documented the asymmetric nature of risk perception by demonstrating that sensitivity to losses is stronger than to gains. Indeed, investors'

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ignoring negative market signals during the 2008 mortgage crisis embodied the neural counterpart of this theory with amygdala hyperactivity (Lo, 2013).

Today, neuroeconomics illuminates the biological roots behind financial risk behaviour. It is now a scientific consensus that the dopaminergic system triggers risk-taking in anticipation of reward, (Schultz, 2016) while the serotonergic system regulates risk aversion in response to fear of loss (Cools, et al., 2011). Disruption of this neurochemical balance explains systemic vulnerabilities such as the overconfidence illusion caused by misleading AAA ratings from credit rating agencies (Sharot, et al., 2011). Similarly, herding behaviour in institutional investors is associated with activation of the anterior cingulate cortex (ACC) under social conformity pressure (Klucharev, et al., 2009).

Even high-frequency algorithmic trading (HFT) is not immune to these neurobehavioral dynamics. The collapse of the S&P 500 index in the 2010 "Flash Crash" was amplified by algorithms that exhibited anchoring bias to the VIX index (Kirilenko, et al., 2017). These findings suggest that the future of risk management is to integrate neuroscientific models into financial engineering.

This study aims to restructure the financial decision-making paradigm by synthesising the neural and behavioural basis of risk perception from an interdisciplinary perspective. It integrates the success of behavioural economics in mapping cognitive biases with the explanations of neuroeconomics at the level of brain circuits (dorsolateral prefrontal cortex, amygdala, striatum) and neurochemical processes (dopamine/serotonin interaction).

1.1 The Rising Importance of Risk in Contemporary Decision-Making

The importance of risk perception in financial decisions has been recognised only in the past two decades, thanks to the interdisciplinary fields of behavioural economics and neuroscience. Kahneman and Tversky's (1979) Prospect Theory initiated a paradigm shift by demonstrating the limitations of traditional rational choice models (Neumann & Morgenstern, 1944) in explaining human psychology. This theory shows that individuals tend to react more strongly to potential losses than to potential gains. This phenomenon was evident during the 2008 mortgage crisis when investors overlooked negative market signals, which was linked to increased activation of the amygdala (Lo, 2013)

Research in neuroeconomics has identified two primary neurochemical systems that influence financial risk behaviour. The dopaminergic pathways drive risk-taking in anticipation of rewards (Schultz, 2016), while serotonergic pathways regulate risk aversion due to the fear of loss (Cools, et al., 2011). Understanding

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