Neurofinance versus the efficient markets hypothesis

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ABSTRACT

This paper develops the implication of neurofinance with respect to the efficient markets hypothesis. Neurofinance informs us that thinking imposes strain on the mind, in the sense that thinking is a comparatively laborious, biologically costly, and neurologically expensive cognitive process. The paper shows that people balance the costs and benefits of thinking and demonstrates mathematically that such balancing makes financial markets inefficient.

Neurofinance is an emerging transdisciplinary field that uses neuroscientific measurement techniques to identify the neural substrates associated with financial decisions. Neurofinance intends to go beyond behavioral finance, as it promises to identify the physiological causes underlying deviations from neoclassical utility-maximizing behavior.

Traditional neoclassical finance starts by assuming utility maximization to generate models that try to predict how people make financial choices. Behavioral finance examines conditions under which human behavior persistently violates the utilitarian assumption of the neoclassical finance models, and considers alternative explanations. Behavioral finance focuses on the application of behavioral economics to conditions of risk. That is, it investigates how people act and interact in the process of making financial decisions, and interprets these actions according to established psychological concepts and theories. In contrast, neurofinance intends to open the black box of the human brain to understand the physiological processes (including hormonal activities) that take place when people make financial decisions.

This paper emphasizes the implication of neurofinance with respect to the efficient markets hypothesis. To this end, Section 1 discusses neurofinance, which informs us that thinking imposes strain on the mind, in the sense that thinking is a comparatively laborious, biologically costly, and neurologically expensive cognitive process. Section 2 demonstrates that people balance the costs and benefits of thinking and that this balancing act makes financial markets inefficient. Finally, Section 3 concludes the paper. The purpose of this paper is not to create a new piece of the puzzle, but to put the existing pieces together to make sense of it.

1. Neurofinance: thinking is straining

Neuroeconomics notes that an entirely new set of constructs underlies economic decision-making. Although neoclassical economists may privately acknowledge that flesh-and-blood human beings often choose without much deliberation, their written
economic models invariably represent decisions that are in a state of “deliberative equilibrium”: one where further deliberation, computation, reflection, etc. would not change the decision-maker’s choice. It is as if the decision-maker had unlimited time and computing ability. Neuroscience does not deny that deliberation is part of human decision-making, but it points out that the neo-classical approach disregards the crucial role of automatic processing.

Automatic processes constitute much of what the brain implements. These take place much faster than conscious deliberations, and occur with little (or no) awareness or feeling of effort. Since people have little or no introspective access to these processes and little or no volitional control over them, and since these processes have evolved to solve problems of evolutionary importance rather than respect logical dicta, the behavior that these processes generate need not follow normative axioms of inference and choice.

Human behavior is partly the outcome of a fluid interaction between controlled and automatic processes. However, neoclassical models routinely and falsely interpret many behaviors that emerge from that interplay as being the product of cognitive deliberation alone. Such introspective accounts of the basis for choice should be taken with a grain of salt. Since for efficiency automatic processes must keep behavior “off-line” and below consciousness, human beings have far more introspective access to controlled than to automatic processes. Indeed, since we see only the top of the automatic iceberg, we tend to exaggerate the importance of control.

Automatic and controlled processes go by various labels: rule-based and associative processes; rational and experiential systems; reflective and reflexive processes; deliberative and implementive systems; assessment and locomotion; and type I and type II processes.

Controlled processes are serial (they follow step-by-step logic or computations), are used deliberately by the human being when he or she encounters a challenge or surprise, and are often associated with a subjective feeling of effort. Human beings can often provide a good introspective account of controlled processes. Standard tools of neoclassical economics, such as decision trees and dynamic programming, are stylized representations of controlled processes.

Automatic processes have the opposite characteristics: they operate in parallel, are not accessible to consciousness, and are relatively effortless. Parallelism facilitates rapid response and allows for massive multitasking that empowers the brain to perform certain types of tasks, such as visual identification, and provides redundancy that decreases the brain’s vulnerability to injury.

Since people are not able to consciously scrutinize automatic processes, they often have surprisingly little introspective insight into the way they make their automatic choices or judgments. Afterwards, the controlled system may reflect on the automatic choice or judgment and attempt to substantiate it logically, but it often does so spuriously.

Automatic and controlled processes occur in different regions of the brain. Automatic processes mostly occur in the back (occipital), top (parietal), and side (temporal) parts of the brain. The amygdala, which is located below the cortex, handles many important automatic affective responses, especially fear. Controlled processes mainly occur in the front (orbital and prefrontal) parts of the brain. The prefrontal cortex (pFC) is sometimes referred to as the “executive” region, because it retrieves inputs from almost all other regions of the brain, integrates them to form near- and long-term goals, and plans actions based on these goals. The prefrontal area is the region of the brain that has grown the most in the course of human evolution and, therefore, most sharply differentiates human beings from their closest primate relatives.

Automatic processes are the default mode of the operation of the brain. They operate all the time—even when human beings dream—and constitute most of the electrochemical activities in the brain. Controlled processes occur at special moments when they “interrupt” automatic processes. This happens when a human being encounters unexpected events, experiences strong visceral states, or faces some kind of explicit challenge in the form of a novel decision or problem.

Deliberation is hard work. It requires competing for mental resources and attention with all the other work that needs to be done at the same moment. Given the severe limitations of controlled processes, the brain constantly automates the processing of deliberative tasks, so that it can execute such tasks through automatic rather than controlled processes. When the brain confronts a new problem, it initially draws heavily on diverse regions of itself, including the prefrontal cortex (where controlled processes are concentrated). But, over time, the response to that problem becomes more streamlined and concentrated in brain regions that are specialized in processing the relevant tasks.

2. Costly thinking and the efficient markets hypothesis

This section discusses the implication of costly thinking with respect to the efficient markets hypothesis. Subsection 2.1 presents the idea intuitively, and Subsection 2.2 presents it formally.

2.1. Intuitive presentation

Neuroscience informs us that thinking imposes strain on the mind, in the sense that thinking is comparatively laborious and neurologically expensive. Cognition requires concentration. When thinking is costly, decision-making is costly. Individuals compare...
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