evaluating the welfare effects of a given private choice or public policy as follows:

- 1. Identify the various types and subtypes of resource uses in the economy.
- 2. Develop formulas that relate the aggregate percentage distortion in profits yielded by the marginal resource use of each such type and subtype to various Pareto imperfections in the economy.
- 3. Collect existing information on, and guesstimates of, the pre-choice or prepolicy magnitude of the parameters from step 2 showing those marginal resource uses whose profit yields seem likely to be inflated.
- 4. Take a random sample of marginal resources uses and estimate the aggregate percentage distortion in their profit yields.
- 5. Estimate the distribution of the nonnegative aggregate percentage profit distortions.
- 6. Analyze the way in which the private choice or public policy would affect (or did affect) the economy's various Pareto imperfections.
- 7. Estimate the allocative efficiency of the private choice or public policy by comparing the prechoice or prepolicy profitdistortion distribution with the postchoice or postpolicy profit-distortion distribution.

Professor Markovits notes, with no apparent sense of irony or humor, that a given TBLE analysis must pass its own TBLE test, resulting in an infinite regress where we conduct TBLE analyses on TBLE analyses on TBLE analyses, and so on forever (pp. 155–56).

Based on his TBLE analysis, Professor Markovits reaches a number of conclusions, including the following:

"I believe that too few resources are allocated to the production of goods other than leisure relative to the amount allocated to the production of leisure" (p. 170).

"Too few resources are allocated to unit-output-producing uses as opposed to [quality or variety] investment creation and use" (p. 170). "Too few resources are allocated to the production of existing products through existing production processes as opposed to [production-process-resource] execution and use" (p. 170).

"Too few resources are devoted to the production of existing products with existing technologies as opposed to the combination of [quality or variety] investment creation and use and [production-process-resource] execution and use-that is, almost certainly, economic efficiency would be increased if, without generating any allocative transaction costs, one reallocated some percentage of the resources currently devoted to [quality or variety] investment creation and use and the same percentage of the resources currently devoted to [production-process-resource] execution and use from a random sample of the marginal uses of each of these types to a random sample of unit-output-producing uses that are currently just extramarginal" (p. 170).

I could go on quoting Professor Markovits, but I am unable to provide any more insight into what he's trying to say. Unfortunately, any valuable substance that *Truth or Economics* may contain is lost in a blizzard of incomprehensible jargon.

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Midbrain Mutiny: The Picoeconomics and Neuroeconomics of Disordered Gambling: Economic Theory and Cognitive Science. By Don Ross, Carla Sharp, Rudy Vuchinich, and David Spurrett. Cambridge and London: MIT Press, Bradford, 2008. Pp. x, 301. \$38.00. ISBN 978-0-262-18265-2. JEL 2008-0806

Can economic theory inform how the brain carries out computations necessary to make economic choices? And can an understanding of the biological basis of such behavior help improve and refine economic models? These are some of the larger questions surrounding the nascent but rapidly growing field of neuroeconomics. For some, however, the goal of neuroeconomics is a practical one. For example, does the introduction of economic models of decision making help clarify issues concerning diagnosis and treatment of neurological and mental illnesses? The latter set of questions, through the case study of disordered

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gambling, are the focus of *Midbrain Mutiny*. At the same time, however, the evidence reviewed along the way helps to clarify and answer the larger question of why should economists care about neuroscience, and vice versa.

Midbrain Mutiny continues the thesis set forth in Economic Theory and Cognitive Science (Don Ross 2005). In the latter book, Ross (one of the four authors here) argues against the standard depiction in economic theory of a unitary decisionmaker with stable, transitive preferences. In contrast, Ross offers the view that an individual's choices can be best interpreted as a game between subagents within the individual, an approach referred to as "picoeconomics," first put forth by George Ainslie (1992). The current book focuses on the specific case of disordered gambling, gathering an impressive collection of data from behavioral psychology, experimental economics, neuroeconomics, and pharmacology. Chapter 2 describes the scientific disagreements surrounding gambling addiction and traces much of the confusion over the diagnosis of "pathological gambling," defined through the Diagnostic and Statistical Manual of Mental Disorders – IV (DSM-IV, 2000). For economists, this chapter also illustrates the contributions that experimental economics can make to neuroscientific studies of addictive behavior and psychopathologies by measuring behavior in a precise and quantitative manner. The DSM-IV diagnostic for pathologic gambling criterion, for example, includes some the following: (1) you have often gambled longer than you had planned, (2) you have made repeated, unsuccessful attempts to stop gambling, and (3) you have felt depressed or suicidal because of your gambling losses (p. 33). Agreeing with five or more of the ten statements would qualify one as a pathological gambler. Not surprisingly, this qualitative diagnostic tool has generated much controversy in both over- and underdiagnosis of pathological gambling.

Chapter 3 and 4 presents the experimental evidence from behavioral studies of impulsivity and temporal discounting, identifying these as crucial features of addictive behavior. Informed readers of the hyperbolic discounting literature will not be surprised to find that this literature had its origins in studies of animal behavior in the 1960s, due in large part to the efforts of the late Richard Hernstein. These studies laid the foundation for the modern effort to model and quantify addictive behavior. This chapter also discusses the rational addictions model, including behavior that are difficult for such a model to account for, such as external commitment and personal rules, which are often imposed at great cost to the individual. Much of this was previously discussed in Ross (2005) and is only mentioned briefly here.

Chapter 5 somewhat abruptly introduces the literature on the neuroeconomics of addiction. It draws from the flurry of studies in the past ten years or so on the midbrain dopaminergic regions, the so-called "reward system." This is the network of regions that are enervated by dopamine, a neurotransmitter that is now thought to be intimately tied to reward. Many of these studies either involve or draw upon the research of economists working in tandem with neuroscientists. This then becomes the thesis and title of the book, presented in chapter 6-that disregulation of these basic structures related to reward is at the core of disordered gambling. Some of the most powerful evidence for this view are studies documenting the development of addictive gambling behavior as caused by certain pharmaceutical agents (p. 190). This evidence is presented in chapter 7 and it is, in many ways, the strongest chapter of the book. It offers a clear glimpse of why neuroeconomics is valuable to theorists and practitioners alike-economic models provide precise, quantitative behavioral measures that can improve the sensitivity and validity of clinical trials, which in turn provide powerful tests of causality.

This chapter, however, also highlights an unfortunate aspect of the book—the tendency to mention many studies briefly, while not describing any in detail. This leads to a relative paucity of details on the methodology and background of the many studies cited. For example, table 7.1 (pp. 182–85) presents no less than twenty-four separate pharmacotherapy studies, across five different drug classes. Many of the studies are so new that it is difficult to separate the signal from the noise. There are also practical and ethical constraints faced in conducting such studies, which often result in small and heterogeneous samples. Readers not intimately familiar to the neuroscience and pharmacology literature (that is, most lis

economists) will have difficulty understanding the weight they should attach to these findings.

The eighth and final chapter is in large part an attempt to bridge the picoeconomics view of an individual's decisions as the byproduct of the game between multiple subagents, each with their own particular goals and desires, and the algorithmic and mechanistic decision-making approach of neuroeconomics. One possibility is, as the neuroscientist Greg Berns succinctly put it, "The interaction of different pools of neurons in the brain may result in phenotypic behavior that appears to be irrational, but it is possible that the rational agents are the neurons, not the person" (p. 125). Unfortunately, such pools of neurons have proved elusive. Perhaps even more troublesome, it is unclear what constitutes as proof of the existence of such neurons. To take the example of a highly influential but at the same time controversial study, Samuel M. McClure et al. (2004) observed distinct brain regions that responded choice sets that included only delayed rewards versus those that also included immediate rewards. This, along with other results, were interpreted as evidence for existence of separate impulsive " β -system" and a patient " δ -system." Such an interpretation has been challenged on both empirical and conceptual grounds (pp. 237-39). Ross et al., however, offer no suggestion on what would qualify as persuasive evidence for the existence of such subsystems, and sidestep the issue as an empirical one, "Evidence that they do not have direct molecular counterparts as McClure et al. suggest is not evidence that they don't exist (italics original)" (p. 238). This is disappointing as the authors, given the emphasis in the philosophy of science and their positioning of picoeconomics as a serious alternative model, are well-positioned to make such an argument.

In sum, *Midbrain Mutiny* is a welcome addition to the growing literature in neuroeconomics. It will likely prove to be difficult to follow at various points for all but the most well-informed readers. Someone who is expecting a gentle introduction to the terminology and stylized facts of neuroeconomics will likely be overwhelmed by the immediate references to, among others, brain regions, neurotransmitters, and pharmacological agents. Those willing to invest the effort, however, will find a thoughtful and provocative book that will appeal to those who are interested in seeing the real world implications of a biological understanding of economic behavior, as well as how economic theory contributes to such an understanding.

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Nudge: Improving Decisions about Health, Wealth, and Happiness. By Richard H. Thaler and Cass R. Sunstein. New Haven and London: Yale University Press, 2008. Pp. x, 293. \$26.00. ISBN 978-0-300-12223-7.

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In the first chapter of Nudge, Thaler and Sunstein lay out two types of people: homo economicus and homo sapiens. Homo economicus, or "Econ" for short, is "economic man" who "chooses unfailingly well, and thus fits within the textbook picture of human beings offered by economists" (page 6). Homo sapiens, or "Humans" for short, are real people who make systematic mistakes, experience temptation, have limited energy, attention, knowledge, will-power, and computational capacity. Nudge leads us through a summary of current research in economics, cleverly organized to highlight the differences between Econs and Humans as they make decisions in key markets central to current economics and public policy debates.

The typical Human who reads this book will find it interesting and enjoyable to read—a book that systematically describes and defines behaviors and summarizes current research showing