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Neuroeconomics: Bringing Neuroscience and Economics Together

Noroiktisat: Norobilim ve Iktisadi Biraraya Getirmek

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Abstract

There are revealed situations in economics where the key axioms of mainstream theory are violated. Bandwagon, snob and Veblen effects are the examples from the demand theory . Maurice Allais and Daniel Ellsberg have determined the behavior anomalies under risk and uncertainty in 1953 and in 1962 respectively.

Deviations from the optimal economic behavior have been argued by several economists and psychologists. Currently the components of economic behavior is being discussed at a neural base by neuroeconomists combining the methods of neuroscience and economics.

This study is designed to understand neuroeconomics, its techniques and applications and also it is aimed to better understand the basic motives underlying economic behavior in real life situations.

Keywords: Neuroeconomics, rationality, irrational economic behavior.

Özet

Iktisatta, temel teorik yapilarin anahtar aksiyomlarinin ihlal edildigine dair aciklanmis durumlar vardir. Bandwagon, snob ve Veblen etkileri talep teorisinden ornekleridir. Maurice Allais(1953) ve Daniel Ellsberg(1962) risk ve belirsizlik altinda ortaya cikan davranis anomalilerini saptamislardir.

Optimal iktisadi davranistan sapmalar, cesitli iktisatcilar ve psikologlar tarafindan ele alinmistir. Gunumuzde iktisadi davranisin bilesenleri; noroiktisatcilar tarafindan, norobilim ve iktisadin metodlari birlestirilerek, noral temelde tartisilmaktadir.

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Bu calisma noroiktisadi, tekniklerini ve uygulamalarini anlamak icin tasarlanmistir ve ayrica gercek hayat kosullarinda, iktisadi davranisa temel teskil eden esas guduleri daha iyi anlamak amaclanmistir.

Anahtar Kelimeler: Noroiktisat, rasyonellik, irrasyonel iktisadi davranis.

INTRODUCTION

Economics is a branch of social sciences that studies how society manages its scarce resources (Mankiw, 2003:4). Methodologists have often found social sciences including economics problematic because of their relationship to experiment; especially controlled, repeatable laboratory experiments have been almost non-existent in the practice of social sciences (Nelson, 1998:179). However, experimental studies have grown rapidly since 1960 and now laboratory experimentation has a considerable share in economic research. Some sprung up, new subdisciplines such as experimental economics, behavioral economics, psychological economics, cognitive economics and neuroeconomics have been possessing significant conributions to economic analysis. It is now possible to discover the key components of economic behavior and develop more accurate models.

Under standard economic assumptions, individuals are presumed to be motivated by self-interest, preoccupied with maximizing individual utility or satisfaction, driven by cold economic calculation without concern for others, capable of instantaneous learning and so on (Agarwall and Vercelli, 2005:2). It is natural to expect a person donated with these characteristics to be narrowly rational and inevitably unemotional. On these grounds, while the basic parameters of economic behavior; utility and satisfaction are analyzed, the emotional mechanisms have been suppressed. As a result individual economic behavior has fallen short of reality.

Theoretically it has been sceptic about the measurement of economic behavior and also the parameters such as utility and satisfaction. Utility was thought of as a numeric measure and an indicator of a person's happiness and well-being; conceptualized as "cardinal" (enables quantitative measurement of utility) and "ordinal" (enables relative ranking of preferences) in economic analysis (Varian, 1987:54). Originally, measuring utility had been discussed in classical economics before Pareto and the neoclassicals abandoned. For example, Francis Y. Edgeworth (1845-1926), dreamed of a 'hedonimeter' that could measure utility directly; Frank Ramsey (1903-1930) fantasied about a 'psychogalvanometer'; and Irving Fisher (1867-1947), wrote extensively due to frustration about how utility could be measured directly (Camerer, 2007:40).

Emotional processes were ignored in economics because of the quantitative measurement problem. This was epressed by William Stanley Jevons (1835-1882) in 1871. He mentioned that; it was a hesitation for him to say that men would ever have the means of measuring directly the feelings of the human heart. (Camerer et al. , 2005:9).

This turn -of-the-century pessimism about understanding the brain led directly to the rise of 'as if' rational choice models in neoclassical economics (Camerer, 2007:27). Although, "as if" modeling is necessary for simplicity, generality and variability; factually it is not enough for the evaluation of real life situations.

Furthermore, recent technological developments in genetics, biology, cognitive and neuroscience now make it possible to obtain direct measurements of emotions, pain, satisfaction and pleasure. It is now possible to better understand economic behavior with interdisciplinary studies. Combining the techniques of different disciplines, more accurate models of economic decision making, preferences and choice behavior can be constructed. Several psychologists (Edwards, Kahneman, Lichtenstein, Slovic and Tversky) and economists (Allais, Ellsberg) have examined hypothetical and actual individual choice behavior in this respect.

As an interdisciplinary research field "neuroeconomics" uses neuroscientific tools and methods to understand economic behavior by testing traditional economic axioms, models and theories at a neural base and builds a bridge between neuroscience and economics. It also merges methods from neuroscience and economics to better understand how the human brain generates decisions in economic and social contexts (Fehr et al. , 2005:346) using functional magnetic resonance imaging (f MRI), transcranial magnetic stimulation (TMS), pharmacological interventions and other techniques (Fehr and Camerer, 2007:419).

Neuroeconomics integrates the disparate theoretical models, techniques and axioms of psychology, neuroscience and economics. We know that, the brain has specialized systems for different functions. Accordingly; decision making, bargaining, choice, trust and fairness in monetary games, rationality, time and risk preferences, altruism can be observed and understood by the interactions among brain systems determining individual behavior.

This study includes some examples of neuroeconomic studies examining rational behavior. Thus, the theory of expected utility, the discounted utility model and the ultimatum game are briefly described to understand the deviations from rational behavior predicted in the mainstream economic theory.

Examples From The Theory Of Expected Utility And The Discounted Utility Model

Different disciplines have approached decision making using different methods. How we make decisions and judgments have been attractive for both economists and behavioral scientists. Decision making processes can be examined in a perspective of psychology, neuroscience and economics and each can benefit others' insights in this respect.

Research in neuroscience and psychology has already begun to investigate decision predictability and value as central parameters in the economic theory of expected utility (Sanfey et al. , 2006:108). The theory was at first suggested by Daniel Bernoulli in 1738 as a resolution of the St. Petersburg and Allais Paradoxes. It was reinterpreted by John Von Neumann and Oscar Morgenstern in 1944.

The theory of expected utility states that decision maker chooses between risky or uncertain prospects by comparing the expected utility values that are the weighted sums obtained by adding the utility values of outcomes multiplied by their respective probabilities (Mongin, 1998:171). For example the expected utility for the two-outcome lottery L=(P, A, B) is E[U(L)]=PU(A)+(1-P)U(B) where the outcomes and their probabilities are denoted by A, B and P, (1-P) respectively (Henderson and Quandt, 1980:54).

Knutson et al. investigated the neural bases of individual utility perception and found that the subcortical nucleus accumbens (NAcc) was activated proportional to anticipated gain magnitude, whereas the cortical mesial prefrontal cortex (MPFC) was additionally activated according to anticipated gain probability (RongJun and XiaoLin, 2007:1155).

In another study examining individual time preference; the discounted utility model is tested and found strong evidence that discounting is more different for short time delays than for longer delays (Sanfey et al. , 2006:112). When people were offered to make a choice between $10 today and $11 in a week; many people chose the immediate $10. On the other hand, when they were offered to make a choice between $10 in a year and $11 in a year and a week; most people chose $11. There is an inconsistency conflicting with the economic point of view. This phenomenon is called as hyperbolic time discounting. However, canonical economic theory suggests that intertemporal choice should be consistent over time; we usually choose the alternatives tempting in the short-run which would be more optimal in the long-run in real life situations. The explanation is that short term gratification delays have strong effects, while long term benefits and costs are difficult to perceive on the same basis as immediate benefits and costs (Mcfadden, 1999:95). This can be related to "the fear of the unknown". Because when we make decisions, we make some kind of predictions and every prediction has inherent risk and uncertainty. Intertemporal choice is also related to passions. Adam Smith (1723-1790) viewed the passions as largely myopic: "the pleasure which we are to enjoy ten years hence, interests us so little in comparison with that we may enjoy to-day" (Ashraf et al. , 2005:133).

Mc Clure et al. (2004) used fMRI to examine the neural correlates of time discounting and found that the limbic system was activated by decisions involving immediate available rewards and in contrast regions of the lateral prefrontal cortex and posterior parietal cortex were engaged uniformly by intertemporal choices irrespectively of delay and that relative engagement of the two systems was directly associated with subjects' choices; with greater relative fronto-parietal activity; subjects chose longer term options (RongJun and XiaoLin, 2007:1155).

The contradiction in intertemporal choice behavior is also concerned with "myopic loss aversion". Myopic loss aversion is the combination of a greater sensitivity to losses than to gains and a tendency to evaluate outcomes frequently (Thaler, 1997:647). This definition has important consequences on the shape of the standard value function in economic theory. Daniel Kahneman and Amos Tversky illustrated the value function; having a kink at its origin in the "prospect theory" in 1979. The value function was also defined on deviations from the reference point,

generally concave for gains, commonly convex for losses and also steeper for losses than for gains (Kahneman and Tversky, 1979:279). The value function is displayed in the figure. H. C. Breiter et al. and C. B. Holroyd et al. have provided support for this prediction that people evaluate the outcomes of decisions based on a flexible reference point, using both fMRI and scalp electrical recordings (Sanfey et al. , 2006:110).

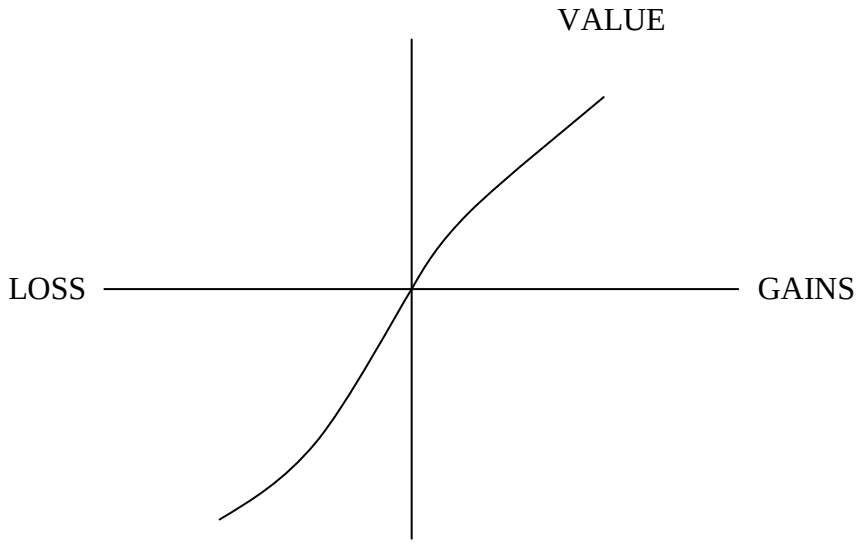

Figure-A hypothetical value function (Kahneman and Tversky, 1979:279).

The Ultimatum Game: An Example Of Irrational Economic Behavior

In the ultimatum game there are two participants. One of them is proposer and the other is responder. The proposer's task is to divide some money between himself and the responder. If the responder accepts, gets the offered amount and the proposer gets the rest. But if the responder rejects; neither player receives anything. Theoretically and reasonably "more is better than less". So, we expect that the proposer will offer the smallest amount and the responder will accept any offer more than zero. However, the empirical results differed so dramatically from the predictions of economic theory; observed that proposers offered around 40% and offers of less than 20% were rejected (Fehr and Camerer, 2007:420). People reject inequality, even if it means leaving empty-handed.

Although economic theory considers individuals as unemotional utility maximizers; behavior in real life situations is more complex; not just driven by self interest but also by altruism, guilt, desire and other emotions (Agarwall and Vercelli, 2005:2). Many people exhibit social preferences that is their preferred choices based on a positive or negative concern for the welfare of the others and on what other players believe about them (Fehr and Camerer, 2007:419). Despite the

existence of dominant individual self-guided goals; social preferences can easily lead to irrational behavior. If people have social preferences the brain must compare social motives and economic self-interest and resolve conflict between them (Fehr and Camerer, 2007:423). G. Tabibnia et al. and A. G. Sanfey et al.(2003)'s neuroimaging studies suggest that the dorsolateral (DLPFC) and ventrolateral (VLPFC) prefrontal cortexes play important roles in the processing of decisions involving social preferences (Fehr and Camerer, 2007:423).

In the ultimatum game, proposers exhibit altruistic or pro-social behavior - as it is called in psychological terminology- offering higher amounts (Kritikos and Bolle, 2005:181). Responders exhibit "altruistic punishment" behavior. That is withholding the money from the proposer is only possible at a loss to the responder. As it was written by Adam Smith in 1759: (Agarwall and Vercelli, 2005:1)"How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it, except the pleasure of seeing it."

Sanfey et al. (2003) investigated the neural bases of economic decision making in the ultimatum game using functional magnetic resonance imaging (fMRI) and found two brain regions particularly active when the participant was confronted with an unfair offer; the anterior insula and the dorsolateral prefrontal cortex (dIPFC) and also found that when the insular activation was greater than the dIPFC activation; participants tended to reject the offer whereas if the dIPFC avtivation was greater they tended to accept it (Sanfey et al. , 2006:113).

CONCLUSION

Plato composed the human soul to a chariot pulled by the two horses of reason and emotion. Generally economic analysis focused on reason and the role of emotions is ignored. Because of his awareness of tendency of the markets to punish foolish behavior; individuals –theoretically called as "homo-economicus" acts only with the aim of maximizing utility without any emotion. To fill the gap, the components of economic behavior must be reexamined and the next step must be to find out how can both economics and neuroscience benefit each other's insights. Thereby, neuroeconomics can provide the other horse for the chariot to economic analysis.

We know that the brain is the ultimate black box. The facilities of neuroeconomics enable economists deepen the analysis to understand economic behavior, studying with the related areas in the brain. It is not possible to fully open the black box yet. But measuring brain activity using neuroimaging techniques and observing subjects' brains second by second, it can be leaved ajar!

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