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Abstract

In the Theory of Rational Decision Making the psychological aspects are set aside. This contribution seeks to point out the relevance of psychology into economic decisions. The essay treats the "framing of decisions", which is a pillar of Kahneman's behavioral theory. Framing must be considered a special case of the more general phenomenon of dependency from the representation. The best-known risky choice-framing problem, i.e. the "Asian Disease Problem", is shown where an essential aspect of rationality: *invariance*, is violated. In addition, the contribution explains Kahneman and Tversky's Prospect Theory and illustrates their value function. Finally, it discusses the reversals of preference in framing and framing of contingencies. The framing manipulation is viewed as a public tool for influencing the decision maker's private framing of the problem in terms of gains or losses, which determines the decision maker's evaluation of the options. In conclusion, the psychology of choice is relevant both for the descriptive question of how decisions are made and for the normative question of how decisions ought to be made.

Keywords: Behavioral Economics; Framing of Decisions; Prospect Theory; Daniel Kahneman
JEL Classfication: D01; D03; D81

1. Introduction.

The Theory of Rational Decision Making was characterized by a view, according to which the psychological aspects of decision-making were not considered worthy of investigation, because non-rational behaviors were thought to be a minor aspect of market economies.

The theoretical basis of this view was provided by Milton Friedman and Leonard Savage in 1948, when they published in the *Journal of Political Economy* the article "The Utility Analysis of Choices Involving Risks". In this article they constructed an utility function, arguing that the curvature of an individual's utility function differs based upon the amount of wealth the individual has. In particular, this variably curving utility function would explain why an individual is risk-loving when he has more wealth (e.g., by playing the lottery), and risk-averse when he is poorer (e.g., by buying insurance).

In 1952 Friedman and Savage published, again in the *Journal of Political Economy*, a second article "The Expected-Utility Hypothesis and the Measurability of Utility**",** in which they constructed an expected utility curve that, they claimed, provided a reasonably accurate representation of human behavior at the aggregate level. Friedman and Savage (1952) argued that deviations from rational decision making were supposed to be detectable only at the aggregate level. They made many attempts to justify the persuasion that, on average, individuals behave rationally.

Friedman, in particular, suggested an evolutionary defense of full rationality by claiming that those who failed to conform to rational behavior would be gradually excluded by market selection.

However, during the fifties there has been important explorations along the boundaries between economics and psychology. This line of research determined the development of *behavioral economics* which exactly relates psychological factors to economic behavior (Rabin, 1998).

In general, Behavioral economics explores:

I) why people sometimes make irrational decisions,

II) why and how their behavior does not follow the predictions of (mainstream) economic models.

Daniel Kahneman, who won the Nobel Prize in Economics in 2002, in his Nobel Lecture "Maps of Bounded Rationality: A Perspective on Intuitive Judgment and Choice" follows a line of human reasoning different from pure rationality and proposes an innovative approach with his development of the dual-process account of reasoning. Kahneman's line of thought is based on the distinction between the process of *deliberate reasoning*, that is a controlled mode, which is slower, and that of *intuition* in which judgments and decisions are made automatically. In other words, in a first approximation, "intuition" denotes a mental activity largely automatized and inaccessible from conscious mental activity.

The analysis of the interactions between these two processes (*deliberate reasoning* & *intuition*) provides the basis for explaining the persistence of the gap between normative and behavioral patterns, and, interestingly, is not limited to the field of decision making; in two fundamental fields, probability and logic, large evidence shows that human activities deviate from the prescriptions of the theoretical models.

An important topic that Kahneman treat in his Nobel Lecture is "framing effects", since this is one pillar of his behavioral theory. He designed the "framing effect" with Amos Tversky, who died in 1996.

2. The Framing of Decisions and the Psychology of Choice

Tversky and Kahneman, in their article "The Framing of Decisions and the Psychology of Choice", *Science,* 1981**,** look at the psychological principles that govern the perception of decision problems. According to Tversky and Kahneman, the evaluation of probabilities and outcomes produce predictable shifts of preference when the same problem is framed in different ways.

In the classical Theory of Rational Choice, choices should satisfy some elementary requirements of consistency and coherence[1].

Tversky and Kahneman describe decision problems in which people systematically violate the requirements of consistency and coherence of the Theory of Rational Choice, and trace these violations to the psychological principles that govern the perception of decision problems and the evaluation of options.

2.1. Framing Effect and the Framing of Decision

Kahneman emphasizes the essential role of the "Framing effect" for understanding the origin of biases in decision making and reasoning. He suggests that framing must be considered a special case of the more general phenomenon of dependency from the representation: the question is how to explain the fact that different representations of the same problem yield different human decisions.

[1] For a critical analysis of the Theory of Rational Choice see Schilirò (2012)

The "Framing of Decision" implies a criticism to Subjective Expected Utility Theory (Savage, 1954), which is a theory of decision making under uncertainty, used to define choice-based subjective probabilities.

One of the axioms of Subjective Expected Utility Theory, violated by the experimental results, is *invariance*. This violation is attributed by Tversky and Kahneman (1981) to the different *accessibility*, where a*ccessibility* is defined as "the ease with which particular mental contents come to mind".

Thinking is supposed to be composed *by two different cognitive processes*: on the one hand a controlled, deliberate, sequential and effortful process of calculation; on the other a non-deliberate process, which is automatic, effortless, parallel and fast. The two processes were described in many different ways, by different authors, but there is nowadays considerable agreement among psychologists on the characteristics that distinguish them.

2.2. The Asian Disease

The term decision frame refers to the decision- maker's conception of the acts, outcomes and contingencies associated with a particular choice. It is possible to frame a given decision problem in more than one way.

The best-known risky choice-framing problem is the so-called "Asian Disease Problem" (Tversky and Kahneman, 1981).

Imagine that the United States is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed. Assume that the exact scientific estimates of the consequences of the programs are as follows: **Problem 1**

- If Program A is adopted, 200 people will be saved,
- If Program B is adopted, there is a one-third probability that 600 people will be saved and a two-thirds probability that no people will be saved.

Which of the two programs would you favor?

72 per cent of the respondents say A; 28 per cent say B

The majority of choice in this **Problem 1** is risk averse: the prospect of certainly saving 200 lives is more attractive than a risky prospect of equal expected value.

A second group of respondents, selected at random, receive a question in which the same cover story is followed by a different description of the options: **Problem 2**

- If Program A' is adopted, 400 people will die,
- If Program B' is adopted, there is a one-third probability that nobody will die and a two-thirds probability that 600 people will die

Which of the two programs would you favor?

22 per cent of the respondents say A'; 78 per cent say B'

The majority choice in **Problem 2** is risk taking: the certain death of 400 people is less acceptable than the two-in-three chance that 600 will die.

So respondents choose A and B' in the two problems respectively.

The preferences in **Problems 1 and 2** illustrate a common pattern: choices involving gains are often risk averse and choices involving losses are often risk taking.

However, it is easy to see that the two problems are effectively identical. The only difference between them is that the outcomes are described in **Problem 1** by the number of lives saved and in **Problem 2** by the number of lives lost. The change is accompanied by a pronounced shift of respondents from risk aversion to risk taking.

Inconsistent responses to **Problems 1 and 2** arise from the conjunction of a framing effect with contradictory attitudes towards risks involving gains and losses.

In the Asian Disease problem (Tversky and Kahnemann, 1981), *invariance* is an essential aspect of rationality, which is violated.

2.3. The expected utility theory.

Tversky and Kahneman (1981) go further in their criticism of the classical Theory of Decision-Making Under Risk, i.e. the expected utility theory**.**

The expected utility theory (EUT) has been generally accepted as a normative model of rational choice.
The set of axioms (for example, transitivity of preferences) provides criteria for the rationality of choices.

In the EUT the utility of a risky prospect is equal to the expected utility of its outcomes, obtained by weighting the utility of each possible outcome for its probability. When faced with a choice, a rational decision-maker will prefer the prospect that offers the highest expected utility (Von Neumann, Morgenstern, *Theory of Games and Economic Behavior*, 1944; Savage, *The Foundation of Statistics*, 1954).

Tversky and Kahneman (1981) show that people exhibit patterns of preference, which appear *incompatible* with expected utility theory.

2.4. Kahneman and Tversky's Prospect Theory

Kahneman and Tversky**,** in their article "Prospect Theory: An Analysis of Decision Under Risk", *Econometrica*, 1979) have already presented a critique of expected utility model as a descriptive model of decision making under risk and developed an alternative descriptive model called "Prospect Theory", which is a positive theory to rationalize the puzzles found in the expected utility model.

In fact, choice among risky prospects, as it will be shown in the analysis by Kahneman and Tversky, exhibit several pervasive effects that are inconsistent with the basic tenets of expected utility model.

1. People underweight outcomes that are merely probable in comparison with outcomes that are obtained with certainty. This outcome, called the *certainty effect*, contributes to *risk aversion* in choices involving sure gains and to *risk seeking* in choices involving sure losses.

   The *certainty effect* is also found in the Allais' paradox and common ratio paradox.

2. People have the tendency to isolate consecutive chances, rather than deal with them together. This tendency, called the *isolation effect*, leads to inconsistent preferences when the same choice is presented in different forms.

   Thus, due to *isolation effect* preferences may be altered by different representations of probabilities.

3. Subjects' risk attitude changes according to a reference level that categorizes outcomes into gains and losses. This is the *reflection effect*. In particular, risk aversion exists in the positive domain and risk seeking in the negative domain.

Thus, Kahneman and Tversky (1979) have found systematic violations of expected utility theory in *actual* behavior.

In Prospect Theory, decision process occurs in two stages:

i) *The editing phase*: organize and reformulate the options so as to simplify subsequent evaluation and choice. Editing consists of the application of several operations that transform the outcomes and probabilities associated with the offered prospects. Outcomes are expressed as positive or negative deviations (gains or losses) from a neutral reference outcome. Thus, the value function derived reflect these features (as we shall see below). This value function assigns a value to an outcome.

ii) *The evaluation phase*: assign utilities and choose. In this phase, the decision maker is assumed to evaluate each of the edited prospects, and to choose the prospect of highest value.

Kahneman and Tversky assume for the evaluation phase in their Prospect theory an overall value of an edited prospect, denoted V, wich is expressed in terms of two scales, π and v, and is given by:

$$V = \sum^{n}_{i=1} \pi(p_i)\, v(x_i)$$

The overall or expected utility of the outcomes to the individual making the decision, are the potential outcomes and their respective probabilities, and is a function that assigns a value to an outcome

where

x_1, x_2, etc. are potential outcomes; p_1, p_2, etc. are respective probabilities

Since there are values v(.) associated with outcomes, and decision weights π (.) associated with probabilities. More specifically,

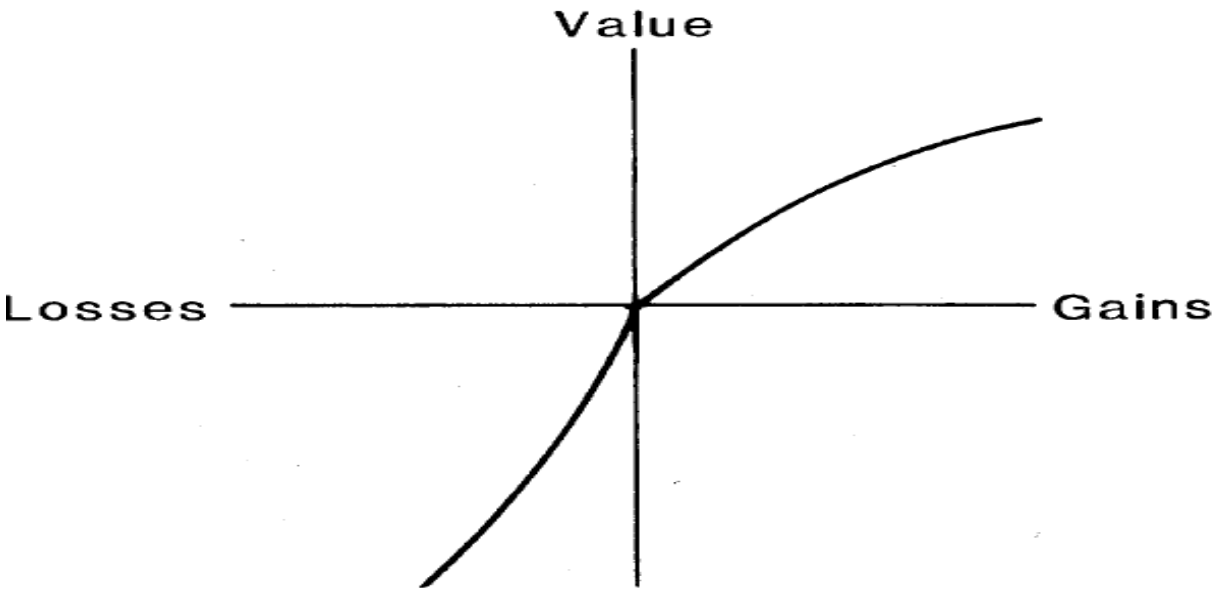
$v(x_i)$ is a value function that assigns to each outcome *x* a number v (x), which reflects the subjective value of that outcome.

$\pi(p_i)$ is the weighting function, namely a transformation function that expresses objective probabilities in subjectively perceived chances.

The value function that Kahneman and Tversky propose in their Prospect Theory is commonly **S-shaped and asymmetrical**, concave above the (neutral) reference point, which is assigned a value of zero, and convex below it, as illustrated in the figure 1.

Figure 1

Value Function



This function is a representation of the difference in utility (amount of pain or joy) that is achieved as a result of a certain amount of gain or loss.

Properties of the value function

According to Kahneman and Tversky (1979, p. 279) the value function is

(i) defined on deviations from the reference point (gain and losses, not wealth). For instance, the difference in subjective value between gains of $10 and $20 is greater than the subjective difference between gains of $110 and $120. The same relation between value differences holds for the corresponding losses;

(ii) The value function is generally concave for gains (implying risk aversion) and commonly convex for losses (implying risk seeking).

(iii) It is steeper for losses than for gains (Loss aversion). This property of the value function reveals that the response of losses is more extreme than the response to gains. The displeasure associated with losing a sum of money is generally greater than the pleasure associated with winning the same amount.

In this value function, impossible events are discarded: $\pi(0) = 0$

Usually the value function is expressed by the following expression:

$v(x) = x^{1-r}$ if $x > 0$
$v(x) = \lambda(-x^{1-r})$ if $x < 0$
$v(x) < -v(-x)$ (Loss aversion)

Therefore, "Prospect Theory…should be viewed as an approximate, incomplete, and simplified description of the evaluation of risky prospects" (Tversky and Kahneman**,** 1981, p.454).
A consequence in Prospect Theory is that overweighting of low probabilities may contribute to the attractiveness of both insurance and gambling (Kahneman and Tversky,1979).

Summing up:

Prospect Theory, which is the alternative theory of choice developed by Kahneman and Tversky (1979), considers that

i) The value function is normally concave for gains, commonly convex for losses, and is generally steeper for losses than for gains.

ii) value is assigned to gains and losses rather than to final assets, and probabilities are replaced by decision weights.

iii) Decision weights are generally lower than the corresponding probabilities.

A "framing effect" is usually said to occur when "*equivalent descriptions of a decision problem lead to systematically different decisions".*

Because of the characteristic nonlinearity of π and v, different frames can lead to different choices.

2.5. Reversals of Preference in Framing and Framing of Contingencies

Tversky and Kahneman (1981) have presented a series of demonstrations in which inconsequential changes in the formulation of choice problems cause significant shifts of preference. They propose several problems to show the reversals of preferences that can be caused by variations in the framing of acts, contingencies and outcomes.

Tversky and Kahneman (1981) show, for instance, that a riskless prospect is preferred to a risky prospect of equal or greater expected value. In contrast, a risky prospect is preferred to a riskless prospect of equal expected value.

For brevity, we focus only on the problems related to the *framing of contingencies*.

People are asked: Which of the following options you prefer?

Problem 1

A. a sure win of (certainty) of $30. [78 per cent]

B. 80% chance to win $45. [22 per cent]

Problem 2

Consider the following two-stage game. In the first stage there is a 75% chance to end the game without winning anything and a 25% chance to move into the second stage.

If you reach the second stage, choose between

C. A sure win (certainty) of $30 [74 per cent]

D. 80% chance to win 45$ [26 per cent]

- Your choices must be made before the game starts, i.e. before the outcome of the first stage is known. Please indicate the option you prefer.

Problem 3

Which of the following options do you prefer?

E. 25% chance to win $30 [42 per cent]

F. 20% chance to win $45 [58 per cent]

Note that **Problems 2 and 3** are identical in terms of probabilities and outcomes, because prospect C offers a 25% chance to win $30 and prospect D offers a probability of 25% x 80% = 20% chance to win $45.

Consistency therefore requires that the same choice be made in **Problems 2 and 3.**

In addition, note that **Problem 2** differs from problem 1 only by the introduction of a preliminary stage.

If the second stage of the game is reached, then **Problem 2** reduces to **Problem 1**; if the game ends at the first stage, the decision does not affect the outcome.

Hence there seems to be no reason to make a different choice in **Problems 1 and 2**.

By this logical analysis, **Problem 2** is equivalent to **Problem 3** on the one hand and **Problem 1** on the other. The participants, however, responded similarly to **Problems 1 and 2** but differently to **Problem 3**.

This pattern of responses exhibits two phenomena of choice: the *certainty effect* and the *pseudo-certainty effect*.

The contrast between **Problems 1 and 3** illustrates a phenomenon discovered by Allais (1953), which Tversky and Kahneman have labeled the *certainty effect*: a reduction of the probability of an outcome by a constant factor has more impact when the outcome was initially certain than when it was merely probable. Prospect theory attributes this effect to the properties of π.

Actually, Prospect theory does not predict a reversal of preference for every individual in **Problems 1 and 3**. It only requires that an individual who has no preference between

A. a sure win of (certainty) of $30

and

B. 80% chance to win $45

prefer F. 20% chance to win $45

to E. 25% chance to win $30

The striking discrepancy between the responses to **Problems 2 and 3**, which are identical in outcomes and probabilities, could be described as a *pseudo-certainty effect*.

The prospect yielding $30 is relatively more attractive in **Problem 2** than in **Problem 3**, as if it had the advantage of certainty. The sense of certainty associated with option C is illusory, however, since the gain is in fact contingent on reaching the second stage of the game.

Tversky and Kahneman obtained the *pseudo-certainty effect* in several studies where the description of the decision problems favored conditional evaluation.

Lastly, many significant decisions concern actions that reduce or eliminate the probability of a hazard, at some cost. The shape of π in the range of low probabilities suggests that a protective action which reduces the probability of a harm from 1 percent to zero, say, will be valued more highly than an action that reduces the probability of the same harm from 2 percent to 1 percent.

For instance, probabilistic insurance, which reduces the probability of loss by half, is judged to be worth less than half the price of regular insurance that eliminates the risk altogether.

Tversky and Kahneman reach the conclusion that the inconsistencies highlighted in the problems shown were traced to the interaction of two sets of factors: variations in the framing of acts, contingencies, and outcomes, and the characteristic nonlinearities of values and decision weights. The demonstrated effects are large and systematic, although by no means universal. They occur when the outcomes concern the loss of human lives as well as in choices about money; they are not restricted to hypothetical questions and are not eliminated by monetary incentives.
Preference reversals, or other errors of choice or judgment, are not necessarily irrational.

Finally, the assumption that preferences are not affected by variations of irrelevant features of options or outcomes has been called *extensionality* (Kenneth Arrow, 1982) and *invariance* (Tversky and Kahneman, 1986).

Conclusions

The work of Tversky and Kahneman (1981) has been primarily concerned with the descriptive question of how decisions are made. But, according to these authors, the psychology of choice is also relevant to the normative question of how decisions ought to be made.

The susceptibility of preferences to variations of framing raises doubt about the feasibility and adequacy of the coherence criterion, which is the one adopted by the modern theory of rational choice.

Risky choice framing effects have been put forward as *positive* evidence for Prospect theory that represents a theory of choice which aims to be both formally tractable and cognitively realistic .

Thus, the framing manipulation is viewed as a public tool for influencing the decision maker's private framing of the problem in terms of gains or losses, which determines the decision maker's evaluation of the options.

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