Prospect Theory or A Misuse of the Concept of Opportunity Cost?

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ABSTRACT

This paper shows that "risk seeking in the domain of losses" phenomenon of prospect theory may be just: "people misuse the concept of opportunity cost in the domain of losses". The reference points of Kahneman et al.'s (1979) value function in the domain of gains and in the domain of losses are different. The paper also shows that Kahneman et al.'s two-stage experiment is in fact a one-stage experiment, and their isolation effect (reversal of preferences) does not exist.

Key words: opportunity cost, prospect theory, reference point, isolation effect (reversal of preferences), framing effect.

JEL Classification: D81.

" … Forgetting the things which are behind and stretching forward to the things which are before." (Philippians 3:13)

1. A Misuse of Opportunity Cost

The following is a true story. One day a senior female student (Jade) of the quantitative finance department came to my office, and happily told me that she just got an admission from a university to pursue a Master degree in finance. And we chatted:

Jade: Professor, I am so happy that my application is accepted by X university.

Professor: Congratulation!! …. But did you also apply for other disciplines, such as MS or Ph.D. programs in computer science, statistics, or economics.

Jade: No. Why should I? If I pursue those degrees, then my four-year study of finance will be a waste.

Professor: Apparently, you don't understand the meaning of opportunity cost. And your study of Principles of Economics (Econ101) and Financial Management courses is a waste and futile.

Jade: I don't understand. Can you explain more on this?

Professor: Let me give you an example. A beautiful girl just enters a university, and meets a boy. The boy asks for dating with her, and she agrees. After two weeks, the boy asks for more dating. The girl thinks: "If I stop dating with him, then my two weeks of dating (investment) will be a waste". Hence, they continue to date for another two years. After two years, the girl thinks again: "If I stop dating with him, then my previous two years of dating with him will be a waste". They continue to date for two more years. After four years, upon graduation, the boy asks the girl to marry him. The girl thinks: "If I do not marry him, then my four years of dating with him will be a waste", and they marry. And you are the girl.

Jade: No, I am not. I am not that stupid!

Professor: Oh, yes, you are. If you are not so stupid in your marriage, how come you are so stupid in choosing your profession?

What matters in Jade's choosing a particular graduate program is: Does it provide positive net present value (NPV, the difference between revenues and costs), and is its NPV the largest one among all the mutually exclusive projects (graduate programs)? Costs in the NPV analysis are opportunity costs, which mean that you still have the opportunity to make choice to spend or not to spend, i.e., opportunity costs are ex-ante (Buchanan, 1969). When calculating the NPV of the finance graduate program, Jade should consider only how much more costs and time she will spend, and compare them with the revenues

(cash flows) she will get if she finishes the study. Jade's four-year study of finance is already sunk. It is not an opportunity cost, and it should not be considered in the NPV analysis.

Jade's case is not an exception. There are many similar cases in investments, such as: "Since we already spent 10 million dollars in developing this product, if we stop the project now and do not put more money in it, the 10 million dollars invested will be wasted"; or, "Our investment in that stock already loses 1000 dollars. But if we sell the stock now, we will never have the chance to win back our 1000 dollars" (just as a gambler in a casino).

2. Prospect Theory or Opportunity Cost?

Kahneman and Tversky's (1979) prospect theory argues that people show risk aversion in the domain of gains and risk seeking in the domain of losses. Kahneman et al. use the following two experiments to prove their arguments:

E1. People are asked to choose from:

(A) 80% chance to win $4000 and 20% chance to win nothing; or

(B) obtain $3000 for sure.

E2. People are asked to choose from:

(A) 80% chance to lose $4000 and 20% chance to lose nothing; or

(B) lose $3000 for sure.

Kahneman et al. find that in experiment 1, most subjects chose (B), but in experiment 2, most subjects chose (A). They argue that with the *same* reference point (asset position), a person will show risk aversion in the domain of gains (i.e., in experiment 1) and risk seeking in the domain of losses (i.e., in experiment 2), and hence, "the value function for changes of wealth is normally concave above the reference point and often convex below it" (p. 278).

For Kahneman et al.'s claims, I will argue:

(1). In experiment 1, people in fact have three choices: (A), (B), or (C) throw away any gains, rather than two choices: (A) or (B). That is, in the domain of gains, people have a third choice to go back to their original wealth position. But for experiment 2 (in the domain of losses), people have only two choices: (A) or (B), i.e., people cannot go back to their original wealth position if there are losses.

(2). We can rewrite Kahneman et al.'s experiments 1 and 2 as:

E3. People are first given $3000 and then are asked to choose from:

(A) 80% chance to win $1000 and 20% chance to lose $3000; or

(B) do nothing.

E4. People lose $3000 first and then are asked to choose from:

(A) 80% chance to lose another $1000 and 20% chance to win back $3000; or

(B) do nothing.

Experiment 3 is equivalent to experiment 1, and experiment 4 is equivalent to experiment 2. But in experiment 3, people's original wealth increases $3000 before they make any choice, and in experiment 4, people's original wealth decreases $3000 before they make any choice. That is, the reference points (original wealth positions) of Kahneman et al.'s experiments 1 and 2 are different (i.e., in their paper, the value function of Figure 3 has two reference points).

(3). Experiment 4 (as Jade's or other cases) shows that people often misuse the concept of opportunity cost: When people lose $3000 in the investment of a stock, they will still keep the stock and join the gamble that has a 80% chance to lose another $1000 and a 20% chance to win back $3000. Kahneman et al.'s claim: "people favor risk seeking in the domain of losses (p. 269)" may be just: "people misuse the concept of opportunity cost in the domain of losses".

Kahneman et al. also use the following experiment to show that people often disregard components that alternatives share, and focus on the components that distinguish them:

E5. 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, you are asked to choose from:

(A) 80% chance to win $4000 and 20% chance to win nothing; or

(B) obtain $3000 for sure.

Your choice must be made before the game starts, i.e., before the outcome of the first stage is known.

Kahneman et al. argue that in this two-stage game, one has a choice between $0.25 \times 0.80 = 0.20$ chance to win $4000, and a $0.25 \times 1.0 = 0.25$ to win $3000, and hence, this two-stage game (experiment 5) is equivalent to the following game:

E6. People are asked to choose from:

(A) 20% chance to win $4000 and 80% chance to win nothing; or

(B) 25% chance to win $3000 and 75% chance to win nothing.

Kahneman et al. find that in experiment 5, most subjects chose (B), but in experiment 6, most subjects chose (A). They refer this phenomenon as the *isolation effect*, and claim that "evidently, people ignored the first stage of the game, whose outcomes are shared by both prospects" (p. 271), and "the reversal of preferences due to the dependency among events is particular significant because it violates the basic supposition of a decision-theoretical analysis, that choices between prospects are determined solely by the probabilities of final states" (p. 272).

I will argue that Kahneman et al.'s two-stage game (experiment 5) is in fact only a one-stage game, and their isolation effect (reversal of preferences) does not exist. In experiment 5, although people are asked to make their choices before the outcome of the first stage is known, the probabilities in the first stage are irrelevant in their decision-making. For example, suppose you are sending an application to

join a firm, and you have a 0.25 chance to succeed. Once you enter the firm, you have two choices for your salary: (A) obtain $4000 with a probability 0.80 and $0 with a probability 0.20; (B) obtain $3000 for sure. Note that in this game, you only care which salary structure you should choose *if* the firm accepts your application. Before the firm informs you their decision, there is nothing you can do but wait. The probabilities in the first stage should not affect how you make your choice, i.e., if you choose a particular alternative, say, (B), before the firm informs you their decision, then you will also choose the same alternative (B) after the firm accepts your application. Hence, Kahneman et al.'s experiment 5 is the equivalent to the following one-stage game:

E5'. 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, you are asked to choose from:

(A) 80% chance to win $4000 and 20% chance to win nothing; or

(B) obtain $3000 for sure.

You make your choice only after the outcome of the first stage is known.

The second stage of this game is experiment 1. The first stage of the game is irrelevant. Experiment 5 and experiment 6 are two different games, and Kahneman et al.'s isolation effect (reversal of preferences) does not exist.

Kahneman et al. have used the following two experiments:

E7. In addition to whatever you own, you have been given $1000. You are now asked to choose from:

(A) 50% chance to win $1000 and 50% chance to win nothing; or

(B) obtain $500 for sure.

E8. In addition to whatever you own, you have been given $2000. You are now asked to choose from:

(A) 50% chance to lose $1000 and 50% chance to lose nothing; or

(B) lose $500 for sure.

Kahneman et al. argue that experiment 8 can be obtained from experiment 7 by adding $1000 to the initial bonus, and subtracting $1000 from all outcomes, and hence, experiments 7 and 8 are equivalent to:

E9. People are asked to choose from:

(A) 50% chance to win $2000 and 50% chance to win $1000; or

(B) obtain $1500 for sure.

Kahneman et al. find that in experiment 7, most subjects chose (B), but in experiment 8, most subjects chose (A). They argue that these results show: "evidently, the subjects did not integrate the bonus with the prospects. The bonus did not enter into the comparison of prospects because it was common to both options in each problem" (p. 273), and "choice may be altered by varying the representation of outcomes" (p. 273), i.e., the *framing effect* exists. But the reference points of experiments 7 and 8 are different: the

subjects' initial wealth increases $1000 in E7, and increases $2000 in E8. Also, in experiments 7 and 8, the increases in initial wealth are not people's choices (people cannot determine the amount of the increase, and the increases in initial wealth are irrelevant in people's decision-making). Thus, just as the case that people will treat experiment 4 as experiment 2, people will treat the following experiment as experiment 8:

E10. People have been given $2000 first. Then they lose $500, and then are asked to choose from:
(A) 50% chance to lose another $500 and 50% chance to win back $500; or
(B) do nothing.

That is, the behavior of the subjects in Kahneman et al.'s experiments 7 and 8 may not be: "people show risk aversion in the domain of gains and risk seeking in the domain of losses", but just: "people misuse the concept of opportunity cost in the domain of losses" (i.e., when people lose $500 in the investment of a stock, they will still keep the stock and join the gamble that has a 50% chance to lose another $500 and a 50% chance to win back $500).

3. Concluding Remarks

The prospect theory argues that people show risk aversion in the domain of gains and risk seeking in the domain of losses. This paper shows that the so-called "risk seeking in the domain of losses" phenomenon may be just: "people misuse the concept of opportunity cost in the domain of losses". The reference points of Kahneman et al.'s value function in the domain of gains and in the domain of losses are different. The paper also shows that Kahneman et al.'s two-stage experiment is in fact a one-stage experiment, and their isolation effect (reversal of preferences) does not exist.

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