

## **Exam: Behavioral Economics and Finance**

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In the following I will present the exam that students have to solve and sketches of answers that students should be able to give.

*(1) Prospect Theory: Against the background of a lot of experimental evidence at odds with “expected utility theory” Kahneman and Tversky (Econometrica, 1979) developed “prospect theory”.*

- a. In “prospect theory” it is assumed that people take decisions by first “editing” and then “evaluating”. Explain these two “phases”. State the value function proposed by Kahneman and Tversky (Econometrica, 1979) and explain it. Furthermore, explain the decision weight  $\pi(p)$  and its salient properties (e.g. subadditivity).*

**Answer:** Prospect theory models choices under risk and uncertainty as a two step process. There is an editing as well as evaluation stage. In the editing phase the offered prospects are transformed into simpler representations. The transformations that have been identified are among others:

1. Coding: Prospects are coded in terms of losses and gains relative to a reference point. In prospect theory the reference point is defined in terms of losses and gains - (see also lecture slide 16 / lecture 7)
2. Combination: Prospects can sometimes be simplified by combining the probabilities associated with identical outcomes - (see also lecture slide 16 / lecture 7)
3. Segregation: Some prospects contain a riskless component that can be segregated from the risky component - (see also lecture slide 17 / lecture 7)
4. Cancellation: When different prospects share certain identical components, these components may be discarded or ignored - (see also lecture slide 18 / lecture 7)
5. Simplification: Prospect might be simplified by rounding either outcomes or probabilities - (see also lecture slide 18 / lecture 7)

6. Detection of dominance: If a prospect is dominated by another prospect e.g. after all other transformations have been performed, then it can be discarded - (see also lecture slide 19 / lecture 7)

After all transformations have (un)consciously been done, the (remaining) prospects are evaluated. Evaluation means that one identifies the prospect that gives the highest value. Note, in prospect theory we do not talk of utility but of value. Consider, for example, a simple prospect:  $s = (x, p; y, q; 0, (1-p-q))$ , where  $x$  is a specific gain/loss that is associated with the probability  $p$ . Prospect theory states that one can write the overall value of this prospect as:

$$v(x, p; y, q) = \pi(p) * v(x) + \pi(q) * v(y)$$

where  $v(0)=0$ ,  $\pi(0)=0$  and  $\pi(1)=1$ . We can disregard  $(0, (1-p-q))$  as  $v(0)=0$ . Note,  $\pi(p)$  is the decision weight attached to the probability  $p$  and  $v(x)$  is the value attached to the outcome  $x$ . From the overall value function one can see that outcomes and probabilities are transformed so as to give the overall value of a prospect. The transformation is done in line with psychological evidence. This is also the reason why prospect theory is often called a descriptive theory of choices under risk and uncertainty.

The assumptions made with regard to the decision weights are the following:

1. Subadditivity: see lecture slide 30-31 / lecture 7
2. Subcertainty: see lecture slide 31-32 / lecture 7
3. Subproportionality: see lecture slide 32 / lecture 7

b. Explain the "disposition effect" that can be observed on the stock market and how it can be explained by "prospect theory". Furthermore, describe the evidence for a disposition effect presented in Odean (1998).

**Answer:** The 'disposition effect' is the tendency to sell assets that have gained value ('winners') too early and keep assets that have lost value ('losers') too long. The disposition effect can be explained by the two features of prospect theory:

- the idea that people value gains and losses relative to a reference point (the initial purchase price of shares), and
- the tendency to seek risk when faced with possible losses, and avoid risk when a certain gain is possible – loss aversion.

For a theoretical explanation see lecture slides 12-15 / lecture 9. In the following points I present a brief list sketching the evidence from Odean (1998). The list is taken from lecture 9:

- Odean (1998) obtained records of 10000 accounts from a large discount broker
- In this study several different tests all show a significant disposition effect
- Investors hold losers longer (a median of 124 days) than they hold winners (104 days).
- Across the entire year, investors realize about 24% of the gains they could realize by selling, but they realize only 15% of their losses
- In December, however, these two figures are both close to 20% and are statistically indistinguishable
- This shows: the only time investors do not exhibit a disposition effect is at the year-end, when there is a nearby tax advantage to selling
- Odean's able to test the hypothesis: Investors are rational to keep losers / sell winners e.g. because they guess correctly that losers will rebound and winners will slip back in price
- This proves to be false: unsold losers return only 5% over the subsequent year, while winners that are sold would have returned 11.6%

More can be found in part III in Odean (1998), 'Are Investors Reluctant to Realize Their Losses?', *The Journal of Finance*, Vol. 53(5), pp. 1775-1798

*(2) Myopic Loss Aversion and the Equity Premium Puzzle: There is a large discrepancy between returns on stocks and fixed income securities. This discrepancy is difficult to explain with traditional assumptions about choices under risk and uncertainty – the “equity premium puzzle”.*

*a. Explain what myopic loss aversion is and explain intuitively why it can explain the “equity premium puzzle”.*

**Answer:** Loss aversion says that psychologically losses hurt more than equivalent gains make happy, i.e. losses loom larger than gains. Kahneman and Tversky (1979) write:

“A salient characteristic of attitudes to changes in welfare is that losses loom larger than gains. The aggravation that one experiences in losing a sum of money appears to be greater than the pleasure associated with gaining the same amount.”

Myopic loss aversion is based on the principle of (1) loss aversion, due to which losses loom larger than gains, and (2) mental accounting, i.e. a thematic grouping of expenses and gains. People are assumed to have mental (investment) accounts which they evaluate from time to time. In an evaluation people perceive paper gains and losses which might be realized when investors decide to e.g. sell assets held in the portfolio. Also paper gains and losses hurt. When an investor evaluates his investment account e.g. once a year and has prospect theory preferences he suffers from myopic loss aversion as his investment/evaluation horizon is 1 year only. Myopic loss aversion adds to risk aversion. This means safe investment like government bonds become more attractive than risky stocks. This might explain why people forgo a high expected return from risky stock investments and invest into e.g. government bonds more than they should given the historical return data.

*b. Describe Bernatzi and Thaler (1995)'s analysis and explain how they explain the equity premium puzzle with the help of myopic loss aversion.*

**Answer:** Bernatzi and Thaler (1995) use myopic loss aversion to explain the equity premium puzzle. The equity premium is the difference in the rate of return on equities and a safe investment like treasury bills. The puzzle is that the difference in returns has historically been very large (an average of about 6% over the last 80 years). Part of this can be explained by risk aversion, but only to some extent. The rest has to be explained by something else: myopic loss aversion. Bernatzi and Thaler (1995) say: the risk attitude of loss averse investors depends upon the frequency with which they close (evaluate) their accounts and reset their reference point. They ask in their analysis: assuming investors have prospect theory preference functions, how often do they have to evaluate the changes in their portfolios, i.e. close and reset mental accounts, to make them indifferent between the (US) historical distributions of returns on stocks and bonds.

Their analysis is well described in section IV of Bernatzi and Thaler (1995) 'Myopic Loss-Aversion and the Equity Premium Puzzle'. Quarterly Journal of Economics, Vol. 110.1, pp. 73-92.

(3) *Hyperbolic Discounting/Self Control Problems: Very often we have to take decisions today which might have consequences in the future. The classical model that is used to analyze intertemporal decisions is the discounted utility model.*

a. *Explain why the discounted utility model implies time consistent behavior. Is it realistic to assume time consistent behavior? Give an example of time inconsistent behavior.*

**Answer:** The following points highlight the relation between the assumption of constant discounting that is made in the discounted utility model and time consistency:

- The discounted utility model assumes a constant discount factor  $\rho$ , i.e. a discount function  $\Delta(k) = (1/(1-\rho))^k$
- $\rho$  is the discount rate applied between two (future) periods  $k$  and  $k+1$
- The assumption of constant discounting permits a person's time preference to be summarized as a single discount rate often called:  $\delta = (1/(1-\rho)) < 1$
- Constant discounting implies: a person's intertemporal preferences are time-consistent – later preferences “confirm” earlier preferences...
- This means, delaying or accelerating two dated outcomes by a common amount should not change preferences between the outcomes: If in period  $t$  a person prefers  $X$  at  $t$  to  $Y$  at  $t+k$  for some  $t$ , then in period  $t$  she must prefer  $X$  at  $t$  to  $Y$  at  $t+k$  for all  $t$

There is by now persistent evidence that intertemporal choices are not time consistent. Hence, it is reasonable to question the validity of this assumption. Two very different examples that we also talked about during the lecture are i) retirement savings and ii) smoking. Both have in common that costs and benefits of saving smoking occur at different points in time. Hence, time inconsistencies might arise.

b. *Laibson (1997) develops a simple model of hyperbolic discounting. He finds that hyperbolic discounting leads a person to consume more than she would like from a prior perspective (i.e. to under-save for e.g. retirement). Furthermore, he explores role of illiquid assets, such as housing, as a commitment technology, emphasizing how a person could limit overconsumption by tying up her wealth in illiquid assets. Explain intuitively why a person*

*that uses hyperbolic discounting under-saves and uses illiquid assets as commitment devices.*

**Answer:** see slides 22-30 / lecture 11