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# EXTENDING THE PROSPECT THEORY: ANALYSIS OF ANIMAL SPIRITS AND CONSECUTIVE GAMBLES IN THE DECISION-MAKING PROCESS*

## INTRODUCTION

Contrary to traditional economics, behavioural decision-making research verifies empirically how people make decisions in face of incomplete information, limited cognitive resources, and decision biases. The latest economic crisis proved that analysing behaviour of individuals, reasons behind massive bank runs, and loss of confidence in assets is fundamental. Behavioural economics has a huge potential to determine how to avoid herding behaviour, which leads to deep recessions; how to predict the psychological manipulation of speculators, who cause big economic instabilities; how to tell people to make more rational decisions, and many other issues. Studies on decision-making process try to analyse what makes investors buy certain assets and sell the others.

This work is aimed to extend the prospect theory, developed by psychologists Amos Tversky and Daniel Kahneman. The scientists proved that decisions under risk can be characterized through the value function, which is concave for gains and convex as well as steep for losses; and has the reference

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point (the status-quo of the individual). Most real decisions, unlike those of economics textbooks, have a status quo alternative, a reference point to which the additional gains or losses are compared. Kahneman and Tversky created model, valuable for economics, proving that people are risk averse in terms of gains and risk pro in terms of losses. The prospect theory helped to understand many irrational actions of individuals. Extending it is extremely useful in order to understand and generalize the irrational decisions of individuals.

In my paper, first, the theoretical framework of the prospect theory and animal spirits is discussed. Later, all necessary methodological explanations are presented. The core element of this paper is the empirical experiment based on the survey. The direct approach questionnaire is used, in which participants are asked to choose among alternatives and also to rate their satisfaction under certain conditions. The designed questionnaire is composed of three parts, representing different types of hypotheses which need to be verified. The first part consists of the multiple choice questions which are designed to prove that the prospect theory indeed works in practice. In the second part, participants are asked to indicate the utility maximizing price of a certain asset. This section is aimed to check the significance of animal spirits in the decision-making process. The third part of the questionnaire is a multistage lottery in which the participants should choose among several gambling alternatives. The aim of this part is to see whether there is a certain tendency among individuals during consecutive gambles. The data analysis is employed in accordance to each part and the last section presents the conclusions as well as the implementation of key findings.

## 1. Expected Utility Theory vs. Prospect Theory

Expected utility theory has been popular among economists for a long time. Initiated by Daniel Bernoulli in 1738, the expected utility theory states that individual will prefer those alternatives which dominate the other ones evaluated by the expected utility. Alternatives with greater utility will be always chosen relatively to those with smaller utility. Moreover, expected utility model implies that the manner of presenting the alternatives does not matter and will not influence the choice (choice is invariant). Also, this theory states that no matter whether there is a loss or gain, decision makers will always behave in the same, rational way. Generalizing, the expected utility model does not include the relativity issue: according to the expected utility theory, final outcome matters rather than gains and losses experienced

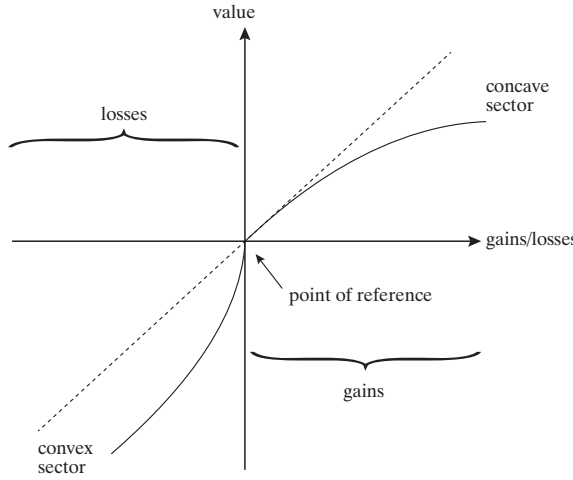
before. Individuals rank their preferences according to expected utility and discard alternatives offering lower utility.

Kahneman and Tversky were among the first to present the critique of the rational expected utility model, developing the alternative 'Prospect theory' (1979). The famous prospect theory later resulted in psychologist Daniel Kahneman being awarded the Nobel Prize in Economics. Kahneman and Tversky investigated people's behavior, formation of the reference point and, most importantly, the properties of the value function.

The value function is treated as a function of asset position that serves as a reference point and the deviation from that reference point (positive or negative in magnitude). The function is defined in terms of relative gains and losses in initial wealth rather than in terms of final states. The main result of the Kahneman and Tversky's findings and experiments is that the S-shaped value function is concave for gains, convex for losses, and is steeper for losses than for gains. The theory proves that people are risk-averse towards gains and pro risk towards losses. It also states that human beings place much more weight on the outcomes which are certain rather than on those which are just probable, a feature known as the 'certainty effect'. Moreover, the value function is the steepest at the reference point. This means that a particular gain or loss has a smaller effect on the value experienced by a person when the distance to the reference point is large.

**Figure 1**

**The S-shaped value function of prospect theory**




Source: Kahneman, D. and Tversky, A. (1979) *Prospect theory: An Analysis of Decision Under Risk*, Econometrica, 47(2), pp. 263–291.

For instance, assuming the expected utility equals the expected value, for simplicity of calculations, in the prospect between getting $1000 with probability of 50% and receiving $500 for certain, people tend to choose the most certain option, which is $500. However, in the prospect between losing $1000 with probability of 50% and losing $500 for certain, people tend to risk and to avoid losses which are certain. According to expected utility, though, the mentioned gambles are treated as equal and the decision-maker in cases of both gains and loss should be equally indifferent, judging solely on expected value.

Problem I and Problem II show another example of expected utility theory criticism:

Problem I: choose among[1]:
A: 4000 with probability 0,80 B: 3000 for sure
N = 95 [20] [80]*

Problem II: choose among:
A: 4000 with probability 0,20 B: 3000 with probability 0,25
N = 72 [65]* [35]

In problem I, $0{,}80u(4000) < u(3000)$ holds. However, in Problem 2, the reverse situation is visible:

$$0{,}20u(4000) > 0{,}25u(3000) \mid \times 4$$
$$0{,}80u(4000) > u(3000)$$

Both results contradict each other and cannot be explained by the expected utility theory. The prospect theory explains the problem through the value function and the 'certainty effect', stating that in case of gains individuals prefer certain options and are risk-averse, whereas in the case of losses individuals tend to be pro risk and choose the less probable option.

The prospect theory is able to explain much more aspects of decisions in reality, contrary to the expected utility model. For instance, according to Sanjit Dhamiy and Ali al-Nowaihiz, expected utility fails to explain why tax evasion exists. According to expected utility theory people should evade less when the tax rate increases due to higher penalty rates and audit. However, intuition and the fact that the return on evasion ranges from 91–98 per cent do not support this result. Scientists prove in their paper that only the prospect theory gives the right and satisfactory explanation of tax evasion, and

[1] Kahneman, D. and Tversky, A. (1979) *Prospect theory...*, op. cit.

actually supports, contrary to expected utility theory, the Allingham-Sandmo-Yitzhaki tax avoidance model (2006).

## 2. Animal Spirits

In Kahneman and Tversky's prospect theory, gains and losses are defined relative to some neutral reference point. For simplification of the model, the reference point was mainly assumed to be given; it served as a neutral status quo. In reality, however, reference point is determined by various different factors. This issue became the idea of many investigations and experiments held in order to extend the prospect theory. In this chapter, behavioural biases which influence the reference point position will be analysed.

### 2.1. Expectations

Many experiments were conducted on the evaluation of factors the reference point is influenced by. Andreas Hack and Frauke Lammers (2008) showed empirically and proved econometrically the significance of expectations. Both economists developed a new experimental design employing an indirect approach (when individual's risky choices allow making an inference regarding the reference point) and the direct one (when participants are asked to rate their satisfaction concerning certain outcome). The scientists conducted an experimental study proving that expectations do indeed influence the adaptation of reference points, and the higher the margin of expectations of individual is, the higher the new reference point will be. Andreas Hack and Frauke Lammers also found out that individuals 'shift reference points upward more strongly when expected values exceed the information for adaptation contained in the recent status quo, and they adapt less strongly if expected values are lower'. Koszegi and Rabin (2004) also proved that it is one's expectations about future outcomes that serve as reference point among investors, not the original purchase price.

Raj Chetty and Adam Szeidl (2010) endogenized the reference points with the following exogenous variables: aggregate consumption dynamics, changes in policy parameters, and the welfare cost of shocks. Findings of scientists state that reference point is determined by both latest expectations and latest consumption patterns, and becomes less relevant when individuals face large shocks.

## 2.2. Regret Aversion

Regret is another anchoring factor which influences the reference point. Regret aversion is a psychological bias that occurs due to focusing on unpleasant feelings after having made a wrong decision (or the right decision with bad outcome). The feeling of regret is observable only when the outcomes of the alternative decision option are visible. Every individual hates being wrong. Michael J. Seiler, Vicky L. Seiler, Stefan Traub, and David M. Harrison (2008) investigated the role of regret in the reference point formation among different cultural and gender groups. Their studies proved that even if not the majority, but quite a significant number of people exhibit the regret bias and stick towards the new, higher reference point.

Graham Loomes and Robert Sugden constructed the model concerning the regret behaviour and stated that the irrational regret behaviour which contradicts the expected utility theory is actually rational and predictable (2005).

According to Kahneman, the regret of commission (regret about things person actually did) proved to be more popular than the weaker regret of omission (regret concerning the missed opportunities). However, Kahneman also noticed an interesting observation, such as that the minority of investors who suffered from the regret omission tended to have an untypically high proportion of their portfolio in stocks. Holding a considerably big amount of stocks implies that the investors who regret the missed opportunities have a tendency to take more risk than those who suffer from regret of commission (2002).

## 2.3. Biases in Financial Economics

When it comes to financial economics, mainly the purchase price of the stocks serves as a natural reference point. On the other hand, investors suffer from various psychological heuristics, such as, for instance, the current stock price, purchase price, or the 52-week low of the stock, to which investors give a significant importance and thus use it as the status quo item (Pompian, 2006).

Poteshman and Serbin (2003) show that investors tend to select a stock's 52-week high as the reference point. This reference point is disadvantageous as investors will hesitate to sell stocks which deviate from their 52-week highs. Such a false reference point leaves investors with the feeling they lost at some level, even though the overall rational investment could have made a positive return. When treating stock's 52-week high as the reference point, investors treat the stock purchase as a failure, and thus, they will not tend to sell the stock even when their quantitative analysis states they should (Shefrin and Statman, 1985).

According to Gneezy (2002), if individual's behaviour follows the prospect theory and investors are risk averse in the domain of gains, they should sell assets only when the current price is above the reference point. His results indicate that people are most likely to use the historical peak as the reference point.

### 2.4. Herd Behaviour and Rivals' Possessions

Herd behaviour and other people's state have also a crucial impact on the reference point. Herding effect is the tendency of individuals to copy the actions of a large group or the rivals. And it is quite possible that individually most people would not make the same decision. Economou, Kostakis and Philippas (2010) proved in their research that herding is present in the Portuguese stock market during periods of reduced returns as well as in the period of the global financial crisis of 2008. Crowd behaviour makes the reference point of individual change towards the value of the popular analysts` suggestions, index figures, or other similar sources of herding. The massive bank run during the crisis also occurs due to herding effect.

## 3. Methodology and the Empirical Experiments

There are mainly two approaches towards empirical studying in the behavioural economic literature: indirect and direct one. The indirect approach is based on the assumption that an individual has risk preferences according to a prospect theory`s value function. With such an assumption, the individual's risky or riskless choices determine the reference point. For instance, a risk-seeking individual is going to be in the steep loss domain of the value function relative to the initial reference point.

The direct approach, on the other hand, consists of questionnaires in which participants are asked to rate their satisfaction with a certain outcome. Using this approach, individual's utility can be estimated given the outcome. There is no assumption concerning the exact shape of the utility function but there is an assumption that the initial shape remains unchanged when reference points shift during the questioning. Also, margins of satisfactions are needed to be clearly stated for the better interpretation of results.

The direct approach is used in the empirical part of this paper. Questionnaire I constructed is composed of three parts, each representing different hypotheses which needed to be verified. The first part consists of the multiple

choice questions which are designed to prove that individuals indeed follow the prospect theory in reality. In the second part, participants should indicate the utility maximizing price of a certain share. This section is devoted to the role of animal spirits in the decision-making process. The third part of the questionnaire is a multistage lottery in which the participants should choose among several gambling alternatives. This section is created to analyse the tendency people have during consecutive gambles.

During the experimental process, the questionnaire was available both online and in paper form. Half of the responders completed the paper-based questionnaire under controlled conditions in Lazarski University's classrooms. Participants were given task instructions beforehand. Concerning the online version of the questionnaire, instructions were stated at the beginning of the form; participants had two weeks to complete the electronic version.

252 people participated in this survey; out of them 172 have been studying or working in the field of economics. The average age of participants was 22.5 and 52% of them were female. The geographical scope is diversified as responders come from various countries, such as: Poland, Ukraine, US, Italy, Finland, Morocco, Belarus, Germany, South Korea, Iran, Russia, Spain, Vietnam, Georgia, Turkey, Albania, Kazakhstan, Yemen, and Hungary. The total number of participants will be denoted by 'N'.

## 3.1. Experiment 1

As it was mentioned before, this part of the survey was designed to prove the fact that prospect theory indeed works in practice. Participants were asked to choose between some gambles taken from Kahneman and Tverky's paper (1979).

**Figure 2**

**Analysis of Responses for the Experiment 1**

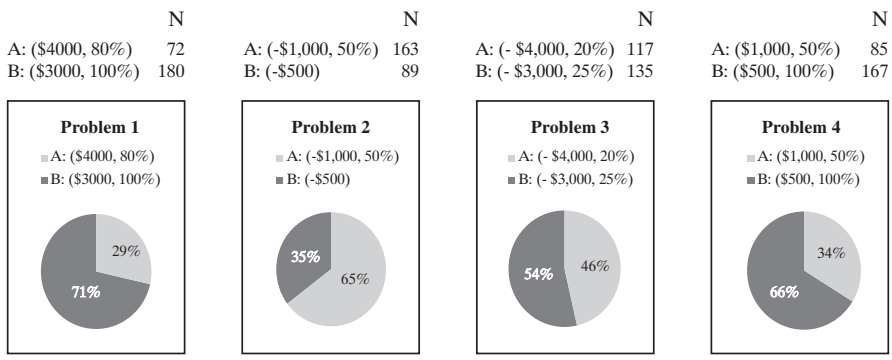


Figure 2 shows that in three out of four problems participants showed clear irrational behaviour. Responders chose certain options among positive gambles, and more risky options among negative prospects. Those options which are considered rational under the expected utility were neglected and participants were acting according to the prospect theory.

Responders selected the certain option rather than the one with higher expected value in Problem 1 with positive gambles. Similarly, in Problem 4, the certain option was the most popular, even though, according to expected utility theory, individuals should be indifferent between both prospects. On the contrary, in Problem 2 with negative gambles, the risky option was chosen despite the fact that the expected value of gambles is the same. Therefore, all three mentioned problems show that people make their decisions according to the prospect theory, showing risk aversion in the domain of gains and risk-seeking behaviour in the domain of losses.

In Problem 3, however, participants were almost equally indifferent between two gambles. Such a tendency occurred because people are indifferent when the probability of winning or losing the gamble is relatively small. Though the probabilities of 25% and 20% are not small, they were probably treated by individuals in this way, which led to a different behaviour towards decision making process.

**Table 1**

**Significance of Calculations of Experiment 1**

| | **Problem 1** | **Problem 2** | **Problem 3** | **Problem 4** |
|---|---|---|---|---|
| Mean | 0.71429 | 0.646825 | 0.535714 | 0.662698 |
| Std Deviat. | 0.45265 | 0.478908 | 0.499715 | 0.47373 |
| Norm.Dist | 0.05728 | 0.088407 | 0.141851 | 0.080922 |
| Significance | * | * | not signif | * |

Table 1 shows that all results are significant apart from the Problem 3, the one which contradicted the prospect theory. All other problems follow the normal distribution as variables have values below 0.1.

## 3.2. Experiment 2

The goal of this experiment was to determine the role of regret, crowd effect, expectations, and untrustworthy information in the decision making process. The comparison method of the reference point adaptation was used for calculations. The method introduced by Arkes, Hirshleifer, Jiang, and

Lim (2008) was employed and extended in order to evaluate the significance of various factors. The authors proposed to use the differences between the historical price and recent status quo to examine the magnitude of shifts in the reference point following gains and losses. Using this new method, scientists calculated the reference point adaptation and came to the conclusion that it is significantly greater in domain of gains than in domain a losses.

## Design, Procedure, and Materials

The survey used a between-subjects design with nine treatments: one control treatment and eight experimental ones which differed in terms of additional information regarding the asset price. Participants were randomly assigned to one treatment. However, every questionnaire had different amount responders at the end, varying from 25 to 61. This occurred due to different willingness of people to fill in the online forms.

Participants in the control treatment received the following statement, very similar to Arkes, Hirshleifer, Jiang, and Lim (2008):

'Two months ago, you bought a stock for €30 per share. One month ago, you were delighted to learn the stock was trading higher – at €36 per share. This month, you decide to check the stock's price again. At what price would the stock need to trade today to make you just as happy with the stock's price this month as you were when you learned the stock had risen from €30 to €36 last month?'

This initial scenario does not have any additional biased information. The experimental treatments, on the contrary, include one of the following additional sentences:

- 'One month ago, you also found out that your peer-competitor had purchased the same stock several months ago for €40' (A).
- 'One month ago, you also found out that your peer-competitor had purchased the same stock several months ago for €20' (B).
- 'One month ago, however, you also found out that the other stock, DEF, you were considering investing into initially, increased from €30 to €40' (C).
- 'One month ago, you also delightfully found out that the other stock, DEF, you were considering investing into decreased from €30 to €20' (D).
- 'One month ago, you also heard a gossip that the company which stock you hold was about to make a new invention and patent it' (E).
- 'One month ago, you also heard a gossip that the company which stock you hold was about to change its CEO' (F).

- 'One month ago, you also learned that this month's stock price is expected to range between €30 and €40, with each price within this interval being equally likely' (G).
- 'One month ago, you also learned that this month's stock price is expected to range between €26 and €36, with each price within this interval being equally likely' (H).

The additional sentences A and B are used to check for the presence of herding effect bias (rival's stock possession), being high and low treatments respectively. Just one competitor's price decision was indicated in the questionnaire instead of many to achieve better and more precise results. In order to check for the presence of strong and weak regret, sentences C and D were introduced. Statement E contains doubtful positive information, whereas statement F contains the ambiguous negative one. Sentences G and H were designed to see the significance of expectations with different range in the determination of the utility maximizing price.

After reading the scenario, participants were asked to indicate such a stock price which, in their opinion, was generating the same subjective value as the previous price increase.

## Discussion and evaluation

The statement about the stock price changes in different periods makes it possible to calculate the magnitude of the reference point adaptation through verifying the average within each treatment. Participants in the questionnaire have the same status quo $R_0$ (initial reference point) and the same information about the recent price $P_1$: in the first period ($t$=1) the stock price has increased from €30 to €36. The value of such a change depends on individual's initial reference point $R_0$. Additional biased information regarding the stock prices in the experimental treatments is also given in the first period ($t$=1). Participants are then asked to indicate such a stock price $P_2$ in the second period ($t$=2) that will generate the same subjective value as the price increase from €30 to €36. If the shape of the value function stays constant, then the distance between the new reference point $R_1$ and $P_2$ also remains unchanged. Thus, considering the treatment's average as $P_2$, the new reference point $R_1$ can be calculated from the following formula:

$$P_2 - R_1 = P_1 - R_0$$

$P_2 - R_1$ – reference point adaptation, magnitude of the reference point,
$P_1$ – price one month ago (€36),
$R_0$ – initial reference point (€30).

If there is a behavioural anchor on the extreme value, then there will be the differences in the magnitude of reference point adaptation.

## Hypotheses

The following hypotheses will be rejected or accepted during Experiment 2:

1. All animal spirits evaluated in this paper (rival's purchasing price, regret, doubtful information and expectations) are significant in the decision-making process of individuals.
2. The new reference point of individuals in treatments with a high rival's purchasing price (A), strong regret (C), and positive information (E) is higher than in the corresponding treatments with low rival's purchasing price (B), weak regret (D), and negative information (F).
3. In treatments with expectations (G and H), individuals indicate the highest value of expectations as the utility maximizing price.

Low rival's purchasing price is treated as losses, whereas the corresponding treatment is considered as gains. Taking into account the value function, the magnitude of reference point adaptation would be much more visible and larger in the domain of losses than in the domain of gains. Thus, the new reference point is expected to be much smaller in treatment B than in treatments A. Investors who regret the missed opportunities (C) have a tendency to take more risk (Kahneman, 2002). Higher risk means higher returns are expected, thus, it is assumed that when having feelings of strong regret, the new reference point which will satisfy the individual should be higher in treatment C than in corresponding one with weak regret (D).

Arkes, Hirshleifer, Jiang, and Lim (2008) stated that expectations` influence on reference point adaptation is stronger for positive information (gains) than for the negative one. Therefore, the reference point adaptation in treatment E should be bigger than in treatment F.

## Results

The new reference point was calculated to be 34.89 in the control treatment. On average, participants indicated that their utility maximizing price in the second period should be 40.89. In the survey conducted by Arkes, Hirshleifer, Jiang, and Lim (2008), the researchers got the average of €40.24, which means that our control treatment's averages differ from each other by 1.6%. The reference point adaptation in the control treatment equals 4.89.

Table 2

Results of Experiment 2

| Type of Survey | A | B | C | D | E | F | G | H | Control |
|---|---|---|---|---|---|---|---|---|---|
| Average | 43.5333 | 40.6393 | 40.02105263 | 37.6231 | 37.9524 | 39.7 | 39.95 | 35.48 | 40.8943 |
| Mode (# repeated most) | 41 | 40 | 40 | 36 | 42 | 40 | 40 | 36 | 42 |
| Median | 41 | 42 | 40 | 37 | 37 | 40 | 40 | 36 | 42 |
| HarMean | 42.8201 | 39.811 | 39.36426345 | 36.1771 | 37.495 | 39.5202 | 39.4478 | 35.0522 | 40.1369 |
| GeoMean | 43.174 | 40.2685 | 39.70498368 | 36.9571 | 37.7232 | 39.6092 | 39.6979 | 35.2889 | 40.5402 |
| Reference point adaptation | 7.533333 | 4.63931 | 4.021052632 | 1.623077 | 1.952381 | 3.7 | 3.95 | -0.52 | 4.894286 |
| New Reference Point | 37.53333 | 34.63931 | 34.02105263 | 31.62308 | 31.95238 | 33.7 | 33.95 | 29.48 | 34.89429 |

The results of this survey (Table 2) show that the highest new reference point was achieved by participants in the treatment A, which means that individuals expect even higher price increase than initially when they know the rival has purchased the stock more expensively before. It can be explained that with each price increase the individual will gain much more than his/her competitor. The rival's high purchasing price had the biggest effect on the reference point adaptation.

The lowest reference point was noticed in the treatment H, meaning that low expectations had a significant impact on reference point adaptation. When individuals expect the new price of the share to the range between €26 and €36, they, on average, tend to indicate the highest value of their expectations as the utility maximizing price. The mode of this treatment equals €36, which supports the statement that individuals mainly chose to indicate the highest value of expectations as the best price the stock can reach. Such a statement can also be supported by the fact that individuals do not tend to indicate the utility maximizing price higher than the maximum value of their expectations.

The value of new reference point of survey B is similar to the one in the control treatment. Such a tendency means that the fact of rival's purchasing the stock cheaper than the individual leads to particularly the same value of new reference point.

In survey C, it can be observed that the reference point adaptation is lower than in the control treatment but higher than in corresponding one with weak regret (D). This behaviour of participants can imply that when the possible gain of the other option the individuals could invest into increases in value, they get discouraged and expect a smaller price of the share they possess. However, contrary to the treatment with weak regret (D), individuals state the utility maximizing price higher in case of strong regret. Such a tendency can be explained through higher risk seeking behaviour when experiencing the regret of missed opportunity leading to demand of higher returns.

The reference point adaptation in survey G is also lower than the one in control treatment. Such a result follows the previous remark made about expectations: individuals indicate the highest value of expectations as the utility maximizing price and, generally, do not write the price higher than expected. The average of 39.9 and mode of 40 support this conclusion.

The small value of the new reference points in surveys E and F can be summarized as following: individuals do not trust the doubtful information and treat the gossips as probable factors which can decrease the price of the share in future. However, the reference point adaptation was expected to be lower in survey F rather than in E.

Small reference point adaptation in survey D proves that when the possible gain of the other option the individuals could invest into decreases, they are quite happy with the share they possess and do not expect high price increase of the asset. Thus, participants indicated the lower utility maximizing price than in the control treatment and in the one with strong regret.

The following calculations of normal distribution show that the mentioned results are all significant.

**Table 3**

**Identifying Significance of Variables of Experiment 2**

| | C | A | B | D | E | F | G | H | CNTRL |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 38.65455 | 43.63636 | 41.56364 | 37.10909 | 37.63636 | 39.09091 | 40.18182 | 34.36364 | 41.06364 |
| Median | 40 | 41 | 42 | 37 | 37 | 38 | 40 | 36 | 40 |
| Maximum | 46 | 54 | 45 | 50 | 42 | 45 | 50 | 38 | 51 |
| Minimum | 30 | 36 | 36 | 20 | 30 | 36 | 30 | 22 | 30 |
| Standard Deviation | 4.564288 | 5.920688 | 2.989071 | 8.242021 | 4.153859 | 2.385563 | 6.161464 | 4.295875 | 5.889359 |
| Normal Distribution | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## 3.3. Experiment 3

This part of the questionnaire is a multistage lottery in which participants should choose among several gambling alternatives. Such a lottery was designed to see the tendency people have during consecutive gambles.

### Design, Procedure, and Materials

This section of the survey is composed of two treatments. Regardless of the roulette option the individual chooses, one treatment leads to consecutive losses while the second treatment leads to consecutive gains. Participants were equally assigned to one of the treatments. In total, 125 individuals replied to the losing treatment and 127 replied to the winning one.

Participants were asked to imagine the following situation:

You came to casino A to unwind a bit. You have already bought jettons worth 50 zł (around $16.66) and you thus have 5 games to play (each jetton is worth 10 zł). You always have a choice between Roulette A and Roulette B. Each bet is 10 zł.

There is a possibility to play a super game. You can either lose 90% of what you have or you can win 90% of what you have. Probability of win/lose is 50/50. You can play this game any time you want after the first two gambles.

| | Roulette A | Roulette B |
|---|---|---|
| Gamble 1: | Win extra 10 zł (0.6) and Lose 10 zł (0.4) | Win extra 5 zł (0.8) and Lose 10 zł (0.2) |

There were five rounds of this game: in first two, participants could choose among two roulettes with equal expected value, whereas in later rounds, responders could select from the same roulettes and the super game. As it was mentioned before, no matter which option individual chooses, it will lead to consecutive losses or consecutive gains. The main goal of this experiment was to see at which stage people choose the super game when constantly losing or winning. If there is a difference between the decision-making process in the domain of sequential winning and in the domain of consecutive losing, then the prospect theory can be expanded and new features of the reference point adaptation can be noticed.

## Discussion and Hypotheses

In theory, the final value of consecutive gambles is positive; there is a certain gain in the long run, even though in the short run wins and losses are chaotically distributed.

However, individuals tend to forget about the statistical aggregation. Generally, each gamble is treated as the last one, meaning that people do not stick to a certain roulette option though they should. Sticking to one certain decision in consecutive gambles reduces the relative risk of the series of games.

Also, the tendency of individuals to choose the super game can be seen as the process of the reference point adaptation. Super game is available to individuals only after the first two gambles. These two rounds of the experiment were designed to make people get used to the roulette options and to make their reference point change from the initial position. When the super game item becomes available, it attracts participants.

Those individuals who are constantly winning should adapt to gains within several gambles. In theory, people start considering the initial state of their possessions as worse than the current state. Reference point of those individuals shifts to the right and, therefore, any option they considered risky initially is located on the flatter part of the value function and does not seem

to be that risky any more. If not immediately chosen, the super game option is even more attractive in later gambles, after the reference point of participants is changed as even more money is gained. From psychological side, person will risk more when he/she gets used to gains.

Individuals in the losing treatment should also choose the super game option throughout the game. When constantly losing individuals think they have less money to risk with. Participants find their initial state as better than current and after the first gambles should adapt to losses. The process of adaptation will lead to a new reference point, on the left of the initial one. At this new reference point, the option which was perceived risky initially will not be seen as much risky anymore. This occurs because the risky item will now locate on the gain domain of value function, which is flatter than any point of the loss curve. Psychologically, individual tends to risk more when having lost much.

Taking into account the prospect theory, the following hypotheses can be made:

1. The majority of participants (more than 50%) will choose a super game option rather than sticking to certain roulette or acting randomly.
2. A bigger amount of individuals will choose a super game option in the losing treatment than in the winning one.

## Results

Looking at results (Table 4), the majority of responders (67% in case of sequential winnings and 77.6% in case of losses) selected the super game option in third, fourth or fifth gamble. 73% of those who chose the super game in the winning treatment went for this option in the third gamble while the remaining 27% picked up the super game after the fourth or fifth gamble. In case of losing treatment, the super game was chosen by 64% after the third gamble. It can be thus seen that, in general, the reference point adapts already in the third gamble. Also, in the treatment of losses, more individuals were selecting the options randomly, without any strategy (23%), comparing to participants in the treatment of gains (21%).

An unusual tendency in this experiment was noticed: a twice bigger amount of responders were sticking to one particular option when facing sequential gains than when facing sequential losses. 23.6% of responders in winning treatment and 12.8% in the losing one were acting according to theory and decided to stick to one of the roulettes. Thus, it can be highlighted that individuals neglect the theory faster when consequently losing rather

Table 4

Results of Experiment 3

| Roulettes Winning | N | | | Roulettes Losing | N | | |
|---|---|---|---|---|---|---|---|
| No game<br>Super game | 42<br>85 | | | No game<br>Super game | 28<br>97 | | |
| % | 66,92913 | | N | % | 77,6 | | N |
| Rational | 3 | | 127 Total | Rational | 2 | | 125 Total |
| Rational | 3 | Sum with game | 70 | Rational | 1 | Sum with game | 68 |
| Stick to 1 and super game | 31 | Sum when sticking | 30 | Stick to 1 and super game | 28 | Sum when sticking | 16 |
| Stick to 1 and super game | 8 | Random strategy | 27 | Stick to 1 and super game | 11 | Random strategy | 41 |
| Stick to 1 and super game | 4 | | | Stick to 1 and super game | 3 | | |
| Stick to 1 fully | 13 | | | Stick to 1 fully | 9 | | |
| Stick to 0 fully | 17 | | | Stick to 0 fully | 7 | | |
| Stick to 0 and super game | 18 | | | Stick to 0 and super game | 15 | | |
| Stick to 0 and super game | 3 | | | Stick to 0 and super game | 4 | | |
| Stick to 0 and super game | 6 | | | Stick to 0 and super game | 7 | | |

than when consequently winning. This strange irrational tendency can be explained by the discouragement individuals feel when losing steadily. Decision makers become more pro risk in the domain of losses and, therefore, get used to the new reference point faster than the individuals in the domain of gains. This statement contradicts the theory as it would be logical to stick to one roulette in which individual has just lost as probability of the later wins increases. It is less logical (though still rational) to stick to the particular roulette when having just won because the probability of the next win is not high. Summarizing, the reference point adapts faster among individuals facing consecutive losses than among those facing consecutive wins. This important result means that the same movement in wealth on the value function will lead to a bigger change of the reference point in the domains of losses than in the domains of gains. Longer time is thus needed for reference point to adjust when consecutively winning than when consecutively losing.

**Figure 3**

**Modified graphical depiction of prospect theory value functions with left and right shifted reference points based on results from Experiment 3**

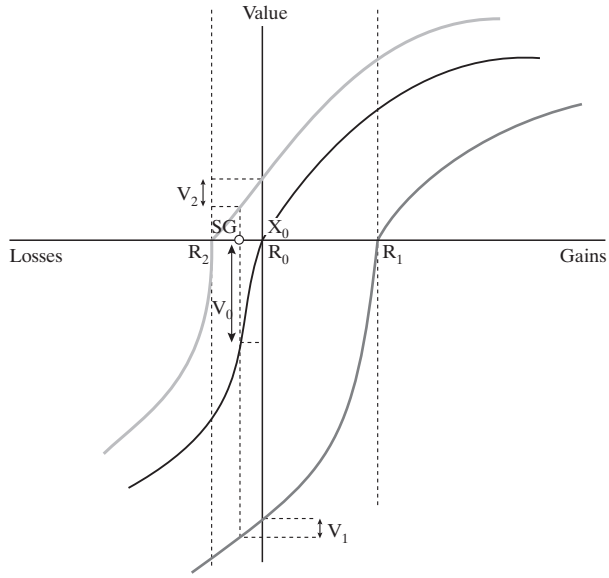



Figure 3 above visualizes the achieved result. The risk of playing super game (SG) is located on the steep loss side of the value function relative to the initial reference point ($R_0$). When an individual consecutively wins and gets to the reference point $R_1$, SG value now locates on the flatter part of the

loss curve and is thus perceived less risky than initially. When an individual gets to the reference point $R_2$ after consecutively losing, the risky value of SG is located on the gain curve now which is flatter than any point of the loss curve. Therefore, SG is also treated as less risky than before. The big negative risky value of SG becomes smaller in both domains of losses and gains. It can be clearly noticed from the graph that reference point adjusts more slowely in terms of gains than in terms of losses.

The one-sample statistical test showed that the variables and the samples are significant (Figure 4). Values of t-statistic are much higher than the critical t-values associated with the degrees of freedom observed in the table. High t-statistics, low values of p-value, and the fact of having significantly big sample show that variables are significant.

**Figure 4**

**One-Sample test for significance evaluation of responses in Experiment 3**

| One-Sample Statistics | | | | |
|---|---|---|---|---|
| | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| a | 127 | 0.59 | 0.494 | 0.044 |
| b | 127 | 0.50 | 0.502 | 0.045 |
| c | 127 | 1.25 | 0.816 | 0.072 |
| d | 65 | 0.48 | 0.709 | 0.088 |
| aa | 125 | 0.60 | 0.492 | 0.044 |
| bb | 125 | 0.58 | 0.496 | 0.044 |
| cc | 125 | 1.27 | 0.807 | 0.072 |
| dd | 63 | 0.94 | 0.914 | 0.115 |

| One-Sample Test | | | | | | |
|---|---|---|---|---|---|---|
| | **Test Value = 0** | | | | | |
| | | | | | **95% Confidence Interval of the Difference** | |
| | **t** | **df** | **Sig. (2-tailed)** | **Mean Difference** | **Lower** | **Upper** |
| a | 13.481 | 126 | 0.000 | 0.591 | 0.50 | 0.68 |
| b | 11.314 | 126 | 0.000 | 0.504 | 0.42 | 0.59 |
| c | 17.286 | 126 | 0.000 | 1.252 | 1.11 | 1.40 |
| d | 5.420 | 64 | 0.000 | 0.477 | 0.30 | 0.65 |

| | | | | | | |
|---|---|---|---|---|---|---|
| aa | 13.638 | 124 | 0.000 | 0.600 | 0.51 | 0.69 |
| bb | 12.979 | 124 | 0.000 | 0.576 | 0.49 | 0.66 |
| cc | 17.623 | 124 | 0.000 | 1.272 | 1.13 | 1.41 |
| dd | 8.137 | 62 | 0.000 | 0.937 | 0.71 | 1.17 |

## Conclusion and Implementation of Key Findings

To summarize, using the data with 252 observations, the experiments conducted in this paper proved that individuals generally follow the prospect theory. Responders chose certain options among positive gambles, and more risky ones among negative prospects. The expected values were neglected and participants were acting in the way which contradicts the expected utility theory.

All animal spirits evaluated in this paper (rival`s purchasing price, regret, doubtful information, and expectations) were proved to be significant in the decision-making process of individuals. The results of this survey show that the lowest new reference point was noticed in the treatment with low expectations ranging between €26 and €36. It was also proved that individuals tend to indicate the highest value of their expectations as the utility maximizing price and do not indicate values exceeding expectations.

The highest reference point adaptation was achieved by participants in the treatment with high rival's purchasing price. The fact of rival purchasing the stock cheaper than the individual, on contrary, leads to particularly the same value of new reference point. When there is a possible gain of the other option the individuals could invest into increases in value, reference point was noticed to be lower than in the control treatment. It was also observed that individuals do not tend to trust the doubtful information and actually treat the gossips as probable factors which can decrease the price of the share in future. To sum up, new reference points of individuals in treatments with high rival's purchasing price and strong regret, were higher than in the corresponding treatments with low rival`s purchasing price and weak regret.

During the experiment with consecutive gambles it was proved that the majority of participants, 67% in case of sequential wins and 77.6% in case of losses, were choosing the risky super game option rather than sticking to certain roulette or acting randomly.

A significant tendency was noticed during the research: the reference point adapts faster among individuals facing consecutive losses than among

those facing consecutive gains. This important result means that the same movement in wealth on the value function will lead to a bigger change in the domains of losses than in the domains of gains. Longer time is thus needed for reference point to adjust when consecutively winning than when consecutively losing.

Such a conclusion can extend the scope of existing economic researches. For instance, according to Bokhari and Geltner (2010), under prospect theory, a seller in the real estate industry will set a higher reservation price than his purchase price if facing losses. This remark can be now extended, stating that if the seller is facing consecutive losses or losses from several resources (not just real estate business individual is in), then the seller will not stick to this price for a long time. Probably, quite soon the mentioned seller will increase the price even more.

In the health industry case (Alan Schwartz, Julie Goldberg, Gordon Hazen, 2008), the distance between both new reference points and the initial one is the same. However, a long scope of getting over the tough disease or aging, can be treated as consecutive gains and losses. Therefore, slightly modifying the problem and looking at it from the perspective of Figure 3, some additional remarks can be made. If the initial reference point of individual is $R_0$ at which he/she has moderate health, then at new reference point $R_1$ the person gains some health through medical procedures or recovering. At $R_2$, on contrary, individual faces some losses (through becoming older or through some diseases). As the risk of negative value of an invasive procedure (SG) remains constant all the time, the distance between the initial reference point and $R_2$ should be smaller than the distance between the same starting point and $R_1$. According to the result of this paper achieved for consecutive gambles, when individual is getting older (experiencing a loss), he/she will faster agree to the risky decision (invasive procedure in this case) than when recovering from the tough disease and getting better (experiencing a gain).

The results achieved in this paper can be used to extend many research findings. Statistical tests proved that values presented in this paper are significant.

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## Extending the Prospect Theory: Analysis of Animal Spirits and Consecutive Gambles in the Decision-Making Process

### Summary

The aim of this dissertation is to extend the prospect theory, developed by psychologists Amos Tversky and Daniel Kahneman. In this paper, the impact of animal spirits (rival's purchasing price, regret, doubtful information, and expectations) and the influence of consecutive gambles on the reference point adaptation are investigated.

The core element of this thesis is the empirical experiment based on the direct approach survey. The questionnaire is composed of three parts, representing different types of hypotheses that need to be verified. The first part consists of a multiple choice questions, which prove that prospect theory indeed works in practice. In the second part, participants are asked to indicate the utility maximizing price of a certain asset. This part shows that the highest reference point adaptation was achieved by participants in the treatment of high rival's purchasing price. Another important finding of

this experiment is that individuals tend to indicate the highest value of their expectations as the utility maximizing price and do not state values exceeding expectations. The third part of the questionnaire is a multistage lottery in which participants choose among several gambling alternatives. A significant tendency was noticed during this experiment: the reference point adapts faster among individuals facing consecutive losses than among those facing consecutive gains. Longer time is thus needed for reference point to adjust when consecutively winning than when consecutively losing.

## ROZSZERZENIE TEORII PERSPEKTYWY: ANALIZA ROLI ZWIERZĘCYCH INSTYNKTÓW ORAZ SERII KOLEJNYCH GIER W PROCESIE PODEJMOWANIA DECYZJI

### Streszczenie

Celem artykułu jest rozszerzenie teorii perspektywy sformułowanej przez psychologów Amosa Tverskiego i Daniela Kahnemana. W niniejszej pracy badany jest wpływ zwierzęcych instynktów (cena nabycia przez konkurenta, żal, wątpliwa informacja i oczekiwania) oraz wpływ serii kolejnych decyzji w warunkach ryzyka na adaptację punktu odniesienia. Głównym elementem opracowania jest empiryczny eksperyment na podstawie badania podejścia bezpośredniego. Kwestionariusz składa się z trzech części, reprezentujących różne rodzaje hipotez wymagających weryfikacji. Pierwsza część obejmuje pytania wielokrotnego wyboru, na które odpowiedzi udowodnią, że teoria perspektywy naprawdę działa w praktyce. W drugiej części uczestnicy są proszeni o wskazanie ceny niektórych aktywów, która maksymalizuje ich użyteczność. Ta część pokazuje, że najwyższa adaptacja punktu odniesienia była osiągnięta przez uczestników w zakresie reakcji na wysoką cenę zakupu przez konkurenta. Innym ważnym odkryciem tej części jest fakt, że pytani często wskazują najwyższą wartość oczekiwań jako cenę maksymalizacji ich użyteczności i nie wskazują wartości powyżej oczekiwań. Trzecia część kwestionariusza to wieloetapowa loteria, w której uczestnicy muszą wybierać spośród kilku wariantów ryzyka. Zauważono istotną tendencję podczas tego eksperymentu: punkt odniesienia dostosowuje się szybciej u osób mających kolejne straty niż wśród tych, które mają kolejne zyski. Można zatem wywnioskować, że czas dostosowania punktu odniesienia podczas kolejnych zwycięstw jest dłuższy niż podczas kolejnych porażek.

## Расширение теории перспективы: Анализ Animal Spirits и игр в процессе принятия решений

Резюме

Целью данной статьи является попытка расширения теории перспектив, разработанной психологами Амосом Тверским и Даниэлем Канеманом. Объектом исследования служат «животные инстинкты» (стадный эффект, сожаление, сомнительная информация и ожидания), а также последовательные игры и их влияние на адаптацию точки отсчёта. Основным элементом данной работы является эмпирический эксперимент, основанный на использовании прямого опроса. Опрос состоит из трёх частей, представляющих различные виды исследуемых гипотез. Первая часть представляет собой вопросы с множественным выбором. Вышеупомянутые вопросы служат доказательством того, что теория перспективы действительно работает на практике. Во второй части участники должны указать максимальную полезность цены определённого актива. Она помогла выявить, что самая высокая адаптация точки отсчёта была достигнута группой с информацией о высокой закупочной цене соперника. Ещё один важный вывод данного эксперимента заключается в том, что индивидуумы, как правило, указывают самый высокий уровень своих ожиданий как максимальную полезность цены и не склонны указывать значения, превышающие ожидания. Третья часть опроса представляет собой многоступенчатую лотерею, в которой участники должны сделать выбор между несколькими игорными альтернативами. Важная тенденция была отмечена во время этого эксперимента: адаптация точки отсчёта проходила быстрее среди индивидуумов, испытывающих очередные потери, чем среди тех, у кого были очередные прибыли. Следовательно, больше времени требуется для адаптации точки отсчёта в случаях последовательных выигрышей, чем в случаях последовательных проигрышней.