

# LOSS AVERSION

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## Abstract

The paper focuses on the presentation of the concept of loss aversion, as well as the concept of „deviation from rationality“. The main aim of the article is to define loss aversion and to describe several examples realized by authors such as: Daniel Kahneman and Amos Tversky (1991), Masashi Toshino and Megumi Suto (2004), Stephen G. Dimmock and Roy Kouwenberg (2010). The intention of the paper is to introduce the meaning of subjective value losses, as well as to mathematically express loss aversion by using utility function. The aim of the paper is not only to present the notion of loss aversion, but also to inform about the difficulty of obtaining necessary data for potential research, applying complex experiments rather than simply questionnaire.

**Key words:** Loss Aversion. Hypothetical Weighting Function. Deviation from rationality.

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## INTRODUCTION

Prospect theory is dealing with the core and functioning of loss aversion, which formation can be dated back in 1979, when Daniel Kahneman and Amos Tversky published an article titled: "Prospect Theory: An Analysis of Decision under Risk" – Prospect Theory: Analysis of Decision Making under Conditions of Risk.

As reported by Vladimír Baláž (2009), deviations from rationality are errors in judgments and proceedings, occurring in certain situations in humans. These are patterns of reasoning and performing that can be defined, and which differ from the reasoning and performing of other subjects and/or differ from reasoning and performing the same subjects but in different situations. Deviations thus represent a "bias economic agents in collecting, analyzing and evaluating information and in making economic decisions". (Vladimír Baláž, 2009)

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At the time of continuous decision making processes in everyday activities (e.g.: while visiting theater or cinema, while shopping, visiting family by using public transport or car, and so on...) the loss aversion is one, which consciously or unconsciously influences our decisions.

Loss aversion reflects the intuition that the loss of  $X \text{ €}$  is more aversive than the profit of  $X \text{ €}$  is attractive. (D. Kahneman, A. Tversky, 1984)

The aim of this paper is to introduce one of emotional deviations from rationality, the loss aversion. In addition, the aim is to present subjective value of losses, because the attraction of potential profit is far from sufficient in the aim to compensate for the eventual loss aversion at the same bets.

The intention of this work is also to define a mathematical expression through loss aversion utility function. The work provides examples of the loss aversion realized by the authors: D. Kahneman and A. Tversky (1991), M. Toshino and M.Suto (2004), S. G. Dimmock and R. Kouwenberg (2010).

### LOSS AVERSION AS EMOTIONAL DEVIATION FROM RATIONALITY IN FINANCIAL BEHAVIOR

The expression of loss aversion as emotional deviation from rationality is that people feel losses much more intensive than profits. The most visible expression of loss aversion is the reluctance to invest in risky assets, especially in shares. Loss aversion is a universal deviation that is not limited just to investors' amateurs. The majority of funds in the financial markets are not held by individual investors, but mostly by institutional investors: banks, insurance companies, mutual and pension funds, securities dealers and the like. (Vladimír Baláž, 2009)

Emotional deviations can be rectified only with a lot of difficulties, if at all. It is necessary to adapt the client with strong emotional tendencies. (Vladimír Baláž, 2008)

Kahneman and Tversky (1984) report in their work, that the psycho-physical approach to decision-making can be observed already in a remarkable essay of Daniel Bernoulli, published in 1738. He tried to explain why people are generally averse to risk and why risk aversion with growing wealth is decreasing. To illustrate this example: "Imagine that you have a choice between two possibilities:

- a) **85%** chance to win **1000 €** (**15%** chance that you win nothing),
- b) definite win **800 €**."

Most people prefer sureness before gambling, even though gambling represents mathematically higher outlook. Expectations arising from gambling are  $0,85 \times 1000 \text{ €} + 0,15 \times 0 \text{ €} = 850 \text{ €}$ , what exceeds the expectations of **800 €** connected with sureness. Prioritizing definite profit is an instance of risk aversion.

### SUBJECTIVE VALUE OF LOSSES

The decision analysis usually describes the results in terms of overall wealth. For example: Offer to bet 20 € on the coin toss is a choice between the current individual wealth  $W$  and its possibility to move to  $W + 20 \text{ €}$  or to  $W - 20 \text{ €}$ . It seems psychologically unrealistic: People usually do not think of relatively small results, as to the state of wealth, but rather focus on profits, losses and neutral results (e.g.: maintaining status quo). If they convey effective subjective value of change in the wealth rather

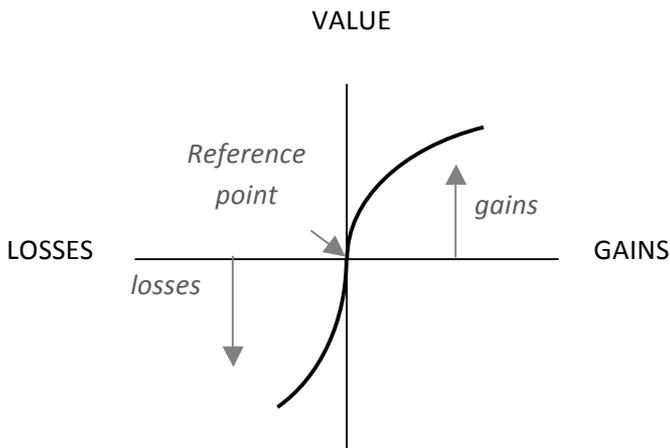
than the final status of wealth as we assume, than the psycho-physical analysis of the results should be applied rather to gains and losses, as to the total assets. (D. Kahneman, A. Tversky, 1984)

The difference in subjective value between the loss of 200 € and loss of 100 € seems to be greater than the subjective value between the loss of 1200 € and 1100 €. If the function value for gains and for losses shown in the same graph, we get S-shaped function, as can be seen in Figure 1. (D. Kahneman, A. Tversky, 1984)

Loss aversion reflects the intuition that the loss of  $X$  € is more aversive than the profit of  $X$  € is attractive. Loss aversion explains the reluctance of people to bet on a "fair coin" for the same bets: attractiveness of potential profit is not nearly enough to compensate the eventual aversion to loss. For example: The majority of respondents in a sample of students refused to bet 10 € on the loss of the coin flip, if they would win less than 30 €. (D. Kahneman, A. Tversky, 1984)

### Figure 1 Hypothetical Weighting Function

The function value is defined by gains and losses (rather than total wealth) and is concave in the area of gains and convex in the area of losses and is considerably steeper for losses than for gains.



SOURCE: Own processing on the basis of Daniel Kahneman and Amos Tversky: *Choices, Values, and Frames*, 1984.

### MATHEMATICAL EXPRESSION OF LOSS AVERSION

Kahneman and Tversky (1991) named loss aversion as uselessness of giving up the things that is greater than the utility associated with acquiring them. The nature intuition concerning the loss aversion is that the losses (scores below a certain reference value) represent a bigger threat compared with corresponding gains (scores above the same reference value).

According to N. Barberis and M. Huang (2001) the loss aversion means that people are more sensitive to a decrease in wealth rather than to its increase, what can be included in the utility function. Simple form of function that captures loss aversion is:

$$w(X) = \begin{cases} X, & \text{for } X \geq 0 \\ 2X, & \text{for } X < 0 \end{cases}$$

Where:  $X$  – is an individual loss or gain,  $w(X)$  shows the utility of profit or loss.

D. Kahneman and A. Tversky (1979) presented loss aversion as a way of explaining why people tend to reject smaller hazard, by using the following form:

$$G = \left( 110, \frac{1}{2} ; -100, \frac{1}{2} \right)$$

Meaning that: we get 110 € with probability  $\frac{1}{2}$  and we lose 100 € with probability  $\frac{1}{2}$ .

Most of utility functions used by financial economists are not able to explain risky attitudes, because they can be differentiated and they make investors risk-neutral despite small gambling. (N. Barberis and M. Huang, 2001)

If we wanted loss aversion to be included into inter-temporal framework, we would have to take the dynamic aspect into account. A. Tversky and D. Kahneman (1981) acknowledged that their prospect theory was originally developed only for one-time hazard and any requirements in the context of a dynamic development should be subjects for further evidence of how people think in context of gains and losses.

It is assumed that the investor's loss aversion is captured by function according to D. Kahneman and A. Tversky (1979). Starting with an example (N. Barberis and M. Huang, 2001) where investor is considering buying a portfolio of two shares. The shares are currently trading at 100 € and after careful thinking the investor decides for both shares. The value of share will be from now distributed as follows:

$$\left( 150, \frac{1}{2} ; 70, \frac{1}{2} \right)$$

That will be a function of the investor's aversion to loss. If the loss aversion is above the fluctuations in the portfolio, the expected utility of the investment can be expressed as follows:

$$\frac{1}{4} w(100) + \frac{1}{2} w(20) + \frac{1}{4} w(-60) = 5$$

This implies that:

- with probability  $\frac{1}{4}$ , both shares will earn 50 €, with total profit of 100 €,
- with probability  $\frac{1}{2}$ , one share earns 50 €, second loses 30 €, with total profit of 20 €,
- with probability  $\frac{1}{4}$ , both shares lose 30 €, with total loss of 60 €.

However, if the investor's loss aversion to partial (individual) share volatility, the expected utility from the investment will be expressed as follows:

$$2 \left[ \frac{1}{2} w(50) + \frac{1}{2} w(-30) \right] = -10$$

It means that for every share there is the same chance to earn 50 €, but there is also the same chance to lose 30 €. As we can see, the result is not very attractive. (N. Barberis and M. Huang, 2001)

The question is that which form of calculation better describes the behavior of the individual. Traditional pricing models usually assume such a broad form of accounting as possible: the utility is usually specified only by total wealth or consumption, not through the individual shares fluctuations. N. Barberis and M. Huang (2001) indicate in their work that with the help of mental accounting, people are involved in the narrow framing, what means that there often occurs focusing on narrowly defined gains and losses.

#### EXAMPLES OF LOSS AVERSION FROM THE PERSPECTIVE OF SEVERAL AUTHORS

In practice, we can find many examples of loss aversion. We are daily encountered with it and are faced decision-making in which loss aversion is manifested in various forms and frequencies. In the next chapter we discuss examples implemented by authors such as: D. Kahneman and A. Tversky (1991), Masashi Toshino and Megumi Suto (2004), Stephen G. Dimmock and Roy Kouwenberg (2010).

Let me take the following example (D. Kahneman and A. Tversky, 1991):

"Imagine you have been assigned to work part-time as a part of your professional training. However training is over and you are looking for a work. You are considering two possibilities. Both possibilities are similar to your professional training in many ways, with the exception of the amount of social contact, convenience, commuting to and from work. To compare the two jobs to the current one, it is advisable to draw up a table:

**Table 1 Example for loss aversion**

**Comparison of the reference point (present work) with two options: job A and job B with help of taking two factors into account: social contact and time attendance to/from work.**

Job	Social contact	Commuting time
Current job	isolated	10 min.
Job A	limited contact with surroundings	20. min
Job B	certain degree of social contact	60 min.

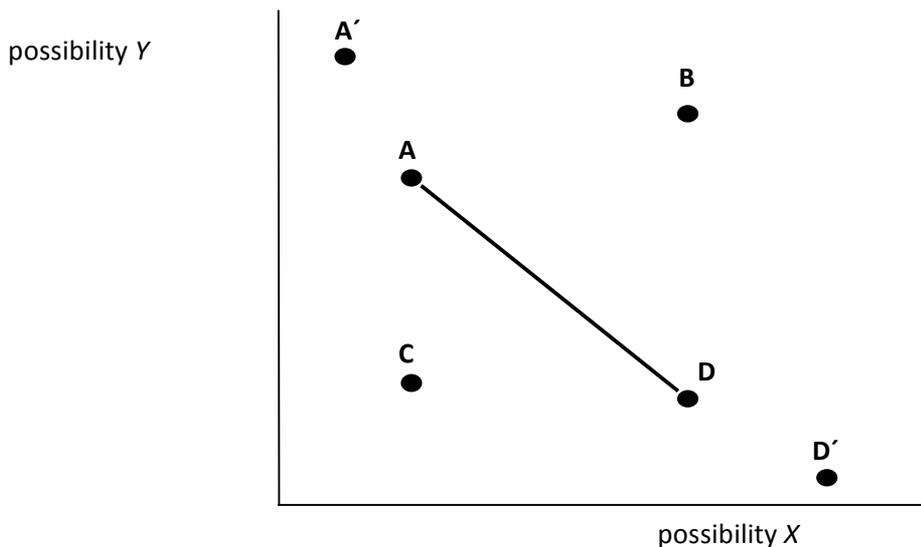
*SOURCE: Own processing on the basis of D. Kahneman and A. Tversky: Loss Aversion in Riskless Choice: A Reference – Dependent Model, 1991.*

Job A and job D are evaluated on the basis of the reference point represented by the current job, which is better in terms of commuting time, but worse with respect to social contact. Based on the study, the proportion of individuals who choose the possibility of “job A”, represents 70% of all respondents.

However, if a reference point (current job) includes social interaction and 80 min. commuting time to and from work (D'), then the proportion of respondents who choose "job A", was only 33%. It means that the subjects are more sensitive to the dimensions in which they tend to lose due to the reference point. (D. Kahneman, Jack L. Knetsch, Richard H. Thaler, 1991)

**Figure 2 More reference points for choosing between options A and option D.**

**Behavioral changes of respondents when changing the reference point (current job) to new reference point D', providing better social interaction and 80 min. commuting time to/from job.**



*SOURCE: Own processing on the basis of D. Kahneman, Jack L. Knetsch, and Richard H. Thaler: Anomalies – The Endowment Effect, Loss Aversion, and Status Quo Bias, 1991.*

Another example represents the observation realized by the authors: Masashi Toshino, Megumi Suto (2004). Their research is based on a questionnaire querying, so the results may be affected by the prevailing feelings of the Japanese securities markets during the period October – November 2003. They stated that if they repeat their survey again, they could get completely different results.

Regarding the loss aversion, the authors examined only the factor of relative size of losses against gains. However, prospect theory also implies that people are beginning to take greater risks when suffering from losses. Their research did not focus on this aspect. Their research confirmed the tendency to loss aversion, where investors feel much more pain of losses than pleasure from the same amount of profit. (Masashi Toshino, Megumi Suto, 2004)

In order to further investigation in the risk attitudes of investors in the area of gains and losses, it would be necessary to meet and to get know investors and the subsequent application of complex experiments instead of a simple questionnaire survey of anonymous investors. (Masashi Toshino, Megumi Suto, 2004, Beáta Gavurová, 2012, Vincent Šoltés and Beáta Gavurová, 2013).

Stephen G. Dimmock and Roy Kouwenberg (2010) were able to calculate the coefficient of loss aversion for each household assumed on data relating to the required risk premium. Subsequently the coefficient was compared with data relating to whether the household own equity assets or not. If household own equity assets, the share of total household financial assets was observed. Authors reached the following conclusions:

- The higher loss aversion is, the less probability of owning equity assets by the household is.
- If the household really have equity assets, their share of total financial assets also depends on the degree of loss aversion. The smaller aversion, the higher proportion of equity assets (stocks, equity funds, shares in private companies etc.).

Loss aversion as a pattern of thinking and behaving of the population is so common that it is considered to be a standard rather than to be a deviation from rationality. In all likelihood, loss aversion is the reason why most people are refusing involvement in investment into risky assets and in the case they have decided to participate, extremely high risk premium is required. (Vladimír Baláž, 2009)

## CONCLUSION

The intention of the work is to bring the loss aversion into attention, as one of emotional deviation from rationality in financial behavior. Aim of this paper is to present subjective value of losses with a graphical view of a hypothetical weighting function.

Daniel Bernoulli already in 1738 tried to explain why people are averse to risk and why risk aversion is decreasing with increase in wealth. However, as has been demonstrated, people usually do not think about relatively small results concerning the amount of wealth, but they focus on gains and losses.

The work also examines a mathematical representation of loss aversion followed by the example of application in which respondents have to choose between two new job opportunities compared to the current work, defined as the reference point. The results of the survey conducted by the authors: D. Kahneman and A. Tversky (1991) have shown that subjects are more sensitive to the dimensions in which they lose (the loss), with respect to a reference point.

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