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Empirical Paper

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The effect of uncertainty on negative discounting

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Abstract: The preference to receive benefits as early as possible and delay costs as much as possible is natural for people. That means a positive discount rate in the intertemporal choice, which is a common assumption in economics. However, as research in behavioral economics proves, in certain situations a negative discount rate occurs. The purpose of this paper is to show that the assumption of positive discounting is not always true. The presented experimental study shows how a decrease in probability increases the chances of negative discounting. According to the results, the expected large, uncertain profit is more likely to be deferred over time than a certain profit of the same value. On the other hand, the expected large, uncertain loss is more willingly experienced earlier than a certain loss of the same value. In both cases, it means an increase in the frequency of negative discounting due to increased uncertainty. The results of the study broaden the existing knowledge about the impact of probability on discounting in a situation of expected losses and the area of negative discounting.

Keywords: behavioural economics, intertemporal choice, negative discounting, uncertainty **JEL Classification:** D15, D91

1 Introduction

Both empirical research and life experience show that people most often prefer to receive benefits as early as possible and incur costs as late as possible. That means that the discount rate in intertemporal choices is positive and the amount loses its value with the deferral. The discounting process involves a decrease in the subjective value of an award or penalty (e.g., in the form of a cash amount) along with a deferral [e.g., Green and Myerson, 1996]. According to another definition [Frederick et al., 2002], discounting over time means assigning more weight to present than future consequences due to various factors that reduce future utility, such as uncertainty or changing tastes. For example, getting a cash prize now is much more attractive than getting the same prize after 5 years. Similarly, most people would prefer to pay for an apartment in 10 years, than now, if the amount was the same. This is because a given amount in the future seems, and almost always is, worth less than the same amount now. The more a given amount loses its value with the delay, the stronger the discounting – in other words, the higher the discount rate.

There are many reasons for justifying discounting over time. First, the benefits that can be obtained in the future are never 100% certain – even if they are assumed to be. Unforeseen things can always happen and in the end it may not be possible to obtain the benefit. For example, the individual may die before receiving the given amount; in the meantime there may be hyperinflation, which will make the amount received in the future worth very little; or the person (institution) who promised the given amount may die (go bankrupt). Penalties that are significantly delayed in time may also ultimately not take place for various

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reasons. Thus, postponement is always associated with uncertainty [Keren and Roelofsma, 1995; Weber and Chapman, 2005; Halevy, 2008].

In economics, receiving an amount of money later, instead of earlier, is associated with the opportunity cost, i.e., interest or other benefits that a given amount of money could bring. Before the global crisis of 2009, it was obvious that by keeping your funds in a bank or buying government-guaranteed treasury bonds, you would get additional interest on top of your original value. For this reason, it is better to receive a given amount of money now, even if it is not needed, because by allocating it properly, you can additionally receive a guaranteed interest from it. Inflation is another economic reason for discounting. When prices rise, a given amount of money loses purchasing power over time and therefore its value drops. Therefore, it is natural to prefer to get it as early as possible. Another factor that contributes to discounting is the psychological discomfort that people feel when positive events are postponed. On top of other rational and economic reasons, people simply want to get the benefits right away [e.g., Laibson, 1997; O'Donoghue and Rabin, 1999]. For these reasons, people generally have a positive discount rate.

Positive values of discount rates are often taken for granted. This, however, resembles the situation of interest rates in the economy, which were also considered not to be negative until about 12 years ago. Reality has shown that this assumption is not true. Similarly, there are conditions under which negative discounting occurs. The purpose of this article is to show that there are situations that increase the chances of negative discounting occurring in intertemporal choices. There is already evidence that negative discounting is very common in certain cases. The following review will present situations already described in the literature. Then, based on the Loewenstein model, hypotheses will be derived, indicating that probability is related to negative discounting. Finally, experimental studies will be presented showing that for large amounts (losses and gains), the chance of negative discounting increases as the probability decreases.

2 Literature review

Economists generally use the Samulson [1937] model, in which a single discount rate is used to discount various events (sources of utility); this rate is constant over time and cannot be negative. As shown by empirical research in the field of behavioral economics, these assumptions are often inconsistent with reality [Frederick et al., 2002]. In this paper, we use the Loewenstein [1987] model to show empirically that, under the influence of a change in probability, some people modify their preference from a positive to a negative discount rate.

Behavioral economists have found a few situations in which people make decisions in line with a negative discount rate, that is, they prefer to postpone favorable events and to experience negative events as early as possible. The first such phenomenon is the preference for improvement. This means that when people are asked to choose a sequence of given positive events, they prefer to experience them in such an order that the most favorable events occur later, after less positive events [Loewenstein and Prelec, 1993; Frederick and Loewenstein, 2008]. This preference applies, for example, to cash in the case of wages. In the study by Loewenstein and Sicherman [1991], the respondents preferred the increasing sequence of received wages rather than the decreasing ones, assuming a constant sum of the whole sequence. Ariely and Carmon [2000] noticed that patients in the hospital prefer pain sequences in which the intensity of the pain becomes weaker and weaker and with the discomfort perceived as the smallest at the end. It can be said that the subjects preferred the stronger pain sooner rather than later. The improvement preference implies a negative discount rate when events are viewed as a sequence.

The second phenomenon consistent with negative discounting is the preference for paying small amounts of money earlier. Most researches on discounting do not allow participants to choose in line with a negative discount rate. When Mitchell and Wilson [2010] gave a choice that was consistent with a small but negative discount rate, it was found that a significant proportion of participants made a choice that was consistent with negative discounting when the questions concerned a small loss (US\$10). However, the design of this study still suggested to participants that a more appropriate choice was in line with a positive discount rate. Finally, Hardisty et al. [2013], found that the preference to pay fines early is common for small amounts (US\$10 and US\$100), but not for large amounts (US\$1,000, US\$10,000). The authors of the

study explain the negative discount rate for small losses by the argument that people prefer to have small problems behind them as soon as possible so that they can forget about them. Moreover, waiting for an unpleasant future event (e.g., a punishment) can provoke negative emotions. However, with large amounts to be paid, it is the economic motivation that begins to prevail.

Other situations that lead to negative discounting were shown by Palenik [2017]. In his research, he discovered that there may be conditions under which a positive monetary amount, which is usually discounted with a positive rate, will be deferred, i.e., discounted with a negative rate. Such conditions are the expected decrease in income and the expectation of insufficient income in relation to expenditure in the future. The study did not deal with deferring consumption as it would be a normal saving situation. The respondents chose answers that delayed the moment of receiving the funds. It is difficult to justify such behavior with classical economic theories and a positive discount rate. However, Palenik [2017] showed that such behavior is consistent with the behavioral theory of Shefrin and Thaler [1988].

The last case of a preference for postponing favorable events and making sooner unfavorable ones is Loewenstein's [1987] anticipation effect. According to it, some events, even before they start, generate such strong emotions that the utility of anticipating outweighs the natural, positive discount rate. This causes the desire to postpone pleasant consumption as a result of savoring its prospect and to experience sooner the negative events in order to go through them as soon as possible. In Loewenstein's study, participants were asked to provide the subjective value of a future kiss from their favorite movie star. When they had the choice of kissing immediately, in 3 h, in 24 h, in 3 days, in a year, and in 10 years, the one they would receive in 3 days was the most valued, and not the immediate one as the positive discount rate would suggest. In the second part of the study, participants had to decide what compensation they would expect for an electric shock in the future. The respondents demanded the greatest compensation for the shock in 10 years, and not the immediate one, which meant a negative discount rate. Expecting a negative event has a negative value in its own right: for example, waiting for torture is in itself a psychological distress. In the experiment of Berns et al. [2006], the respondents were faced with the choice of receiving an electric shock after 3 s or 27 s. It turned out that when the strength of the shocks was identical, the vast majority preferred to wait for a shorter time. Moreover, some subjects preferred an even stronger paralysis right away rather than a weaker but delayed paralysis. The preference for earlier punishment was also demonstrated by Mischel et al. [1969]. Additionally, neuroimaging data in a study by Berns et al. showed an increase in the activity of brain regions associated with pain sensation before the electric shock occurred. This result supports the theory of utility (in this case negative utility) resulting from anticipation.

The classical model of discounted utility by Samuelson [1937] does not take into account the utility of anticipation. In this model it is assumed that apart from the moment of consumption of a given good, there is no other utility resulting from that good. This means that the utility of a given pleasure, for example, a vacation, is to come from being on vacation, and not from the joy of waiting for it. In fact, as Jevons had already pointed out [Loewenstein and Elster, 1992], people get pleasure not only from the current consumption, but also from the consumption expected in the future, thanks to anticipating it. Similarly, the prospect of unpleasant events is having a negative effect right now. According to Loewenstein's [1987] anticipation theory, certain events, especially emotionally strong ones, generate additional utility while waiting for them. According to Loewenstein, savoring is getting positive utility from anticipating future consumption, and fear means negative utility from future unfavorable events.

Loewenstein believes that the total current utility of deferred consumption is the sum of the discounted utility from consumption and utility from anticipation. Total utility of consumption may increase along with its deferral, in the event that future utility loses less with the deferral than the anticipation utility increases. Loewenstein gives the necessary and sufficient condition to postpone positive events and the preference to experience negative events earlier as the following:

$(\alpha/\delta) (1 - e^{-\delta L}) > 1 - e^{-rL}$

where *r* indicates conventional discount rate used to discount future utility from all sources (assumed to be positive); δ indicates measure of an individual's preoccupation with the future (someone with a low δ savors or dreads even those outcomes that will occur in the distant future); α indicates measure of the "imaginability" or "vividness" of a particular outcome; and finally *L* indicates the duration of consumption.

(1)

From the above relationship, Loewenstein made the implication that postponement of positive events and making sooner negative events will be more likely when the events are emotionally strong, influencing the imagination (high value α) and short-lived (low value *L*). Loewenstein suggests that people may want to postpone pleasant things, not only because they want to enjoy the time spent waiting for an event but also because they want to delay the regret of ending a future pleasure. They prefer to think about a given positive experience in the future tense than in the past tense. So they will be particularly eager to postpone it, when it is short-lived, because anticipation causes their experience to stretch over time. On the other hand, people prefer to experience negative events, which are fleeting and intense, immediately, to put them behind them as soon as possible. The theory of anticipation explains different levels of discounting of different goods (which is ruled out by mainstream economic theories). Goods that produce a greater degree of emotions have a lower discount rate.

Further analysis will show that Loewenstein's theory can justify the influence of uncertainty on the occurrence of negative discounting. According to the literature to date, uncertain events are less discounted than certain events [e.g., Keren and Roelofsma, 1995; Weber and Chapman, 2005; Vanderveldt et al., 2015). The studies conducted by Chew and Ho [1994], Lovallo and Kahneman [2000], and Palenik [2014] suggest that uncertainty has some impact on the possibility of a negative discount rate. Chew and Ho argue that hoping for a good outcome of a lottery leads to satisfaction with the expectation, and anxiety about possible loss leads to a desire to resolve uncertainty early. According to the assumptions of these authors, the greatest chance of the anticipation effect occurs when the probability of a future event is low. In the studies by Lovallo and Kahneman [2000] and Palenik [2014], the majority of participants showed reluctance to postpone games with a negative expected value by 2 weeks. The results of Lovallo and Kahneman also indicate that lotteries with a positive expected value, but with a low probability of a big win, are especially willingly postponed. Sagristano et al. [2002] reached a similar conclusion in their research. They showed that in the case of a lottery with a low probability and a high win, the respondents preferred to play it in 2 months rather than the next day, while in the case of a lottery with a high probability and a low win, the respondents preferred to play it the next day rather than in 2 months. The phenomenon of a negative discount rate should therefore be visible, especially with extremely low probabilities and very high rewards. However, the research of the above authors had the feature that both probabilities and amounts changed in the analyzed lotteries. Therefore, to our knowledge, there is no study that verified the impact of probability on the occurrence of negative discounting.

3 Hypotheses

According to Loewenstein's theory of anticipation [1987], the phenomenon of postponing positive and making sooner negative events is more frequent when the expected events are fleeting. Based on this relationship, the hypotheses regarding the influence of probability on negative discounting are substantiated below. In the case of positive events that are fleeting and intense, people experiencing them want to stretch the moment over time. Loewenstein suggests that people prefer to think about such positive experiences as if they belonged to the future. According to Loewenstein's theory, the short duration of a positive stimulus affects the possibility of preferring its remoteness in time. A further conclusion can be drawn from this condition. It is based on the observation that the duration of the impact of a future amount of money and the consumption of it depends on whether the receipt of the amount is certain or only likely. Receiving a guaranteed amount of money means that using it and enjoyment from it are stretched over time. Apart from the moment of receiving the money, there is a time to decide what to spend it on, the moment of purchase, and then the benefits from the consumption of a given good. So a positive impact is not just for a short time when you receive an amount of money. Especially in the case of a large amount, the receipt of which means the possibility of using it for a long time. For example, the receipt of US\$10,000 does not produce a shortterm utility when the amount is received, but is related to the utility of many different purchases over a longer period of time. So there are no compelling reasons to postpone the moment of accepting US\$10,000, which is only the beginning of long-term consumption. The situation is very different when the probability of receiving cash is <100%, and especially if it is only slightly above zero. In such a situation, it is possible

that the only short-lived event will be the moment of the lottery settlement, after which there will be no financial benefit and no impact on later utility. When the probability of winning is very low, the average expected duration of utility from lottery is very short. As the probability of winning decreases, the value of hope itself and the savoring of a possible win in relation to the economic value of the lottery increases. Thus, the chance of postponing the lottery increases due to the utility of anticipation. For example, receiving US\$10,000 with a probability of 1% means that with a probability of 99% the entire utility of the event will end at the moment of the lottery settlement. While there is a 1% probability that utility will be more long-lasting, the average expected duration of lottery consumption is very short. It is certainly much shorter than if the probability of receiving the amount was 100%. According to Loewenstein's condition, a shorter consumption time means a greater chance of postponing a favorable event. Since – as shown above – the average expected time of consumption decreases with a decrease in the probability of receiving a monetary amount, the following hypothesis to be empirically verified may be presented:

H1: The expected uncertain profit is more willingly delayed than guaranteed profit of the same value.

By analogy people prefer to experience fleeting and intense negative events now, in order to have them "put behind" as soon as possible. Similarly as with profits, a drop in probability means a reduction in the time of perceived utility, in this case negative utility. The occurrence of large losses with a 100% probability (e.g., a certain penalty of a large amount) has a negative effect long after the penalty has been paid. Payment may, for example, involve incurring a debt and then paying it off over a long period of time. This will thus limit future consumption. Thus, the impact of a large loss causes effects that extend much beyond the moment of its payment. However, when the payment requirement is uncertain, it is possible that the only event will be the fleeting moment of the lottery's settlement, after which there will be no financial loss or impact on subsequent utility. In a situation of uncertainty, the negative utility of the fear of a possible loss may become more significant than the expected economic value of the loss. Therefore, the following hypothesis will be empirically verified:

H2: The expected uncertain loss is more willingly experienced early than guaranteed loss of the same value.

4 Study

The empirical research was conducted using an experimental method, as the research tool used a questionnaire with questions about decisions in hypothetical situations. Two surveys were conducted through the CrowdFlower platform on two different groups. In the first survey, the questions referred to profits, and in the second survey, the questions referred to losses. In each survey there was one additional question with the sole purpose of checking whether the questionnaire was filled in with sufficient attention and understanding. Additionally, a limit of 1.5 min was introduced as the minimum time that must be spent on filling in, for the answers to be considered credible. The rejection criteria (time and test question) are in line with the proposals of Mason and Suri [2012].

4.1 Participants

The questionnaires were completed by Indian respondents due to the easy access to Indian citizens on the CrowFlower platform. The respondents received a small fee of US\$0.1 for completing the survey. In the survey, respondents were choosing between hypothetical amounts of money. However – as the publications of other authors indicate – experiments with choices between real and hypothetical amounts yield similar results [Johnson and Bickel, 2002; Madden et al., 2003].

In the group of questions on profits, 60 questionnaires remained (out of 130) after the rejection of people who did not meet the attention criterion or the minimum time to complete. The mean age was M = 32.3 years (SD = 9.8) and 73% of the respondents were men. In the group of questions concerning losses, the qualitative criteria were met by 61 questionnaires (out of 122). The mean age was M = 30.5 years

(SD = 8.1) and 74% of the respondents were men. The analysis of the rejected questionnaires showed that the conclusions would not change if they were included.

4.2 Procedures

Each respondent was presented with eight experimental questions plus an attention checking question. In each question related to profits, the respondent was to answer whether he preferred a given amount of money immediately, after 3 months, or after 12 months. Respondents who answered the questions related to losses had to choose when to pay a given amount of money (immediately, after 3 months, or after 12 months). This procedure, with a few possible postponements, was similar to the study by Harris [2012], which tested the fear of an expected event. The pattern of each profit question was always as shown in the following two questions:

In the following questions you will have to choose when to experience a particular favorable event. Please read the instructions carefully and answer the questions as though they were representative of real situations.

Q1. Imagine that the tax office was wrong some time ago to your disadvantage and it will have to return to you the amount of US\$10,000. You can receive funds now, after 3 months, or after 12 months. When do you want to receive US\$10,000 ?

a) Immediately

b) After 3 months

c) After 12 months

Q2. Imagine that you have noticed the possible mistake of the tax office. You think they should pay you US\$10,000. So you appeal against their earlier decisions. Your friend who is a tax advisor claims that the tax office will almost certainly agree with you. He estimates the probability that you will receive US\$10,000 at 95%.

The final decision of the office may still take place immediately (immediate mode), or it can be resolved after 3 months (as ordinary mode), or after 12 months as delayed mode. The mode does not change the size of the compensation nor the probability that you will receive it. After the decision, if it is favorable to you, the office will immediately pay you the amount of US\$10,000.

What would you choose:

a) Immediate mode - receive US\$10,000 with a probability of 95% immediately

b) Ordinary mode – receive US\$10,000 with a probability of 95% after 3 months

c) Delayed mode – receive US\$10,000 with a probability of 95% after 12 months

Each respondent answered questions Q1–Q8, in which the probability and the value of the amount varied as follows:

Q1: US\$10,000, 100%; Q2: US\$10,000, 95%; Q3: US\$10,000, 50%; Q4: US\$10,000, 5%; Q5: US\$200, 100%; Q6: US\$200, 95%; Q7: US\$200, 50%; Q8: US\$200, 5%.

Also, in the second survey, which referred to losses, the subjects were presented with eight experimental questions, and in addition a question checking the level of attention paid to the questionnaire. In each question, the respondent was to answer whether he preferred to pay a given amount of money now or in the future. The pattern of each loss question was always as shown in the following two examples:

In the following questions you will have to choose when to experience a particular unpleasant event. Please read the instructions carefully and answer the questions as though they were representative of real situations.

Q1. Imagine that you have received a letter from the court notifying that you lost a lawsuit and you will have to pay a penalty at the amount of US\$10,000. You can pay it immediately, or after 3 months, or after 12 months. When would you like to pay US\$10,000 ?

a) Immediately

b) After 3 months

c) After 12 months

Q2. Imagine that you were involved in a car accident and you will probably have to pay a compensation of US\$10,000. However, your guilt is not so certain to be proved. You decide to appeal to the court. Your friend (a lawyer) believes that the verdict of the court will almost certainly be unfavorable and you will have to pay the compensation. He estimates the probability that you will have to pay at 95%.

The case in court can be settled immediately (immediate mode), or it can be resolved after 3 months (as ordinary mode), or after 12 months as delayed mode. The mode does not change the size of the compensation nor the probability that you will have to pay.

What would you choose:

- a) Immediate mode pay US\$10,000 with a probability of 95% immediately
- b) Ordinary mode pay US\$10,000 with a probability of 95% after 3 months
- c) Delayed mode pay US\$10,000 with a probability of 95% after 12 months

Each respondent answered questions Q1–Q8, in which the probability and the amount of losses varied as follows:

Q1: US\$10,000, 100%; Q2: US\$10,000, 95%; Q3: US\$10,000, 50%; Q4: US\$10,000, 5%; Q5: US\$200, 100%; Q6: US\$200, 95%; Q7: US\$200, 50%; Q8: US\$200, 5%.

4.3 Measures

In the part concerning profits, the independent variable directly related to the H1 hypothesis was the probability of receiving a monetary reward. Depending on the question, the probability was 100%, 95%, 50%, and 5%. The study was conducted for a profit of US\$200 and US\$10,000. The respondents could choose to receive the given amount immediately, in 3 months, or in 12 months. The dependent variable was the frequency of choosing the answer "immediately". A choice other than "immediately" means a willingness to postpone a given amount. According to the H1 hypothesis, increasing uncertainty should reduce the frequency of "immediately" responses.

In the part of the study relating to losses, the independent variable related to hypothesis H2 was the probability of the need to pay a given amount of money. Depending on the question, the probability of loss was 100%, 95%, 50%, and 5%. The study was conducted for losses of US\$200 and US\$10,000. The respondents could choose the time of payment of a given amount: immediately, in 3 months, or in 12 months. The dependent variable was the frequency of choosing the answer "immediately". Choosing "immediately" indicated willingness to experience the adverse event as quickly as possible. According to the H2 hypothesis, an increase in uncertainty should increase the frequency of the response "immediately", and thus increase the occurrence of the negative discount rate.

5 Results

5.1 Impact of uncertainty on profit deferral

To investigate whether the uncertainty affects the willingness to defer the profit, a statistical analysis was performed using the Friedman test. Separate tests were conducted for two experimental conditions: a profit of US\$200 and of US\$10,000. The results of the percentage of responses for the US\$200 profit condition are presented in Table 1. In the case of a smaller amount, the test showed no statistically significant differences between the responses "Immediately," "after 3 months," and "after 12 months" ($\chi^2(3) = 3.08$; P = 0.379). This means that for US\$200, there was no demonstrated impact of probability on the preferred time of the positive event. Therefore the results did not support hypothesis H1.

Next, the effect of uncertainty level was examined when the potential profit was US\$10,000. The results of the percentage share of responses are presented in Table 2. Friedman's test in this case turned out to be statistically significant, so the probability of profit influenced the willingness to postpone it ($\chi^2(3) = 11.59$; P = 0.009). The less likely the profit was, the more readily it was deferred. With a 100% probability of receiving US\$10,000, 88.3% of the respondents chose the answer "immediately," while for the probability of 50% and 5%, it was 71.7% of the respondents. The results supported the hypothesis H1.

5.2 Impact of uncertainty on loss deferral

To verify whether the uncertainty affects the willingness to postpone the loss, an analogous analysis was performed as in the case of profits. The results of the responses are shown in Tables 3 and 4, in percentage values. Again, the loss of US\$200 and the loss of US\$10,000 were analyzed separately. For the amount of US\$200, the Friedman test showed no statistically significant differences in the preferred payment date depending on the probability ($\chi^2(3) = 1.82$; p = 0.611). Therefore the results did not support hypothesis H2. It is worth emphasizing the very high share of the "immediately" answer – for the probability of 100%, 95%, and 5%, it was the most frequently chosen answer.

Finally, a situation in which the loss amount was US\$10,000 was considered. The results of the responses are presented in Table 4 in percentage values. According to the Friedman test results, the influence of the uncertainty level on the willingness to defer the payment could be ascertained ($\chi^2(3) = 11.55$; p = 0.009). The less likely the loss, the more often the answer "immediately" was chosen. The respondents significantly more often preferred immediate payment when the loss was 5% than when its probability was 100%. The results supported hypothesis H2.

	Immediately (%)	3 months (%)	12 months (%)
Profit US\$200, probability 100%	83.3	10.0	6.7
Profit US\$200, probability 95%	81.7	15.0	3.3
Profit US\$200, probability 50%	73.3	23.3	3.3
Profit US\$200, probability 5%	75.0	18.3	6.7

Table 1. The response percentage for the US\$200 profit condition and its various probabilities

Table 2. The response percentage for the US\$10,000 profit condition and its various probabilities

	Immediately (%)	3 months (%)	12 months (%)
Profit US\$10,000, probability 100%	88.3	8.3	3.3
Profit US\$10,000, probability 95%	85.0	13.3	1.7
Profit US\$10,000, probability 50%	71.7	26.7	1.7
Profit US\$10,000, probability 5%	71.7	18.3	10.0

Table 3. The response percentage for the US\$200 loss condition and its various probabilities

	Immediately (%)	3 months (%)	12 months (%)
Loss US\$200, probability 100%	47.5	16.4	36.1
Loss US\$200, probability 95%	45.9	24.6	29.5
Loss US\$200, probability 50%	32.8	39.3	27.9
Loss US\$200, probability 5%	50.8	13.1	36.1

Table 4. The response percentage for the US\$10,000 loss condition and its various probabilities

	Immediately (%)	3 months (%)	12 months (%)
Loss US\$10,000, probability 100%	13.1	14.8	72.1
Loss US\$10,000, probability 95%	16.4	23.0	60.7
Loss US\$10,000, probability 50%	18.0	32.8	49.2
Loss US\$10,000, probability 5%	29.5	16.4	54.1

6 Discussion

The research confirmed the hypotheses that the expected uncertain profit is more likely to be delayed than the certain profit and that the expected uncertain loss is more willingly experienced early than a certain loss. The relationship was positively verified but only for large amounts (US\$10,000) and not for small amounts (US\$200). Due to the introduction of uncertainty, large losses are more likely to be experienced right away, while in the case of large profits, some respondents began to postpone them due to uncertainty. In both cases, this means an increased chance of a negative discount rate due to uncertainty.

The results of the study can be interpreted as the effect of the difference between the opposite motivations: economic and emotional (Loewenstein's anticipation). As the probability of suffering a large loss decreases, the economic incentive to postpone an adverse event decreases. For low probabilities, there is less economic incentive to postpone the loss, but people still feel anxious about the possibility of incurring it. Therefore, the negative emotional effect related to fear and waiting for a resolution, in the case of low probabilities, begins to prevail for some part of the respondents and encourages them to experience the unfavorable event immediately. Similarly, in the case of profits, as the probabilities, the excitement of the economic effect decreases in comparison with emotional effect. For low probabilities, the excitement of a possible win outweighs the real economic value of the lottery.

Previous studies [e.g., Keren and Roelofsma, 1995; Vanderveldt et al., 2015] have shown that uncertainty causes reduction in the discount rate for expected profits in intertemporal choices. The results of our study are consistent with these conclusions and broaden the knowledge of the occurrence of negative discount rates and the loss condition. Earlier, thematically similar studies did not deal directly with the relationship between uncertainty and negative discounting. For example, the research conducted by Chew and Ho [1994] indicated the existence of the phenomenon of hope leading to the desire to postpone the resolution of a positive lottery and the phenomenon of fear leading to the desire to experience the resolution a negative lottery early. However, these studies concerned the very resolution of uncertainty, and not the moment of receipt/payment of a given amount. The moment of receipt/payment was constant in the future. So, the desire to resolve the uncertainty about the loss earlier was not the same as the desire to experience the lottery, followed immediately by the possible loss, as it was in our study. In addition, the choices in the Chew and Ho study did differ in terms of probabilities, but none concerned the guaranteed amounts (with a 100% probability). Similarly, the respondents forming part of the studies by Lovallo and Kahneman [2000] and Palenik [2014] indicated their willingness to make sooner lotteries with losses. In these studies, however, apart from the general reluctance to postpone lotteries with a negative expected value, it is difficult to conclude about the impact of uncertainty itself on the occurrence of a negative discount rate. It resulted from the research methodology in which the expected value was constant, so apart from the probabilities, the values of losses/gains also changed. Also, in these studies, there were no guaranteed sums of money. Additionally, both studies were conducted using a rarely employed rating method [Frederick et al., 2002]. Most of the above reservations can also be applied to the research carried out by Sagristano et al. [2002], in which lotteries with a low probability of winning were rated higher when they were to take place in 2 months than on the same day.

In our study, the negative discount rate increased its frequency due to the uncertainty for large gains and losses, but the effect was not visible for small amounts. How can the above results be explained by the Loewenstein model? The model indicates that a negative discount rate will be more likely when a given phenomenon is more fleeting (short-lived). It can be assumed that for small amounts it does not matter whether the amount is certain or unlikely – its impact on satisfaction will be quite short-lived. However, for large values, as justified in deriving H1 and H2, the average profit/loss effect will be more fleeting for unlikely amounts than for certain amounts. The noticeable impact of uncertainty for large amounts, but not small amounts, is consistent with the so-called "reverse magnitude effect" for uncertain amounts. This effect indicates that the impact of uncertainty on the valuation of a given lottery is greater for large amounts than for small amounts [e.g., Ostaszewski and Karzel, 2007]. When it comes to a large amount, a very important element of information for the assessment of an event is whether it is a certain amount or only

a probable amount with a probability of, for example, 10%. However, for small amounts, the probability is not so important – whether the amount is certain or unlikely still remains insignificant.

The tendency to prefer a large uncertain loss earlier may result from the phenomenon of hedonic adaptation, which reduces the impact of negative events. According to Frederick and Loewenstein [1999], hedonic adjustment may require "taking the hit" – recognition, admission, and confrontation with loss. As the authors point out, confirmation of the death of a long-missing person positively influences the family and relatives' adaptation to the situation. To say that there is 100% probability that something bad happened is better than a 99% probability is counterintuitive. However, a little hope worsens the possibility of returning to a normal level of satisfaction with life. Similarly, those surveyed by Wiggins et al. [1992], who were informed of an adverse medical diagnosis, felt better than those who obtained an inconclusive result. Frederick and Loewenstein [1999] also cite cases in which the hope of parole causes worse feelings in prisoners who are sentenced to life imprisonment compared to those without the possibility of parole. Therefore, the resolution and experience of a negative random event can be preferred earlier in time so as to avoid unwanted uncertainty.

In the case of a loss of US\$200, a high percentage of people (47.5% for a loss scenario with a probability of 100%) chose the option " immediately". These results are consistent with the discovery by Hardisty et al. [2013] of a negative discount rate for small losses, as opposed to large losses, where the positive discount rate was definitely dominant. However, the research by these authors did not deal with the case of uncertain amounts. Our study confirmed with another methodology – demonstrated earlier – the phenomenon of a frequent negative discount rate for small losses and an increase in the discount rate (toward the positive side) along with the increasing amount of loss.

According to Loewenstein's model, the anticipation effect is most pronounced in the short term. Our research results for a 5% loss probability agree with this claim. The distribution of preferences was bimodal, that is, the delay by 3 months was the least preferred. In the case of a short delay, some people prefer to "get it over with," which is in line with the cognitive load reduction preference [Hardisty et al., 2013]. However, other respondents would prefer to postpone a potential loss as far as possible, because they will not think about it at all anyway. Such a distribution is consistent with the results of Harris [2012], who investigated the willingness to postpone unpleasant events. It turned out that people most often wanted to experience either immediately or as late as possible (in 5 years) short-term aversive experiences, such as splashing a glass of water on oneself or a bee bite.

The results showing the anticipation effect under the influence of uncertainty have interesting practical applications. For example, when a person suspected of a very significant crime begins to use a tactic of slowing down the proceedings as much as possible, the proper counter-practice of investigators may be to show the suspect that his defeat in court is not obvious. When the offender is convinced of this, he should be much more likely to speed up the resolution of the case. Indeed, one of the investigative techniques aimed at obtaining a confession from a suspect is justifying his actions [Tokarz, 2006, p. 372]. In the eyes of the real perpetrator, such justification should reduce the size of the expected penalty and/or the probability of its inevitability, and thus increase the willingness to resolve the case earlier. It is also common to postpone difficult but inevitable events, such as meeting an unpleasant person to carry out a task. It is worth realizing then that meeting this person may not be unpleasant, because maybe he will be in a good mood or will not have time to be rude. This way of thinking will reduce the subjective probability of a negative event significantly <100%. Consequently, such a meeting will be more likely to be scheduled sooner. Probability manipulation can therefore be used in the fight against the tendency to put off difficult matters. The results of the study also suggest the means to communicate future negative, uncertain events so that they are as less severe as possible. Based on the results, it can be concluded that the time between the information about the potential threat and the resolution of the uncertainty should be as short as possible, so that the negative impact is as small as possible. For example, when a company has to lay off a small part of the workforce, it should provide this information preferably immediately, with the list of people to be dismissed. In the case of the announcement of restructuring itself, the fear of layoffs may adversely affect all employees while waiting for final decisions.

The limitation of the study was that only the periods of 3 months and 12 months have been taken into account. In the future, it is worth examining the phenomenon of negative discounting caused by uncertainty for both shorter (several hours, days, weeks) and very long periods (e.g., 5 years and 10 years). Future research could also more accurately define time delays where a negative discount rate most often occurs. In the future, it is also worth examining the values of probabilities for which the anticipation effect is the strongest. Most likely, these are low probabilities that people tend to overstate. However, examining for extremely low probabilities is also necessary, as they are usually completely ignored by people [Slovic et al., 1982].

7 Conclusions

The above studies tested hypotheses based on Loewenstein's [1987] anticipation theory, describing savoring a future positive event and fearing a future, emotionally strong, negative event. They showed that the expected large, uncertain profit will be more likely to be deferred over time than a certain profit of the same value. On the other hand, the expected large, uncertain loss will be more willingly experienced earlier than a certain loss of equal value. In both cases, this means an increase in the frequency of negative discounting due to increased uncertainty. These results are consistent with the current knowledge about the impact of uncertainty on the reduction of the discount rate in the context of expected profits. However, the study additionally extends these conclusions to include the situation of expected losses and the area of negative discounting, which are the original results.

The research results supplement Lowenstein's theory of anticipation with uncertain events. Based on Loewenstein's theory, it is known that a negative discounting most often occurs in the case of intense and fleeting events. The amount of the potential reward/penalty is related to the intensity, while the probability is related to the average expected duration of the reward (penalty). High awards and penalties evoke strong emotions, while a low probability of an event means that, apart from a fleeting lottery, most likely no consequences will occur. Therefore, large, low-probability rewards will be relatively willingly deferred, while large low-probability penalties will be more often preferred earlier compared to certain events. In general, negative discounting will occur in human choices most often for large amounts with low probability. The results of the study show that the assumption of a positive discount rate should not be generalized to every situation. It should be emphasized that the research did not deal with postponing consumption, which would be a normal saving situation, but with postponing the receipt of money itself, which would be difficult to justify with classical economic theories. These behaviors can, however, be explained in terms of behavioral economics.

The phenomenon of negative discounting is still scarcely studied. However, it may be helpful in explaining the negative interest rates that have emerged in some economies in recent years. This is because interest rates and discounting rates in intertemporal choices are related. A correlation between both variables was shown by Wang et al. [2016]. Moreover, according to some schools of economics (classical economics, Austrian school), the strength of time preference measured by the discount rate influences people's behavior (saving, investing) affecting market interest rates. Therefore, research on negative discounting may have practical applications in economic policy in the future.

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