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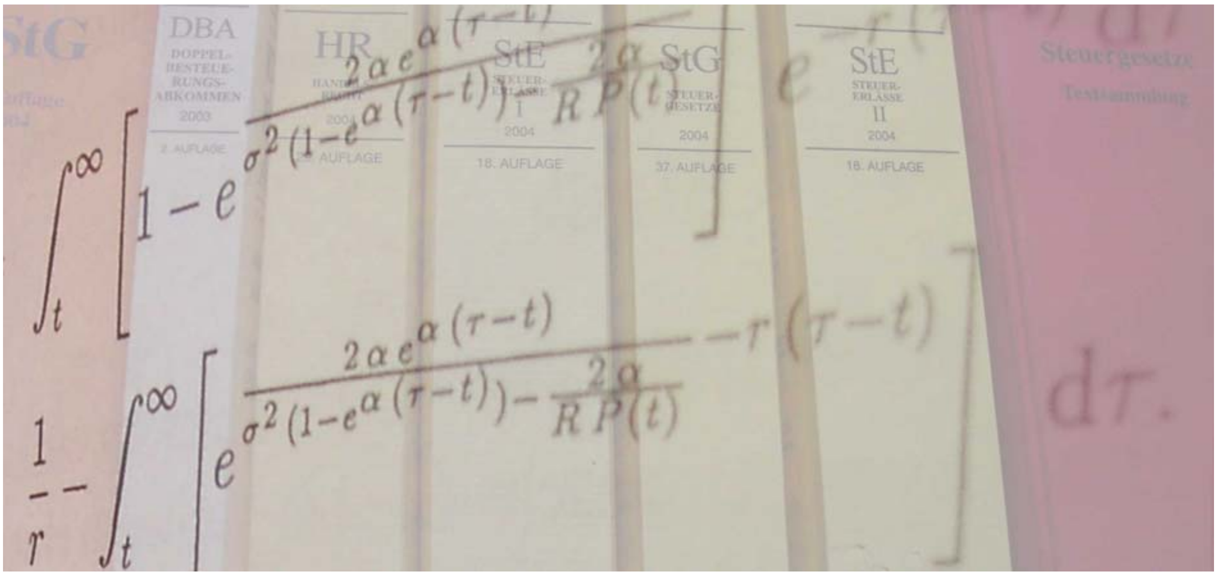

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The Perception of Income Taxation on Risky Investments – an experimental analysis of different methods of loss compensation –

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The Perception of Income Taxation on Risky Investments
– an experimental analysis of different methods of loss compensation –

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Abstract

We analyze the effect of income taxation with limited loss deduction on investment decisions. An experiment with five treatments was conducted, one without taxation as a reference and four with taxation and limited loss compensation. The participants' task was to repeatedly choose one out of two risky investment opportunities. Earnings from the experiment depended on the payoffs of the participant's investments.
Our results reveal that subjects do not only look at gross payoffs but also take taxes into account in their decisions. The experimental setup made sure that a rational participant who correctly perceives the effect of the different loss offset rules would take exactly the same decisions with and without taxation. Nevertheless, we find out that individuals tend to overestimate the value of loss compensation rules which offer less than a complete loss offset.

1 Introduction

This paper presents an experiment on the influence of income taxation on risk-taking in investment decisions. Its focus is twofold: (1) on comparing situations with and without income taxation, and (2) on comparing the effect of different forms of (limited) loss offset-rules. From theory we know that the effect of taxation on risk-taking may be ambiguous depending on the specific tax schedule and on the investor's attitude towards risk. Therefore, we have taken care to model equal situations in all treatments. This allows us to compare treatments without knowing the subjects' utility function. The tax schedule is linear except for the limitation on loss compensation.

2 Literature

2.1 Theoretical Contributions

There is an important body of literature analyzing the effect of taxation on risk taking in investment decisions which has been inseminated by *Domar and Musgrave* (1944). Based on the Keynesian model of liquidity preference, this paper models the choice between riskless cash holdings and risky interest-earning bonds in the presence of a linear income tax in which the degree of possible loss offset is varied. The investor's objective is to maximize expected yield. Risk is modeled not as standard deviation but rather as expected loss which reduces expected yield.[1] It is argued that without loss offset the effect on risk taking is ambiguous. The yield will be cut by taxation, while risk is unchanged so that the investor will want to take less risk. On the other hand the investor will want to compensate for the tax-induced reduction in income by increasing his risky investments. The total effect is uncertain. With complete loss offset risk-taking does not become less attractive since risk and yield are reduced by the same percentage. The investor will increase risky investments to compensate for the reduction in yield. With partial loss offset the result is uncertain again, as this is a mixed case, somewhere between the two cases discussed.[2]

Richter (1960) shows that the assumption on the investor's behavior is not necessarily Bernoulli rational. Nevertheless, his and other subsequent contributions confirm the main results of *Domar and Musgrave* (1944) using different optimization frameworks like the μ-σ-criterion (*Tobin 1958*), expected utility with different utility functions (*Mossin 1968*, *Stiglitz 1969*, *Allingham 1972* and *Sandmo 1989*), mathematical optimization (*Näslund 1968*) or stochastic dominance (*Russell and Smith 1970*): Under a proportional income tax with

1 *Domar and Musgrave 1944*, p. 393–395, *Haegert and Kramm 1975*, p. 76.
2 *Domar and Musgrave 1944*, p. 388–390.

complete loss offset, a risk averse investor will tend to invest a bigger share of his wealth in risky assets than without taxation provided that relative risk aversion is increasing. Likewise, risk-taking increases with the tax rate as taxation not only reduces positive returns to the investor, but also risk through tax loss compensation. With incomplete loss offset, the effect is ambiguous.[3]

A progressive income tax with full or with limited loss offset will reduce risk taking by a risk neutral investor. For a risk-averse investor the effect is ambiguous even with full loss offset. Provided that the utility function is nonlinear and concave it is always possible to find a tax schedule which increases risk taking with respect to a specific risky investment and another tax schedule which decreases risk taking with respect to another specific risky investment (*Bamberg and Richter 1984*, p. 96–100)

2.2 Experimental Contributions

To our knowledge, no experiment has been conducted on the influence of income taxation on risk-taking in investment decisions. Nevertheless there is some empirical evidence on related questions from experiments, from data analysis, and from interviews. It has been shown that the perception of an individual's average or marginal tax rate is not always correct (*Gensemer et al. 1965*, *Lewis 1978*, *Fujii and Hawley 1988*, *König et al. 1995*, *Rupert and Fischer 1995*, *Arrazola et al. 2000*, *Hundsdoerfer and Sichtmann 2007*). It seems that the complexity of rules or of their presentation has a negative influence on the correct perception (de *Bartolome 1995*, *Rupert and Wright 1998*, *Rupert et al. 2003*, *Boylan and Frischmann 2006*, *Blaufus and Ortlieb 2009*). In games with repeated decisions, subjects have been observed to learn and thus to improve their decisions in the course of the experiment (*Ruffle 2005*, *Sausgruber and Tyran 2005*/ 2008, *Boylan and Frischmann 2006*).

[3] *Bamberg and Richter 1984*, p. 93. Seemingly opposite results are not in contradiction to this: *Tobin* (1958, p. 81–82) assumes a tax on interest paid without loss offset for capital losses, but there is also no tax on capital gains. *Mintz 1981* produces ambiguous results by assuming discrimatory taxation of (1st) economic rents and the cost of capital or (2nd) returns to equity and bond holders. *Feldstein* (1969, p. 761–763) shows that a proportional tax has no effect on risk-taking with decreasing absolute risk aversion.

3 Decision task

Participants' decision task in this experiment was to choose one of two investments. Each investment consisted of three payoffs which were given in Euros and were equal to the (possible) earnings from this part of the experiment. In each treatment 20 decision situations with different investments existed. In each decision situation, pairs of investments similar to the following were presented:

$$(x \quad , \quad z \quad , \quad -x) \quad \text{and} \quad (y \quad , \quad z \quad , \quad -y)$$

where $x > y > 0$. In both investments, the payoffs z were identical but investments differed in their payoffs x and y. All three states of nature are equally probable with $p = 1/3$ and, therefore, expected values of both investments were identical. However, the variance of the right investment is smaller since x was strictly larger than y. We will refer to the investment on the right side as low-risk investment in the following. Assuming risk averse behavior of participants, the following preference should be observed in the experiment:

$$(x \quad , \quad z \quad , \quad -x) \quad \prec \quad (y \quad , \quad z \quad , \quad -y)$$

The first treatment (without taxation) was used to measure the risk attitude of each participant. It served as a *baseline-treatment* to analyze the effect of the different tax regimes in the other treatments. If tax rules were perceived wrongly this was expected to have influence on the participant's decision patterns. Therefore, the decisions of each participant in this first treatment were used as reference values to determine this influence on participants' risk taking in the tax treatments. For the analysis of the perception of income taxation and of different methods of loss compensation only the difference in risk taking between the baseline-treatment and the other treatments is important.

3.1 Do taxes matter?

The first question we address is: Do taxes matter at all? In particular: Do participants integrate fiscal facts in their decision process? To test this, the same pairs of investments as in the baseline-treatment were used as *gross* pairs in the *check-treatment*. Gains were subject to a tax with a rate of t but losses were not deductible (no loss deduction). This implied a taxation of positive payoffs, only. Consequently, symmetrical gross investments (as in the baseline-treatment) became asymmetrical net investments. Hence, the expected value of the low-risk investment exceeds the value of the high-risk investment, as the following transformation shows:

$$
\begin{aligned}
E(\text{low-risk investment}) &> E(\text{high-risk investment}) \\
\frac{1}{3}\cdot\left[(1-t)\cdot y+(1-t)\cdot z-y\right] &> \frac{1}{3}\cdot\left[(1-t)\cdot x+(1-t)\cdot z-x\right] \\
(1-t)\cdot z-t\cdot y &> (1-t)\cdot z-t\cdot x \\
y &< x
\end{aligned}
$$

As a consequence, it could be expected that participants would decide more often for the low-risk investments in this check-treatment compared to the baseline-treatment where both expected values were identical. The following hypothesis results:

Hypothesis 1: *In the check-treatment the preference for low-risk investments is higher compared to the baseline-treatment.*

This treatment was used to examine whether taxes matter at all and whether subjects identify the asymmetry of taxation, or not. If participants do not integrate fiscal facts in their decision process and only look at gross payoffs, the preference for the low-risk investments should be the same as in the baseline-treatment since the same gross payoffs were applied. Note that results from this treatment have not been used to analyze the perception of income taxation.

3.2 Perception of income taxation and loss deduction

The main purpose of this paper is to analyze the perception of income taxation and of different methods of loss compensation on risky investments. Therefore, three treatments with different loss offset rules were applied, which were called *perception-treatments* in the following. Contrary to the payoff structure in the check-treatment, the pairs of investments from the baseline-treatment were used as *net* pairs in these treatments. This means that the payoffs presented to the participants had been grossed up by taxes in such a way that net payoffs after taxes were completely identical compared to payoffs in the baseline-treatment.[4] When correctly integrating taxation, participants' preference in these treatments should be the same as in the baseline-treatment. Thus, the following hypothesis results:

Hypothesis 2: *In each perception-treatment the preference for low-risk investments does not differ from the preference in the baseline-treatment.*

[4] For a suitable presentation the second decimal place of gross payoffs were rounded to 0.05 in the perception-treatments. However, there isn't any important change for the net values.

In each perception-treatment, gains were subject to taxation at a rate of t but loss deduction was limited. To achieve the gross payoffs in each perception-treatment, the investment payoffs of the baseline-treatment (x, y, z) were grossed up as follows.

$$\left(\frac{x}{1-t} \quad , \quad \frac{z}{1-t} \quad , \quad -x+T(x) \right) \quad \text{and} \quad \left(\frac{y}{1-t} \quad , \quad \frac{z}{1-t} \quad , \quad -y+T(y) \right)$$

T denotes the tax payment which is a tax refund in the loss cases $T(\bullet) \leq 0$. The three perception-treatments differed in the tax refund T:

- *no-deduction-treatment*: Losses were not deductible: $T(\bullet) = 0$,
- *partial- deduction-treatment:* 50 % of losses were deductible:

$$T(x) = \frac{-x \cdot t}{2-t} \quad ; \quad T(y) = \frac{-y \cdot t}{2-t},$$

- *capped-deduction-treatment:* Up to a limit L losses were completely deductible; losses above L were not deductible:

$$T(x) = \begin{cases} \dfrac{-x \cdot t}{1-t} & \text{for} \quad -x-T \geq -L \\ -L \cdot t & \text{for} \quad -x-T < -L \end{cases} \quad ; \quad T(y) = \begin{cases} \dfrac{-y \cdot t}{1-t} & \text{for} \quad -y-T \geq -L \\ -L \cdot t & \text{for} \quad -y-T < -L \end{cases}.$$

Contrary to hypothesis 2, it is possible that participants do not integrate all fiscal facts into a calculus of returns. They may as well base their decisions on gross payoffs or apply some kind of heuristic or just decide by intuition. In the latter two cases an over- or underestimation of tax effects might be observed. The consequences for preferences can be pointed out suitably with the payoffs of the no-deduction-treatment, where $T = 0$. Thus, the following gross pair of investments results:

$$\left(\frac{x}{1-t} \quad , \quad \frac{z}{1-t} \quad , \quad -x \right) \quad \text{and} \quad \left(\frac{y}{1-t} \quad , \quad \frac{z}{1-t} \quad , \quad -y \right)$$

Positive payoffs from the baseline-treatment have been grossed up but negative payoffs have not been grossed up since losses were not deductible. Therefore, the treatment of positive and negative payoffs was asymmetric. If a participant does not integrate fiscal facts in his/her decisions and only looks at gross payoffs, the expected value of the low-risk investment (right hand side) appears to him lower than the expected value of the high-risk investment (see following transformation). This might induce such a participant to prefer the high-risk investment over the low-risk alternative more often than in the baseline-treatment.

$$\begin{aligned}
E(\text{low-risk investment}) &< E(\text{high-risk investment}) \\
\frac{1}{3}\cdot\left[\frac{y}{1-t}+\frac{z}{1-t}-y\right] &< \frac{1}{3}\cdot\left[\frac{x}{1-t}+\frac{z}{1-t}-x\right] \\
y\cdot\left(\frac{1}{1-t}-1\right) &< x\cdot\left(\frac{1}{1-t}-1\right) \\
y &< x
\end{aligned}$$

Note that these considerations apply similarly to the partial- and capped-deduction-treatment (in the following called deduction-treatments).

If a participant decides by intuition, analogous considerations apply. An underestimation of the tax effect on positive payoffs leads to a smaller "perceived" expected value of the low-risk investment than of the high-risk investment. Again, this might induce such a participant to prefer the high-risk investment more often than in the baseline-treatment. The opposite holds if the tax effect on positive payoffs is overvalued. These considerations can be examined best with the no-deduction-treatment since no loss deduction existed. The perception of loss deduction can be analyzed with the deduction-treatments. If the effect of loss deduction is overrated, a stronger preference for the high-risk investment will be observed since the "perceived" expected value of the high-risk investment is larger.

4 Experimental design and setup

The experiment consisted of two parts. The first part ("Hill Climbing"[5]) was used to endow the participants with initial capital, whereas the second part (investment experiment) was the actual analysis of income taxation and of different methods of loss deduction.

4.1 Experimental design of investment experiment

In the investment experiment[6] each person participated in five treatments (within-subject design). In each treatment, 20 pairs of investments were presented to the participants.[7] Hence, each participant had to make 100 decisions. In the experiment the investments were called business opportunities. In all tax treatments, the payoffs were subject to an income tax with a

[5] See also *van Dijk et al. 2001*, p. 190–194.
[6] The instructions of the investment experiment are available in appendix A1.
[7] All investments are shown in appendix A2.

rate of 35 %. Towards the participants, a non-neutral framing was applied.[8] This means that specific fiscal terms like “tax”, “tax rate”, and “loss deduction” were used in the instructions. Table 1 gives an overview of the different treatments and their special characterization.

<table>
<tr><th>treatment</th><th>tax characteristics</th><th>presentation</th></tr>
<tr><td>baseline</td><td>no tax</td><td></td></tr>
<tr><td>check</td><td>positive payoffs are taxed at a rate of 35 %,
losses are not deductible</td><td>investments of the baseline-treatment were used as gross investments</td></tr>
<tr><td>no-deduction</td><td>positive payoffs are taxed at a rate of 35 %,
losses are not deductible</td><td rowspan="3">investments of the baseline-treatment were used as net investments</td></tr>
<tr><td>partial-deduction</td><td>positive payoffs are taxed and 50 % of losses may be deducted at a rate of 35 %</td></tr>
<tr><td>capped-deduction</td><td>positive payoffs are taxed and 100 % of losses up to a limit of -12 may be deducted at a rate of 35 %</td></tr>
</table>

Table 1: Overview of treatments

To avoid learning effects during the experiment, the treatments, the pairs of investments, and an investment’s position on the screen (right or left hand side) were presented to each participant at random. In order to examine the comprehensibility of the different tax regimes the participants had to fill out a control questionnaire after reading the instructions. The questionnaire contained different arithmetic problems. If a test person gave an incorrect solution, the experimentator corrected this mistake together with the person to ensure that all participants completely understood the tax parameters. In each situation the participants were informed about the current treatment. After the investment experiment the participants were asked to fill out a second questionnaire. In a first part, participants were asked about their age, gender, program of study, and possible expertise in tax law. In the second part we asked (1) which loss compensation method was regarded as fairest among all methods offered in the

[8] Some experimental papers used neutral framing: *Sillamaa;* 1999a / 1999b / 1999c and *Sutter and Weck-Hannemann 2003*.

different treatments and (2) whether participants had based their decisions rather on net or gross payoffs.

4.2 Experimental design of Hill Climbing

In the investment experiment participants faced the possibility of losing money. Therefore, it had to be made sure that participants would not have to pay for a loss at the end of the experiment, themselves. One possible solution would be to forgive losses. This could cause an unwanted change in participants' risk attitude thus distorting the analysis. To avoid this, "Hill Climbing" was used to endow participants with money. Starting capital can either be exogenously provided or, like in "Hill Climbing", participants can be demanded to make an own effort to earn money. In a sense, this makes the experiment more realistic, as this is similar to a salary earned on a job. There is some evidence from experimental research showing that the decisions of participants are significantly affected by initial capital. Contrary to earned money, exogenously given money leads to more risk seeking behavior.[9] In the literature, this is called the *house money effect*.[10]

The task of the game was to seek out the single maximum of a function by vertical and horizontal movements in a two-dimensional coordinate system.[11] The maximum payoff amounts to 15 € and it was rather easy to earn this amount. This has the advantage that almost all subjects started the investment experiment with the same amount of money. Hence, distorting effects because of different initial endowment can be excluded.[12]

4.3 Experimental setup

The experiment was conducted at the Otto-von-Guericke University of Magdeburg with 91 participants (37 women and 54 men) in 7 sessions. Each session took about 1.5 to 2 hours depending on the duration of the decision process of each person. At the end of the second experiment the amounts earned were paid directly to each participant. In nearly all cases the maximally attainable payoff of 15 € was obtained in the game "Hill Climbing". Additionally, one decision from the investment experiment was selected at random for each participant to determine the payoff from the second part of the experiment. To avoid income effects during the second experiment, a single decision was paid rather than the sum or an average of all decisions. The individual sum of both payoffs from the first and second part of the experiment

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9 For supporting research see *Thaler and Johnson 1990*, p. 657, *Keasey and Moon 1996*, p. 108, *Ackert et al. 2006*, p. 10. The effect could not be significantly proven in *Clark 2002*, p. 228, *Weber and Zuchel 2005*, p. 37.

10 See *Clark 2002*, p. 223.

11 Instructions for "Hill Climbing" are available in appendix A3.

12 E.g. *Torgler 2002*, p. 21 could prove that higher initial endowment leads to a higher tax moral.

resulted in the total payoff to this participant. Subjects earned between 1 € and 29 € (mean: 13.64 €).

For the first part of the experiment, we have modified the game "Hill Climbing" (*van Dijk et al. 2001*). The investment experiment has been programmed and conducted by the authors with the software z-Tree[13].

5 Results

5.1 Do taxes matter?

To analyze whether participants took taxes into account when making their investment decisions, the number of low-risk choices of each treatment in the baseline-treatment is compared with the number in the check-treatment. If a participant integrated fiscal facts in his/her decision process a higher preference for the low-risk investment should be observed (hypothesis 1). Note that in each treatment 20 decision situations were presented and, therefore, the number of low-risk choices was 20 at maximum. Table 2 depicts the mean and the median over all 91 participants.

	baseline	check
mean	9.45	12.69
median	9	16

Table 2: Number of low-risk choices (baseline- and check-treatments)

In line with hypothesis 1, the number of low-risk choices increased in the check-treatment compared to the baseline-treatment. The difference is highly significant with a *p*-value below 0.001 (Wilcoxon signed ranks test for two dependent samples). Apparently, subjects integrate fiscal facts in their decision process.

For a closer look at the risk attitudes of the participants, three risk categories were defined: risk seeking, unclassified and risk averse. The category risk seeking (risk averse) includes those participants who decided mostly for the high-risk (low-risk) investment. The remaining participants were categorized as "unclassified". Note that this class is a residual group and should not be interpreted as a risk neutral category. We have to point out that we do not claim to assess a person's actual risk attitude. For example a participant can be categorized as risk seeking although he/she is in fact risk averse. This could be the result of the relatively low payoffs in the experiment or some kind of decision heuristic which we cannot observe directly. Therefore, the categorization rather exhibits the extent to which a participant was

[13] For detail see *Fischbacher 2007*.

prone to choose the riskier or the less risky alternative than revealing the actual risk attitude. It allows comparisons between the different treatments of this experiment.

For class determination limits were defined with a two-sided binomial test (significance level: 5 %) depending on the number of low-risk choices. In the several treatments each participant had to decide in 20 situations. A classification in the category risk seeking (risk averse) took place if a participant decided at most (at least) in 5 (15) situations for the low-risk investment.[14] Table 3 depicts the resulting class distribution for the baseline- and check-treatments. The *p*-values in the bottom row results from the non-parametric Wilcoxon signed ranks test for two dependent samples, which was used to examine a significant preference for a type of investment (based on the number of low-risk choices).The hypothesis was in each treatment, that the number of low-risk choices amounts to 10.

	baseline	check
risk seeking	38	19
unclassified	23	23
risk averse	30	49
significance	$p = 0.656$	$p = 0.002$

Table 3: Risk classification based on low-risk choices (baseline- and check-treatments)

In the baseline-treatment without taxation, more participants were categorized as risk seeking than risk averse. But regarding the Wilcoxon signed ranks test, there is no significant preference for one investment ($p = 0.656$). The number of risk averse subjects strongly increased in the check-treatment. Contrary to the baseline-treatment, the Wilcoxon signed ranks test indicates that the low-risk investments were preferred significantly more often than the high-risk investments. This confirms hypothesis 1, again. Therefore, it can be summarized: Participants do not simply look at gross payoffs but integrate fiscal facts in their decision process and identify the asymmetry of taxation. Investors are aware of tax effects on the outcome of their investments.

[14] A two-sided binomial test with a sample size of 20 and a probability of success of 0.5 leads to following probability mass: $P(X \leq 5 \text{ or } X \geq 15) = 0.0414$. Whereby X is a stochastic variable and denotes the number of low-risk choices of one participant.

5.2 Perception of income taxation and loss deduction

5.2.1 Risk classification

To analyze the perception of income taxation and of different methods of loss offset rules, three perception-treatments were implemented. In each of these treatments, the pairs of investments from the baseline-treatment were used as net pairs. Thus, participants' preference should be the same as in the baseline-treatment (hypothesis 2). Table 4 depicts the mean and the median of low-risk choices for the baseline-treatment and for the perception-treatments.

	baseline	no-deduction	partial-deduction	capped-deduction
mean	9.45	10.00	6.91	7.54
median	9	11	5	5

Table 4: Number of low-risk choices (baseline- and perception-treatments)

As in section 5.1, a risk classification was made. The following class distribution results for the perception-treatments compared to the classification in the baseline-treatment.

	baseline	no-deduction	partial-deduction	capped-deduction
risk seeking	38	32	46	48
unclassified	23	27	26	24
risk averse	30	32	19	19
significance	$p = 0.656$	$p = 0.827$	$p < 0.001$	$p = 0.001$

Table 5: Risk classification (baseline- and perception-treatments)

Table 4 and Table 5 depict that there is no obvious difference between the baseline- and the no-deduction-treatment. In both treatments, the Wilcoxon signed ranks test reveals that there was no stronger preference for the low-risk or for the high-risk investments. Contrary to these results, subjects had a stronger preference for the high-risk investments in the treatments where a loss deduction was applied (partial- and capped-deduction-treatment). In seems that the existence of loss deduction had an influence of participants' willingness to take risk.

5.2.2 Differences between baseline- and perception-treatments

In this section the results are analyzed with respect to differences in the willingness to take risk between the baseline- and the perception-treatments. We look for differences in the number of low-risk choices of each participant. The non-parametric Friedman test, which is used if more than 2 dependent samples exist, verifies differences between the treatments ($p < 0.001$). The Wilcoxon signed ranks test is used for a more precise comparison of each treatment. The underlying null hypothesis in each investigation is: the distribution of the results of each participant does not differ between two treatments. A rejection of this hypothesis leads to the conclusion that the participant exhibited different behavior in the respective treatments. Table 6 summarizes the results of this analysis by illustration the *p*-values:

	no-deduction	**partial-deduction**	**capped-deduction**
baseline	$p = 0.657$	$p = 0.001$	$p = 0.007$
no-deduction	---	$p < 0.001$	$p = 0.004$
partial-deduction		---	$p = 0.146$

Table 6: Differences in risk-taking between treatments (participant-related)

There existed a strong significant difference between all treatments, except for the pairwise comparisons of treatments *baseline / no-deduction* and *partial-deduction / capped-deduction*. Table 7 shows in which treatment the preference for the low-risk investments was higher. Therefore ">" indicates in which treatment a higher number of low-risk choices occurred. Parenthesized expressions in Table 7 refer to insignificant differences.

	no-deduction	**partial-deduction**	**capped-deduction**
baseline	(>)	>	>
no-deduction	---	>	>
partial-deduction		---	(<)

Table 7: Direction of differences in risk-taking between treatments (participant-related)

In the perception-treatments the net payoffs of the investments were identical to the payoffs of the baseline-treatment where no taxation existed. If participants integrated the fiscal facts completely, there should be no difference between decisions in these treatments compared to the same persons' decisions in the baseline-treatment (hypothesis 2). In contrast, results of Table 7 indicate a stronger preference for the low-risk investments in the baseline-treatment. This difference is significant in comparison to both deduction-treatments, and hypothesis 2 is to be rejected there. The difference between the baseline-treatment and the no-deduction-treatment is in the same direction, but it is not significant ($p = 0.657$). Thus, hypothesis 2 can be confirmed in the no-deduction-treatment. Differences between the no-deduction-treatment and the partial- and also the capped-deduction-treatment are highly significant.

The following analysis focuses on the comparison of aggregated preferences of all participants within a pair of investments over all treatments. Figure 1 exhibits the relative number of low-risk choices in each pair of investments in the baseline- and in the perception-treatments. Note that each treatment consisted of 20 pairs of investments.

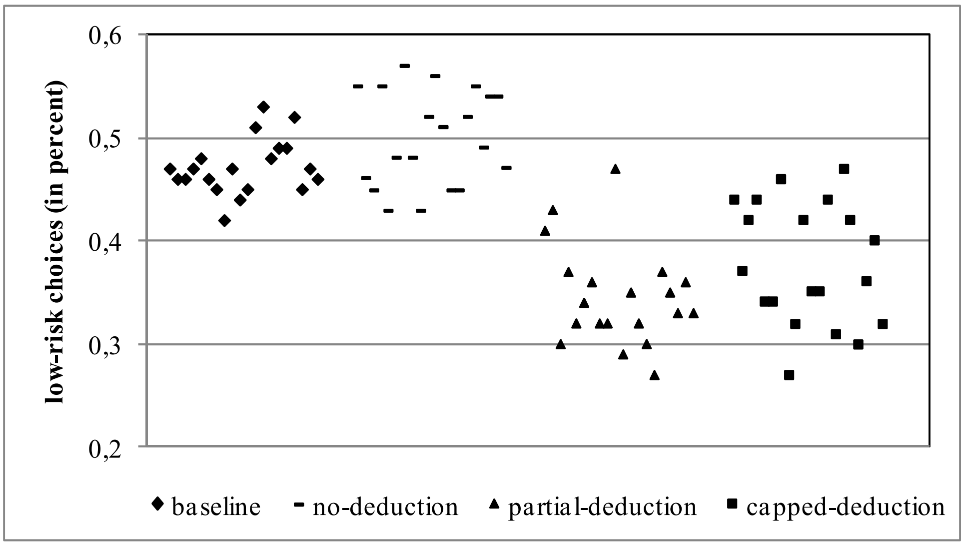


Figure 1: Relative number of low-risk choices

Figure 1 depicts that a lower preference compared to the baseline-treatment was observed in the partial- and capped-deduction-treatment. Apparently, no differences existed between the baseline- and no-deduction-treatments and also between the partial- and capped-deduction-treatment.

The following examination confirms this observation. Table 8 exhibits the results of a comparison between the absolute number of participants in a treatment who preferred the low-risk investment and the same number in another treatment. This means for example for the baseline-treatment and the no-deduction-treatment: the number of participants who preferred the low-risk investment number *one* (*two*, *three*, …, *twenty*) in the *baseline-treatment* is compared with the number of participants who preferred the low-risk investment number *one* (*two*, *three*, …, *twenty*) in the *no-deduction-treatment*. E.g. “baseline > partial-deduction” indicates a higher number of such participants existed over all 20 pairs of investments in the baseline-treatment compared to the partial-deduction-treatment.

	no-deduction	**partial-deduction**	**capped-deduction**
baseline	<	>	>
no-deduction	---	>	>
partial-deduction		---	(<)

Table 8: Direction of differences in risk-taking between treatments (investment-related)

Except for the comparison of the partial- and capped-deduction-treatment, each result is statistically significant at a 5 %-level (Wilcoxon signed ranks test). Compared to all other treatments, the least risk averse behavior was observed in these deduction-treatments. This supports rejection of hypothesis 2, again.[15]

It could not be determined exactly which method of limited loss deduction (partial or capped) led to riskier decisions since behavior did not differ significantly between the two treatments (neither participant-related nor investment-related). However, partial loss deduction was perceived as fairer by most participants. In the questionnaire at the end of the experiment, 63 % of participants evaluated this method as fairest among all methods offered in the different treatments. Only 34 % of the participants favored capped loss deduction and 3 % preferred no loss deduction. Participants were not asked to explain their opinion. We suspect that an equitable treatment of all losses irrespective of their size seemed more attractive than a capped loss deduction where losses beyond the cap have to be borne by the investor alone.

5.3 Influence of potentially important factors

In this section we examine to what extent the orientation on gross or net payoffs and gender have an influence on individual behavior.[16]

5.3.1 Orientation on gross or net payoffs

Differences observed in the behavior between subjects may be explained by different decision techniques rather than by different attitudes towards risk. Therefore, participants were asked in a questionnaire, whether they had used gross or net payoffs from the investments when they had made their decisions. We are aware that the answers must be interpreted carefully. Participants might have intentionally given wrong answers, or they may not be able to correctly describe their decision behavior in the experiment.

In the questionnaire, 56 out of 91 participants (61.54 %) declared that they had been geared to net payoffs. This is somewhat surprising, since we had expected participants to neglect the legal setting to minimize their effort. It may be that the experimental design has influenced participants' behavior. We have deliberately chosen a non-neutral framing. In the instructions it was explained that participants had to make choices between "business opportunities" with different risky payoffs and that, depending on the treatment, these payoffs may be subject to a flat income tax with different loss offset-rules. We have presented examples for how to

[15] This analysis was also done for the check-treatment. Compared to all other treatments, the absolute number of participants in the check-treatment who preferred the low-risk investment was always larger over all 20 pairs of investments. The differences are highly significant. This supports confirmation of hypothesis 1.

[16] We have not found any significant effect of other characteristics collected in the questionnaire at the end of the experiment.

calculate net payoffs in each case. Therefore, we may very well have influenced participants' perspective on the investments.

Table 9 depicts the mean and median number of decisions for the low-risk investment in each treatment taken by participants geared to net payoffs versus participants with a gross payoff orientation. In order to control for differences between the two groups the Chi-square test and the Wilcoxon-Mann-Whitney test were applied. Both are non-parametric tests for two independent samples, but they differ in the nature of the dependent variable. The Chi-square test is used if the dependent variable is categorical. In this analysis the dependent variable is the risk classification of each participant: risk averse, unclassified, or risk seeking. The null hypothesis is: the classification in a certain risk category is independent of the orientation on net or gross payoffs. Note that the distribution of the risk classification dependent on the orientation is not shown in Table 9. However, this distribution is in line with these results. The Wilcoxon-Mann-Whitney test can be used if the dependent variable is at least ordinal. Therefore, the dependent variable is the number of low-risk choices of each participant. Contrary to the Chi-square test, a risk classification is not necessary. Thus, the null hypothesis is: the preference for the low-risk investments is independent of the orientation on net or gross payoffs. Both statistical methods have been used for more precise statements.

	net payoff orientation		**gross payoff orientation**		**Wilcoxon-Mann-Whitney test**	**Chi-square test**
	mean	**median**	**mean**	**median**		
baseline	10.1	9.0	8.5	5.0	$p = 0.221$	$p = 0.327$
check	14.7	17.0	9.4	11.0	$p = 0.002$	$p < 0.001$
no-deduction	11.2	13.0	8.1	6.0	$p = 0.041$	$p = 0.292$
partial-deduction	6.9	6.5	6.9	5.0	$p = 0.805$	$p = 0.843$
capped-deduction	7.9	5.5	7.0	5.0	$p = 0.407$	$p = 0.780$

Table 9: Orientation on gross or net payoffs

In all treatments, participants who orientated themselves on net payoffs had a higher preference for the low-risk investments. In the check-treatment this difference is highly significant. At a significance level of 5 % the difference is also significant in the no-deduction-treatment for the Wilcoxon-Mann-Whitney test but not for the Chi-square test.

As mentioned in section 3.1, payoffs from the baseline-treatment were used as gross payoffs in check-treatment. Due to this, net payoffs in this treatment were asymmetrical, unlike all other treatments. In the check-treatment the expected payoff of each low-risk investment was higher than for the respective high-risk alternative. This could only be detected by participants who calculated or correctly estimated net payoffs, and should lead to a higher preference for the low-risk investments compared to the baseline-treatment (hypothesis 1). Indeed, it could be observed that participants who orientated themselves on net payoffs preferred the low-risk investments more often. From this we conclude that participants tend to base their decision on expected returns as well as on risk.

5.3.2 Gender effects

In some experiments it has been shown that women react more sensitively to losses than men.[17] Overall, 37 women and 54 men participated in this experiment. Again, we use the Chi-square and Wilcoxon-Mann-Whitney tests. The null hypothesis for both tests is: the preference for the low-risk investments is independent of gender. Both tests reveal no statistical difference in behavior between male and female participants in this experiment. Table 10 gives an overview of the resulting *p*-values.

	Wilcoxon-Mann-Whitney test	**Chi-square test**
baseline	$p = 0.477$	$p = 0.742$
check	$p = 0.430$	$p = 0.921$
no-deduction	$p = 0.590$	$p = 0.872$
partial-deduction	$p = 0.977$	$p = 0.740$
capped-deduction	$p = 0.884$	$p = 0.463$

Table 10: gender effects

However, it could be observed that the orientation on net or gross payoffs depends on gender (Chi-square test: $p = 0.022$). 28 out of 37 women (75.68 %) but only 28 out of 51 men (51.85 %) stated that they orientated themselves on net payoffs. We have no explanation for this observation. To our knowledge, there is no experimental evidence that women act more dutifully than men in solving comparable problems.

5.4 Linear Regression

For reasons of verification, we run a linear regression. Table 11 shows the results. The dependent variable is the number of participants, who chose in one out of 100 decision situations the low-risk investment. For each treatment, one dummy variable was integrated. Model 1 consists only of these dummy variables. As a result, all dummy variables are highly significant, except the no-deduction-treatment, which is only significant on a level of 10 %. Moreover, the variable's influence is very small. Thus it can be stated, that there is no

[17] See e.g. *Brooks and Zank 2005*, p. 317, and *Schmidt and Traub 2002*, p. 245.

meaningful difference compared to the baseline-treatment. In all, this is in line with the previous results.

In each decision situation, pairs of investments similar to the following were presented to the participants:

$$(x \quad , \quad z \quad , \quad -x) \quad \text{and} \quad (y \quad , \quad z \quad , \quad -y)$$

where $x > y > 0$. One pair of investment differed from another pair in two main aspects: (1) the common payoff z of both investments and (2) the payoff y of the low-risk investments. In model 2, these differences are considered. Variable z could be 0, 3, 6, or 9. Payoff y was $x-1$ in 11 out of 20 pairs of investment opportunities and $x-3$ in 9 out of 20 pairs. For a given z, the variance of the low-risk investment in the setting $x-1$ is smaller than the variance of the low-risk investments in the setting $x-3$. But both low-risk investments had the same expected values. This property is used to analyze the influence of the variance on the decisions. Note that high-risk investments were not adjusted. As a result, no significant influence on participants' decisions could be observed for the modification of payoff z and y. Compared to model 1, no variation appears regarding the dummy variables. As a result, both regressions verify the results of the previous sections.

	Model 1	Model 2
constant	43.00**** (0.931)	43.63**** (1.129)
check	14.75**** (1.316)	14.75**** (1.321)
no-deduction	2.50* (1.316)	2.50* (1.321)
partial-deduction	- 11.55**** (1.316)	- 11.55**** (1.321)
capped-deduction	- 8.70**** (1.316)	- 8.70**** (1. 321)
common payoff z		- 0.04 (0.145)
payoff y		- 0.89 (0.854)
N	100	100
Adjusted R^2	0.833	0.832

Note: **** $\alpha = 0.001$, *** $\alpha = 0.01$, ** $\alpha = 0.05$, * $\alpha = 0.1$

Table 11: Linear Regression

6 Discussion

The decision task in this experiment was to choose one out of two investments. In each treatment, 20 decision situations with two different investments each were presented. The two investment alternatives differed in the variance but not in the expected values of their returns. The first treatment (baseline-treatment) without taxation served as a reference. The decisions of each participant in this treatment were used as reference values to determine the influence of income taxation and of loss deduction on participants' risk taking.

We first addressed the question whether participants take account of taxes in their decision process? Therefore, the 20 pairs of investments from the baseline-treatment were used in the check-treatment where positive payoffs were subject to a tax but losses were not deductible. This asymmetric taxation led to a higher expected value of the investment with the lower variance (low-risk investment). Consequently, it could be expected that participants would decide more often for the low-risk investments compared to the baseline-treatment (hypothesis 1). Indeed, the experimental results reveal that subjects integrate fiscal facts in their decisions since hypothesis 1 can be confirmed. Thus, taxes do matter in investment decisions.

Our second research question was: How do investors perceive income taxation and different forms of (limited) loss deduction? Therefore, three further treatments with an income tax and different loss offset rules were applied (no-deduction-, partial-deduction- and capped-deduction-treatment). In each of these perception-treatments, net payoffs of the 20 pairs of investments were the same as in the baseline-treatment. Gross payoffs were adapted in such a way that, after deducting tax payments, net payoffs and, therefore, expected returns and variances of returns were identical to those of the corresponding investment in the baseline-treatment. Given this setup, it could be expected that rational participants take exactly the same decisions in all four treatments (hypothesis 2). Note that this design allows us to compare participants' behavior between the treatments without knowing their risk attitude.

In the no-deduction-treatment, positive payoffs were subject to tax at a rate of 35 % and negative payoffs had to be borne by the investor alone (no tax loss deduction). The pattern of decisions observed was the same as in the baseline-treatment. This confirms hypothesis 2. In the partial- and capped-deduction-treatments a loss deduction was offered in form of an immediate negative tax payment at a rate of 35 %. In the partial-deduction-treatment half of the losses suffered could be deducted, in the capped-deduction-treatment losses were fully deductible up to a limit of -12 € per investment, exceeding losses could not be deducted. The tax treatment of positive and negative payoffs was asymmetric in both treatments. Therefore, in order to offer the same net payoffs as in the baseline-treatment, negative payoffs were grossed up by a smaller factor than positive returns. This should have induced participants which use gross payoffs in their decisions to prefer the high-risk investment over the low-risk alternative more often than in the baseline-treatment because expected gross returns of the first are now higher than those of the latter.

Participants exactly calculating net payoffs could be expected to come to the same decisions as in the baseline-treatment. From the questionnaire we only know whether test persons were geared to gross or net payoffs. Those in the second group may have tried to calculate but they may as well have made more or less rough-cut guesses or have used intuition. In this case, there may have been some misperception of the value of loss deductions.

The data resulting from the experiment show that in the partial- and capped-deduction-treatment participants tended to choose the riskier alternative more often than in the baseline- and in the no-deduction-treatment. Hypothesis 2 has to be rejected for these treatments. The value of loss deduction is overestimated in both treatments inducing participants to pick riskier investments.[18] There is no significant difference in the behavior of participants deciding based on gross payoffs and those geared to net payoffs in these treatments. This means that both groups on average suffer the same degree of misperception of tax effects. We conclude from this that participants who have declared to be geared to net payoffs actually have used intuition or guesswork to make their decisions, not calculus.

The central finding of this experiment is that individuals tend to overestimate the value of loss compensation rules which offer less than a complete loss offset. This is an important finding which is in line with anecdotic evidence one may have gathered from observing one's own friends and relatives. Sometimes, even financially important decisions like buying a life insurance policy or buying real estate, are taken without exactly understanding the tax consequences. We do not claim to draw conclusions from this on the behavior of firms. It is well known that firms tend to consult their tax departments and buy external consulting

[18] Misperception cannot be explained by an underestimation of the tax burden on positive payoffs since no difference existed between the baseline- and the no-deduction-treatment. Misperception can only be explained by an overestimation of the loss deduction since differences between both deduction-treatments and the baseline-treatment and also between both deduction-treatments and the no-deduction-treatment are highly significant.

services to back up important decisions. This dichotomy is also reflected in many countries' tax codes: loss compensation tends to be more restricted in personal income taxation than in corporate taxation. Legislators seem to have taken advantage of this phenomenon extensively.

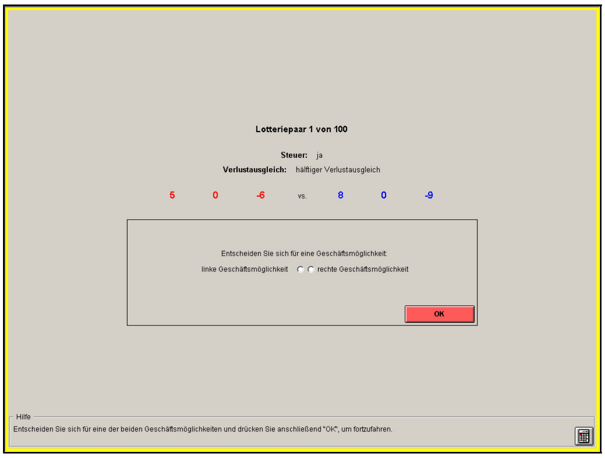
Appendix

A1 Instructions of the investment experiment (original in German)

After the first partial experiments, the participants got instructions for the second partial experiment, the investment experiment.

Imagine you are an entrepreneur and have to decide, which business you want to use in future. In this connection there are two possibilities of business with different payoffs available. Your task is to decide which one of them you prefer.

In the course of this partial experiment, 100 of such situations exist, which are similarly represented in each case as follow:



Each business is specified by **three payoffs** and each of them occurs with a **probability of 1/3**. This means for the red business (left business), that with a probability of 1/3 a payoff of 5, with 1/3 the payoff of 0 or with 1/3 a (negative) payoff of -6 can occur. After you made all 100 decisions, one situation will be selected at random to determine your payoff of the second partial experiment at the end of the experiment. Thus, your result depends on one of your 100 decisions.

With respect to the fiscal treatment of payoffs, **four** different methods exist. Perhaps positive payoffs are taxable and negative payoffs can be tax-deductible (loss deduction). Loss deduction means that you receive a tax refund from tax authority in the case of losses, i.e. your actual losses are reduced. The present valid method, which always affects both businesses, is presented at you above the illustration of both alternatives. For example the 3rd method (50 % loss deduction) is represented by the illustration:

tax: yes

loss deduction: 50 % loss deduction

In the following the four different fiscal consequences are specified:

1. Tax exemption

No taxation does exist, i.e. all presented payoffs of the business are not subject of a tax. In consequence no loss deduction does exist. All positive and negative payoffs remain unchanged.

2. No loss deduction (no l.d.)

A tax with a rate of 35 % of the payoff does exist, but no loss deduction. Hence, **all** positive payoffs are subject to a tax-deduction, but negative payoffs are fiscally unremarkable and aren't reduced.

3. 50 % loss deduction (50 % l.d.)

Also a tax rate of 35 % does exist. Negative payoffs are tax-deductible up to half the negative payoff.

4. Capped loss deduction (capped l.d.)

Also a tax rate of 35 % does exist. However, negative payoffs are completely tax-deductible up to a height of -12. This means, that negative payoffs between 0 and -12 are subject to a complete loss deduction, for higher losses, i.e. for values smaller than -12, no loss deduction does exist.

Example:

		tax exemption		**no l.d.**		**50 % l.d.**		**capped l.d.**		
(1)	payoff (gross)	5	-6	5	-6	5	-6	5	-6	-14
(2)	of that is taxable	0	0	5	0	5	-3	5	-6	-12
(3)	resulting tax = (2) · 0.35	0	0	1.75	0	1.75	-1.05	1.75	-2.10	-4.20
	net result = (1) - (3)	**5**	**-6**	**3.25**	**-6**	**3.25**	**-4.95**	**3.25**	**-3.90**	**-9.80**

- For calculating net payoffs during the experiment you can use the Windows-calculator. If required, press the calculator-symbol at the lower right corner.

- If you have any question please lift your hand for clarification with an assistant.

- Please fill out the questionnaire before the experiment starts and call attention to yourself afterwards.

A2 Investments of the investment experiment

Table 12 exhibits all used gross investments in the investment experiment according to each treatment. Note that in the perception-treatments the net payoffs were the same as in baseline-treatment and the right investment is the low-risk investment.

	investment number	left investment			right investment		
baseline-treatment	1	14.00	0.00	-14.00	13.00	0.00	-13.00
	2	12.00	0.00	-12.00	11.00	0.00	-11.00
	3	10.00	0.00	-10.00	9.00	0.00	-9.00
	4	14.00	3.00	-14.00	13.00	3.00	-13.00
	5	12.00	3.00	-12.00	11.00	3.00	-11.00
	6	10.00	3.00	-10.00	9.00	3.00	-9.00
	7	14.00	6.00	-14.00	13.00	6.00	-13.00
	8	12.00	6.00	-12.00	11.00	6.00	-11.00
	9	10.00	6.00	-10.00	9.00	6.00	-9.00
	10	14.00	9.00	-14.00	13.00	9.00	-13.00
	11	12.00	9.00	-12.00	11.00	9.00	-11.00
	12	14.00	0.00	-14.00	11.00	0.00	-11.00
	13	12.00	0.00	-12.00	9.00	0.00	-9.00
	14	10.00	0.00	-10.00	7.00	0.00	-7.00
	15	14.00	3.00	-14.00	11.00	3.00	-11.00
	16	12.00	3.00	-12.00	9.00	3.00	-9.00
	17	10.00	3.00	-10.00	7.00	3.00	-7.00
	18	14.00	6.00	-14.00	11.00	6.00	-11.00
	19	12.00	6.00	-12.00	9.00	6.00	-9.00
	20	10.00	6.00	-10.00	7.00	6.00	-7.00
check-treatment	21	14.00	0.00	-14.00	13.00	0.00	-13.00
	22	12.00	0.00	-12.00	11.00	0.00	-11.00
	23	10.00	0.00	-10.00	9.00	0.00	-9.00
	24	14.00	3.00	-14.00	13.00	3.00	-13.00
	25	12.00	3.00	-12.00	11.00	3.00	-11.00
	26	10.00	3.00	-10.00	9.00	3.00	-9.00
	27	14.00	6.00	-14.00	13.00	6.00	-13.00
	28	12.00	6.00	-12.00	11.00	6.00	-11.00
	29	10.00	6.00	-10.00	9.00	6.00	-9.00
	30	14.00	9.00	-14.00	13.00	9.00	-13.00
	31	12.00	9.00	-12.00	11.00	9.00	-11.00
	32	14.00	0.00	-14.00	11.00	0.00	-11.00
	33	12.00	0.00	-12.00	9.00	0.00	-9.00
	34	10.00	0.00	-10.00	7.00	0.00	-7.00
	35	14.00	3.00	-14.00	11.00	3.00	-11.00
	36	12.00	3.00	-12.00	9.00	3.00	-9.00
	37	10.00	3.00	-10.00	7.00	3.00	-7.00
	38	14.00	6.00	-14.00	11.00	6.00	-11.00
	39	12.00	6.00	-12.00	9.00	6.00	-9.00
	40	10.00	6.00	-10.00	7.00	6.00	-7.00

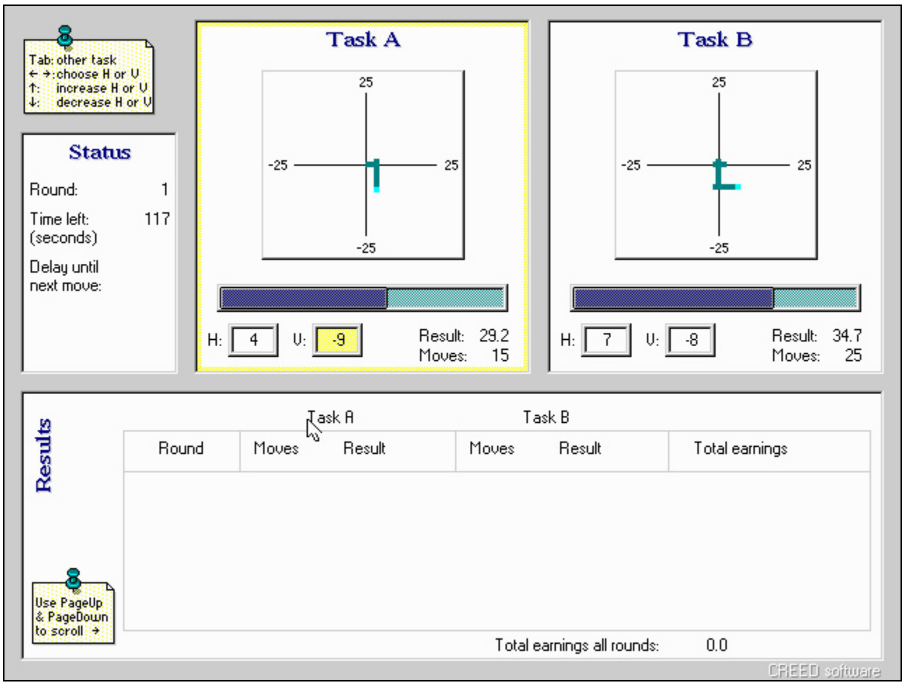
no-deduction-treatment	41	21.55	0.00	-14.00	20.00	0.00	-13.00
	42	18.45	0.00	-12.00	16.90	0.00	-11.00
	43	15.40	0.00	-10.00	13.85	0.00	-9.00
	44	21.55	4.60	-14.00	20.00	4.60	-13.00
	45	18.45	4.60	-12.00	16.90	4.60	-11.00
	46	15.40	4.60	-10.00	13.85	4.60	-9.00
	47	21.55	9.25	-14.00	20.00	9.25	-13.00
	48	18.45	9.25	-12.00	16.90	9.25	-11.00
	49	15.40	9.25	-10.00	13.85	9.25	-9.00
	50	21.55	13.85	-14.00	20.00	13.85	-13.00
	51	18.45	13.85	-12.00	16.90	13.85	-11.00
	52	21.55	0.00	-14.00	16.90	0.00	-11.00
	53	18.45	0.00	-12.00	13.85	0.00	-9.00
	54	15.40	0.00	-10.00	10.75	0.00	-7.00
	55	21.55	4.60	-14.00	16.90	4.60	-11.00
	56	18.45	4.60	-12.00	13.85	4.60	-9.00
	57	15.40	4.60	-10.00	10.75	4.60	-7.00
	58	21.55	9.25	-14.00	16.90	9.25	-11.00
	59	18.45	9.25	-12.00	13.85	9.25	-9.00
	60	15.40	9.25	-10.00	10.75	9.25	-7.00
partial-deduction-treatment	61	21.55	0.00	-16.95	20.00	0.00	-15.75
	62	18.45	0.00	-14.55	16.90	0.00	-13.35
	63	15.40	0.00	-12.10	13.85	0.00	-10.90
	64	21.55	4.60	-16.95	20.00	4.60	-15.75
	65	18.45	4.60	-14.55	16.90	4.60	-13.35
	66	15.40	4.60	-12.10	13.85	4.60	-10.90
	67	21.55	9.25	-16.95	20.00	9.25	-15.75
	68	18.45	9.25	-14.55	16.90	9.25	-13.35
	69	15.40	9.25	-12.10	13.85	9.25	-10.90
	70	21.55	13.85	-16.95	20.00	13.85	-15.75
	71	18.45	13.85	-14.55	16.90	13.85	-13.35
	72	21.55	0.00	-16.95	16.90	0.00	-13.35
	73	18.45	0.00	-14.55	13.85	0.00	-10.90
	74	15.40	0.00	-12.10	10.75	0.00	-8.50
	75	21.55	4.60	-16.95	16.90	4.60	-13.35
	76	18.45	4.60	-14.55	13.85	4.60	-10.90
	77	15.40	4.60	-12.10	10.75	4.60	-8.50
	78	21.55	9.25	-16.95	16.90	9.25	-13.35
	79	18.45	9.25	-14.55	13.85	9.25	-10.90
	80	15.40	9.25	-12.10	10.75	9.25	-8.50
capped-deduction-treatment	81	21.55	0.00	-18.20	20.00	0.00	-17.20
	82	18.45	0.00	-16.20	16.90	0.00	-15.20
	83	15.40	0.00	-14.20	13.85	0.00	-13.20
	84	21.55	4.60	-18.20	20.00	4.60	-17.20
	85	18.45	4.60	-16.20	16.90	4.60	-15.20
	86	15.40	4.60	-14.20	13.85	4.60	-13.20
	87	21.55	9.25	-18.20	20.00	9.25	-17.20
	88	18.45	9.25	-16.20	16.90	9.25	-15.20
	89	15.40	9.25	-14.20	13.85	9.25	-13.20
	90	21.55	13.85	-18.20	20.00	13.85	-17.20
	91	18.45	13.85	-16.20	16.90	13.85	-15.20
	92	21.55	0.00	-18.20	16.90	0.00	-15.20
	93	18.45	0.00	-16.20	13.85	0.00	-13.20
	94	15.40	0.00	-14.20	10.75	0.00	-10.75
	95	21.55	4.60	-18.20	16.90	4.60	-15.20
	96	18.45	4.60	-16.20	13.85	4.60	-13.20
	97	15.40	4.60	-14.20	10.75	4.60	-10.75
	98	21.55	9.25	-18.20	16.90	9.25	-15.20
	99	18.45	9.25	-16.20	13.85	9.25	-13.20
	100	15.40	9.25	-14.20	10.75	9.25	-10.75

Table 12: Used investments of the investment experiment

A3 Instructions of "Hill Climbing" (original in German)

Before the first partial experiment started the following instructions for "Hill Climbing" were handed out:

In the first partial experiment you have the possibility to earn money. The payoff, which you can receive, depends exclusively on your own activity. Regarding this you will find a similar presentation on your monitor after starting the program as in the following illustration:



In this partial experiment you have to detect a maximal value in a coordinate system. This value depends on two variables *H* (horizontal) and *V* (vertical) and can be found by changing these variables *H* and/or *V*. In each coordinate system only **one** maximum does exist, which is defined at **50**. Towards the maximal value the slope is always positive. Therefore, the value rises if you move towards the maximal value, and falls if you remove from the maximal value.

The values (*Result*) of each task, which you have reached at the end of the first partial experiment, are basis for your first payoff. The number of steps is unimportant for the height of the payoff. Your payoff in € from the first partial experiment computes itself as follows:

$$\text{payoff} = 0.15 \cdot \text{Result(TaskA)} + 0.15 \cdot \text{Result(TaskB)}.$$

Therefore your maximal attainable payoff is 15 € if you detect the maximal value in both tasks.

Movements in the coordinate system: At the beginning of the partial experiment the variables are preset at $H = 0$ and $V = 0$. The resulting extent of the searched value can read off in the field “Result”. By pressing the arrow keys *right/left* you can shift between the variables and by pressing the keys *up/down* you can modify the variables. In the example of the illustration the variables are $H = 4$ and $V = -9$. The resulting extent by the values of the variables is 29.2 (*Result*). With the tab key you can shift between task A and B.

After an exercise round, which is unimportant for your payoff, you have 3 minutes time for detecting the maximal values of task A **and** B. After the expiration of this term the first partial experiment ends. It is **very important** that you write down the final values of each treatment on the provided notepad, since you will be request to enter these values at the beginning of the second partial experiment. This input is used for your total payoff at the end of the experiment.

After you have read these instructions please lift your arm. An assistant will start the program on your computer to accomplish the first partial experiment.

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