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The Biased Effect of Aggregated and Disaggregated Income Taxation on Investment Decisions*

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Abstract

Income taxation may not only affect investment behavior by distorting payoffs, it may also have a more subtle, psychological effect, by biasing investors' perceptions of the financial consequences. In a laboratory experiment that allows us to vary the taxation method, while keeping the financial outcomes constant, we find clear evidence that aggregated income taxation (comparable to profit taxation) with complete loss deduction induces a sustained bias towards more risk-taking, while disaggregated income taxation (comparable to a transaction taxation with loss offset) does not. We suggest that this bias may be exploited to increase the volume of private investments by choosing aggregated income taxation, if investors are (too) risk-averse, and to decrease the volume and the risk by choosing disaggregated income taxation, if investors are (too) risk-seeking.

Keywords

tax perception, risk-taking behavior, distorting taxation

JEL-Classification

C91, D14, H24

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1 Introduction

Income taxation affects investments in obvious ways. Gains from the investment are generally reduced by the tax, while losses are either unaffected, partially, or fully deductible, depending on the tax scheme.[1] Income taxation, however, may also affect investment behavior in a more subtle, psychological way, if investors' perceptions of the financial consequences of taxation are biased.

In this paper, we use a laboratory experiment to study the extent to which investors' choices are affected by a biased perception of income taxation. Our research is motivated by the observation that individuals often exhibit a biased perception of their own tax burden, especially in complex decision tasks.[2] Income taxation, especially when it is non-linear, can lead to risky choice situations that are sufficiently multi-level as to bias the investment decision. If, for example, the financial benefit of loss deduction is under-estimated by an investor, the investor may be willing to invest less in risky projects than she or he would be willing to with a non-biased perception of the taxation. Similarly, an overly optimistic view of the advantage of loss deduction may increase risk-taking by investors. In either case, knowledge about any type of perception bias in investment decisions enables business partners to make better judgments on each others' behavior and tax authorities to create more efficient taxation systems that foster investments and growth.

Our laboratory experiment consists of three treatments. The first treatment, the *No-Tax treatment*, is the reference treatment in which gains (and losses) are not taxed. In the second treatment, the *Aggregated-Tax treatment*, gains are subject to an income tax and losses are completely tax deductible (comparable to profit taxation). In the third treatment, the *Disaggregated-Tax treatment*, a tax is levied on any payment received and a tax refund is given for any payment made (comparable to a transaction taxation with loss offset). In the two tax treatments, gross payoffs are adapted in such a way that net payoffs are identical to the

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1 Heaton (1987) gives a detailed formal account of how income taxation without full loss deduction will bias investment decisions of an expected value maximizing investor towards less risky choices. But, other authors (see e.g. Näslund 1968 and Schneider 1980) show that whether the investor's decisions become more or less risky depends on the details of the investor's utility function.

2 There is much empirical evidence that taxpayers are not aware of their own tax burden (Lewis 1978, Fujii and Hawley 1988, König et al. 1995, Rupert and Fischer 1995). Tax complexity has been found to affect behavior both in empirical (Blaufus and Ortlieb 2009, Chetty and Saez 2009) and experimental studies (de Bartolome 1995, Rupert and Wright 1995, Boylan and Frischman 2006).

payoffs in the reference treatment. Since the only treatment difference is the difference in framing, fully rational investors' behavior should not vary across the three treatments.

Our main result is that the aggregated tax induces a sustained higher level of investments compared to the case without taxes. The disaggregated tax also induces higher investments early on, but investments deteriorate over time, reaching the low level of investments in the No-Tax treatment in the second half of the experiment. We attribute the observed high level of investments to a perception bias of the investors concerning the loss deduction provision. However, investors' over-estimation of the risk reduction effect of loss deduction is only sustained in the Aggregated-Tax treatment, but not in the Disaggregated-Tax treatment. We have reason to believe that the difference between the two tax treatments results from the fact that losses and the tax refunds on losses are more obvious in the Aggregated-Tax treatment than in the Disaggregated-Tax treatment. In the former, where either only a tax payment or only a tax refund occurs, the net tax effect is more easily discernable than in the latter, where tax payments and tax refunds are simultaneously observed in every period.

The rest of the paper is organized as follows. We first give an overview of the theoretical and empirical literature regarding the influence of taxation on investment decisions (section 2). After that survey, we explain, in section 3, a model which can be used to determine the optimum of participants' decision variable in the experiment. Then, in section 4, we explain the details of our experimental decision task. We describe our experimental design and setup in section 5 before we present our results in section 6. We conclude our study with a discussion in section 7.

2 Background

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.[3] 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

[3] Domar and Musgrave (1944, p. 396).

less risk. On the other hand the investor will want to compensate for the tax-induced reduction in income caused by increasing his risky investments. The total effect is uncertain and depends on the investor's utility function. 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.[4]

Based on this contribution, a variety of papers were published which particularly differ with respect to the investor's decision criterion. For example, Tobin (1958) examines the influence of taxation on risk-taking with a model in which the μ-σ-criterion is applied. In contrast to Domar and Musgrave, risk is not modeled as expected loss but as standard deviation. However, the results turn out to be very similar. Other subsequent contributions also confirm the main results of Domar and Musgrave (1944) using different optimization frameworks like expected utility (Richter 1960, Mossin 1968, Stiglitz 1969 and Sandmo 1989), mathematical optimization (Näslund 1968) or stochastic dominance (Russell and Smith 1970): Under a proportional income tax with 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.[5]

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 that increases risk-taking with respect to a specific risky investment and another tax schedule that decreases risk-taking with respect to another specific risky investment (Bamberg and Richter 1984, p. 96–100).[6]

The first experimental examination of the theoretical findings regarding taxation's influence on risk-taking is presented in Swenson (1989). The participants in that experiment choose between a riskless and a risky investment. To analyze the effect of taxation, the decision

4 Domar and Musgrave (1944, p. 388–390).

5 Bamberg and Richter (1984, p. 93).

6 The influence of a progressive tax on risk-taking is also examined by Feldstein (1969), Ahsan (1974), Fellingham and Wolfson (1978) and Schneider (1980).

behavior when no taxes are applied is compared to the behavior under three different tax schemes: proportional tax (30 %), progressive tax (20 % and 50 %, with loss offset at the lower rate only), and proportional tax with tax credit (in an amount that expected income reduction is zero). Observed behavior is only in line with theory under the last two tax schemes. A higher demand for risky assets is theoretically predicted for the proportional tax scheme without a tax credit than for the situation without a tax. However, no difference between the treatments is observed. King and Wallin (1990) report similar findings. They show that the progressive tax reduces, but the proportional tax does not increase risk-taking compared to the tax-free benchmark case.

There are a few other studies in which the effect of taxation on investment decisions is examined. Meade (1990) investigates a different aspect of capital gains taxation. She reports laboratory experiments on the tax deferring effect of capital gains taxation on investment decisions and finds that taxing capital gains may lock investors into inefficient investments. Furthermore, she shows that the inefficient lock-in effect is mitigated by preferential rates, deferred tax interest charges, and/or a tax-free re-investment provision.

Anderson and Butler (1997) investigate the effect of a differential tax treatment on financial markets. They compare assets that are subject to regular capital gains taxation to assets that are subject to a preferential treatment, either an unlimited capital loss deduction or a low tax rate. They find that – as expected – the assets with a preferential tax treatment generally achieve higher market prices than those without. The price difference, however, is stronger for high risk assets than for low risk assets. This asymmetric bias is reflected in the significantly lower risk premiums that are observed with a preferential tax treatment than without. They conclude that while the preferential tax treatment can increase the propensity of investors to take risks, some (or all) of the momentum may be lost due to the increase of the market prices for the high risk assets. Note, however, that this result is driven by the fact that the supply of high risk investment opportunities in the studied market is fixed. It seems plausible that preferential tax treatment will not only lead to an increase of the asset price, but also to an increase in the supply of preferred type of asset.

The influence of tax complexity on investment decisions is empirically analyzed by de Bartolome (1995), Rupert and Wright (1998), Boylan and Frischman (2006), and Blaufus and Ortlieb (2009). As a result it can be stated that the higher tax complexity is, the greater the deviations of observed from predicted behavior. Additionally, Boylan and Frischmann (2006) show that competitive markets can mitigate the negative effects of tax complexity on investment, but cannot fully eliminate the bias.

Apart from these studies, a couple of papers examine the perception of taxation and the influence of tax framing on tax perception. Most of this literature is focused on the question, whether households are aware of their true tax burden. One main finding is that individuals often exhibit a biased perception of their actual tax burden (Lewis 1978, Fujii and Hawley 1988, König et al. 1995, Rupert and Fischer 1995). In a field experiment, Chetty, Looney, and Kroft (2009) demonstrate that taxes on consumer goods are largely ignored, if they are not explicitly posted on the price tags. They conclude that tax perception can be biased by presentation issues. Sausgruber and Tyran (2005) also observe a perception bias comparing direct and indirect taxation. They find a bias of buyers towards indirect taxes when compared to direct taxes. Sausgruber and Tyran (2008) report an experiment in which buyers prefer a sellers' tax even though the fiscal disadvantage is bigger than under the alternative buyers' tax. Blumkin, Ruffle, and Ganun (2008) investigate the effect of tax perception on labor provision in a real effort experiment. They find a perception bias in that labor provision is higher with a consumption tax than with an equivalent income tax. Fochmann et al. (2010) also study a real effort situation with a proportional income tax. Keeping the net wage constant, they vary the tax rate and the gross wage. They find that labor supply is greater in the treatments with income taxes than without a tax and conjecture that employees under-estimate the tax burden.

Only a few experimental studies investigate tax perception in an investment setting. De Bartolome (1995) conducts a laboratory experiment to study whether investors base their decisions on the average or on the marginal tax rate. He finds that the answer to the question depends on the presentation of the tax schedule. Subjects using an aggregate income tax table tend to base their decision on the average tax, while those using a tax rate schedule seem to be much more aware of the marginal tax. The author shows that many individuals in the tax table treatment use their average tax rate as if it is their marginal tax rate. The confusion between average and marginal tax rates is supported by two empirical studies (Liebmann and Zeckhauser 2004, Feldman and Katuščák 2006).

Riedl and van Winden (2007) conduct a macroeconomic experiment in which firms either face consumption taxation or income taxation. They find that firms invest more in the case of consumption taxation than with income taxation. They conjecture that this may be due to the fact that the consumption tax is only levied after financial success (sales) is realized whereas the income tax is levied before the firm's output has been sold. In this result we see a first hint at a possibly biased perception of taxes when losses are possible. The complicated macroeconomic setting in Riedl and van Winden (2007), however, makes it difficult to pinpoint the perception bias in taxation.

Fochmann, Kiesewetter, and Sadrieh (2010) present a simpler experimental study on investment decisions when taxation only allows incomplete loss deduction. They show that the positive effect of incomplete loss deduction (both partial and capped deduction methods) on income is over-estimated when compared to the cases without loss deduction and without taxes.

In contrast to the papers discussed above, our experiment is the first to study the possibility of biases in the perception of tax schemes with complete loss deduction. We compare investment decisions in a no taxation setting to those in an aggregated and a disaggregated taxation setting, both with complete loss deduction. While Fochmann, Kiesewetter, and Sadrieh (2010) investigate the perception of different incomplete loss deduction schemes, we are interested in the perception of complete loss deduction schemes when taxes are levied on conceptually different tax bases.

3 Theoretical framework

In the setting that we study, the investor chooses the level of capital investment *K* where the production function is:

$$F(K,W) = Y_i = A \cdot K^{\alpha} \cdot W_i^{\beta} \tag{1}$$

The second input parameter W_i denotes an exogenous factor that depends on a stochastic state of nature i that cannot be influenced by the investor (e.g. the weather). As usual for Cobb-Douglas production functions, *Y* denotes the total production, *A* the total factor productivity, α the output elasticity of input factor *K*, and β the output elasticity of parameter *W*. All variables are non-negative and $\alpha, \beta < 1$.

Each produced unit is sold at the price *k* and the price for one unit of capital amounts to *c*. Due to the fact that the parameter W_i is an exogenous factor, the price for W_i is zero in every state *i*. Therefore, the following profit function π_i results:

$$\pi_i = k \cdot A \cdot K^{\alpha} \cdot W_i^{\beta} - c \cdot K \tag{2}$$

Overall, n different states of nature exist and each can occur with the probability p_i. The expected utility function of the investor is:

$$EU = \sum_{i=1}^{n} p_i \cdot u\left(\pi_i\right) = \sum_{i=1}^{n} p_i \cdot u\left(k \cdot A \cdot K^{\alpha} \cdot W_i^{\beta} - c \cdot K\right) \tag{3}$$

The first order condition for the optimal K is:

$$\frac{\partial EU}{\partial K} = \sum_{i=1}^{n} p_i \cdot u'\left(\pi_i\right) \cdot \left(k \cdot A \cdot \alpha \cdot K^{\alpha-1} \cdot W_i^{\beta} - c\right) = 0 \tag{4}$$

$$\Leftrightarrow \quad K^{*} = \left(\frac{c}{k \cdot A \cdot \alpha} \cdot \frac{\sum_{i=1}^{n} p_i \cdot u'\left(\pi_i\right)}{\sum_{i=1}^{n} p_i \cdot u'\left(\pi_i\right) \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \tag{5}$$

As equation (5) shows, the optimal amount of input factor K depends on participant's individual utility function. Risk neutral behavior would imply a constant marginal utility function. Considering that the sum of all probabilities is one, the following optimal K results for risk neutral individuals from equation (5):

$$K^{*}_{\text{risk neutral}} = \left(\frac{c}{k \cdot A \cdot \alpha \cdot \sum_{i=1}^{n} p_i \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \tag{6}$$

Risk-averse behavior is characterized by $u' > 0$ and $u'' < 0$ (Pratt 1964). In this case, we can show that the optimal K is smaller than under the assumption of risk neutrality (see appendix A1). In contrast, assuming risk-seeking behavior ($u' > 0$ and $u'' > 0$), the optimal K is greater than under the assumption of risk neutrality (see appendix A1). Therefore, following relations result:

$$K^{*}_{\text{risk averse}} < K^{*}_{\text{risk neutral}} < K^{*}_{\text{risk seeking}} \tag{7}$$

Obviously, different tax schemes may affect the optimal choice of K in different ways. We, however, study three tax settings that are fully equivalent in the after-tax payoff distribution. Hence, while the optimal investment K may be different for each individual depending on the individual's preferences, it is identical in all three tax settings for any rational investor with stable preferences.

4 Experimental Design and Hypotheses

4.1 The parameters

The experiment is framed as an investment decision of a corn farmer. The farmer's task is to choose the capital investment *K* in machines, where $0 \leq K \leq 40$. The weather parameter *W* that defines the effect of the weather on production can take one of the five values [0, 10, 20, 30, 40], each with a probability of 1/5. The investment decision is made under uncertainty, i.e. before the weather situation is known.

We set the parameter of our Cobb-Douglas production function to $\alpha = \beta = 0.5$ with $A = 1$. Hence the production function is:

$$Y_i = A \cdot K^{\alpha} \cdot W_i^{\beta} = K^{0.5} \cdot W_i^{0.5} \tag{8}$$

The decision situation is presented to the subjects in 20 independent and identical periods. The weather parameter is drawn independently for each subject in each period. Subjects are instructed clearly that there are no carry-over effects whatsoever, i.e., no savings and no correlation between the periods.

The experiment consists of three treatments that differ only in taxation scheme. Each subject participates only in one of the treatments.

4.2 The reference treatment: No-Tax treatment

In the No-Tax treatment every unit of production is sold for 3 currency units (i.e. $k = 3$) and each borrowed machine costs 1.5 currency units (i.e. $c = 1.5$). Hence, the payoff of each period is determined as:

$$\pi_i = k \cdot A \cdot K^{\alpha} \cdot W_i^{\beta} - c \cdot K = 3 \cdot K^{0.5} \cdot W_i^{0.5} - 1.5 \cdot K \tag{9}$$

Note that losses are possible in our parameterization, for example, if $W = 0$ and $K > 0$.

The optimal *K* for risk neutral investors is

$$K^*_{\text{risk neutral}} = \left(\frac{c}{k \cdot A \cdot \alpha \cdot \sum_{i=1}^{n} p_i \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha - 1}} = \frac{1}{25} \cdot \left(\sum_{i=1}^{n} W_i^{0.5} \right)^2 \approx 15 \tag{10}$$

Following the result in (7), we know that the optimal K for risk-averse investors is smaller than 15 and for risk-seeking investors is greater than 15.

4.3 The tax treatments: Aggregated-Tax treatment and Disaggregated-Tax treatment

In the tax treatments, either aggregates (tax base: revenue *minus* expense) or disaggregates (tax base: revenue *or* expense) are taxed at a constant rate of $t = 0.25$. The (negative) tax on losses is immediately refunded. Since all payoff-relevant events take place in one period, aggregated and disaggregated taxation both lead to exactly the same net outcomes.

To keep after-tax payoffs in the tax treatments equivalent to the payoffs in the reference treatment, the prices (k and c) in the tax treatments are grossed up by the factor $(1-t)^{-1}$.[7] Hence, the pretax payoff in the tax treatments is

$$\pi_i^{\text{pretax}} = \frac{3}{1-t} \cdot K^{0.5} \cdot W^{0.5} - \frac{1.5}{1-t} \cdot K \tag{11}$$

This leads to an after-tax payoff of

$$\begin{aligned} \pi_i^{\text{after tax}} &= (1-t) \cdot \pi_i^{\text{pretax}} \\ &= (1-t) \cdot \left(\frac{3}{1-t} \cdot K^{0.5} \cdot W^{0.5} - \frac{1.5}{1-t} \cdot K \right) \\ &= \pi_i \end{aligned}$$

4.4 The hypotheses

Considering the fact that the after-tax payoff distributions are identical, our Null Hypothesis generally is that investments should not differ across the treatments:

Hypothesis 0: The investment decisions are identical in all treatments.

As discussed in our literature overview, tax payers may have a biased perception of the effect of taxation on their income or on their investments. Investors, for example, may over-estimate

[7] The instructions for the tax treatments simply state that $k = 4$ and $c = 2$ currency units.

the positive effect of loss deduction in a tax scheme. Fochmann, Kiesewetter, and Sadrieh (2010) have shown a perception bias exists for incomplete loss deduction, but the question remains open, whether a similar or a different bias is observed in a setting with complete loss deduction. If the effect of loss deduction is over-estimated, investors will tend to increase their risky investments, because the expected utility loss in the negative outcomes is decreased by the loss deduction rule. This leads us to the hypothesis:

Hypothesis 1: The investments with taxes tend to be greater than those without taxes.

The literature of bounded rationality shows that some biases remain persistent over time while others tend to diminish (see for example Kahneman, Slovic, and Tversky 1982, Thaler 1994, and Camerer 2003). If the biased perception of loss deduction diminishes over time the investments in the tax treatments should approach the level of investments in the No-Tax treatment:

Hypothesis 2: With experience, over time, the investments in the tax treatments tend to approach the level of the investments in the No-Tax treatment.

The two tax treatments differ only in the tax framing.[8] In the Disaggregated-Tax treatment, a tax is levied on revenues and a negative tax is paid on expenses (comparable to a transaction tax with loss offset). It is important to note that the in-payments and the out-payments are explicitly dealt with separately. In the Aggregated-Tax treatment, in-payments and out-payments are first aggregated to a profit or a loss, before taxation is applied (comparable to a profit tax). While the two different tax treatments would have economically different effects if there were delays between in- and out-payments, in our experiment, the difference is purely a presentation effect, because all payment dates coincide. We have chosen this setup to test the framing effect that may result from a disaggregated tax when compared to an aggregated tax. A framing effect can result from two different transparency phenomena. On the one hand, disaggregated taxation may be more transparent, because it enables the investor to recognize the tax effect on in- and out-payments. On the other hand, aggregated taxation might be perceived as more transparent, because the total effect of taxation is more easily accessible. Tax transparency issues are known to have behavioral effects (see for example de Bartolome, 1995, Rupert and Wright, 1998, Boylan and Frischman, 2006, and Blaufus and Ortlieb, 2009),

8 Other experimental papers have studied different tax regimes without explicitly using a tax framing: Sillamaa (1999a, 1999b, 1999c) and Sutter and Weck-Hannemann (2003).

but *ex ante* we have no reason to believe that the tax aggregation-disaggregation effect will go in a specific direction:

Hypothesis 3: The tax framing affects the investment decision, even though the monetary net effect is identical in both tax treatments.

4.5 Experimental protocol

The experiment was programmed with z-Tree (Fischbacher 2007) and was conducted at the computerized experimental laboratory of the University of Magdeburg (MaXLab) with 126 participants (51 female and 75 male subjects). Each Lab-Point (experimental currency unit) corresponded to 3 Euro-Cents. Participants were paid in cash immediately after the experiment. Each participant made 20 investment decisions (i.e. played 20 periods) and was paid the total sum of the 20 periods' payoffs. Since we paid no show-up fee and since losses were possible in every period, a negative payoff at the end of the experiment was also possible. This, however, was rather unlikely and was not observed. Participants' earnings varied between 0.30 Euro and 21.50 Euro, with an average of 12.88 Euro. Appendix A2 contains the instructions for the three treatments

The software provided the participants with a "what if" calculator, in which they could enter any feasible combination of values for *K* and *W* to check the pre-tax and after-tax results. After each investment decision was made (i.e. at the end of each period), subjects received information about the realized weather parameter *W* and the resulting (pre-tax and after-tax) payoff of the period.

5 Results

5.1 Investment behavior

Since there was no interaction between the subjects in our experiment, subjects can be viewed as statistically independent from each other. The 20 decisions of a single subject, however, are obviously correlated. Hence, we use aggregate measures per subject in the non-parametric tests and panel methods for the econometric analysis. Table 1 depicts the mean, median, minimum, and maximum of participants' investment decisions in each treatment.[9]

[9] The values were calculated by first aggregating the 20 decisions of each participant and then aggregating over participants' aggregates.

Table 1: Investment level

treatment	Mean	median	minimum	maximum
No-Tax	16.91	17.25	7.75	27.50
Aggregated-Tax	19.90	19.50	9.00	38.50
Disaggregated-Tax	19.12	18.95	11.50	36.50

In section 4.2, we derived the optimal investment $K_{\text{risk neutral}}$ of a risk neutral investor, $K_{\text{risk neutral}} = 15$. Furthermore, in section 3, it was shown that risk-averse (seeking) behavior results in a lower (higher) investment. Our experimental results reveal a risk-seeking attitude since the mean and median of all participants' investments are greater than 15. For statistical analysis the parametric t-test[10] and the non-parametric Wilcoxon signed ranks test are applied. The null hypothesis is that participants' investments are neither above nor below 15. For the No-Tax treatment the resulting *p*-values for the parametric and for the non-parametric tests are 0.009 and 0.014 (both two-tailed), correspondingly. For both tax treatments the respective *p*-values are all below 0.001 (two-tailed). Hence, investments are significantly above the risk neutral level in all three treatments, indicating a risk-seeking behavior of most subjects.

Comparing the tax treatments to the No-Tax treatment, we find that our results are in line with hypothesis 1. The mean and median investment levels in the tax treatments are higher than the corresponding aggregates in the No-Tax treatment. The *p*-values displayed in table 2 show that both the t-test and the Mann-Whitney U-test find significant differences between the tax treatments and the No-Tax treatment (5%-level, two-tailed).

Table 2: Statistical comparison of all treatments

Comparison	parametric test	non parametric test
No-Tax vs. Aggregated-Tax	$p = 0.008$	$p = 0.016$
No-Tax vs. Disaggregated-Tax	$p = 0.022$	$p = 0.018$
Aggregated-Tax vs. Disaggregated-Tax	$p = 0.464$	$p = 0.687$

The *p*-values in table 2 also show that our results are not in line with hypothesis 3. We do not find a significant difference between the investment levels in the two tax treatments. On first

[10] Using the parametric *t-Test* the assumption of normally distributed results must hold. Therefore, we test this with the *Kolmogorov-Smirnov Test* and *Shapiro-Wilk Test*. The respective *p*-values are (1) for No-Tax treatment: $p > 0.200$ / $p = 0.521$, (2) for Aggregated-Tax treatment: $p = 0.024$ / $p = 0.061$ and (3) for Disaggregated-Tax treatment: $p = 0.060$ / $p < 0.001$. Thus, the assumption of normal distribution holds not in all cases.

sight, it seems as though the tax framing has no effect on investment choices. A closer look at the dynamics of investment choices, however, reveals an important difference between the two tax treatments. Figure 1 displays the mean investment in each of the treatments over all 20 periods. It is evident that the average investment in the No-Tax treatment starts and remains on a low level compared to the other treatments. It lies between 16 and 18 in most periods. The figure reveals no trend for the investments in the No-Tax treatment.

Figure 1 also reveals no clear trend over time for investments in the Aggregated-Tax treatment. The average investments in the Aggregated-Tax treatments lie between 19 and 21 in most periods. In contrast to the two stable treatments, the average investment in the Disaggregated-Tax treatment rapidly falls from well above 20 in the first four periods to below 18 in the last 5 to 6 periods. The question is whether the difference between the development of the investments is significant across treatments. To check this statistically, we first apply simple statistical tests to the investment choices of the last 5 periods. If investment choices in the Disaggregated-Tax treatment drop significantly over time, we should observe a significant difference between the investment levels in the last 5 periods of the Aggregated- and the Disaggregated-Tax treatments.

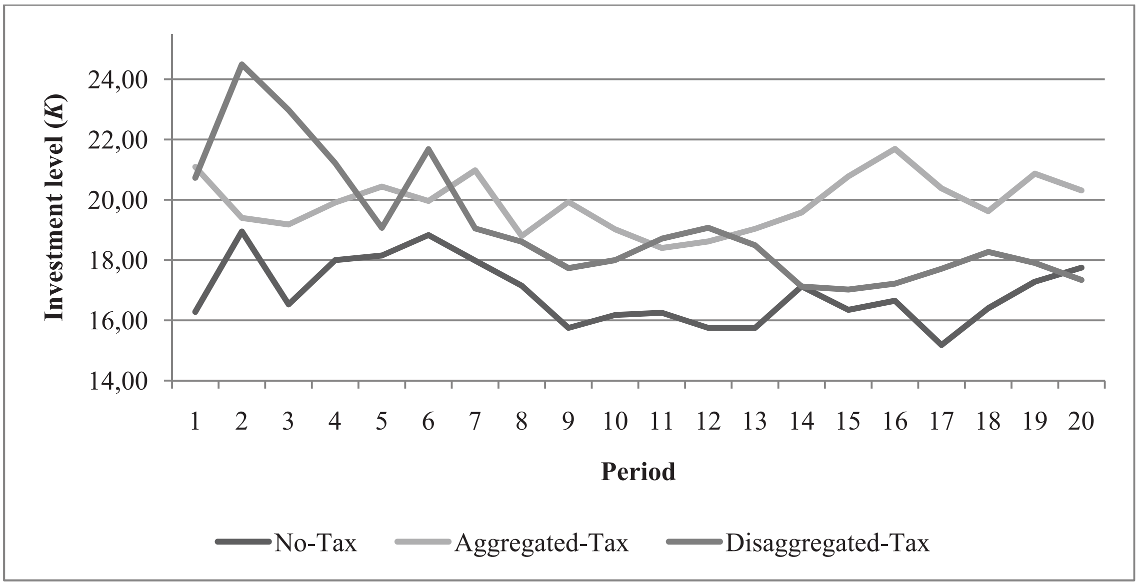

Figure 1: Participants' investment level on average over all 20 periods

Table 3 displays the mean, median, minimum, and maximum investment levels in the last 5 periods of the treatments. Obviously, the mean and median investment levels in the Disaggregated-Tax treatment are almost as low as the mean and median investment levels in the No-Tax treatment. Table 4 shows that the difference between the two tax treatments is significant, both with the t-test and the Mann-Whitney U-test (5%-level, two-tailed).

However, the difference between the Disaggregated-Tax treatment and the No-Tax treatment is no longer significant. Finally, since the difference between the No-Tax and the Aggregated-Tax treatments remains significant even in the last 5 periods, we conclude that the investment levels in the Disaggregated-Tax treatment start out high, close to the level in the Aggregated-Tax treatment, but significantly drop to the level of the No-Tax treatment.

This is a surprising result concerning hypothesis 2 that conjectures that the framing effect of taxation diminishes over time. While we find that there is a significant framing effect in both tax treatments, the effect diminishes only in the Disaggregated-Tax treatment, but not in the Aggregated-Tax treatment.

This last result also affects our evaluation of hypothesis 3. Taking all periods into account, it may seem that the two tax treatments are rather similar. But, since we detect a strong dynamic effect in the Disaggregated-Tax treatment, we can assert that there are significant differences in the way the framing of taxation affects investment behavior. While an aggregated tax (comparable to a profit tax) with full loss deduction has a sustained enhancing effect on investments, the enhancing effect of an economically equivalent disaggregated tax (comparable to a transaction tax with loss offset) on investment deteriorates over time.

Table 3: Investment level in the last 5 periods

treatment	Mean	median	minimum	maximum
No-Tax	16.65	16.40	7.00	28.00
Aggregated-Tax	20.57	20.00	6.00	40.00
Disaggregated-Tax	17.69	16.80	9.00	38.00

Table 4: Statistical comparison of all treatments (last 5 periods)

Comparison	parametric test	non parametric test
No-Tax vs. Aggregated-Tax	$p = 0.005$	$p = 0.009$
No-Tax vs. Disaggregated-Tax	$p = 0.357$	$p = 0.511$
Aggregated-Tax vs. Disaggregated-Tax	$p = 0.033$	$p = 0.034$

To confirm our results we run four linear regressions (see table 5). The dependent variable in each regression is the investment decision of each participant in each period. Since subjects' face repeated decision situations, we run linear regression models with random effects, where *period* is the time variable and subject's identity number is the cross-sectional variable. To check for experience effects, we run one regression with data from only the last 5 periods (model 4) in addition to three regressions with data from all 20 periods (models 1, 2, and 3).

In model 1, we regress the investment decisions on the tax treatment dummies. Each dummy variable takes the value of 1 if a subject participated in the respective treatment. The No-Tax treatment is the default and, therefore, the coefficient of a dummy variable measures the difference between the respective tax treatment and the No-Tax treatment. In line with the previous results, subjects chose a higher investment level in both tax treatments than in the No-Tax treatment. Both dummy coefficients are significant at a 5 % level, but the coefficient of the Disaggregated-Tax treatment dummy indicates a weaker influence of disaggregated taxation on subjects' decision behavior than aggregated taxation.

Table 5: Linear Regression with random effects

	model 1 (20 periods)	model 2 (20 periods)	model 3 (20 periods)	model 4 (last 5 periods)
constant	16.913*** (0.752)	17.618*** (4.113)	17.629*** (0.844)	16.650*** (0.927)
Aggregated-Tax	2.988*** (1.034)	2.911*** (1.055)	2.028* (1.160)	3.923*** (1.273)
Disaggregated-Tax	2.208** (1.057)	2.039* (1.083)	4.368*** (1.186)	1.038 (1.302)
Age		- 0.042 (0.168)		
gender (female = 1)		1.007 (0.881)		
econ major (major in economics = 1)		- 0.100 (0.875)		
Period x No-Tax			- 0.068* (0.036)	
Period x Aggregated-Tax			0.023 (0.034)	
Period x Disaggregated-Tax			- 0.274*** (0.036)	
observations	2,520	2,520	2,520	630

Note: *** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$

In model 2, we regress the investment decisions on the tax treatment dummies, the age, the gender[11], and the academic major[12] of the subjects. Therefore, we defined a dummy for the variable 'gender' (female = 1, male = 0) and a dummy variable *econ major* which takes the value of 1 if the subject studies in a program with a major in economics. The variable *age* is measured on an interval scale. The regression results indicate no significant influence of these variables on participants' decision pattern. Regarding the tax treatment dummies, similar results as in the model 1 are observed.

In model 3, we study interaction effects between experience (as measured by period) and treatment. Since each subject participated only in one treatment, this approach allows us to analyze the behavior over time separated for each treatment. At a 5 % level, there is no significant difference in behavior over time in the No-Tax and in the Aggregated-Tax treatment. However, the investment level decreased significantly over time in the Disaggregated-Tax treatment which is in line with the decision pattern observed in figure 1. Due to this finding, we use only data from the last 5 periods in model 4. In line with the results presented in table 4, the analysis reveals a highly significant difference between the No-Tax and the Aggregated-Tax treatment, but no significant difference between the No-Tax and the Disaggregated-Tax treatment.

5.2 Payoffs

Since our analysis in the last section showed that the tax frames have a significant effect on investment decisions, we obviously can expect to also find a significant effect of the tax frames on the investors' payoffs. Table 6 displays the average per period payoff of investors in the three treatments. The values in the second column show that the average per period payoff over all 20 periods was highest in the No-Tax treatment and lowest in the Aggregated-Tax treatment. The same is true for the average per period payoff of the last 5 periods shown in column three.

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[11] In tax compliance literature, there is much evidence that men are less compliant than women (for a survey see Torgler and Schneider 2004, p. 27). This is in line with other results that men tend to be more risk-seeking than woman (for a detailed survey of experimental and field data see Eckel and Grossman 2008). Furthermore, some experiments have shown that women react more sensitively to losses than men (see e.g. Brooks and Zank 2005, p. 317, and Schmidt and Traub 2002, p. 245).

[12] In a variety of experimental studies, it has been shown that economic students tend to be less cooperative and altruistic as other students or other groups of population (for a survey see Ball and Cech 1996). Analyses focused especially on public goods (Marwell and Ames 1981, p. 306, and Cadsby and Maynes 1998, p. 190), on ultimatum bargaining (Carter and Irons 1991, p. 173) and on prisoner's dilemma games (Frank, Gilovich, and Regan 1993, p. 164).

Table 6: Average payoff per period (in Euro-Cent)

Treatment	all 20 periods	last 5 periods
No-Tax	68.9	66.4
Aggregated-Tax	59.2	63.3
Disaggregated-Tax	65.0	64.0

There are two interesting aspects of this data. First, notice that the values are much farther apart in the 20 periods column than in the 5 periods column. It seems that the payoffs in the three treatments converge over time. This impression is supported by the results of the statistical tests in table 7. While none of the comparisons is statistically significant on a 5%-level (two-tailed), the *p*-values in the 20 periods column are much smaller than in the 5 periods column indicating that the distributions are closer in the last 5 periods than overall.[13]

Table 7: Statistical comparison of payoffs

Comparison	all 20 periods	last 5 periods
No-Tax vs. Aggregated-Tax	$p = 0.052$	$p = 0.940$
No-Tax vs. Disaggregated-Tax	$p = 0.171$	$p = 0.887$
Aggregated-Tax vs. Disaggregated-Tax	$p = 0.346$	$p = 0.637$

The second interesting aspect of the data in table 6 concerns the fact that the investors in the No-Tax treatment seem to earn more than those in the other two treatments. Note that this is true only because the subjects in our experiment generally exhibited relatively low degrees of risk-aversion. In fact, in the No-Tax treatment investment decisions were rather close to the risk neutral prediction[14], even though we found them to be significantly different. In the tax treatments, investments were generally higher indicating an even higher degree of risk-seeking behavior than in the No-Tax treatment. Hence, over all periods the less risk-seeking decisions in the No-Tax treatment provided subjects with higher average payoffs than the more risk-seeking decisions in the tax treatments. It is important to note, however, that in an environment with risk-averse investors the taxation may have biased decisions more towards risk neutrality and, thus, provided a higher payoff to the investors in the tax treatments than in the No-Tax treatment.

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[13] We use the Mann-Whitney U-test for all comparisons.

[14] In the No-Tax treatment the average investment was approximately 17 compared to 15 for the risk neutral decision.

6 Conclusions and Policy Implications

First and foremost, our experiment shows that different taxation methods may be perceived differently, even if the net tax effect is equivalent. This means that in principle the design of the taxation method can generate real economic effects. Specifically, we find that using aggregated income taxation (comparable to profit taxation) instead of disaggregated income taxation (comparable to a transaction taxation with loss offset) tends to induce more risk-taking. Depending on the distribution of risk-preferences amongst investors, this effect may be positive or negative for the economic development. If investors tend to be risk-averse, aggregated income taxation may spur investments more than disaggregated income taxation, increasing investments above the inefficiently low levels. If investors tend to be risk-seeking, disaggregated income taxation may be preferred to aggregated income taxation, because it induces less risk-taking behavior and restrains over-investment and an over-heating of the economy.

While our results are clear and highly significant in the laboratory, they can obviously only be taken as indicative for the field. We have conjectured that the different effects caused by the two-types of taxation mainly are due to the fact that in the disaggregated taxation the fiscal effects on losses and gains are acutely perceivable to the taxpayer, whereas in the aggregated taxation the fiscal effect of loss deduction is perceived overly optimistic, leading to a downwards biased perception of risk.[15] To which extent this perception bias will affect the overall investment behavior in the field obviously depends on how sophisticated the decision-makers are. We do not expect institutional investors to be strongly affected by the bias. The large number of private investors, however, who often make their relatively small investment decisions rather quickly and superficially, may be strongly affected by the taxation mechanism. The large number of such small investments, obviously, can accumulate to substantial economic effects. Furthermore, the institutional investors may knowingly take advantage of the perception bias amongst the individual investors and, thus, amplify the effect of the taxation.

Finally, our research also highlights the necessity to take perception effects into account, when advising public policy. Only few perception effects have been studied so far, leaving plenty of room for further research. Behavioral research is not only in its beginnings

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[15] Our finding of a biased perception of complete loss deduction in profit taxation is supported by the earlier result of Fochmann, Kiesewetter, and Sadrieh (2010), who document a biased perception of incomplete loss deduction in investment decisions.

concerning numerous taxation features, but also concerning the psychological interplay of taxes and subsidies. One such open question, for example, is, whether there is a psychological advantage in paying subsidies to individuals that are subsequently taxed.

Appendix

A1 Optimal amount of input factor capital under the assumption of risk-averse and risk-seeking behavior

In this section, it is shown that the optimal amount of input factor capital K in case of risk-aversion (risk-seeking) is lower (higher) than the optimal amount in case of risk neutrality.

The optimal amount of input factor K is generally determined as follows:

$$K^* = \left(\frac{c}{k \cdot A \cdot \alpha} \cdot \frac{\sum_{i=1}^{n} p_i \cdot u'(\pi_i)}{\sum_{i=1}^{n} p_i \cdot u'(\pi_i) \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \tag{5}$$

Risk neutral behavior implies a constant marginal utility function. Therefore, equation (5) simplifies to:

$$K^*_{\text{risk neutral}} = \left(\frac{c}{k \cdot A \cdot \alpha \cdot \sum_{i=1}^{n} p_i \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \tag{6}$$

Neglecting the assumption of risk neutrality, following relations are possible:

$$K^*_{\text{not risk neutral}} \overset{<}{>} K^*_{\text{risk neutral}} \tag{12}$$

Thus, following inequalities result:

$$\left(\frac{c}{k \cdot A \cdot \alpha} \cdot \frac{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i)}{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i) \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \overset{<}{>} \left(\frac{c}{k \cdot A \cdot \alpha \cdot \sum_{i=1}^{n} p_i \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \tag{13}$$

$$\Leftrightarrow \left(\frac{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i)}{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i) \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \overset{<}{>} \left(\frac{1}{\sum_{i=1}^{n} p_i \cdot W_i^{\beta}} \right)^{\frac{1}{\alpha-1}} \tag{14}$$

Due to the fact that $\alpha<1$, both exponents are less than zero and the inequalities (14) holds if:

$$\frac{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i)}{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i)\cdot W_i^{\beta}} \begin{matrix} > \\ < \end{matrix} \frac{1}{\sum_{i=1}^{n} p_i \cdot W_i^{\beta}} \tag{15}$$

$$\Leftrightarrow \quad \frac{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i)\cdot \sum_{i=1}^{n} p_i \cdot W_i^{\beta}}{\sum_{i=1}^{n} p_i \cdot u'_{\text{not risk neutral}}(\pi_i)\cdot W_i^{\beta}} \begin{matrix} > \\ = \\ < \end{matrix} 1 \tag{16}$$

Each term in each sum is weighted with the respective probability. Thus, every sum term determines an expected value:

$$\frac{E\left(u'_{\text{not risk neutral}}(\pi_i)\right)\cdot E\left(W_i^{\beta}\right)}{E\left(u'_{\text{not risk neutral}}(\pi_i)\cdot W_i^{\beta}\right)} \begin{matrix} > \\ = \\ < \end{matrix} 1 \tag{17}$$

In general, an expected value of two parameters *x* and *y*, which are linked by multiplication, can also be written as:

$$E(x\cdot y)=E(x)\cdot E(y)+Cov(x,y) \tag{18}$$

Considering this, equation (17) can be simplified to:

$$Cov\left(u'_{\text{not risk neutral}}(\pi_i),W_i^{\beta}\right) \begin{matrix} < \\ = \\ > \end{matrix} 0 \tag{19}$$

This means for the initial problem set:

$$K^{*}_{\text{not risk neutral}} \begin{matrix} < \\ > \end{matrix} K^{*}_{\text{risk neutral}} \quad \text{if} \quad Cov\left(u'_{\text{not risk neutral}}(\pi_i),W_i^{\beta}\right) \begin{matrix} < \\ > \end{matrix} 0 \tag{20}$$

The covariance is negative (positive) if there is a negative (positive) relation between marginal utility function and W_i^{β}. Assuming $u'(\pi_i)>0$, the utility function increases in W_i^{β} because the profit π_i rises if W_i^{β} increases given a constant amount of *K* (see equation (2)). For a negative covariance between marginal utility and W_i^{β} the marginal utility function has to decrease if π_i increases, consequently $u''(\pi_i)<0$. In all, this is in line with the definition of risk-aversion (Pratt 1964). Moreover, the covariance is positive if risk-seeking behavior is assumed. This leads to following relations:

$$K^*_{\text{risk averse}} < K^*_{\text{risk neutral}} < K^*_{\text{risk seeking}} \tag{21}$$

A2 Instructions of the experiment

In all three treatments, the beginning of the instructions was identical. The specific instructions of each treatment are described below and follow after these general instructions. For reasons of participants' comprehensibility, input factor capital was represented by *M* (for machines) instead of *K*. Original instructions were written in German.

General instructions

With your participation in this experiment you have the opportunity to earn money. Your payoff at the end of the experiment depends thereby on your decisions during the experiment. For reasons of simplification, amounts of money are not noted in Euro in the experiment, they are noted in Lab-Points. 1 Lab-Point corresponds exactly to 3 Euro-Cent.

We would like to point out that communicating with other participants or leaving your seat is not allowed for you during the whole experiment. Please read the instructions carefully. Raise your hand if you have any questions. In that case we will come to you to answer your questions. If all participants understood the instructions, the experiment starts. The experiment has altogether 20 periods.

Imagine you are a corn farmer. In each period you have to decide how many machines *M* you borrow for money. Besides the quantity of borrowed machines the extent of the corn crop is also determined by the weather. The weather cannot be affected by you. It is known that one of five different weather situations (awfully bad, bad, middle, good, awfully good) can randomly occur in every period. All situations occur with an **equal probability of 1/5**. Of course, the weather can be different from period to period.
The weather parameter *W* indicates the influence of the weather situation on your corn crop. Since five different weather situations are possible, five different weather parameters *W* exist. The potential weather parameters *W* are:

weather parameter W of **awfully bad** weather situation: 0
weather parameter W of **bad** weather situation: 10
weather parameter W of **middle** weather situation: 20
weather parameter W of **good** weather situation: 30
weather parameter W of **awfully good** weather situation: 40

In each period, the extent of your corn crop depends on the quantity of machines M and the weather parameter W. The extent of corn crop is calculated as follows:

$$\text{corn crop} = \sqrt{M} \cdot \sqrt{W}$$

Specific instructions of the No-Tax treatment

At the end of each period, the whole corn crop is sold for 3 Lab-Points per unit corn crop. Thus, you receive the following revenue:

$$\text{revenue from corn crop} = 3 \cdot \sqrt{M} \cdot \sqrt{W}$$

For each machine M, you borrowed at the beginning of a period, you have to pay 1.5 Lab-Points. Thus, you have to render the following expense:

$$\text{expense for chosen machine quantity} = 1.5 \cdot M$$

Altogether, in every period your **payoff** is determined as follows:

$$\text{payoff} = \text{revenue} - \text{expense} = 3 \cdot \sqrt{M} \cdot \sqrt{W} - 1.5 \cdot M$$

Note that even losses are possible if for example the weather parameter W is *zero* and the quantity of machines M is greater than *zero*. During the experiment you have the opportunity to calculate payoffs on trial in each period by entering values for M and W in the respective input mask (bottom half of monitor).

An example:

In this example the quantity of machines M is varied to illustrate different payoff options. According to the payoff function, following payoffs result depending on the values of M and W in each weather situation:

		W				
		0	**10**	**20**	**30**	**40**
M	**0**	0.00	0.00	0.00	0.00	0.00
	5	-7.50	13.71	22.50	29.24	34.93
	10	-15.00	15.00	27.43	36.96	45.00
	15	-22.50	14.24	29.46	41.14	50.98
	20	-30.00	12.43	30.00	43.48	54.85
	25	-37.50	9.93	29.58	44.66	57.37
	30	-45.00	6.96	28.48	45.00	58.92
	35	-52.50	3.62	26.87	44.71	59.75
	40	-60.00	0.00	24.85	43.92	60.00

Please note that 40 machines can be borrowed at most in each period.

After each period, in which you decided on the quantity of machines *M*, you receive information about the realized weather parameter *W* and your resulting payoff in Lab-Points.

The sum of all payoffs (also losses) of each period determines your entire payoff from this experiment. The amount will be converted in Euro and then paid out to you in cash at the end of the experiment.

Specific instructions of the Aggregated-Tax treatment

At the end of each period, the whole corn crop is sold for 4 Lab-Points per unit corn crop. Thus, you receive following revenue:

$$\text{revenue from corn crop} = 4 \cdot \sqrt{M} \cdot \sqrt{W}$$

For each machine *M*, you borrowed at the beginning of a period, you have to pay 2 Lab-Points. Thus, you have to render following expense:

$$\text{expense for chosen machine quantity} = 2 \cdot M$$

Altogether, in every period your **pretax payoff** is determined as follows:

$$\text{pretax payoff} = \text{revenue} - \text{expense} = 4 \cdot \sqrt{M} \cdot \sqrt{W} - 2 \cdot M$$

Note that even losses are possible if for example the weather parameter *W* is *zero* and the quantity of machines *M* is greater than *zero*.

An example:

In this example the quantity of machines *M* is varied to illustrate different pretax payoff options. According to the payoff function, following payoffs result depending on the values of *M* and *W* in each weather situation:

		W				
		0	**10**	**20**	**30**	**40**
M	**0**	0.00	0.00	0.00	0.00	0.00
	5	-10.00	18.28	30.00	38.99	46.57
	10	-20.00	20.00	36.57	49.28	60.00
	15	-30.00	18.99	39.28	54.85	67.98
	20	-40.00	16.57	40.00	57.98	73.14
	25	-50.00	13.25	39.44	59.54	76.49
	30	-60.00	9.28	37.98	60.00	78.56
	35	-70.00	4.83	35.83	59.61	79.67
	40	-80.00	0.00	33.14	58.56	80.00

Please note that 40 machines can be borrowed at most in each period.

Tax collection: Based on the pretax payoff a tax is levied in each period. The tax rate amounts to 25 %. The tax accrues in case of positive and in case of negative pretax payoffs. In case of positive payoffs you have to pay a tax. In case of negative payoffs you receive a tax refund.

An example:

Assuming you have borrowed 25 machines, then following table exhibits your after-tax payoff depending on the weather situation:

	W				
	0	**10**	**20**	**30**	**40**
(1) pretax payoff	- 50.00	13.25	39.44	59.54	76.49
(2) tax = (1) · 0.25	- 50.00 · 0.25 = - 12.50	13.25 · 0.25 = 3.32	39.44 · 0.25 = 9.86	59.54 · 0.25 = 14.88	76.49 · 0.25 = 19.12
(3) after-tax payoff = (1) – (2)	- 50.00 - (-12.50) = - 37.50	13.25 - 3.32 = 9.93	39.44 - 9.86 = 29.58	59.54 - 14.88 = 44.66	76.49 - 19.12 = 57.37

By this example, you can recognize that taxation leads to a decrease of the after-tax payoff in the case of a positive pretax payoff. In the case of a negative pretax payoff, taxation leads to an **increase** of the after-tax payoff due to the tax refund, i.e. your **losses decrease after-tax**.

With respect to the exemplary illustration of the pretax payoff options of the previous page, following after-tax payoff options result respectively:

		W				
		0	**10**	**20**	**30**	**40**
M	**0**	0.00	0.00	0.00	0.00	0.00
	5	-7.50	13.71	22.50	29.24	34.93
	10	-15.00	15.00	27.43	36.96	45.00
	15	-22.50	14.24	29.46	41.14	50.98
	20	-30.00	12.43	30.00	43.48	54.85
	25	-37.50	9.93	29.58	44.66	57.37
	30	-45.00	6.96	28.48	45.00	58.92
	35	-52.50	3.62	26.87	44.71	59.75
	40	-60.00	0.00	24.85	43.92	60.00

During the experiment, you have the opportunity to calculate pretax payoffs and after-tax payoffs on trial in each period by entering values for M and W in the respective input mask (bottom half of monitor).

After each period, in which you decided on the quantity of machines M, you receive information about the realized weather parameter W and your resulting pretax payoff and after-tax payoff in Lab-Points.

The sum of all after-tax payoffs (also losses) of each period determines your entire payoff from this experiment. The amount will be converted in Euro and then paid out to you in cash at the end of the experiment.

Specific instructions of the Disaggregated-Tax treatment (original in German)

At the end of each period, the whole corn crop is sold for 4 Lab-Points per unit corn crop. Thus, you receive following revenue:

$$\text{revenue from corn crop} = 4 \cdot \sqrt{M} \cdot \sqrt{W}$$

For each machine M, you borrowed at the beginning of a period, you have to pay 2 Lab-Points. Thus, you have to render following expense:

$$\text{expense for chosen machine quantity} = 2 \cdot M$$

Altogether, in every period your **pretax payoff** is determined as follows:

$$\text{pretax payoff} = \text{revenue} - \text{expense} = 4 \cdot \sqrt{M} \cdot \sqrt{W} - 2 \cdot M$$

Note that even losses are possible if for example the weather parameter *W* is *zero* and the quantity of machines *M* is greater than *zero*.

An example:

In this example the quantity of machines *M* is varied to illustrate different pretax payoff options. According to the payoff function, following payoffs result depending on the values of *M* and *W* in each weather situation:

		W				
		0	**10**	**20**	**30**	**40**
M	**0**	0.00	0.00	0.00	0.00	0.00
	5	-10.00	18.28	30.00	38.99	46.57
	10	-20.00	20.00	36.57	49.28	60.00
	15	-30.00	18.99	39.28	54.85	67.98
	20	-40.00	16.57	40.00	57.98	73.14
	25	-50.00	13.25	39.44	59.54	76.49
	30	-60.00	9.28	37.98	60.00	78.56
	35	-70.00	4.83	35.83	59.61	79.67
	40	-80.00	0.00	33.14	58.56	80.00

Please note that 40 machines can be borrowed at most in each period.

Tax collection: In each period, two payment dates exist where either an expense or revenue arises:

1. Date: expense, if you borrow machines
2. Date: revenue, if you sell your corn crop

At each payment date, taxation accrues based on the expense or revenue. The tax rate amounts to 25 %. The tax accrues in case of expense and in case of revenue. At the time of revenue you have to pay a tax. At the time of expense you receive a tax refund.

An example:

Expense:

Assuming you have borrowed 25 machines.

Expense for chosen machine quantity: $25 \cdot 2.00 = 50.00$

Received tax refund: $50 \cdot 25\,\% = 12.50$

Total expense: $50 - 12.50 = 37.50$

By this example, you can recognize that the taxation leads to a **decrease of expense** from 50.00 to 37.50 at the time of expense. The extent of total expense is, of course, independent from weather situation.

Revenue:

Assuming you have borrowed 25 machines, then the following table exhibits your total revenue depending on the weather situation:

	W				
	0	**10**	**20**	**30**	**40**
(1) revenue from corn crop	$4 \cdot \sqrt{25} \cdot \sqrt{0}$ = 0.00	$4 \cdot \sqrt{25} \cdot \sqrt{10}$ = 63.24	$4 \cdot \sqrt{25} \cdot \sqrt{20}$ = 89.44	$4 \cdot \sqrt{25} \cdot \sqrt{30}$ = 109.55	$4 \cdot \sqrt{25} \cdot \sqrt{40}$ = 126.49
(2) tax payable = (1) · 0.25	0.00 · 0.25 = 0.00	63.24 · 0.25 = 15.81	89.44 · 0.25 = 22.36	109.55 · 0.25 = 27.39	126.49 · 0.25 = 31.62
(3) total revenue = (1) - (2)	0.00 - 0.00 = 0.00	63.24 - 15.81 = 47.43	89.44 - 22.36 = 67.08	109.55 - 27.39 = 82.16	126.49 - 31.62 = 94.87

By this example, you can recognize that the taxation leads to a **decrease of revenue** at the time of revenue.

After-tax payoff:

Depending on the weather situation, taxation leads to following after-tax payoffs:

	W				
	0	**10**	**20**	**30**	**40**
(3) total revenue	0.00	47.43	67.08	82.16	94.87
(4) total expense	37.50	37.50	37.50	37.50	37.50
(5) after-tax payoff = (3) - (4)	0.00 - 37.50 = - 37.50	47.43 - 37.50 = 9.93	67.08 - 37.50 = 29.58	82.16 - 37.50 = 44.66	94.87 - 37.50 = 57.37

With respect to the exemplary illustration of the pretax payoff options of page 2, following after-tax payoff options result respectively:

		W				
		0	**10**	**20**	**30**	**40**
M	**0**	0.00	0.00	0.00	0.00	0.00
	5	-7.50	13.71	22.50	29.24	34.93
	10	-15.00	15.00	27.43	36.96	45.00
	15	-22.50	14.24	29.46	41.14	50.98
	20	-30.00	12.43	30.00	43.48	54.85
	25	-37.50	9.93	29.58	44.66	57.37
	30	-45.00	6.96	28.48	45.00	58.92
	35	-52.50	3.62	26.87	44.71	59.75
	40	-60.00	0.00	24.85	43.92	60.00

During the experiment, you have the opportunity to calculate on trial in each period by entering values for *M* and *W* in the respective input mask (bottom half of monitor).

After each period, in which you decided on the quantity of machines *M*, you receive information about the realized weather parameter *W* and your resulting pretax payoff and after-tax payoff in Lab-Points.

The sum of all after-tax payoffs (also losses) of each period determines your entire payoff from this experiment. The amount will be converted in Euro and then paid out to you in cash at the end of the experiment.

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