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Real Tax Effects and Tax Perception Effects in Decisions on Asset Allocation*

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Abstract

We test the predictions of the theoretical literature initiated by the study of Domar and Musgrave (1944) with a laboratory experiment in which subjects have to decide on the composition of an asset portfolio. Our simple design enables us to distinguish between Real Tax Effects and Perception Effects when a proportional income tax, with and without a full loss offset provision, is introduced. Observed investment behavior is partially inconsistent with the theoretical predictions if we do not control for the Perception Effects. However, if we consider these effects, we find support for the theory. The isolated Perception Effects can explain the unexpected behavior observed in previous studies and has both scientific and political implications.

Keywords

Taxation, Domar-Musgrave Effect, Tax Perception, Risk Taking Behavior, Portfolio Choice, Behavioral Taxation

JEL-Classification

C91, D14, H24

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1 Introduction

The seminal study by Domar and Musgrave (1944) yielded an important body of literature considering the influence of taxation on risk taking in investment decisions. Although the techniques for analyzing tax effects differ across the various studies, there is general support for Domar and Musgrave's predictions when the investor can choose between a risk-free asset with a zero rate of return and a risky asset: introducing a proportional income tax with a full loss offset provision increases the investor's willingness to take risk. However, if the return of the risk-free asset exceeds zero, the effect on risk taking is ambiguous and depends on the actual utility function of the investor. This applies analogously to an income tax without a loss offset provision. Even if the return of the risk-free asset is assumed to be zero, the total effect is ambiguous as well.

So far, only a few studies analyze the effects presented by Domar and Musgrave (1944) empirically. First, Swenson (1989) analyzes these theoretical predictions utilizing a market experiment. Although the author considers an investment setting in which the return of the risk-free asset is zero (the most unambiguous case), Swenson (1989) does not observe a significant increase in risky investments when a linear income tax with a full loss offset is introduced. However, a progressive tax induces a significant decline in the demand for risky assets, as expected. King and Wallin (1990) utilize an individual environment (not a market experiment) and a positive return of the risk-free asset in their laboratory experiment. Although their experimental design differs from Swenson's design, they observe very similar results: introducing a progressive tax decreases risky investments, whereas a proportional tax induces no significant differences in investment behavior. Based on this unexpected finding, King and Wallin (1990) conduct a second experiment to examine the effect of a linear tax further. However, once more the introduction of a proportional tax does not lead to a significant increase in risky investments.

More recently, a small but growing body of literature focuses on tax perception biases in investment decisions.[1] For example, Fochmann et al. (2012a, b) observe an unexpected high

[1] Tax perception biases are not observed exclusively in investment settings. In a labor supply context, for example, Gamage et al. (2010), Djanali and Sheehan-Connor (2012), and Fochmann et al. (2013) observe that individual's willingness to supply labor is significantly higher when a tax is levied on income than when no tax is applied although the net income is held constant in both situations. In two archival studies, König et al. (1995) and Arrazola et al. (2000) reveal that labor supply decisions are distorted by an incorrect tax perception. Chetty et al. (2009), Finkelstein (2009), and Feldman and Ruffle (2012) find that the consump-

willingness to take risk when an income tax with a loss offset provision is applied although the gross investments are adjusted accordingly to achieve identical net investments in all treatments. Ackermann et al. (2013) analyze how taxes and subsidies affect risky investment decisions. They observe that—although net income is held constant again—individuals invest a significantly lower amount in the risky asset when a tax must be paid or a subsidy is granted. To determine the robustness of these findings, the authors conduct several variations of their baseline experiment and find that only a reduction in environment complexity (by reducing the number of states) mitigates the identified perception bias. Although the authors do not consider losses in their setting and, therefore, are not able to study the perception biases observed by Fochmann et al. (2012a, b) explicitly, their findings clearly demonstrate that investment behavior can be heavily distorted by an income tax as well. The results of all these studies reveal that the individual responses to an income tax are in contrast to what a standard theory, which assumes that individuals decide on their net payoffs, would predict. Such perception biases may explain the unexpected investment behavior observed in studies conducted by Swenson (1989) and King and Wallin (1990) when a proportional income tax is introduced.

To illuminate this discussion, we conduct a simple laboratory experiment in which subjects must decide on the composition of an asset portfolio in different but independent decision situations. Our contribution to the literature is manifold. First, we test the theoretical predictions regarding the willingness to invest in a risky asset when a proportional income tax with *and* without a full loss offset provision is introduced. So far, only Swenson (1989) analyzes the influence of a loss offset provision on investment behavior experimentally. However, the effect of an income tax without any loss offset provision is not examined by him. Second, we analyze how investment behavior is affected by different degrees of loss offset, i.e., the extent to which losses are tax deductible. Third, to control for perception biases, we use decision situations in which the net investments are identical in all treatments.

tion of goods can also be distorted by a biased tax perception. Moreover, Sausgruber and Tyran (2005, 2011) observe that voting behavior is influenced by tax misperception. One determinant of a correct tax perception is the salience of a tax where a higher tax salience improves the tax perception (see, for example, Rupert and Wright, 1998, Sausgruber and Tyran, 2005, 2011, Chetty et al., 2009, Finkelstein, 2009, Fochmann and Weimann, 2013). In addition, the complexity of the tax system is another determinant. For example, de Bartolome (1995), Rupert and Wright (1998), Rupert et al. (2003), Boylan and Frischmann (2006), and Blaufus and Ortlieb (2009) demonstrate that increasing tax complexity lowers the quality of individual investment decisions. Furthermore, individual characteristics, such as education, age, and income, also influence tax perception. In general, a positive relationship between each of these characteristics and the accuracy of the tax effect estimation is observed (see, for example, Gensemer et al., 1965, Morgan et al., 1977, Lewis, 1978, Fujii and Hawley, 1988, König et al., 1995, Rupert and Fischer, 1995).

Thus, we are able to analyze the perception and real tax effects discussed in the literature separately *and* link all these effects. Fourth, because the theoretical literature indicates that the total effect of an income tax depends on whether the return of the risk-free asset is assumed to be zero or greater than zero, we examine both cases. So far, no empirical study examines both cases simultaneously: Swenson (1989) considers a risk-free asset with a zero return and King and Wallin (1990) a secure asset with a positive return. We focus on both cases to fill this gap and to analyze potential interaction effects.

The results of our experiment reveal that the willingness to invest in the risky asset decreases significantly when the income is subject to a proportional tax. This finding holds irrespective of whether a full loss offset or no loss offset is provided. Although this behavior can possibly be explained by the underlying theory in the latter case, an increase of the willingness to invest is hypothesized in the case with a full loss offset. To find an explanation for this non-hypothesized behavior, we adjusted the gross rate of return in each tax treatment in such a way that the net rate of return is identical to the respective rate of return in the tax-free reference treatment. Thus, the same decision pattern is expected in all three treatments. In both tax treatments, however, we observe a significant decrease of the willingness to invest in the risky asset compared to the no tax treatment. We call this unexpected effect Perception Effect which is consistent with the observations of Ackermann et al. (2013). In this light, the previous findings must be interpreted with caution. Because the Perception Effect reduces the investment level in both tax treatments, we overestimate the Real Tax Effects of introducing an income tax in cases without loss offset provisions and underestimate the Real Tax Effects in cases with full loss offset provisions if we do not take the observed bias into account. If we control for the Perception Effect, we actually find that individuals invest more in the risky asset when a full loss offset is provided and less when no loss offset is provided compared to the setting without an income tax, respectively. Thus, if we consider the Perception Effect, we find support for the theoretical prediction. By comparing the treatments with and without a loss offset provision, we observe that a higher degree of loss offset leads to a higher willingness to invest in the risky asset. Although this was expected theoretically, we are able to demonstrate that a Perception Effect also occurs in this context. If this effect is not considered, the Real Tax Effect is underestimated.

Our findings yield both scientific and political implications. First, as the effect of introducing an income tax with and without loss offset is not always unambiguous and therefore an empirical question, our experimental study provides empirical investigation of this important question. Second, our Perception Effect may explain why Swenson (1989) and King and Wallin (1990) find no significant increase in risky investments under a proportional income tax. Therefore, future empirical and experimental work should consider that investment decisions can be heavily biased due to the Perception Effect we have identified and should control for it. Furthermore, theoretical predictions can be improved if behavioral aspects, such as our Perception Effect, are considered in investment models. Third, politicians should note that governmental interventions could bias risk taking behavior even more than theory predicts. Especially, if the complexity of the environment in which the intervention occurs is very high, interventions can produce extremely negative consequences.

The remainder of the paper is organized as follows: in section 2, we provide a brief review of the theoretical and experimental literature. In section 3, we present the design of our experiment, hypotheses, and experimental protocol. The results of our study are provided in section 4. Section 5 summarizes our results and discusses the scientific and political implications of our findings.

2 Literature Review and Hypotheses

2.1 Theoretical Literature

In their seminal paper, Domar and Musgrave (1944) model the choice of an investor to hold cash or to invest the given funds in a risky portfolio, which is liable to a linear tax with various degrees of loss offset. In their context, risk is defined as the expected loss of an investment that reduces its expected yield. By imposing a linear tax without loss offset provision, the tax reduces the yield, but not the risk of an asset. Consequently, risk taking becomes less attractive and the proportion invested in the risky assets declines. On the other hand, an investor who wants to restore his pre-tax income is induced to take more risk. Given these two opposed effects, the overall outcome is uncertain. If a full loss offset is provided, the tax reduces the yield and the risk of the investment proportionally. Because the relation between yield and risk is unaltered, the attractiveness of risk taking is not affected by the tax. Hence, the tax-induced decrease in income leads to lower cash holdings and more risky investments. In the case of partial loss offset, the result must be somewhere between these two; thus, the overall outcome is uncertain as well.

In contrast to Domar and Musgrave (1944), Tobin (1958) measures the risk of an asset by the standard deviation of the possible returns. Nevertheless, the implementation of a linear tax with full loss offset reduces cash holdings in the portfolio and increases the demand for risky assets. Richter (1960) models the allocation of given funds between two risky assets that differ with respect to expected return and variance. The income is subject to a proportional tax with a lump sum element and a full loss offset. By assuming that the investor maximizes a quadratic utility function, the author demonstrates that a discrete rise of the proportional tax rate leads to a higher willingness to take risk.

Mossin (1968) considers an expected utility maximizing and risk averse investor whose portfolio consists of a riskless (with a zero rate of return) and a risky asset. In the case of a proportional income tax with a full offset of losses, the author confirms the result of Domar and Musgrave (1944). Therefore, no further assumptions about the investor's utility function are necessary. This conclusion, however, must be constrained if the riskless asset has a positive rate of return. The author demonstrates that the previous result holds if the investor has a decreasing absolute and an increasing relative risk aversion. In the case of a proportional income tax without a loss offset provision, the analysis is limited to a risk-free asset with a zero rate of return. In this context, the author shows that an increase of sufficiently high tax rates leads to less risky investments. However, on the level of generality an unambiguous prediction demands knowledge about the investor's utility function. Stiglitz (1969) also considers an investor who maximizes the expected utility of his wealth and obtains similar, but more detailed, findings. An increase of a proportional tax with full loss offset leads to a higher investment in the risky asset if the return of the secure asset is zero. On the other hand, if the safe asset yields a positive rate of return, an increase in the demand for the risky asset implies an increasing or constant absolute risk aversion. In the case of a decreasing absolute risk aversion, an increasing or constant relative risk aversion is necessary to ensure more risky investments. Further assumptions about the utility function are also required if an income tax with no offset of losses is imposed. The demand for the risky asset declines if the relative risk aversion of the investor is decreasing or constant and the safe asset has a zero rate of return. If the relative risk aversion is increasing, the effect is ambiguous. Independent of the assumed utility function the demand for the risky asset decreases if the tax rate is sufficiently high. Furthermore, the author declares that risky investment is always less if the offset of losses is incomplete compared to full loss offset. Allingham (1972) outlines different approaches to analyze the influence of taxes on investment decisions. If the investor maximizes the expected utility of his wealth, the author is able to confirm the above-mentioned results of Mossin (1968) and Stiglitz (1969) for a proportional tax with full loss offset. In the case of a safe asset with a zero rate of return, the risk averse investor increases the holding of the risky asset with taxation. The same result is observed for a positive rate of return if the relative risk aversion of the investor is assumed to be increasing.

Eeckhoudt et al. (1997) differentiate between positive and negative consolidated profit. While no loss offset occurs for the latter, positive consolidated profit above an amount of tax exemption is taxed proportionally. In the case of a tax increase, it is demonstrated that the willingness to invest in the risky project decreases. Heaton (1987) also observes that a proportional tax reduces risky investments if there is no possibility to offset losses. To develop a model that approximates reality, the author allows for tax credits, depreciation allowances, and different ways of corporate financing.

To sum up, there seems to be general agreement with Domar and Musgrave (1944) if the investor has the possibility to choose between a risky asset and a riskless asset with a zero rate of return: the imposition of a linear tax with full loss offset leads to a higher demand for risky investments. This unambiguous result can be explained by the substitution effect of the proportional tax.[2] However, if the return of the secure asset exceeds zero, a more risky portfolio is no longer definite. The total effect of income taxation depends on the actual utility function of the investor.[3] If the loss offset is not complete, the total effect is also uncertain, even if the return of the risk-free asset is zero.[4] To illuminate this discussion, we will study the investment behavior in all four cases: 1) linear income tax with full loss offset and a zero rate of return of the risk-free asset, 2) with full loss offset and a positive rate, 3) no loss offset and a zero rate, and 4) no loss offset and a positive rate.

2.2 Experimental Literature

Up to now, only some studies analyze the effects presented by Domar and Musgrave (1944) empirically.[5] The first contribution in this regard is Swenson (1989) who analyzes the theoretical predictions in a market experiment. This researcher differentiates between buyers

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[2] See Mossin (1968, pp. 76-77), Allingham (1972, p. 206).

[3] See Mossin (1968, pp. 77-78), Allingham (1972, p. 207).

[4] See Mossin (1968, pp. 80-81), Stiglitz (1969, p. 275).

[5] In addition to this strand of literature, there are a view studies with an investment context as well, but they focus on other issues. For example, de Bartolome (1995) finds that individuals misperceive the tax effects in investment decisions as they consider the average tax rate instead of the marginal tax rate. Meade (1990) demonstrates that the tax deferring effect of capital gains taxation induces an inefficient lock-in effect. Anderson and Butler (1997) analyze the effect of a differential tax treatment on financial markets and find that assets which benefit from a preferential tax rate or the possibility to offset losses reach higher market prices than equally risky, non-tax-favored assets. In contrast, Davis and Swenson (1993) find no positive effect of preferential taxation on the demand of capital assets.

and sellers, who are endowed with cash or risky assets, respectively. The participants operate on four markets, which are explained in neutral terms: no tax, proportional tax, progressive tax, and proportional tax with a tax credit (within-subject design). As expected, a progressive tax reduces the demand for risky assets,[6] whereas a proportional tax with a tax credit leads to an increase in risky investments. Surprisingly however, for a linear tax with a full loss offset a significant increase cannot be observed. The author argues that the underlying theory does not consider market effects which might produce this unexpected result. To test the validity of this statement, King and Wallin (1990) conduct an additional laboratory experiment. The extent to which risky investment is influenced by the tax structure is figured out by confronting each participant with three scenarios: no tax, proportional tax, and progressive tax (within-subject design). In contrast to Swenson (1989), they do not consider a market design for their experiment and concentrate only on positive payoffs (i.e., no losses are possible). The task of the investor is to allocate the given funds between a risk-free asset (with a positive rate of return) and a risky asset. Contrary to the expectations, the results of the authors are similar to the findings of Swenson (1989): the introduction of a progressive tax induces lower risky investments, whereas the proportional tax delivers no significant result. Based on this unexpected observation, King and Wallin (1990) conduct a second experiment to examine the effect of a linear tax separately. However, once more the introduction of a proportional tax does not lead to a significant increase in risky asset investments.

The studies conducted by Swenson (1989) and King and Wallin (1990) do not consider an important aspect highlighted by Domar and Musgrave (1944), that is, the effect of different methods of offsetting losses on investment behavior. In particular, Swenson considers only the case of a full loss offset, while King and Wallin avoid losses completely and, thus, are not able to examine tax effects on losses. Therefore, Fochmann et al. (2012a) distinguish among three loss offset scenarios in their experiment: no, partial, and capped loss deduction. In each decision situation, participant’s task is to choose between two risky lotteries with different expected values and risk. The design of the payoff structure ensures that the net payoffs of both lotteries in each of these treatments are equal to the payoffs in the no tax treatment. Thus, the preferences for the low and the high risk lottery should be the same in all treatments. As expected, they observe no significant differences between the no tax treatment and the no deduction treatment. However, they find a significant bias in the partial and the

[6] The influence of a progressive tax on risk taking is theoretically examined, for example, by Feldstein (1969), Ahsan (1974), Fellingham and Wolfson (1978), Schneider (1980), and Bamberg and Richter (1984).

capped loss deduction scenario. In particular, they observe that the willingness to invest in the risky investment increases significantly in these treatments compared to the no tax treatment. A similar result is observed by Fochmann et al. (2012b). Because the net payoffs are identical in all treatments, the same decision pattern was expected. However, they observe that individuals have an unexpected high willingness to take risk when a proportional income tax with a full loss offset is applied. Therefore, both studies find evidence that loss offset rules induce perception biases that impact the tendency to take risk.

To refine this result, Ackermann et al. (2013) analyze how taxes and subsidies affect the choice between a risky and a secure asset through a further experiment. They discover that, although the net income is the same in all treatments, participants invest a significant lower amount in the risky asset when a tax must be paid or a subsidy is granted. To check the robustness of this unexpected finding, several variations of the baseline experiment are conducted. However, only a reduction in environment complexity, by reducing the number of states, mitigates the identified perception bias. Although the authors do not consider losses in their setting and, therefore, are not able to explicitly study the perception biases observed by Fochmann et al. (2012a, b), their findings clearly demonstrate that investment behavior can be heavily distorted by an income tax as well. The results of these studies reveal that the individual responses to an income tax are in contrast to what a standard theory, which assumes that individuals decide on their net payoffs, would predict. Such perception biases might explain the unexpected investment behavior observed in the studies conducted by Swenson (1989) and King and Wallin (1990) when a proportional income tax is introduced. Therefore, we use an experimental design that enables us to study perception effects and real tax effects simultaneously. In particular, we will use a choice setting in which the gross payoffs are identical in all our treatments to test the real tax effects discussed in the theoretical literature. Furthermore, we will use a choice setting in which the net payoffs are equivalent (i.e., gross payoffs are adjusted in such a way that the choice situations are identical in net terms) to study the perception effects discussed in the empirical literature. By combining both settings, we are able to separate both effects.

3 Experimental Design and Hypotheses

3.1 Decision Task

In our experiment, subjects must decide on the composition of an asset portfolio in 20 independent decision situations. In each situation, every participant receives a fixed endowment e that has to be allocated on two assets A and B. Individuals act as price takers and the asset price is identical for both asset types and constant over time. The amount invested in the risky asset A is denoted by q and the amount invested in the risk-free asset B is given by $e - q$. The latter yields a rate of return of r_B, which is at least zero. Each subject is informed about this rate before a decision about the allocation is required. In contrast, the rate of return of the risky asset A r_A depends on the state of nature i. In the good state, the rate of return is positive ($r_A^u > 0$). In the bad state, the rate of return is negative ($r_A^d < 0$). Both states of nature occur with the same probability ($p^u = p^d = 0.5$). Participants do not know the actual state of nature when they decide on the composition of their asset portfolio. However, the potential rates of return are displayed before the decision is made. The rates of return of both assets are chosen to satisfy the following inequalities:

$$r_A^u > r_B > r_A^d, \tag{1}$$

$$p^u \cdot r_A^u + p^d \cdot r_A^d > r_B. \tag{2}$$

Therefore, no asset dominates the other. However, the expected value of asset A exceeds the risk-free rate of return of asset B in each decision situation.

3.2 Treatments

Each participant is randomly assigned to one of three treatments (between-subject design).[7] In the first treatment, the *no tax treatment*, no income tax is applied. In the *full loss offset treatment*, however, the gross return (gross rate of return of an asset times the capital invested in this asset) of both investment opportunities is subject to an income tax with a rate τ of 50%. The tax is imposed in case of a positive as well as a negative gross return. While the investor must pay a tax in the first case, she receives an immediate tax refund in the latter (immediate and full loss offset). Thus, an incurred loss is reduced by the income tax. In the *no*

[7] The instructions of all treatments are available in appendix A1.

loss offset treatment, an income tax is applied as well, but no loss offset is provided. In case of a negative gross return, an incurred loss is, therefore, not reduced. Because only the loss offset provision differs, the only distinction between both tax treatments occurs in this case. In both tax treatments, the initial endowment is not subject to taxation. The payoff in the no tax treatment is therefore

$$\begin{aligned}\pi^i &= e + q \cdot r_A^i + (e-q)\cdot r_B \\ &= q\cdot\left(1+r_A^i\right) + (e-q)\cdot(1+r_B),\end{aligned} \tag{3}$$

whereas the payoff in the full loss offset treatment varies to

$$\begin{aligned}\pi^i &= e + q \cdot r_A^i \cdot (1-\tau) + (e-q)\cdot r_B \cdot (1-\tau) \\ &= q\cdot\left(1+r_A^i\cdot(1-\tau)\right) + (e-q)\cdot\left(1+r_B\cdot(1-\tau)\right).\end{aligned} \tag{4}$$

In the no loss offset treatment, the payoff demands a further differentiation:

$$\begin{aligned}\pi^i &= \begin{cases} e + q\cdot r_A^i \cdot (1-\tau) + (e-q)\cdot r_B\cdot(1-\tau) & \text{if} \quad r_A^i \geq 0 \\ e + q\cdot r_A^i + (e-q)\cdot r_B \cdot (1-\tau) & \text{if} \quad r_A^i < 0 \end{cases} \\ &= \begin{cases} q\cdot\left(1+r_A^i\cdot(1-\tau)\right) + (e-q)\cdot\left(1+r_B\cdot(1-\tau)\right) & \text{if} \quad r_A^i \geq 0 \\ q\cdot\left(1+r_A^i\right) + (e-q)\cdot\left(1+r_B\cdot(1-\tau)\right) & \text{if} \quad r_A^i < 0. \end{cases}\end{aligned} \tag{5}$$

3.3 Hypotheses

Based on the payoffs of the three treatments, we now theoretically demonstrate the effect of a tax rate change on the amount invested in the risky asset. We are then able to study the influence of the introduction of an income tax on the willingness to take risk. For this purpose, we assume a risk averse investor with the utility function $u(\pi)$ (with $u'(\pi) > 0$ and $u''(\pi) < 0$) who maximizes her expected utility. If a full loss offset is provided, the investor's maximization problem is:

$$\begin{aligned}&\max_q E\left[u(\pi)\right] \\ &\text{s.t.} \quad \pi^u = q\cdot\left(1+r_A^u\cdot(1-\tau)\right) + (e-q)\cdot\left(1+r_B\cdot(1-\tau)\right) \\ &\qquad\;\; \pi^d = q\cdot\left(1+r_A^d\cdot(1-\tau)\right) + (e-q)\cdot\left(1+r_B\cdot(1-\tau)\right).\end{aligned} \tag{6}$$

The resulting FOC is:

$$\frac{dE\left[u(\pi)\right]}{dq} = p^u \cdot u'\left(\pi^u\right) \cdot \left(r_A^u - r_B\right) + p^d \cdot u'\left(\pi^d\right) \cdot \left(r_A^d - r_B\right) = 0. \tag{7}$$

In appendix A2, we demonstrate that the overall effect of tax rate changes on the riskily invested amount q is:

$$\frac{dq}{d\tau} = \frac{q}{1-\tau} - \frac{dq}{de} \cdot \frac{r_B \cdot e}{1 + r_B \cdot (1-\tau)}. \tag{8}$$

The first term represents the substitution effect, the so-called Domar-Musgrave-Effect.[8] This effect is always positive, i.e., a tax rate increase leads to a higher willingness to invest in the risky asset. The second term is the weighted income effect where $\frac{dq}{de}$ denotes the income effect. The second fraction of this term is always positive, but $\frac{dq}{de}$ can be less than, equal to or greater than zero depending on the investor's utility function. As a result, the overall effect of a tax rate change is ambiguous. In cases of a zero or negative income effect, a tax rate increase leads to a higher willingness to take risk. In cases of a positive income effect, however, a tax rate increase can lead to a higher, constant, or lower willingness to take risk depending on whether the substitution effect is higher, equal, or lower than the (weighted) income effect. However, if we assume that the risk-free asset yields no return ($r_B = 0$), the second term is zero and thus $\frac{dq}{d\tau} > 0$, i.e., a tax rate increase leads to a higher willingness to take risk independent of the income effect. In this case, only the Domar-Musgrave-Effect occurs. This leads us to our first hypothesis:

Hypothesis 1: *In cases with $r_B = 0$, investment in the risky asset is higher when a linear income tax with a full loss offset is applied compared to when no income tax is applied.*

In contrast, no clear hypothesis can be derived if we assume that the risk-free asset yields a positive rate of return ($r_B > 0$) because the overall effect depends on the investor's utility

8 See Mossin (1968, pp. 76-77) and Domar and Musgrave (1944, p. 411).

function. Thus, in this case the influence of the tax rate on the willingness to take risk is an empirical question that can be answered by our study.

A similar consequence results if we assume that no loss offset is provided. In this case, the investor's maximization problem changes as follows:

$$\max_q E\left[u(\pi)\right]$$
$$\text{s.t.} \quad \pi^u = q \cdot \left(1 + r_A^u \cdot (1-\tau)\right) + (e-q) \cdot \left(1 + r_B \cdot (1-\tau)\right) \tag{9}$$
$$\pi^d = q \cdot \left(1 + r_A^d\right) + (e-q) \cdot \left(1 + r_B \cdot (1-\tau)\right).$$

The resulting FOC is:

$$\frac{dE\left[u(\pi)\right]}{dq} = p^u \cdot u'\left(\pi^u\right) \cdot (1-\tau) \cdot \left(r_A^u - r_B\right) + p^d \cdot u'\left(\pi^d\right) \cdot \left(r_A^d - r_B \cdot (1-\tau)\right) = 0. \tag{10}$$

In appendix A3, we demonstrate that the overall effect of tax rate changes on the riskily invested amount q is represented as follows:

$$\frac{dq}{d\tau} = \frac{\begin{array}{l} p^u \cdot u'\left(\pi^u\right) \cdot \left(r_A^u - r_B\right) - p^d \cdot u'\left(\pi^d\right) \cdot r_B \\ +q \cdot \left[p^u \cdot u''\left(\pi^u\right) \cdot (1-\tau) \cdot \left(r_A^u - r_B\right)^2 - p^d \cdot u''\left(\pi^d\right) \cdot r_B \cdot \left[r_A^d - r_B \cdot (1-\tau)\right]\right] \end{array}}{p^u \cdot u''\left(\pi^u\right) \cdot \left[(1-\tau) \cdot \left(r_A^u - r_B\right)\right]^2 + p^d \cdot u''\left(\pi^d\right) \cdot \left[r_A^d - r_B \cdot (1-\tau)\right]^2} - \frac{dq}{de} \cdot \frac{r_B \cdot e}{1 + r_B \cdot (1-\tau)}. \tag{11}$$

Considering that $u'(\pi) > 0$ and $u''(\pi) < 0$ are assumed, the overall effect of a tax rate change on the riskily invested amount depends on the actual utility function of the investor irrespective of whether the risk-free asset yields a positive or a zero return. Here, both the signs of the first and second term are ambiguous. Thus, no clear hypothesis can be formulated, and the influence of the tax rate on the willingness to take risk is an empirical question that can be answered by our study, again.

In addition to the introduction of an income tax, we analyze how the loss offset provision affects the willingness to take risk. To show this influence theoretically, we introduce the parameter α which reflects the degree to which losses are tax deductible. If no loss offset is provided, α is zero, and if a full loss offset is provided, α equals one. For all partial loss offset provisions, the value of α is in between zero and one. The investor's maximization problem is therefore:

$$\begin{aligned}
&\max_q E\left[u(\pi)\right] \\
&\text{s.t.} \quad \pi^u = q\cdot\left(1+r_A^u\cdot(1-\tau)\right)+(e-q)\cdot\left(1+r_B\cdot(1-\tau)\right) \\
&\qquad\;\; \pi^d = q\cdot\left(1+r_A^d\cdot(1-\alpha\cdot\tau)\right)+(e-q)\cdot\left(1+r_B\cdot(1-\tau)\right).
\end{aligned} \tag{12}$$

and the resulting FOC is:

$$\frac{dE\left[u(\pi)\right]}{dq} = p^u\cdot u'\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)\cdot(1-\tau)+p^d\cdot u'\left(\pi^d\right)\cdot\left(r_A^d\cdot(1-\alpha\cdot\tau)-r_B\cdot(1-\tau)\right)=0. \tag{13}$$

In appendix A4, we show that changing the degree of loss offset leads to the following overall effect on the riskily invested amount q:

$$\frac{dq}{d\alpha} = -\frac{p^d\cdot\left(u'\left(\pi^d\right)\cdot\left(-\tau\cdot r_A^d\right)+u''\left(\pi^d\right)\cdot\left(r_A^d\cdot(1-\alpha\cdot\tau)-r_B\cdot(1-\tau)\right)\cdot\left(-\tau\cdot r_A^d\cdot q\right)\right)}{p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2\cdot(1-\tau)^2+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d\cdot(1-\alpha\cdot\tau)-r_B\cdot(1-\tau)\right)^2}. \tag{14}$$

As the first (second) derivative of the utility function is assumed to be positive (negative), the numerator is positive and the denominator is negative, and thus the whole term on the right hand side is positive:

$$\frac{dq}{d\alpha} > 0 \tag{15}$$

As a consequence, an increase of the loss offset provision leads to a higher willingness to take risk. Hence, we expect a higher riskily invested amount in the full loss offset than in the no loss offset treatment (irrespective of whether the risk-free alternative yields a positive return or not). This leads us to our second hypothesis:

Hypothesis 2: *Investment in the risky asset is higher when a linear income tax with a full loss offset is applied than when a linear income tax with no loss offset is applied.*

As mentioned above, a participant must make 20 decisions in each treatment. Because the influence of introducing an income tax on the willingness to take risk depends on whether the risk-free alternative yields a positive ($r_B > 0$) or no return ($r_B = 0$), we consider both cases with ten decision situations, respectively. In five of the ten decision situations, the gross rates of return are in both tax treatments identical to the respective rates of return in the no tax treatment. We call these situations the *gross value equivalence* decision situations. The investment behavior in these situations is used to analyze hypothesis 1 and 2 as well as the cases in which a clear hypothesis cannot be formulated. Table 1 provides an overview over all the examined cases in our study and identifies whether a clear hypothesis can be formulated.

In the other five decision situations, the gross rate of return in each tax treatment is adjusted in such a way that the net rate of return is identical to the respective rate of return in the no tax treatment. We call these decisions the *net value equivalence* decision situations. Because different experimental studies observe perception biases that contradict theoretical predictions (see section 2.2), we designed these decision situations to isolate such biases. This feature will enable us to separate Real Tax and Perception Effects. In all these decision situations, the net rates of return of both assets are identical in all three treatments and thus the same decision pattern is expected in all treatments when no perception bias occurs. This leads us to our hypothesis 3:

Hypothesis 3: *If the net payoffs are identical, investment in the risky and the risk-free asset is identical irrespective of whether a linear income tax (with or without a loss offset provision) is applied.*

To illustrate the procedure in the gross and net value equivalence decision situations, table 2 provides an example for a positive and negative rate of return for each case. In appendix A5, the (potential) gross and net rates of return of both assets are displayed for each treatment and each decision situation.

Within the five decision situations of one category, we vary the (gross) rates of return of both assets to achieve a sufficient high number of observations for our statistical analyses. In total, we need 20 decision situations in both tax treatments for our purpose. Table 3 illustrates the specification of the decision situations in these two treatments. Because the gross and net rates of return are, in fact, identical in the no tax treatment, only 10 decision situations (5 when $r_B = 0$ and 5 when $r_B > 0$) are required to test our hypotheses. However, to obtain the same number of decision situations in all three treatments, we created 20 decision situations in the no tax treatment as well. The results of the ten decision situations that are not relevant for our analyses are not reported.

Table 1: Hypotheses for gross value equivalence decision situations

	risk-free rate of return is zero ($r_B = 0$)		risk-free rate of return is greater than zero ($r_B > 0$)	
	theoretical prediction	hypothesis	theoretical prediction	hypothesis
an income tax with full loss offset is introduced (no tax vs. full loss offset treatment)	unambiguous prediction	**hypothesis 1** (investment level increases)	ambiguous prediction	**empirical question** (no hypothesis)
an income tax with no loss offset is introduced (no tax vs. no loss offset treatment)	ambiguous prediction	**empirical question** (no hypothesis)	ambiguous prediction	**empirical question** (no hypothesis)
degree of loss offset is increased (no vs. full loss offset treatment)	unambiguous prediction	**hypothesis 2** (investment level increases)	unambiguous prediction	**hypothesis 2** (investment level increases)

Table 2: Gross and net rates of return in the gross and net value equivalence decision situations (examples)

		no tax treatment		full loss offset treatment		no loss offset treatment	
		good state	bad state	good state	bad state	good state	bad state
gross value equivalence (*gross* rates of return in both tax treatments are identical to the rates of return in the no tax treatment)	**gross**	**40%**	**-24%**	**40%**	**-24%**	**40%**	**-24%**
	net			20%	-12%	20%	-24%
net value equivalence (*net* rates of return in both tax treatments are identical to the rates of return in the no tax treatment)	gross	**40%**	**-24%**	80%	-48%	80%	-24%
	net			**40%**	**-24%**	**40%**	**-24%**

Table 3: Specification of the decision situations in the tax treatments

	risk-free rate of return is zero ($r_B = 0$)	risk-free rate of return is above zero ($r_B > 0$)
gross value equivalence	5 decision situations	5 decision situations
net value equivalence	5 decision situations	5 decision situations

3.4 Isolating Real Tax Effects and Perception Effects

Our design allows us to separate Real Tax and Perception Effects. Whereas the first effect can be explained by our theoretical model, the second effect cannot be explained by a standard theoretical approach. For example, consider a decision made in the *gross* value equivalence decision situations in the no tax and in the full loss offset treatment, the difference between the amounts invested in the risky asset in both treatments provides both the Real Tax Effect and a potential Perception Effect which biases the investment decision. Formally, this can be described as follows:

$$q_{\text{gross value equivalence}}^{\text{full loss offset}} - q^{\text{no tax}} = RE + PE \tag{16}$$

where RE is the Real Tax Effect and PE the Perception Effect.[9] However, focusing only on the investment decisions in the gross value equivalence decision situations does not allow the effects to be separated. If we consider, on the other hand, an investment decision made in the *net* value equivalence decision situations, the difference in investment in the risky asset for both treatments gives the Perception Effect because the net rates of return are identical in both treatments (i.e., no Real Tax Effect occurs). This can be formally written as follows:

$$q_{\text{net value equivalence}}^{\text{full loss offset}} - q^{\text{no tax}} = PE. \tag{17}$$

Thus, to isolate the Real Tax Effect, equation (17) must be subtracted from equation (16):

$$\begin{aligned} & q_{\text{gross value equivalence}}^{\text{full loss offset}} - q^{\text{no tax}} = RE + PE \\ & -\left(q_{\text{net value equivalence}}^{\text{full loss offset}} - q^{\text{no tax}} = PE\right) \\ & \Leftrightarrow\ q_{\text{gross value equivalence}}^{\text{full loss offset}} - q_{\text{net value equivalence}}^{\text{full loss offset}} = RE. \end{aligned} \tag{18}$$

As a result, the term $q^{\text{no tax}}$ is canceled out and the Real Tax Effect that occurs when an income tax with a full loss offset is introduced is given by the difference between the amounts invested in the risky asset in the gross and net value equivalence decision situation of the full loss offset treatment. This approach enables us to isolate both Real Tax and Perception Effects in our experiment. Notice that the same approach and the same consequences apply for the difference between the no tax and the no loss offset treatment. The resulting separation of both effects is therefore given by the following:

$$q_{\text{net value equivalence}}^{\text{no loss offset}} - q^{\text{no tax}} = PE, \tag{19}$$

$$q_{\text{gross value equivalence}}^{\text{no loss offset}} - q_{\text{net value equivalence}}^{\text{no loss offset}} = RE. \tag{20}$$

[9] To separate these effects, we assume that both effects are additively separable.

The identification of both effects is somewhat different if we only focus on the tax treatments. Analogously to the procedure in equation (16) and (17), the resulting effects for these treatments are:

$$q_{\text{gross value equivalence}}^{\text{full loss offset}} - q_{\text{gross value equivalence}}^{\text{no loss offset}} = RE + PE, \tag{21}$$

$$q_{\text{net value equivalence}}^{\text{full loss offset}} - q_{\text{net value equivalence}}^{\text{no loss offset}} = PE. \tag{22}$$

The separation of the Real Tax Effect is then represented by the following:[10]

$$\begin{aligned} & q_{\text{gross value equivalence}}^{\text{full loss offset}} - q_{\text{gross value equivalence}}^{\text{no loss offset}} = RE + PE \\ & - \left(q_{\text{net value equivalence}}^{\text{full loss offset}} - q_{\text{net value equivalence}}^{\text{no loss offset}} = PE \right) \\ & \Leftrightarrow \left(q_{\text{gross value equivalence}}^{\text{full loss offset}} - q_{\text{net value equivalence}}^{\text{full loss offset}} \right) - \left(q_{\text{gross value equivalence}}^{\text{no loss offset}} - q_{\text{net value equivalence}}^{\text{no loss offset}} \right) = RE. \end{aligned} \tag{23}$$

3.5 Experimental Protocol

The experiment was conducted at the computerized experimental laboratory of the Leibniz University Hannover (LLEW) in April and May 2013. In total, 79 subjects (38 females and 41 males) participated and earned on average 15.30 Euros in approximately 100 minutes (approximately 9.20 Euros per hour). Participants were paid in cash immediately after the experiment. The experimental software was programmed with z-Tree (Fischbacher, 2007). The initial endowment in each decision situation is 1500 lab-points where one lab-point exactly corresponds to one Euro-cent. The price for one asset is 15 lab-points. Because an investor is not allowed to save her endowment, she buys 100 assets in each decision situation in total. To avoid order effects, the sequence of the 20 decision situations is randomized for each participant.

Although we use a very simple setting with a simple tax rate and simple tax rules, we provide several mechanisms to make sure subjects understand the decision environment. First, we include a detailed numerical example in the written instructions for both assets. Second, subjects must solve two numerical examples correctly to ensure comprehension. Third, participants receive a pocket calculator and a computerized “what-if”-calculator for their own

[10] Note that the Real Tax Effect that occurs between the tax treatments with full and no loss offset provision is given by the difference between (1) the Real Tax Effect that occurs between the no tax and the full loss offset treatment (see equation (18)) and (2) the Real Tax Effect that occurs between the no tax and the no loss offset treatment (see equation (20)).

calculations. The latter allows subjects to calculate the tax, net return and resulting payoff at different investment levels automatically.

To avoid income effects and strategies to hedge the risk across all decision situations, only one of the 20 decision situations determines pay. At the end of the experiment, each participant is asked to draw a number randomly that ranges from 1 to 20 to determine the payoff relevant decision situation. Hereafter, the participant has to cast a six-sided die to determine the relevant state of nature. If the numbers 1, 2, or 3 occur, the state of nature is good. Otherwise, the state is bad. Dependent on the chosen quantities of asset A and B in the selected decision situation, the participant's payoff is calculated and paid out.

4 Results

For our statistical analyses, we use the share of endowment invested in the risky asset A as our dependent variable. The amount invested in the risk-free asset B is the residual share. Table 4 presents the mean, median, standard deviation (SD), and number of observations of the dependent variable by treatment, gross and net value equivalence decision situations as well as by the cases with a zero and a positive rate of return of the risk-free asset B. Table 5 provides the *p*-values of Mann-Whitney U tests (two-sided) to analyze our treatment differences statistically. Figure 1 depicts the mean share of endowment invested in the risky asset A for each treatment.

In the *gross value equivalence* decision situations, we observe lower levels of investment in the risky asset in both tax treatments than in the no tax treatment irrespective of whether the rate of return of asset B is zero or positive. All differences are statistically significant (at least) at a 1%-level. Because the opposite result was hypothesized for the full loss offset treatment for a zero risk-free rate of return, hypothesis 1 must be rejected. Comparing both tax treatments, we observe a higher investment level in the full than in the no loss offset treatment ($p = 0.019$ for $r_B = 0$ and $p < 0.001$ for $r_B > 0$). This result provides support for hypothesis 2.

Although the net rates of return of both assets in all treatments are identical in our *net value equivalence* decision situations and, therefore, we expect the same decision pattern in all three treatments in these situations (hypothesis 3), we observe highly significant differences. In particular, we find that the share invested in the risky asset decreases sufficiently when an income tax is introduced. In the full loss offset treatment with a zero rate of return of asset B, for example, we observe that the invested share is approximately 36.3% lower than in the no tax treatment (decrease from 44.01 to 28.04). The differences between the no tax and both tax treatments are significant at a 1%-level. Comparing both tax treatments, we observe a higher willingness to take risk in the treatment without a loss offset provision. The differences between both tax treatments are significant at least at a 5%-level. Overall, these findings reject our hypothesis 3 and demonstrate that Perception Effects exist which bias the investment decisions of the subjects. The only exemption occurs in the no loss offset treatment compared to the no tax treatment when the rate of return of asset B is zero. The decision behavior is here almost identical to the behavior in the no tax treatment and no statistically significant difference is observed. Thus, no Perception Effect exists and our third hypothesis is supported in this case.

Because it must be assumed that the Perception Effect also occurs in the gross value equivalence decision situations, our previous findings should be interpreted with caution. In these decision situations, both the Perception and the Real Tax Effect arise simultaneously. Because the Perception Effect reduces the level of investment in both tax treatments compared to the no tax treatment, the Real Tax Effect of introducing an income tax in the cases with no loss offset provision would be overestimated and the Real Tax Effect of introducing an income tax in the cases with a full loss offset provision would be underestimated if we focus only on these decision situations. With respect to the differences between the two tax treatments, we would underestimate the Real Tax Effect of a full loss offset provision because the Perception Effect reduces investment in the full loss offset case much more than in the no loss offset case.

As theoretically demonstrated in section 3.4, it is possible to separate the Perception and the Real Tax Effect. Figure 2 (3) illustrates the Perception and the Real Tax Effect for the case of a positive rate of return of asset B in the full (no) loss offset treatment. According to section 3.4, the difference between the no tax treatment and one of both tax treatments in case of the net value equivalence decision situations denotes the Perception Effect. In case of the gross value equivalence decision situations, this difference is a mixture of the Perception and the Real Tax Effect. To determine the Real Tax Effect, the difference between the gross and net value equivalence decision situations within a tax treatment must be calculated. In table 6, the resulting Real Tax Effects are presented. Now, we observe an increase of the investment level in the case of a full loss offset provision compared to the no tax setting independently of the risk-free rate of return. Thus, if we control for the Perception Effect, we are able to confirm hypothesis 1. In the no loss offset treatment, the willingness to invest in the risky asset is lower than in the no tax treatment. This confirms our previous findings.

To test the Real Tax Effect statistically, we conduct non-parametric tests. First, we compare the no tax treatment with each of the two tax treatments. According to section 3.4, the Real Tax Effect is the difference in investment in the gross and net value equivalence decision situations. Because one individual decides both in the gross and net value equivalence decision situations, we use the Wilcoxon signed-rank test (two-tailed) for dependent samples to test whether the decision in the gross is different to the decision in the net value equivalence decision situation (i.e., that the Real Tax Effect is different from zero). In the no loss offset treatment, the Real Tax Effect is significantly different from zero ($p < 0.001$) in both cases ($r_B = 0$ and $r_B > 0$). In the full loss offset treatment, the Real Tax Effect is significant at a 5%-level in case of a positive rate of return of asset B ($p = 0.029$). However, in the case with a zero rate of return the Real Tax Effect is not statistically significant ($p = 0.211$).

Second, we compare the full and the no loss offset treatment with each other. In this case, the Real Tax Effect is computed in accordance with equation (23) and the corresponding values are reported in table 6. As a result, the previous finding that an income tax with a full loss offset leads to a higher willingness to take risk than an income tax without a loss offset is also observed if we control for the Perception Effect. For our statistical analysis, we utilize the Mann-Whitney U test (two-tailed) for independent samples as the decisions in the full loss offset treatment are independent of the decisions in the no loss offset treatment because of our between-subject design. In particular, we test whether the difference between the change in investment levels between the gross and net value equivalence decision situations in the full loss offset treatment and this change in the no loss offset treatment differs significantly from zero. We observe that the Real Tax Effect is highly significant (p < 0.001) irrespective of whether the risk-free asset yields a zero or positive return.

Table 4: Share of endowment invested in the risky asset A (in percent)

treatment	statistic	gross value equivalence decision situations		net value equivalence decision situations	
		$r_B = 0$	$r_B > 0$	$r_B = 0$	$r_B > 0$
no tax (# of subjects: 27)	mean	44.01	56.24	44.01	56.24
	median	40	60	40	60
	SD	33.13	31.98	33.13	31.98
	# of observations	135	135	135	135
full loss offset (# of subjects: 26)	mean	32.22	45.73	28.04	40.38
	median	25	40	20	33
	SD	31.84	27.69	27.56	27.35
	# of observations	130	130	130	130
no loss offset (# of subjects: 26)	mean	22.69	28.83	43.98	46.27
	median	12.5	20.5	40	42
	SD	26.21	23.51	30.77	26.24
	# of observations	130	130	130	130

Table 5: Statistical Analyses (Mann-Whitney U test, two-sided)

comparison	gross value equivalence decision situations		net value equivalence decision situations	
	$r_B = 0$	$r_B > 0$	$r_B = 0$	$r_B > 0$
no tax vs. full loss offset	$p = 0.003$	$p = 0.004$	$p < 0.001$	$p < 0.001$
no tax vs. no loss offset	$p < 0.001$	$p < 0.001$	$p = 0.935$	$p = 0.005$
full vs. no loss offset	$p = 0.019$	$p < 0.001$	$p < 0.001$	$p = 0.034$

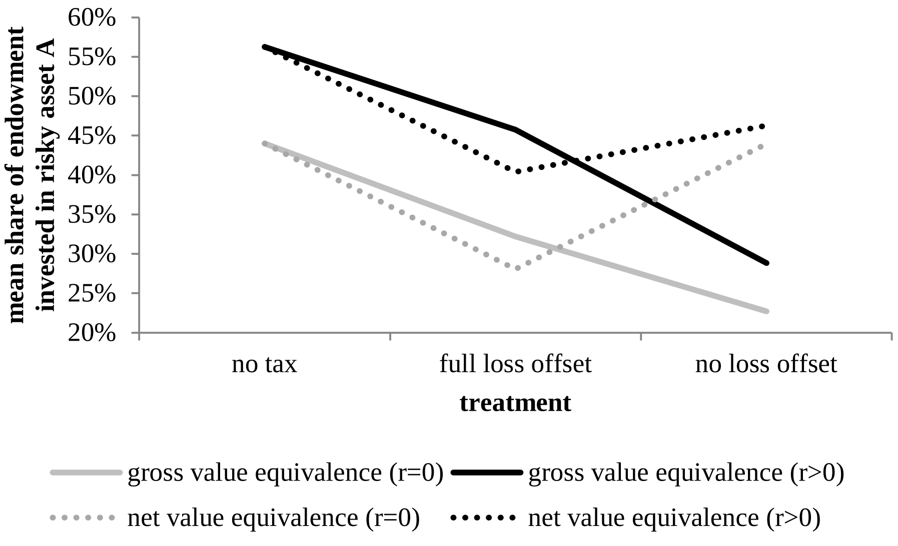

Figure 1: Mean share of endowment invested in the risky asset A (in percent)

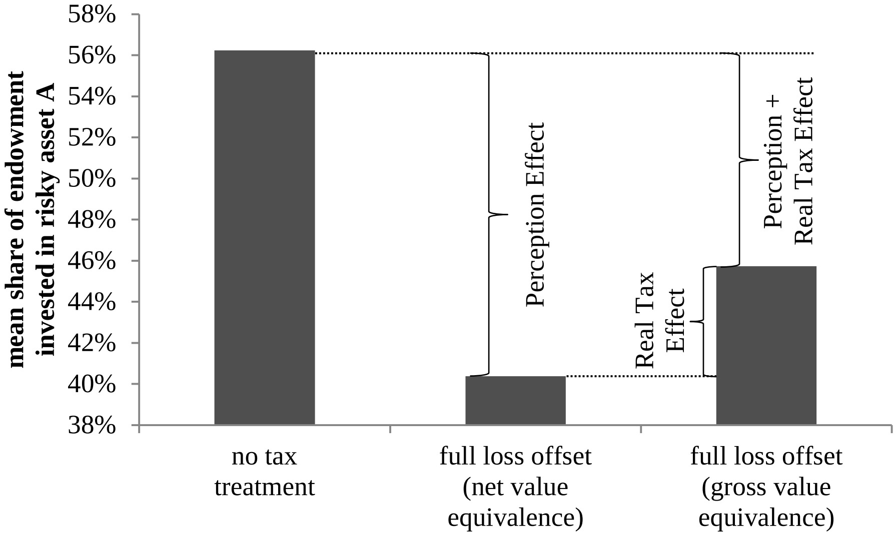

Figure 2: Perception and Real Tax Effect – no tax vs. full loss offset treatment ($r_B > 0$)

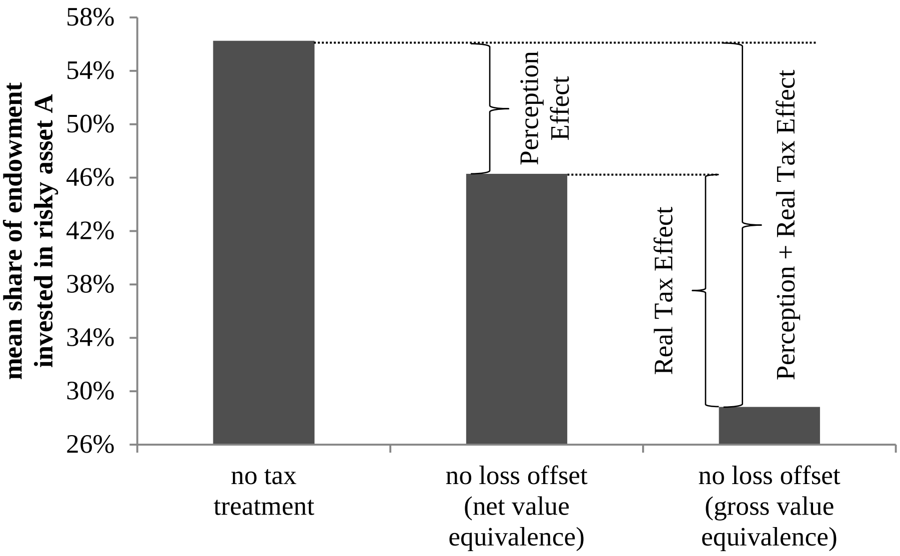

Figure 3: Perception and Real Tax Effect – no tax vs. no loss offset treatment ($r_B > 0$)

Table 6: Perception and Real Tax Effect (as share of endowment)

comparison	full loss offset vs. no tax treatment		no loss offset vs. no tax treatment		full vs. no loss offset treatment	
	$r_B = 0$	$r_B > 0$	$r_B = 0$	$r_B > 0$	$r_B = 0$	$r_B > 0$
Perception Effect	-15.97	-15.86	-0.03	-9.97	-15.94	-5.89
Perception + Real Tax Effect	-11.80	-10.51	-21.32	-27.41	+9.53	+16.90
Real Tax Effect	+4.17	+5.35	-21.29	-17.44	+25.47	+22.79

In addition to the non-parametric tests, we ran regressions with the share of endowment invested in the risky asset A as the dependent variable. Because the variable is between 0 and 100% and, thus, we have left- and right-censored observations, we use Tobit regressions in the following analysis. First, we analyze how the risk taking behavior is affected by our treatment variations, but without controlling for the Perception Effect. In particular, we are interested in how the willingness to take risk is influenced by an income tax with and without a full loss offset provision in our gross value equivalence decision situations. To test this influence, we regress on treatment dummy variables. The dummy variable full (no) loss offset takes the value 1 if a subject participated in the full (no) loss offset treatment and 0 otherwise. The coefficient of this dummy measures the influence of the respective tax treatment compared to the reference group. In models 1 to 4, the no tax treatment is the default and, therefore, the coefficient of each dummy variable measures the difference between the no tax treatment and the respective tax treatment. In models 5 and 6, the full loss offset treatment serves as the default and, therefore, the coefficient of the no loss offset dummy variable measures the difference between the full and no loss offset treatment. In models 1, 3, and 5, we include only these dummy variables.

To control for individual characteristics, we ran three more regressions (models 2, 4, and 6). Here we also include the following variables: age, gender (female = 1, male = 0), economics major (1 if the subject studies economics or management, 0 otherwise), degree (1 if the subject studies in a bachelor's degree program, 0 otherwise), number of semesters, investment behavior (measures whether a subject regularly invests capital in investment assets, 1 = never, 2 = occasionally, 3 = regularly), risk attitude (gives subject's self-reported willingness to take risk, measured on an 11-point scale where 0 = not willing to take risk and 10 = highly willing to take risk), income (monthly income after fixed cost) and the rate of return of asset B (rate of return is positive = 1, rate of return is zero = 0). The results of all six models are displayed in table 7 (robust standard errors in parentheses clustered at the subject level).

Consistent with our previous results, we observe that the coefficients of the treatment dummy variables are all negative in all models. However, the influence is not significant in models 1 and 2, which indicates that introducing an income tax with a full loss offset provision does not lead to a significant change of the investment behavior. Because we expected greater willingness to take risk in the full loss offset treatment compared to the no tax treatment, hypothesis 1 must be rejected when we do not control for the Perception Effect. In contrast, hypothesis 2 is confirmed because we expected a lower degree of loss offset provision effects a lower willingness to take risk (models 5 and 6). Overall, our previous findings are supported. For the individual characteristics, we observe that only risk attitude and rate of return of asset B significantly affect the willingness to take risk in all three models. In particular, risk attitude has a positive influence indicating that subjects who state that they are more willing to take risk invested a higher share of their endowment in the risky asset. The coefficient of the dummy variable rate of return of asset B is positive and, therefore, supports the graphical result observed in figure 1 that the investment level is higher when the rate of return of asset B is greater than zero.

Second, we ran Tobit regressions (with the share of endowment invested in the risky asset A as the dependent variable) to analyze the Real Tax Effects, i.e., with controlling for the Perception Effects. To test the Real Tax Effect between treatments, we utilize the approach presented in section 3.4. To assess the difference between the no tax and the full loss offset treatment as well as between the no tax and the no loss offset treatment, we regress on a dummy variable (Real Tax Effect) which takes the value 1 if the decision was made in a gross value equivalence decision situation and 0 if the decision was made in a net value equivalence decision situation. The coefficient of this dummy variable measures the difference between the gross and net value equivalence decision situations within a tax treatment and, therefore, the Real Tax Effect (as share of endowment) in this treatment. This is consistent with equation (18) for the full loss offset case and with equation (20) for the no loss offset case. In models 7 and 9, we include only this dummy variable.

To analyze the Real Tax Effect that occurs between the full and the no loss offset treatment, the procedure is somewhat different. Consistent with equation (23), we first calculated the differences between the amounts invested riskily in the gross and net value equivalence decision situations within a tax treatment for each subject. Second, we regress on a dummy variable (Real Tax Effect) which takes the value 1 if the decision was made in the no loss offset treatment and 0 if the decision was made in the full loss offset treatment. The coefficient of this dummy then measures the Real Tax Effect that occurs between both tax treatments. In model 11, we include only this dummy variable. To control for individual characteristics, the same variables are used in models 8, 10, and 12 as in table 7. The results are displayed in table 8 (robust standard errors in parentheses clustered at the subject level).

Comparing the no tax and the full loss offset treatment, the coefficient of the Real Tax Effect dummy is positive and significant at a 10%-level in both models 7 and 8. Thus, if we control for the Perception Effect, hypothesis 1 is supported. In addition, the dummy variable rate of return of asset B is positive and significant at a 1%-level. No further variable indicates a significant influence on the investment level. Comparing the no tax and the no loss offset treatment, the Real Tax Effect dummy is negative and significant at a 1%-level in both models 9 and 10. The variable rate of return of asset B is positive, again, but only significant at a 10%-level. In contrast to the full loss offset treatment, the variable risk is now significant at a 1%-level. Comparing the no and the full loss offset treatment, the coefficient of the Real Tax Effect dummy is negative and significant at a 1%-level in both models 11 and 12. Thus, even if we control for the Perception Effect, we observe that a lower degree of loss offset leads to a lower willingness to take risk. This supports hypothesis 2. Overall, our previous descriptive and non-parametric analyses are confirmed.

Table 7: Tobit regressions – without controlling for the Perception Effect

	no tax vs. full loss offset		no tax vs. no loss offset		full vs. no loss offset	
	model 1	model 2	model 3	model 4	model 5	model 6
full loss offset	-0.1207	-0.1022				
	(0.0822)	(0.0807)				
no loss offset			-0.2934***	-0.2479***	-0.1694**	-0.1391**
			(0.0798)	(0.0853)	(0.0753)	(0.0707)
age		0.0283*		0.0223		-0.0029
		(0.0149)		(0.0180)		(0.0148)
gender		0.0571		0.1040		0.1073
(female = 1)		(0.1076)		(0.0835)		(0.0701)
econ major		0.1391		-0.0659		-0.0071
(major in economics = 1)		(0.0978)		(0.1105)		(0.0901)
degree		-0.0258		0.0063		-0.1038*
(bachelor = 1)		(0.0845)		(0.0898)		(0.0569)
no. of semesters		-0.0324***		-0.0115		-0.0128
		(0.0116)		(0.0118)		(0.0110)
investment behavior		-0.1096		-0.0232		0.1025
		(0.0751)		(0.0631)		(0.0707)
risk attitude		0.0577**		0.0333*		0.0668***
		(0.0235)		(0.0179)		(0.0180)
income		-0.0001		0.0001		-0.0000
		(0.0003)		(0.0003)		(0.0003)
rate of return of asset B		0.1971***		0.1560***		0.1468***
(positive = 1)		(0.0433)		(0.0415)		(0.0338)
constant	0.4893***	-0.2274	0.4895***	-0.2129	0.3726***	0.0776
	(0.0596)	(0.4221)	(0.0581)	(0.4252)	(0.0533)	(0.3142)
no. of observations	530	510	530	510	520	520
no. of subjects	53	51	53	51	52	52
model's *p*-value	0.1425	< 0.0001	0.0003	< 0.0001	0.0249	< 0.0001
Pseudo *R*-squared	0.0140	0.1651	0.0900	0.1698	0.0463	0.2071

Note: *** p < 0.01, ** p < 0.05, * p < 0.1

Table 8: Tobit regressions – controlling for the Perception Effect

	no tax vs. full loss offset		no tax vs. no loss offset		full vs. no loss offset	
	model 7	model 8	model 9	model 10	model 11	model 12
Real Tax Effect	0.0564*	0.0561*	-0.2410***	-0.2394***	-0.2470***	-0.2603***
	(0.0320)	(0.0324)	(0.0575)	(0.0563)	(0.0490)	(0.0582)
age		0.0093		-0.0116		0.0022
		(0.0161)		(0.0219)		(0.0076)
gender		0.0211		0.0845		0.0659
(female = 1)		(0.1984)		(0.0593)		(0.0454)
econ major		0.1245		-0.0716		-0.0208
(major in economics = 1)		(0.1561)		(0.0965)		(0.0590)
degree		-0.1373		-0.0170		-0.0288
(bachelor = 1)		(0.0874)		(0.0777)		(0.0446)
no. of semesters		-0.0136		-0.0042		-0.0109
		(0.0136)		(0.0120)		(0.0078)
investment behavior		-0.0309		0.0738		0.0770
		(0.1660)		(0.0591)		(0.0498)
risk attitude		0.0518		0.0544***		-0.0002
		(0.0493)		(0.0171)		(0.0123)
income		-0.0001		0.0001		0.0000
		(0.0003)		(0.0002)		(0.0002)
rate of return of asset B		0.1797***		0.0674*		0.0259
(positive = 1)		(0.0471)		(0.0390)		(0.0283)
constant	0.3152***	0.0131	0.4503***	0.3853	0.0480*	-0.0646
	(0.0482)	(0.5833)	(0.0423)	(0.4268)	(0.0269)	(0.1888)
observations	520	520	520	520	520	520
no. of subjects	26	26	26	26	52	52
model's *p*-value	0.0785	0.0004	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Pseudo *R*-squared	0.0047	0.2010	0.1238	0.2862	0.1681	0.2047

Note: *** p < 0.01, ** p < 0.05, * p < 0.1

5 Summary, Discussion, and Implications

Initiated by the seminal paper of Domar and Musgrave (1944), the influence of an income tax on risky investment decisions is an important question that is analyzed both theoretically and empirically. One primary finding of this strand of literature is that the effect of a proportional income tax on the composition of an asset portfolio depends on how losses are treated. To test the theoretical predictions, we conduct a controlled laboratory experiment and hypothesize that an income tax with a full loss offset provision leads an investor to invest more in the risky asset than without an income tax when the risk-free asset yields no return (hypothesis 1). If the risk-free asset has a positive rate of return or if no loss offset is provided, the effect of the introduction of an income tax is ambiguous and therefore an empirical question. In our experiment, we observe that the willingness to invest in the risky asset decreases markedly when the income is subject to a tax. This result holds irrespective of whether a full loss offset or no loss offset is provided or whether the risk-free asset yields no or a positive return. From this perspective, our first hypothesis must be rejected. In addition to the influence of the introduction of an income tax, we examine how the degree of loss offset affects the willingness to take risk. We hypothesize (hypothesis 2) and observe a higher riskily invested amount in the full loss offset than in the no loss offset treatment (irrespective of whether the risk-free alternative yields no or a positive return).

To analyze why we observe the non-hypothesized behavior when a full loss offset is provided, we adjusted the gross rate of return in each tax treatment in such a way that the net rate of return is identical to the respective rate of return in the tax-free reference treatment (net value equivalence decision situations). Thus, the same decision pattern is expected in all three treatments in these situations (hypothesis 3). Compared to the no tax treatment, however, we observe a significant decrease of the willingness to invest in the risky asset when an income tax with or without loss offset provision is introduced. Therefore, hypothesis 3 must be rejected. We call this unexpected effect Perception Effect. This effect is consistent with the finding of Ackermann et al. (2013).[11] They observe that the willingness to invest in a risky asset decreases significantly when a tax must be paid or when a subsidy is received even when after tax income is identical. However, they also find that reducing the complexity of the choice environment mitigates this perception bias. This finding could possibly explain why we do not observe the Perception Effect in the no loss offset treatment in the case when the rate of return of the risk-free asset B is zero. In this case, the environment complexity is—compared to all other constellations—lowest, because asset B *and* the potential loss of asset A are, in fact, not subject to the income tax.

In the light of the Perception Effect, the previous findings regarding hypothesis 1 and 2 must be interpreted with caution. Because the Perception Effect reduces investment in both tax treatments compared to the no tax treatment, we would, therefore, overestimate the Real Tax Effect of introducing an income tax in cases with no loss offset provision and we would underestimate the Real Tax Effect in cases with a full loss offset provision. With respect to the differences between the two tax treatments, we would underestimate the Real Tax Effect of a full loss offset provision because the Perception Effect reduces the investment level in the full loss offset case much more than in the no loss offset case. If we control for the Perception Effect, we actually find that individuals invest more in the risky asset when a full loss offset is provided and less when no loss offset is provided compared to the setting without an income

[11] Our Perception Effect is, however, in contrast to the results of Fochmann et al. (2012a, b). In both studies, the authors observe that the willingness to take risk increases when a loss offset is provided even though the net income is kept constant in all their treatments.

tax. Thus, if the Perception Effect is considered, we find support for the theoretical prediction. Furthermore, while controlling for the perception effect we can demonstrate that the positive effect of a higher degree of loss offset on the willingness to invest riskily is much higher than without controlling.

Our findings produce both scientific and political implications. First, the effect of introducing an income tax is not always unambiguous and, therefore, an empirical question. If a full loss offset is provided and the risk-free asset has a positive rate of return or if no loss offset is provided, there is a lack of theoretical predictions. Therefore, our experimental study provides an answer to this question. In the case with a full loss offset provision and a positive rate of return of the risk-free asset, we observe a higher willingness to invest in the risky asset when an income tax is introduced if we control for the Perception Effect. As presented in section 2.1, this result must be expected under plausible assumptions regarding the investor's utility function. In the case with no loss offset provision, we find that subjects reduce the riskily invested amount irrespective of whether we do control or do not control for the Perception Effect. Up to now, there are only some papers analyzing the influence of an incomplete loss offset on the demand for risky investments. However, there is evidence consistent with our finding that an imposition of a proportional tax without loss offset leads to a decrease of risky investments especially when the tax rate is sufficiently high (see section 2.1).

Second, our Perception Effect can possibly explain why Swenson (1989) and King and Wallin (1990) find no significant increase of risky investments under a proportional income tax. Interestingly, King and Wallin (1990) observe an unexpected decrease in risky investments in their first and partially in their second (NP group) experiment as in our study. Although their setting does not allow for explicit control of perception biases, our isolated Perception Effect may explain the considerable difference between the expected and observed investment behavior. Therefore, future empirical and experimental work should note that investment decisions can be heavily biased due to our Perception Effect and should control for it. Furthermore, theoretical predictions can be improved if behavioral aspects such as our Perception Effect are considered in investment models. Combined with the strong results observed by Ackermann et al. (2013), the Perception Effect appears very robust, and theorists should take into consideration that the complexity of an environment negatively affects the willingness to take risk.

Third, politicians should be aware that governmental interventions could bias risk taking behavior even more than theory predicts. Especially, if the complexity of the environment in which the intervention takes place is very high, interventions can produce extremely negative consequences. Nevertheless, if the government is able to reduce environmental complexity, these consequences can be mitigated. Thus, one task of the government could be to diminish complexity to reduce such investment biases.

Appendix

A1 Instructions (Originally Written in German)

Instructions for All of the Three Treatments

By participating in this experiment, you will have the opportunity to earn money. The payment at the end of the experiment depends on your decisions during the experiment and on chance. To simplify calculations, Euro-amounts are not utilized during the experiment, but we utilize lab-points. Thereby, 1 lab-point exactly corresponds to 1 Euro-cent. That means, 100 lab-points exactly correspond to 1 Euro.

Note that during the entire experiment you are not allowed to communicate with other participants or to leave your seat. Please read the instructions thoroughly and attentively. If you have questions, please raise your hand. We will then come to you to answer your questions. When all participants have understood the instructions, the experiment will begin. *The experiment consists in total of 20 decision situations that are independent of each other*.

1. Your Task during the Experiment

At the beginning of each decision situation, you receive an initial endowment of 1500 lab-points that you need to invest in assets. As investment opportunities there are two asset-types available: type A and type B. The price to buy one asset is the same for both types and amounts to 15 lab-points. Because your initial endowment is 1500 lab-points, you can buy in total 100 assets of type A and B in each decision situation.

In each decision situation, you should determine how many assets you want to buy from type A and B. To do this, you simply determine the number of assets of type A. The remaining capital, which is still available from your initial endowment, is automatically invested in assets of type B.

Example: *If you decide to buy, for example, 70 assets of type A, then you have spent 1050 lab-points (= 70 · 15 lab-points per asset). The remaining 450 lab-points (= 1500 lab-points – 1050 lab-points) are automatically invested in assets of type B. Then, you will receive 30 assets of type B (= 450 lab-points / 15 lab-points per asset).*

Specific Instructions for the No Tax Treatment

2. Rate of Return per Asset-Type

Rate of Return of Type A

The rate of return of each asset A depends on which state of nature occurs. In total, two states are possible: good and bad. The rate of return is positive in the good state (thus greater than 0), the rate of return is negative in the bad state (thus less than 0). Both states of nature occur with the same probability of 50%. You do not know which state occurs before making your decision.

The possible rate of returns of type A may be different from decision situation to decision situation and are provided to you prior to each decision.

Rate of Return of Type B

In contrast to type A, the rate of return of each asset B is the same in each state of nature. The rate of return of asset B is at least 0. This means that the rate of return can be greater than 0 but also equal to 0. A negative rate of return is not possible with type B.

The rate of return of type B may be different from decision situation to decision situation and is provided to you prior to each decision.

3. Calculation of the Payoff per Asset-Type

Return per Asset-Type

Depending on the amount invested in assets of type A and B, and on the rate of return of type A and B, the "return" results for each of both asset-types. This is calculated as follows:

$$\begin{aligned} & \text{Amount Invested} \cdot \text{Rate of Return} \\ = \; & \text{Return} \end{aligned}$$

Example: *In the following example, it is assumed that you bought 70 assets of type A and 30 assets of type B. The rate of return of type A is 60% in the good state of nature and -20% in the bad state of nature. The rate of return of type B is 20%.*

Calculation of Return of Asset A:

	good state	bad state
number of assets of type A	70	70
amount invested in type A	1050	1050
rate of return of type A	60%	-20%
calculation of return of asset A		
amount invested in type A · rate of return of type A	1050 · 0.60	1050 · (-0.20)
= **return of asset A**	**630**	**-210**

Calculation of Return of Asset B:

	good state	bad state
number of assets of type B	30	30
amount invested in type B	450	450
rate of return of type B	20%	20%
calculation of return of asset B		
amount invested in type B · rate of return of type B	450 · 0.20	450 · 0.20
= **return of asset B**	**90**	**90**

Please note: The rate of return of type B may also be 0 in the experiment. In this case, the return is also 0.

Payoff per Asset-Type

For each of both asset-types the payoff results as follows:

Amount Invested
\+ Return
= Payoff

Referring to the example:

Calculation of Payoff from Asset A:

	good state	bad state
amount invested in type A	1050	1050
+ return of type A	630	-210
= **payoff from asset A**	**1680**	**840**

Calculation of Payoff from Asset B:

		good state	bad state
	amount invested in type B	450	450
+	return of type B	90	90
=	**payoff from asset B**	**540**	**540**

4. Total Payoff from Type A and B

Your total payoff from a decision situation is the sum of “payoff from type A” and “payoff from type B”. Based on the above examples the following total payoffs result—depending on the particular state of nature:

	good state	bad state
payoff from type A	1680	840
payoff from type B	540	540
total payoff from type A and B	**2220**	**1380**

Specific Instructions for the Full Loss Offset Treatment

2. Gross Rate of Return per Asset-Type

Gross Rate of Return of Type A

The gross rate of return of each asset A depends on which state of nature occurs. In total, two states are possible: good and bad. The gross rate of return is positive in the good state (thus greater than 0), the gross rate of return is negative in the bad state (thus less than 0). Both states of nature occur with the same probability of 50%. You do not know which state occurs before making your decision.

The possible gross rate of returns of type A may be different from decision situation to decision situation and are provided to you prior to each decision.

Gross Rate of Return of Type B

In contrast to type A, the gross rate of return of each asset B is the same in each state of nature. The gross rate of return of asset B is at least 0. This means that the gross rate of return can be greater than 0, but also equal to 0. A negative gross rate of return is not possible with type B.

The gross rate of return of type B may be different from decision situation to decision situation and is provided to you prior to each decision.

3. Calculation of the Payoff per Asset-Type

Gross Return per Asset-Type

Depending on the amount invested in assets of type A and B, and on the gross rate of return of type A and B, the "gross return" results for each of both asset-types. This is calculated as follows:

Amount Invested · Gross Rate of Return
= Gross Return

Example: *In the following example, it is assumed that you bought 70 assets of type A and 30 assets of type B. The gross rate of return of type A is 60% in the good state of nature and -20% in the bad state of nature. The gross rate of return of type B is 20%.*

Calculation of Gross Return of Asset A:

	good state	**bad state**
number of assets of type A	70	70
amount invested in type A	1050	1050
gross rate of return of type A	60%	-20%
calculation of gross return of asset A		
amount invested in type A · gross rate of return of type A	1050 · 0.60	1050 · (-0.20)
= **gross return of asset A**	**630**	**-210**

Calculation of Gross Return of Asset B:

	good state	**bad state**
number of assets of type B	30	30
amount invested in type B	450	450
gross rate of return of type B	20%	20%
calculation of gross return of asset B		
amount invested in type B · gross rate of return of type B	450 · 0.20	450 · 0.20
= **gross return of asset B**	**90**	**90**

Please note: The gross rate of return of type B may also be 0 in the experiment. In this case, the gross return is also 0.

Net Return per Asset-Type

For both types a tax is levied. The tax is 50% of the gross return. Then the net return results for each of the two asset-types as follows:

	Gross Return
–	Tax
=	Net Return

Please note: The tax is levied in the case of a positive gross return as well as in the case of a negative gross return. However the effect of the tax differs in both cases: For a positive gross return you have to pay taxes. For a negative gross return you get a tax refund.

Referring to the example:

Calculation of Net Return of Asset A:

		good state	**bad state**
	gross return of type A	630	-210
–	tax (= 50% of the gross return)	630 · 0.50 = 315	-210 · 0.50 = -105
=	**net return of asset A**	**630 – 315** **= 315**	**-210 – (-105)** **= -105**

Calculation of Net Return of Asset B:

		good state	**bad state**
	gross return of type B	90	90
–	tax (= 50% of the gross return)	90 · 0.50 = 45	90 · 0.50 = 45
=	**net return of asset B**	**90 – 45** **= 45**	**90 – 45** **= 45**

Please note: For a positive gross return, the net return is less than the gross return, because a tax hast to be paid. For a negative gross return, however, the net return is greater than the gross return, because of the tax refund, i.e., losses are reduced by the tax.

Payoff per Asset-Type

For each of both asset-types the payoff results as follows:

	Amount Invested
+	Net Return
=	Payoff

Referring to the example:

Calculation of Payoff from Asset A:

		good state	bad state
	amount invested in type A	1050	1050
+	net return of type A	315	-105
=	**payoff from asset A**	**1365**	**945**

Calculation of Payoff from Asset B:

		good state	bad state
	amount invested in type B	450	450
+	net return of type B	45	45
=	**payoff from asset B**	**495**	**495**

4. Total Payoff from Type A and B

Your total payoff from a decision situation is the sum of "payoff from type A" and "payoff from type B". Based on the above examples the following total payoffs result—depending on the particular state of nature:

	good state	bad state
payoff from type A	1365	945
payoff from type B	495	495
total payoff from type A and B	**1860**	**1440**

Specific Instructions for the No Loss Offset Treatment

2. Gross Rate of Return per Asset-Type

Gross Rate of Return of Type A

The gross rate of return of each asset A depends on which state of nature occurs. In total, two states are possible: good and bad. The gross rate of return is positive in the good state (thus greater than 0), the gross rate of return is negative in the bad state (thus less than 0). Both states of nature occur with the same probability of 50%. You do not know which state occurs before making your decision.

The possible gross rate of returns of type A may be different from decision situation to decision situation and are provided to you prior to each decision.

Gross Rate of Return of Type B

In contrast to type A, the gross rate of return of each asset B is the same in each state of nature. The gross rate of return of asset B is at least 0. This means that the gross rate of return can be greater than 0, but also equal to 0. A negative gross rate of return is not possible with type B.

The gross rate of return of type B may be different from decision situation to decision situation and is provided to you prior to each decision.

3. Calculation of the Payoff per Asset-Type

Gross Return per Asset-Type

Depending on the amount invested in assets of type A and B, and on the gross rate of return of type A and B, the "gross return" results for each of both asset-types. This is calculated as follows:

Amount Invested · Gross Rate of Return
= Gross Return

Example: *In the following example, it is assumed that you bought 70 assets of type A and 30 assets of type B. The gross rate of return of type A is 60% in the good state of nature and -20% in the bad state of nature. The gross rate of return of type B is 20%.*

Calculation of Gross Return of Asset A:

	good state	**bad state**
number of assets of type A	70	70
amount invested in type A	1050	1050
gross rate of return of type A	60%	-20%
calculation of gross return of asset A		
amount invested in type A · gross rate of return of type A	1050 · 0.60	1050 · (-0.20)
= **gross return of asset A**	**630**	**-210**

Calculation of Gross Return of Asset B:

	good state	bad state
number of assets of type B	30	30
amount invested in type B	450	450
gross rate of return of type B	20%	20%
calculation of gross return of asset B		
amount invested in type B · gross rate of return of type B	450 · 0.20	450 · 0.20
= **gross return of asset B**	**90**	**90**

Please note: The gross rate of return of type B may also be 0 in the experiment. In this case, the gross return is also 0.

Net Return per Asset-Type

In the case of a positive gross return, for both types a tax is levied. If this is the case, then the tax is 50% of the gross return. Then the net return results for each of the two asset-types as follows:

Gross Return
– Tax
= Net Return

Please note: In the case of a negative gross return, no tax is levied. In this case the net return and the gross return are the same.

Referring to the example:

Calculation of Net Return of Asset A:

		good state	bad state
	gross return of type A	630	-210
–	tax (= 50% of the gross return)	630 · 0.50 = 315	---
=	**net return of asset A**	**630 – 315 = 315**	**-210**

Calculation of Net Return of Asset B:

		good state	bad state
	gross return of type B	90	90
–	tax (= 50% of the gross return)	$90 \cdot 0.50$ = 45	$90 \cdot 0.50$ = 45
=	**net return of asset B**	**90 – 45** **= 45**	**90 – 45** **= 45**

Please note: For a positive gross return, the net return is less than the gross return, because a tax hast to be paid. For a negative gross return however the tax does not lead to a change. In this case the net return and the gross return are the same.

Payoff per Asset-Type

For each of both asset-types the payoff results as follows:

Amount Invested
\+ Net Return
= Payoff

Referring to the example:

Calculation of Payoff from Asset A:

		good state	bad state
	amount invested in type A	1050	1050
+	net return of type A	315	-210
=	**payoff from asset A**	**1365**	**840**

Calculation of Payoff from Asset B:

		good state	bad state
	amount invested in type B	450	450
+	net return of type B	45	45
=	**payoff from asset B**	**495**	**495**

4. Total Payoff from Type A and B

Your total payoff from a decision situation is the sum of "payoff from type A" and "payoff from type B". Based on the above examples the following total payoffs result—depending on the particular state of nature:

	good state	bad state
payoff from type A	1365	840
payoff from type B	495	495
total payoff from type A and B	**1860**	**1335**

Instructions for All of the Three Treatments

5. General Information

During the experiment, you will have the opportunity to practice calculations on your computer (bottom half) in each decision situation. Here, the net values are also provided.[12] In addition, you can use the calculator which is at your workplace for own calculations.

After you have made decisions in all 20 situations, you will be asked to draw a slip of paper from a container in which 20 numbered slips of paper (from 1 to 20) are located. The number on the slip of paper you will draw determines the decision situation that is paid out. This means that at the end of the experiment **one** decision situation is chosen randomly, which then determines your payoff from the experiment.

To determine which state of nature is present in this decision situation, you will be asked to cast a six-sided die. If you cast 1, 2 or 3 the state of nature is "good", if you cast 4, 5 or 6 the state of nature is "bad". Depending on the number of assets of type A and B you have bought in this decision situation, the payoff from the experiment results. The total payoff from this decision situation converted into Euro will be paid to you in cash after the experiment.

After you have read these instructions, we will ask you to answer some questions on your computer. Answering these questions is merely for checking the understanding and is not relevant for the payoff. Subsequently, the experiment starts. Please note that the computer program we use does not separate decimal places with a comma, but with a period.

[12] This sentence was only included in the instructions for both tax treatments.

A2 Overall Effect of Tax Rate Changes on the Riskily Invested Amount in Case of a Full Loss Offset Provision[13]

In our experimental setting, the rate of return of the risky asset is either positive ($r_A^u > 0$) in the good state of nature which occurs with probability p^u or negative ($r_A^d < 0$) in the bad state of nature which occurs with probability p^d. The rate of return of the risk-free asset is denoted by $r_B \geq 0$ where $r_A^u > r_B > r_A^d$. The degree to which losses are tax deductible is denoted by α. Consequently, based on the expected utility theory the maximization problem of the assumed to be risk averse investor is:

$$\begin{aligned}
&\max_q E\left[u\left(\pi\right)\right] \\
&\text{s.t.} \quad \pi^u = q \cdot \left(1 + r_A^u \cdot \left(1-\tau\right)\right) + \left(e-q\right) \cdot \left(1 + r_B \cdot \left(1-\tau\right)\right) \qquad (24) \\
&\qquad\;\; \pi^d = q \cdot \left(1 + r_A^d \cdot \left(1-\alpha \cdot \tau\right)\right) + \left(e-q\right) \cdot \left(1 + r_B \cdot \left(1-\tau\right)\right),
\end{aligned}$$

where $0 \leq q \leq e$. The FOC of the maximization problem is:

$$\frac{dE\left[u\left(\pi\right)\right]}{dq} = p^u \cdot u'\left(\pi^u\right) \cdot \left(1-\tau\right) \cdot \left(r_A^u - r_B\right) + p^d \cdot u'\left(\pi^d\right) \cdot \left(r_A^d \cdot \left(1-\alpha \cdot \tau\right) - r_B \cdot \left(1-\tau\right)\right) = 0 \quad (25)$$

As the investor is assumed to be risk averse, $u''\left(\pi\right)$ is always negative. Therefore, $E\left[u\left(\pi\right)\right]$ has a single maximum. To derive the overall effect of tax rate changes on the riskily invested amount *q*, we first consider the total differential:

$$d\frac{dE\left[u\left(\pi\right)\right]}{dq} = \frac{\partial\left(\frac{dE\left[u\left(\pi\right)\right]}{dq}\right)}{\partial q} dq + \frac{\partial\left(\frac{dE\left[u\left(\pi\right)\right]}{dq}\right)}{\partial \tau} d\tau = 0 \quad (26)$$

Rearranging leads to:

$$\frac{dq}{d\tau} = -\frac{\partial\left(\frac{dE\left[u\left(\pi\right)\right]}{dq}\right)}{\partial \tau} \Bigg/ \frac{\partial\left(\frac{dE\left[u\left(\pi\right)\right]}{dq}\right)}{\partial q} \quad (27)$$

[13] Compare Mossin (1968, pp. 75-78) for a general approach.

Consequently we can write:

$$\frac{dq}{d\tau}=\frac{\begin{array}{l} p^u\cdot u'\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)-p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)\cdot\left[-q\cdot\left(r_A^u-r_B\right)-e\cdot r_B\right] \\ +p^d\cdot u'\left(\pi^d\right)\cdot\left(\alpha\cdot r_A^d-r_B\right)-p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d\cdot(1-\alpha\cdot\tau)-r_B\cdot(1-\tau)\right]\cdot\left[-q\cdot\left(\alpha\cdot r_A^d-r_B\right)-e\cdot r_B\right]\end{array}}{p^u\cdot u''\left(\pi^u\right)\cdot\left[(1-\tau)\cdot\left(r_A^u-r_B\right)\right]^2+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d\cdot(1-\alpha\cdot\tau)-r_B\cdot(1-\tau)\right]^2} \quad (28)$$

If a full loss offset is provided, α amounts to one and (28) changes to:

$$\frac{dq}{d\tau}=\frac{\begin{array}{l} p^u\cdot u'\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u'\left(\pi^d\right)\cdot\left(r_A^d-r_B\right) \\ +q\cdot(1-\tau)\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)^2\right] \\ +e\cdot r_B\cdot(1-\tau)\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)\right]\end{array}}{(1-\tau)^2\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)^2\right]} \quad (29)$$

Moreover, the FOC (25) can be written as:

$$\begin{aligned}\frac{dE\left[u(\pi)\right]}{dq}&=p^u\cdot u'\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)+p^d\cdot u'\left(\pi^d\right)\cdot(1-\tau)\cdot\left(r_A^d-r_B\right)\\&=p^u\cdot u'\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u'\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)=0\end{aligned} \quad (30)$$

Considering (30), simplifications lead to:

$$\begin{aligned}\frac{dq}{d\tau}&=\frac{q\cdot(1-\tau)\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)^2\right]}{(1-\tau)^2\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)^2\right]}\\&\quad+\frac{e\cdot r_B\cdot(1-\tau)\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)\right]}{(1-\tau)^2\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)^2\right]}\\&=\frac{q}{1-\tau}+r_B\cdot e\cdot\frac{p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)}{p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)^2+p^d\cdot u''\left(\pi^d\right)\cdot(1-\tau)\cdot\left(r_A^d-r_B\right)^2}\end{aligned} \quad (31)$$

To achieve a further simplified form, we use the FOC again and analyze how the riskily invested amount q is influenced by changes of the endowment e by using the total differential:

$$d\,\frac{dE\left[u(\pi)\right]}{dq}=\frac{\partial\left(\frac{dE\left[u(\pi)\right]}{dq}\right)}{\partial q}dq+\frac{\partial\left(\frac{dE\left[u(\pi)\right]}{dq}\right)}{\partial e}de=0 \quad (32)$$

Rearranging leads to:

$$\frac{dq}{de} = -\frac{\partial\left(\frac{dE\left[u(\pi)\right]}{dq}\right)}{\partial e} \Bigg/ \frac{\partial\left(\frac{dE\left[u(\pi)\right]}{dq}\right)}{\partial q}$$

$$= -\frac{\left[1+r_B\cdot(1-\tau)\right]\cdot p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right) + \left[1+r_B\cdot(1-\tau)\right]\cdot p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d\cdot(1-\alpha\cdot\tau)-r_B\cdot(1-\tau)\right]}{p^u\cdot u''\left(\pi^u\right)\cdot\left[(1-\tau)\cdot\left(r_A^u-r_B\right)\right]^2 + p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d\cdot(1-\alpha\cdot\tau)-r_B\cdot(1-\tau)\right]^2} \quad (33)$$

Again, in the case of a full loss offset α amounts to one and (33) changes to:

$$\frac{dq}{de} = -\left(1+r_B\cdot(1-\tau)\right)\cdot\frac{p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)}{p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)^2+p^d\cdot u''\left(\pi^d\right)\cdot(1-\tau)\cdot\left(r_A^d-r_B\right)^2} \quad (34)$$

Next, we combine both $\frac{dq}{d\tau}$ and $\frac{dq}{de}$ to analyze the overall effect of tax rate changes on the willingness to take risk. For this purpose, we multiply the second term of equation (31) by $\frac{1+r_B\cdot(1-\tau)}{1+r_B\cdot(1-\tau)}$, leading to:

$$\begin{aligned}\frac{dq}{d\tau} &= \frac{q}{(1-\tau)} + r_B\cdot e\cdot\frac{1+r_B\cdot(1-\tau)}{1+r_B\cdot(1-\tau)}\cdot \\ &\quad \frac{p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)}{p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2\cdot(1-\tau)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)^2\cdot(1-\tau)} \\ &= \frac{q}{(1-\tau)} + \frac{r_B\cdot e}{1+r_B\cdot(1-\tau)}\cdot \\ &\quad \underbrace{\left(1+r_B\cdot(1-\tau)\right)\cdot\frac{p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)}{p^u\cdot u''\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)^2\cdot(1-\tau)+p^d\cdot u''\left(\pi^d\right)\cdot\left(r_A^d-r_B\right)^2\cdot(1-\tau)}}_{-\frac{dq}{de}}\end{aligned} \quad (35)$$

Finally, we can write:

$$\frac{dq}{d\tau} = \frac{q}{(1-\tau)} - \frac{dq}{de}\cdot\frac{r_B\cdot e}{1+r_B\cdot(1-\tau)} \quad (36)$$

A3 Overall Effect of Tax Rate Changes on the Riskily Invested Amount in Case of a No Loss Offset Provision [14]

As mentioned, the degree to which losses are tax deductible is denoted by α . If no loss offset is provided, α amounts to zero and (28) changes to:

$$\frac{dq}{d\tau}=\frac{\begin{array}{l}p^u\cdot u'\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)-p^d\cdot u'\left(\pi^d\right)\cdot r_B\\+q\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)^2-p^d\cdot u''\left(\pi^d\right)\cdot r_B\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]\right]\\+r_B\cdot e\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]\right]\end{array}}{p^u\cdot u''\left(\pi^u\right)\cdot\left[(1-\tau)\cdot\left(r_A^u-r_B\right)\right]^2+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]^2}\tag{37}$$

Furthermore, in the case of no loss offset, (33) changes to:

$$\frac{dq}{de}=-\left(1+r_B\cdot(1-\tau)\right)\cdot\frac{p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]}{p^u\cdot u''\left(\pi^u\right)\cdot\left[(1-\tau)\cdot\left(r_A^u-r_B\right)\right]^2+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]^2}\tag{38}$$

Next, we again combine both $\frac{dq}{d\tau}$ and $\frac{dq}{de}$ to analyze the overall effect of tax rate changes on the willingness to take risk. For this purpose, we multiply the fourth term in the numerator of equation (37) by $\frac{1+r_B\cdot(1-\tau)}{1+r_B\cdot(1-\tau)}$, leading to:

$$\frac{dq}{d\tau}=\frac{\begin{array}{l}p^u\cdot u'\left(\pi^u\right)\cdot\left(r_A^u-r_B\right)-p^d\cdot u'\left(\pi^d\right)\cdot r_B\\+q\cdot\left[p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)^2-p^d\cdot u''\left(\pi^d\right)\cdot r_B\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]\right]\end{array}}{p^u\cdot u''\left(\pi^u\right)\cdot\left[(1-\tau)\cdot\left(r_A^u-r_B\right)\right]^2+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]^2}$$
$$+\frac{r_B\cdot e}{1+r_B\cdot(1-\tau)}\cdot$$
$$\underbrace{\left(1+r_B\cdot(1-\tau)\right)\cdot\frac{\left[p^u\cdot u''\left(\pi^u\right)\cdot(1-\tau)\cdot\left(r_A^u-r_B\right)+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]\right]}{p^u\cdot u''\left(\pi^u\right)\cdot\left[(1-\tau)\cdot\left(r_A^u-r_B\right)\right]^2+p^d\cdot u''\left(\pi^d\right)\cdot\left[r_A^d-r_B\cdot(1-\tau)\right]^2}}_{-\frac{dq}{de}}$$

[14] Compare Mossin (1968, pp. 78-81) for a general approach.

$$= \frac{\begin{array}{l} p^u \cdot u'(\pi^u) \cdot (r_A^u - r_B) - p^d \cdot u'(\pi^d) \cdot r_B \\ + q \cdot \left[p^u \cdot u''(\pi^u) \cdot (1-\tau) \cdot (r_A^u - r_B)^2 - p^d \cdot u''(\pi^d) \cdot r_B \cdot \left[r_A^d - r_B \cdot (1-\tau) \right] \right] \end{array}}{p^u \cdot u''(\pi^u) \cdot \left[(1-\tau) \cdot (r_A^u - r_B) \right]^2 + p^d \cdot u''(\pi^d) \cdot \left[r_A^d - r_B \cdot (1-\tau) \right]^2} - \frac{dq}{de} \cdot \frac{r_B \cdot e}{1 + r_B \cdot (1-\tau)} \tag{39}$$

A4 Influence of Loss Offset Provision on the Riskily Invested Amount

To show the influence of the loss offset provision on the willingness to take risk, the maximization problem of the assumed to be risk averse investor remains the same:

$$\begin{array}{ll} \max\limits_q E\left[u(\pi)\right] & \\ \text{s.t.} & \pi^u = q \cdot \left(1 + r_A^u \cdot (1-\tau)\right) + (e-q) \cdot \left(1 + r_B \cdot (1-\tau)\right) \\ & \pi^d = q \cdot \left(1 + r_A^d \cdot (1-\alpha \cdot \tau)\right) + (e-q) \cdot \left(1 + r_B \cdot (1-\tau)\right) \end{array} \tag{40}$$

and the resulting FOC still is:

$$\frac{dE\left[u(\pi)\right]}{dq} = p^u \cdot u'(\pi^u) \cdot (r_A^u - r_B) \cdot (1-\tau) + p^d \cdot u'(\pi^d) \cdot \left(r_A^d \cdot (1-\alpha \cdot \tau) - r_B \cdot (1-\tau)\right) = 0 \tag{41}$$

To determine the influence of the degree of the loss offset provision (i.e., parameter α) on the riskily invested amount *q*, we consider the total differential:

$$d\,\frac{dE\left[u(\pi)\right]}{dq} = \frac{\partial\left(\frac{dE\left[u(\pi)\right]}{dq}\right)}{\partial q} dq + \frac{\partial\left(\frac{dE\left[u(\pi)\right]}{dq}\right)}{\partial \alpha} d\alpha = 0 \tag{42}$$

This leads to:

$$\begin{array}{l} dq\left[p^u \cdot u''(\pi^u) \cdot (r_A^u - r_B)^2 \cdot (1-\tau)^2 + p^d \cdot u''(\pi^d) \cdot \left(r_A^d \cdot (1-\alpha \cdot \tau) - r_B \cdot (1-\tau)\right)^2 \right] \\ + d\alpha\left[p^d \cdot \left(u'(\pi^d) \cdot (-\tau \cdot r_A^d) + u''(\pi^d) \cdot \left(r_A^d \cdot (1-\alpha \cdot \tau) - r_B \cdot (1-\tau)\right) \cdot (-\tau \cdot r_A^d \cdot q) \right) \right] = 0 \end{array} \tag{43}$$

Rearranging results in:

$$\frac{dq}{d\alpha} = -\frac{p^d \cdot \left(u'(\pi^d) \cdot (-\tau \cdot r_A^d) + u''(\pi^d) \cdot \left(r_A^d \cdot (1-\alpha \cdot \tau) - r_B \cdot (1-\tau)\right) \cdot (-\tau \cdot r_A^d \cdot q) \right)}{p^u \cdot u''(\pi^u) \cdot (r_A^u - r_B)^2 \cdot (1-\tau)^2 + p^d \cdot u''(\pi^d) \cdot \left(r_A^d \cdot (1-\alpha \cdot \tau) - r_B \cdot (1-\tau)\right)^2} \tag{44}$$

As we assumed a risk averse investor, the first derivative of the utility function is positive and the second derivative is negative. As a consequence, the numerator is positive, the denominator is negative, and thus the whole term on the right hand side is positive:

$$\frac{dq}{d\alpha} > 0 \tag{45}$$

As a result, an increase of the loss offset provision leads to a higher willingness to take risk.

A5 Gross and Net Rates of Return

Table A1 depicts the (potential) gross and net rates of return of both assets in each decision situation for each treatment.

Table A1: Gross and net rates of return

	decision situation	**risky asset A**		**risk-free asset B**	**risky asset A**		**risk-free asset B**
		good state	bad state		good state	bad state	
no tax treatment	1	96%	-40%	22%	96%	-40%	22%
	2	82%	-36%	18%	82%	-36%	18%
	3	68%	-32%	14%	68%	-32%	14%
	4	54%	-28%	10%	54%	-28%	10%
	5	40%	-24%	6%	40%	-24%	6%
	6	48%	-20%	11%	48%	-20%	11%
	7	41%	-18%	9%	41%	-18%	9%
	8	34%	-16%	7%	34%	-16%	7%
	9	27%	-14%	5%	27%	-14%	5%
	10	20%	-12%	3%	20%	-12%	3%
	11	54%	-40%	0%	54%	-40%	0%
	12	48%	-36%	0%	48%	-36%	0%
	13	42%	-32%	0%	42%	-32%	0%
	14	36%	-28%	0%	36%	-28%	0%
	15	30%	-24%	0%	30%	-24%	0%
	16	27%	-20%	0%	27%	-20%	0%
	17	24%	-18%	0%	24%	-18%	0%
	18	21%	-16%	0%	21%	-16%	0%
	19	18%	-14%	0%	18%	-14%	0%
	20	15%	-12%	0%	15%	-12%	0%

full loss offset treatment	1	192%	-80%	44%	96%	-40%	22%
	2	164%	-72%	36%	82%	-36%	18%
	3	136%	-64%	28%	68%	-32%	14%
	4	108%	-56%	20%	54%	-28%	10%
	5	80%	-48%	12%	40%	-24%	6%
	6	96%	-40%	22%	48%	-20%	11%
	7	82%	-36%	18%	41%	-18%	9%
	8	68%	-32%	14%	34%	-16%	7%
	9	54%	-28%	10%	27%	-14%	5%
	10	40%	-24%	6%	20%	-12%	3%
	11	108%	-80%	0%	54%	-40%	0%
	12	96%	-72%	0%	48%	-36%	0%
	13	84%	-64%	0%	42%	-32%	0%
	14	72%	-56%	0%	36%	-28%	0%
	15	60%	-48%	0%	30%	-24%	0%
	16	54%	-40%	0%	27%	-20%	0%
	17	48%	-36%	0%	24%	-18%	0%
	18	42%	-32%	0%	21%	-16%	0%
	19	36%	-28%	0%	18%	-14%	0%
	20	30%	-24%	0%	15%	-12%	0%
no loss offset treatment	1	192%	-40%	44%	96%	-40%	22%
	2	164%	-36%	36%	82%	-36%	18%
	3	136%	-32%	28%	68%	-32%	14%
	4	108%	-28%	20%	54%	-28%	10%
	5	80%	-24%	12%	40%	-24%	6%
	6	96%	-40%	22%	48%	-40%	11%
	7	82%	-36%	18%	41%	-36%	9%
	8	68%	-32%	14%	34%	-32%	7%
	9	54%	-28%	10%	27%	-28%	5%
	10	40%	-24%	6%	20%	-24%	3%
	11	108%	-40%	0%	54%	-40%	0%
	12	96%	-36%	0%	48%	-36%	0%
	13	84%	-32%	0%	42%	-32%	0%
	14	72%	-28%	0%	36%	-28%	0%
	15	60%	-24%	0%	30%	-24%	0%
	16	54%	-40%	0%	27%	-40%	0%
	17	48%	-36%	0%	24%	-36%	0%
	18	42%	-32%	0%	21%	-32%	0%
	19	36%	-28%	0%	18%	-28%	0%
	20	30%	-24%	0%	15%	-24%	0%

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