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Saving at Tax Time: Do Additional Retroactive Savings Opportunities Increase Retirement Savings?

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Abstract

Using a series of experiments, we examine whether the additional opportunity to save retroactively for retirement at the time of tax filing increases overall retirement savings. Our findings show that introducing the additional savings opportunity at tax time increases the total savings rate by almost 5 percentage points. This positive effect holds regardless of whether retirement savings are taxed immediately (back-loaded pension plans) or deferred (front-loaded pension plans) or whether subjects expect back taxes or a tax refund. We show that the effect is not due to higher tax salience at tax time but that the additional offer to save nudges impulsive savings behavior. Policymakers may thus consider the introduction of an additional savings opportunity at tax time as a policy tool to encourage retirement savings. In addition, policymakers should consider the advantage of immediate over deferred taxation in increasing retirement savings. We show that the savings gap between immediate and deferred taxation found in previous studies can expand further if savings are additionally allowed at tax filing.

Keywords
Retirement savings, tax incentives, impulsive savings, tax salience, nudging, deferred taxation

JEL Codes
D9, D14, D15, G51, H31

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1 Introduction

This study examines the effect of an additional retroactive savings opportunity at tax time on retirement savings. Due to the declining level of public pensions and the decreasing availability of defined-benefit pension plans in many countries in recent decades, the importance of voluntary participation in private pension plans has become more important for building sufficient retirement savings. Therefore, most countries provide tax and other financial incentives to encourage private savings for retirement (OECD 2021).

However, recent research questions the effectiveness of these incentives. Regarding tax incentives, Chetty et al. (2014) estimate that 85% of the Danish taxpayers are passive savers, who are unresponsive to tax incentives, and Beshears et al. (2017) report that the retirement savings of employees at eleven U.S. firms are nearly unresponsive to the introduction of differently taxed pension plans. While Beshears et al. (2017) show that the reason for this unresponsiveness is that many subjects are simply unaware of the tax rules, Blaufus and Milde (2021) find significant tax misperceptions even if the experimental participants are explicitly informed about the tax rules, possibly because subjects suffer from confirmation bias. These tax misperceptions result in significantly lower after-tax pensions if retirement savings are subject to deferred taxation, both compared to economically equivalent immediate taxation or to a net equivalent no-tax setting, because subjects ignore or underweight the future pension tax (Blaufus and Milde 2021).[1] In addition, subjects overestimate their after-tax retirement savings and are less willing to take investment risks under deferred taxation compared to immediate taxation (Stinson et al. 2021). Moreover, noneconomic reasons such as preferences for prepaying for consumption may also limit the effectiveness of retirement tax incentives (Cuccia et al. 2022). In sum, the effectiveness of current tax incentives is limited because they are often ignored due to individuals' unawareness of the tax rules, misperceived due to cognitive limitations, or the tax incentive design is in conflict with other noneconomic preferences.

[1] Under deferred taxation, contributions to the pension plan are tax deductible, the return on investment is tax-free, and pensions are taxed upon withdrawal. By contrast, under immediate taxation, contributions to the pension plan are not tax deductible, the return on investment is tax-free, and pensions are tax-free upon withdrawal. Both systems are economically equivalent if the tax rate does not change over time (Blaufus and Milde 2021).

A promising approach to increasing the effectiveness of tax incentives could be to allow additional retroactive savings opportunities at the time of tax filing, as is already possible in some countries, such as the United States (Cuccia et al. 2022). Filing a tax return affects almost every working individual, and therefore very small changes in tax law or the filing process can be highly effective. Retroactive saving enables taxpayers to postpone the final saving decision for a given tax year until the following year. It allows them to make saving decisions and file the tax return at the same point in time. In particular, in the case of deferred taxation, taxpayers can claim savings for tax purposes even if they are not incurred in the relevant tax year but in the tax return (e.g., by an extension of the retirement contribution due date).

When individuals make their savings decisions at tax time, they become more easily aware of the tax consequences of tax-deductible retirement savings. There is robust evidence that nonsalient taxes enhance tax misperceptions and biased behavior. Individuals tend to either ignore, neglect or forget about taxes that are not salient (Chetty et al. 2009; Goldin and Homonoff 2013; Taubinsky and Rees-Jones 2018). In the case of deferred taxation, the tax benefit from savings is not salient to the taxpayer when a taxpayer contributes to a tax-deferred pension plan during the tax year until the taxpayer claims the contribution as tax deductible on the tax return and receives a tax refund in the following tax year. Thus, the increased salience of the tax benefit at tax time may encourage retirement savings under deferred taxation. Under immediate taxation, there is no tax-deductibility of retirement savings and thus no salience effect. Therefore, one might expect that the additional savings opportunity at tax time has the potential to reduce the observed gap in effective savings between deferred and immediate taxation (Beshears et al. 2017; Blaufus and Milde 2021).

In addition to the salience effect, the additional opportunity to save at tax time might also nudge taxpayers to increase retirement savings. According to dual process theory (Kahneman 2003, 2011), the human mind is separated into an ”impulsive system” and an ”analytical system”. Offering an additional savings opportunity might stimulate the impulsive system, and individuals who have already made their saving decision during the tax year may be nudged to make an additional impulsive saving decision on the tax return, similar to the often observed phenomenon of impulse buying behavior (Allom et al. 2018). Due to the impulsive nature of the decision,

this effect should occur independent of the tax treatment, i.e., under deferred and immediate taxation.

Prior research has already begun to examine whether taxpayers can be encouraged to save part of their tax refund by interventions during the tax filing process. For example, simply providing the option to purchase US savings bonds with tax refunds, increases savings (Tufano 2011). In further field experiments, it is shown that financial incentives such as matched contributions for retirement savings increase savings (Duflo et al. 2006; Saez 2009; Azurdia et al. 2014; Grinstein-Weiss et al. 2015). Moreover, other field experiments show that informational interventions, including the provision of anchors, and precommitments also increase the propensity to save part of the tax refund (Grinstein-Weiss et al. 2017; Roll et al. 2019, 2020); however, the effect is sometimes very small (e.g., Roll et al. 2021) and is limited by the taxpayers' ex ante desire to spend the refund (Bronchetti et al. 2013). While previous research examines how an option in the tax return to save the tax refund should be designed to increase savings at tax time, it is unclear whether the additional savings option would increase overall retirement saving at all and why this should occur. The current paper addresses this research gap by examining the effect of an additional retroactive savings option at tax time on overall savings under different tax treatments (deferred vs. immediate taxation) and different tax return results (tax refund, back taxes, neither refund nor back taxes).

To this end, we conduct a series of online experiments with more than 1,400 participants with various ages and educations. By definition, online experiments involve a certain degree of abstraction that may limit external validity. However, such experiments have several advantages in the current context. First, in an online experiment, we can perfectly control for subjects' overall savings, which is often not possible with administrative data. Second, in contrast to field data, we can exogenously vary the tax return result, i.e., whether subjects must pay back taxes or receive a tax refund. This is important because the tax return result may affect the impact that an additional savings opportunity at tax time has on overall savings. Third, only in an online or lab experiment can one control the current and future tax rates and thus ensure that the examined tax treatments (immediate and deferred pension taxation) are economically equivalent.

In line with the idea of the life-cycle consumption model (Modigliani and Brumberg 1954), the experimental subjects participate in a life-cycle that consists of an income phase and a subsequent pension phase. In the income phase, subjects earn income and make saving decisions; in the pension phase, subjects earn no exogenous income but receive a constant pension, which results from their entire savings in the income phase. To analyze how retroactive saving opportunities affect retirement savings, we use two between-subjects designs. First, we conduct experiment 1 with a 2×3 design with the treatment variables tax system (deferred vs. immediate) and the time of the savings decision (regular during the year, retroactive in the tax return, regular during the year and retroactive in the tax return). Second, to study a potential moderating effect of the tax return result, we conduct experiment 2 with a $2 \times 2 \times 3$ design with the treatment variables tax system (deferred vs. immediate), the time of the savings decision (regular during the year, regular during the year and retroactive in the tax return), and tax return result (tax refund, back taxes, neither tax refund nor back taxes).[2]

Our findings demonstrate that an additional option for retroactive savings in the tax return can significantly increase the effective savings rate by almost 5 percentage points and results in an average after-tax pension increase of 16.7%. However, the higher salience of the tax deductibility at the time of tax filing does not drive the positive effect on savings. Rather, the additional savings opportunity nudges subjects to make additional impulsive savings decisions. Therefore, we observe the same positive effect in both tax systems, immediate and deferred taxation of savings. Accordingly, the additional savings opportunity cannot reduce the tax savings gap between immediate and deferred taxation. Confirming earlier research, we find that immediate taxation results in significantly larger after-tax pensions than deferred taxation. The tax saving gap is even increased in some cases due to the additional savings opportunity because subjects under immediate taxation respond strongly to a tax refund setting when making savings at tax time while subjects do not respond to the tax return result under deferred taxation.

Taken together, our results provide causal evidence of the potential to increase retirement savings by introducing an additional savings opportunity at tax time. Most countries tax retirement

[2]Note that we also use the treatments with a regular savings decision during the year and a regular savings decision during the year and retroactive in the tax return from experiment 1 in experiment 2. Thus, we only add eight additional treatments in experiment 2. In total, we use 14 different treatments in our study.

savings according to a deferred system (OECD 2021). In this case, note that the positive effect holds independent of the taxpayers' individual tax return result. Thus, it may not be necessary to introduce a retrospective option to save at tax time; rather, a prospective opportunity should result in similar incentive effects if retirement savings are taxed according to a deferred system. However, our study also informs policymakers that immediate taxation of retirement savings seems to be more effective in encouraging retirement savings. Depending on the tax return result, we find differences between the effective savings rates under immediate and deferred taxation ranging from a minimum of 3.2 percentage points up to a maximum of 9.6 percentage points.

The remainder of this study is organized as follows. In the next section, we derive our hypotheses. The experimental design is presented in Section 3, and the results are described in Section 4. Section 5 discusses and concludes the implications for future research and tax policy.

2 Theory and Hypothesis Development

2.1 Additional Retroactive Retirement Saving at Tax Time

As indicated in the introduction, retirement savings are regularly reported as insufficient (e.g., Beshears et al. 2017; Stinson et al. 2021). Against this background, we investigate whether an additional retroactive savings opportunity at tax time increases retirement savings. However, from a rational choice perspective, the additional savings opportunity should not affect savings behavior. In a simple life-cycle model (Modigliani and Brumberg 1954), individuals maximize their lifetime utility according to the following utility function:

$$U = \sum_{t=1}^{T} \frac{u(C_t)}{(1+i)^t}, \tag{1}$$

with C_t denoting consumption at point in time t and i denoting the interest rate. We assume positive decreasing marginal utility with $u'(C_t) > 0$ and $u''(C_t) < 0$. Consumption C_t is defined as $C_t = Y_t - S_t \cdot (1 - \tau \cdot D)$, with Y_t denoting the after-tax income, S_t the pre-tax savings amount, τ the tax rate, and D a binary variable that indicates the tax treatment of

retirement savings (deferred taxation: $D = 1$; immediate taxation: $D = 0$). Since we are only interested in the effects of an additional savings decision, we keep the model as simple as possible and do not consider lifetime and income uncertainty and do not include any interest in our model ($i = 0$). The optimal consumption path over time, also known as Euler's rule, is given by $u'(C_t) = u'(C_{t+1})$. Hence, rational individuals smooth consumption over their lifetime. Accordingly, an additional saving decision at tax time has no impact on overall consumption and saving behavior. Furthermore, the optimal consumption allocation is not affected by the tax treatment of retirement payments if we assume time-invariant tax rates and either deferred or immediate taxation of retirement savings (Blaufus and Milde 2021).

In contrast, from a behavioral economics perspective,[3] the additional savings opportunity may increase retirement savings for the following reasons. First, saving in the tax return increases the salience of the tax benefit resulting from deferred taxation and therefore might enhance retirement saving behavior. In regular savings decisions during the tax year, the tax consequences of deferred taxation (a tax refund or reduced back taxes) are frequently not salient to taxpayers. The tax consequences only become salient in the tax return when the taxpayer claims retirement savings as tax-deductible. For example, an estimation of the tax return result is regularly available while filing the tax return (e.g., Brink and Lee 2015). Many tax filing software providers offer a live prediction of the tax return result to their customers (e.g., TurboTax). In contrast, during the tax year, tax salience is low, and taxpayers might misperceive the tax benefit from savings under deferred taxation.

There is robust evidence that individuals incorrectly perceive nonsalient taxes across various contexts. For example, customers do not react sufficiently to sales taxes that are not salient (Chetty et al. 2009; Goldin and Homonoff 2013; Taubinsky and Rees-Jones 2018). In the case of property taxes, Cabral and Hoxby (2012) show that homeowners with a low tax salience estimate their property tax less accurately than owners with salient taxes. Rupert and Wright (1998) show in their laboratory experiment that an increase in the visibility of the marginal tax rate improves investment decision performance. Further examples in the context of direct

[3]For a review on how behavioral economics can help to explain different accounting phenomena see (Hanlon et al. 2022)

and indirect taxes (Sausgruber and Tyran 2005), toll systems (Finkelstein 2009) and real effort experiments (Fochmann and Weimann 2013; Blumkin et al. 2012; Weber and Schram 2017) confirm that non-salient taxes enhance tax misperceptions. Individuals tend to either ignore, neglect or forget about taxes that are not salient.

In line with this evidence, increased tax salience at tax time might reduce potential misperceptions of the tax benefit from savings under deferred taxation. Retroactive saving enables taxpayers to respond directly in the tax return to the salient tax consequences of deferred taxation and adjust prior savings decisions. If subjects underweight (or completely ignore) the tax benefit resulting from the deductibility of retirement savings under deferred taxation, we would expect savings to increase when they learn about the tax benefit because it has high visibility in their decisions at tax time.[4] However, this applies only to taxpayers who actually misperceive the tax benefit form savings. Blaufus and Milde (2021) demonstrate that taxpayers mainly misperceive the deferred pension tax while the tax benefit from savings is perceived almost correctly. Thus, it is unclear to what extent tax savings can actually be increased through improved salience of the tax benefit. Moreover, in the case of immediate taxation, there are no tax consequences from retirement savings in the tax return. Hence, tax salience should not affect savings behavior at tax time under immediate taxation.

Second, the additional savings opportunity might nudge taxpayers to increase retirement savings. Nudges are defined as changes in the choice architecture to direct behavior in a certain direction (Thaler and Sunstein 2009). Recent literature demonstrates that nudges can enhance saving behavior in several ways (e.g., Madrian and Shea 2001; Beshears et al. 2021). For example, Blaufus and Milde (2021) demonstrate that numerical informational nudges can increase saving and decrease tax misperceptions under deferred taxation. Grinstein-Weiss et al. (2017) demonstrate that saving prompts presented at tax time can raise savings in the tax return.

The effects of nudges on behavior can be explained by the architecture of the human mind. According to the widespread dual process theory (Kahneman 2003, 2011), the human mind is separated into two different processing systems. There is one ”impulsive system” that responds

[4]For a formal proof, see the Online Appendix to Blaufus and Milde (2021).

automatically and quickly with no cognitive effort or conscious control to stimuli. The other "analytical system" consciously allocates cognitive effort to tasks and operates on complex choices. To stimulate behavior, nudges can either address the analytical system or exploit the weaknesses of the automatic system (Hertwig and Grüne-Yanoff 2017). Due to limited cognitive abilities, nudges can more easily address the impulsive system than the analytical system.

In our context, simply offering an additional savings opportunity might nudge impulsive savings behavior at tax time. Although retirement planning is often insufficient (Benartzi and Thaler 1999), individuals might fulfill their personal saving intentions (at least partially) during the tax year. Individuals invest cognitive effort to plan for retirement and understand and calculate tax consequences from deferred taxation in their savings decisions during the tax year. Because savings intentions are satisfied at tax time, the additional savings opportunity might stimulate the impulsive system rather than the analytical system of the human mind. In line with the character of the impulsive system, prior saving intentions might be unconsciously overruled at tax time, leading to an impulsive increase in retirement savings. Because savings intentions can be fulfilled without taking taxation into account, impulsive savings behavior should be effective under immediate and deferred pension taxation.

Such impulsive behavior might have similar behavioral roots to the well-studied field of impulse buying behavior (Allom et al. 2018). Impulse buying behavior is characterized as the irrational and unintentional urge to make an additional consumption decision despite initial consumption intentions having already been fulfilled (e.g., Bayley and Nancarrow 1998; Beatty and Ferrell 1998). For example, everyone has experienced buying something even though the planned purchase was already complete. It is reported that material portions of consumption are caused by such impulsive buying behavior (e.g., Hausman 2000; Ruvio and Belk 2013; Bellini et al. 2017). Although impulsive behavior is often regarded negatively, it could help increase savings in the case of an additional savings decision at tax time. However, impulsive saving behavior at tax time might be limited if individuals take the additional decision into account and reduce savings during the tax year. Thus, it is an empirical question whether an additional opportunity to save at tax time really increases overall savings. We assume a positive overall effect of an additional savings decision on retirement savings and thus state our first hypothesis as follows:

H1: The additional retroactive savings opportunity at tax time increases overall retirement savings.

2.2 Tax Return Result and Retirement Savings

According to a wide field of literature, income allocation over time due to tax prepayments significantly affects savings behavior (Shapiro and Slemrod 1993; Chambers and Spencer 2008; Feldman 2010; Jones 2012; Messacar 2018). Tax prepayments serve to distribute the tax burden over the tax year, affecting both the available preliminary net income during the tax year and the tax return result. In particular, in the case of the additional savings opportunity at tax time, the tax return result might affect savings behavior. If, for example, the tax prepayments are higher [lower] than the actual tax burden, then the tax return results in a tax refund [back taxes].There is empirical evidence that individuals take more risks in reporting and investment decisions when they expect a back tax payment rather than a tax refund (e.g., Jackson and Hatfield 2005; Falsetta and Tuttle 2011; Brink and Lee 2015; Fochmann and Wolf 2019). . Recent research explains asymmetrical reporting behavior at tax time by the perception of tax refunds in a gain frame and back taxes in a loss frame. According to prospect theory (Kahnemann and Tversky 1979), individuals asymmetrically weight information over gains and losses in decision making. It predicts that individuals respond more strongly to a loss frame than to a gain frame (loss aversion). In the case of the additional savings decision, individuals can respond directly to the result of the tax return. Thus, savings behavior at tax time might be affected by the result of the tax return.

In the gain frame, the additional short-term liquidity from the tax refund could provide an incentive for individuals to increase their retirement savings. For example, an option to save a tax refund in the tax return can enhance savings behavior (e.g., Bronchetti et al. 2013; Grinstein-Weiss et al. 2015, 2017; Roll et al. 2019). By contrast, individuals in the loss frame might decide to reduce spending on retirement savings to compensate for the loss. However, these effects might be different in the case of deferred taxation due to the tax-deductibility of savings. Under deferred taxation, taxpayers can actively decide in their tax returns whether to further increase their tax refund or to reduce back taxes through additional tax-deductible savings. Because the

tax refund is perceived as a gain, there might be an additional incentive for taxpayers to further increase this gain by additional tax-deductible savings in the tax return. In the case of back taxes, the taxpayers may attempt to reduce the potential loss through additional tax-deductible savings rather than reducing expenses (Cuccia et al. 2022).

By contrast, the theory of mental accounting (Thaler 1999) proposes a different explanation for asymmetrical savings behavior at tax time (e.g., Shefrin and Thaler 1988; Chambers and Spencer 2008; Feldman 2010). It suggests that individuals allocate income from different sources into different mental accounts depending on the decision timing and the decision environment. In our context, taxpayers might allocate tax refund income from the tax return into a different mental account than regular working income during the tax year. Recent research demonstrates that income from tax refunds is more likely to encourage saving than regular working income. For example, Chambers and Spencer (2008) show that a tax refund delivered in a lump-sum enhances saving behavior more than the same tax refund provided in monthly payments. Thus, in line with the previous theoretical implications, tax refunds might be perceived as a bonus payment that incentivizes taxpayers to increase retirement savings. However, in the case of back taxes, there is no positive income allocated to the tax refund mental account. For this reason, there is no additional incentive to increase retirement savings in the case of back taxes.

Overall, there is strong evidence that a tax refund in the tax return might increase savings. In contrast, the effect of additional back taxes is not entirely clear. However, we suppose that taxpayers will be more inclined to reduce spending on retirement savings in the event of back taxes. Thus, we state our second hypothesis as follows:

H2a: Tax refunds [back taxes] increase [reduce] retirement savings at tax time.

In addition to the tax return result, tax prepayments also affect the preliminary net income during the tax year. For example, increasing [decreasing] tax prepayments reduce [increase] the preliminary net income during the tax year. There is evidence that individuals deviate from efficient behavior based on the actual tax burden and instead use simple decision heuristics (e.g., Blaufus et al. 2013; Fochmann et al. 2013; Morrow et al. 2018; Stinson et al. 2021; Blaufus et al. 2022). A widespread and well-known phenomenon is the anchoring and adjustment heuristic

(Tversky and Kahneman 1974). It describes the tendency of people to start their decision making at an initial reference point in the decision environment and then adjust it until they are satisfied. In our context, individuals might initially anchor on their preliminary net income during the tax year and than adjust for the expected result of the tax return. In the case of a tax refund [back taxes], individuals might anticipate that the preliminary net income is lower [higher] than the true after-tax income and increase [decrease] retirement savings. If taxpayers correctly anticipate the result of the tax return when making their savings decisions during the tax year, there may be no incentive to respond to the result of the tax return. However, research indicates that adjustments are often insufficient (Epley and Gilovich 2001, 2004, 2006; Stinson et al. 2021). Following this evidence, we expect that individuals anchor on their preliminary net income during the tax year instead of their true after-tax income and adjust insufficiently for the tax return result when making their saving decisions. Consequently, we hypothesize as follows:

> **H2b:** Higher [lower] tax prepayments yielding tax refunds [back taxes] reduce [increase] retirement savings in the tax year.

Due to the opposing effects of tax prepayments on retirement savings at tax time (H2a) and on retirement savings during the tax year (H2b), the effect of tax prepayments on overall savings is theoretically unclear. However, the general character of the savings decisions during the tax year and in the tax return could give an indication of the overall effect. As argued above, taxpayers might fulfill their personal saving intentions during the tax year. Thus, the largest portion of retirement savings might be affected by the anchor and adjustment during the tax year rather than by the tax return result. Since the effects are unclear, our hypothesis is nondirectional:

> **H2c:** The amount of tax prepayments yielding tax refunds or back taxes affects overall retirement savings in the case of an additional retroactive savings opportunity.

Based on the theory above, the effect of an additional retroactive savings opportunity at tax time on overall retirement savings should be moderated by the amount of tax prepayments. The potential use of an anchor and adjustment heuristic affects savings behavior during the tax year independent of an additional savings opportunity. However, the gain/loss frame due to the tax refund/back taxes is only effective when subjects are allowed to make additional savings at tax

time. Thus, we expect that the effect of the additional savings decision on overall retirement savings is moderated by the tax return result. As argued for H2a above, tax refunds [back taxes] should increase [decrease] the impact of the additional savings decision. Thus, we formulate our final hypothesis as follows:

H3: The positive effect of an additional retroactive savings opportunity at tax time on overall retirement savings increases [decreases] in the case of tax refunds [back taxes].

3 Experimental Design

3.1 Procedure and Treatment

To examine our research hypotheses, we conducted multiple online experiments. In a life-cycle setting, subjects made saving decisions for retirement (Modigliani and Brumberg 1954; Blaufus and Milde 2021). The life-cycle consists of ten periods and is divided into a seven-period income phase and a three-period pension phase. In each period of the income phase, the subjects receive a certain and increasing income to make a savings decision for the pension phase.[5] Subsequently, the subjects complete a tax return for the respective income phase period. In the pension phase, the participants receive no income but a constant payment depending on their savings during the income phase. At the end of the experiment, the participants complete a questionnaire with socio-demographic questions. We present translated instructions and screenshots of the experimental procedures in online Appendix B. To induce additively separable utility in line with equation 1, only one of the ten periods was considered for payment such that subjects maximize their experimental wealth according to the following utility function U by choosing their savings:

$$U = \frac{1}{10} \sum_{t=1}^{10} u(C_t). \tag{2}$$

We use two between-subjects designs. First, we conduct experiment 1 with a 2×3 design with the treatment variables tax system (deferred vs. immediate) and the time of the savings decision

[5] We used an increasing income stream instead of a constant income stream to avoid depletion and to maintain the attention of the subjects. Moreover, it allows us to clearly differentiate between the simple heuristic of always saving the same absolute amount and the rational choice of consumption smoothing.

(regular during the year, retroactive in the tax return, regular during the year and retroactive in the tax return). Second, to study a potential moderating effect of the tax return result, we conduct experiment 2 with a $2 \times 2 \times 3$ design with the treatment variables tax system (deferred vs. immediate), the time of the savings decision (regular during the year, regular during the year and retroactive in the tax return), and tax return result (tax refund, back taxes, neither tax refund nor back taxes).[6]

We distinguish between treatment groups with a deferred and an immediate tax system. For treatments under deferred taxation, the savings are tax-deductible, while the pension is fully taxable. Accordingly, the subjects receive a tax refund for tax-deductible savings in the tax return. Under immediate taxation, the savings are not tax-deductible and the pension is tax-free. We use a constant tax rate of 30% for both treatment groups. In Table 1, we present the treatments in our experimental design (conducted for both deferred and immediate taxation).

Table 1: Treatment Overview by the Time of the Savings Decision and Result of Tax Return

Treatments	**Time of the Savings Decision**	**Tax Return Result**
Experiment 1		
Regular_No	Income Phase	No Tax Refund/Back Tax
Regular+Retroactive_No	Income Phase + Tax Return	No Tax Refund/Back Tax
Retroactive_No	Tax Return	No Tax Refund/Back Tax
Experiment 2		
Regular_No	Income Phase	No Tax Refund/Back Tax
Regular+Retroactive_No	Income Phase + Tax Return	No Tax Refund/Back Tax
Regular_TaxRefund	Income Phase	Tax Refund
Regular+Retroactive_TaxRefund	Income Phase + Tax Return	Tax Refund
Regular_BackTax	Income Phase	Back Tax
Regular+Retroactive_BackTax	Income Phase + Tax Return	Back Tax

Notes: The table shows an overview of our treatments by the time of the savings decision and result of tax return. We distinguish between treatments with a regular savings decision in the income phase (*Regular*), a regular savings decision in the income phase and an additional retroactive savings decision in the tax return (*Regular+Retroactive*) and a retroactive savings decision in the tax return (*Retroactive*). Furthermore, we distinguish treatments with no initial tax refund/back tax (*No*), an initial tax refund (*TaxRefund*) and an initial back tax (*BackTax*). We conduct all shown treatments for both deferred and immediate taxation (not tabulated). Note that we use treatments *Regular_No* and *Regular+Retroactive_No* for both experiment 1 and experiment 2.

In treatment *Regular_No*, the subjects make their savings decision during the income phase (see online Appendix Figures B4 and B7). Therefore, in the first period of the income phase,

[6]Note that we also use the treatments with a regular savings decision during the year and a regular savings decision during the year and retroactive in the tax return from experiment 1 in experiment 2. Thus, we only add eight additional treatments in experiment 2. In total, we use 14 different treatments in our study.

subjects receive a pre-tax income of 2,500 experimental currency units (ECU; 100 ECU = €0.18). This pre-tax income increases by 100 ECU each period until it reaches 3,100 ECU in the last period of the income phase. To levy income taxes, the participants are subject to a constant withholding tax and make tax prepayments of 30% of the pre-tax income. The actual tax rate of 30% is therefore equal to the withholding tax rate, resulting in an initial tax return result of zero (excluding any tax-deductible savings). In sum, we provide information on the pre-tax income, the tax prepayment and the resulting preliminary net income for the subjects to make their savings decisions in the income phase.[7]

After the savings decision in the income phase, the subjects complete a tax return. Hence, they declare information about their pre-tax income and, in the case of deferred taxation, their tax-deductible savings amount. Subsequently, the subjects receive a calculation of their tax burden and the result of the tax return. At the end of each period in the income phase, the subjects receive a summary of their savings, the result of the tax return and the payoff for the period (preliminary net income + result of the tax return - savings). Furthermore, they receive information about the potential pre-tax pension if they continue to save the average saving amount of the past periods until the pension phase starts. After all periods of the income phase are completed, the subjects receive a calculation of their total savings, the corresponding pre- and after-tax pension for the pension phase and an overview of all payoffs in the life-cycle. There are no further tasks in the pension phase.

To analyze how an additional retroactive savings decision at tax time affects saving behavior, we introduce the treatment *Regular+Retroactive_No*. The treatment procedure does not deviate from treatment *Regular_No* except for an additional savings opportunity in the tax return. Hence, after the subjects declare the pre-tax income and any tax-deductible savings from the previous savings decision, they can decide to further increase retirement savings at tax time (see online Appendix Figures B11 and B15). The additional decision is based on salient tax information in

[7]The maximum achievable after-tax pension is in principle higher under immediate taxation than under deferred taxation, because the savings are theoretically limited to the same after-tax income in both tax systems. However, under deferred taxation, the pension is still taxed. To address this issue, we have implemented different savings limits depending on the tax system. Thus, we ensure that if the maximum possible amount was saved in both tax systems (immediate [deferred]: 40.00% [57.14%] of pre-tax income), the effective savings rate was the same. In addition, we calculated the savings limits such that in the treatments with back taxes, there are also back taxes, if the maximum amount was saved under deferred taxation, thereby reducing back taxes.

the tax return (pre-tax income, tax-deductible savings, taxable income, actual tax burden, tax prepayment and the result of the tax return). Under deferred taxation, subjects are immediately informed of the tax consequences as part of a live calculation. For example, if a subject decides to save an amount of 500 ECU, we provide the following information: *"The tax refund has increased by 150 ECU as a result of the tax-deductible savings contributions."*

To examine how the salience of the tax benefit from savings affects savings behavior, we introduce treatment *Retroactive_No*. In this treatment, subjects make their savings decisions exclusively in the tax return (see online Appendix Figures B14 and B18). As in the other treatments, in the income phase, we provide the subjects with information on pre-tax income, tax prepayment, and the resulting preliminary net income. However, there is no regular saving decision during the income phase based on this information. Instead, subjects make their initial savings decision in the tax return based on salient tax information just as they do their additional savings decision in treatment *Regular+Retroactive_No*.

To examine a potential moderating effect of the tax return result, we manipulate the amount of tax prepayments. In addition to treatments with matching tax prepayments and tax burden (*No*), we introduce treatments with either an initial tax refund (*TaxRefund*) or an additional tax payment (*BackTax*) in the tax return. In the *TaxRefund* [*BackTax*] treatments, we increase [decrease] the withholding tax rate by 20 percentage points. This manipulation has two consequences for the treatments. First, the preliminary net income in the *TaxRefund* treatments decreases to 50% of the pre-tax income (see online Appendix Figures B5 and B8) and increases in the *BackTax* treatments to 90% of the pre-tax income (see online Appendix Figures B6 and B9) compared to the net income in treatments *No* that amounts to 70% of the pre-tax income. Second, the subjects receive an initial tax refund (see online Appendix Figures B12 and B16) or additional tax payment (see online Appendix Figures B13 and B17) of 20% of their pre-tax income in the respective treatment in the tax return without taking any tax deductible savings into account.

The following example illustrates the procedure for the first round. In the case of treatments with no initial tax refund or back taxes (*No*), the subjects receive information on their pre-tax income of 2,500 ECU, the tax prepayment of 750 ECU and the resulting preliminary net income

of 1,750 ECU. By contrast, in the case of treatments with an initial *TaxRefund* [*BackTax*], the subjects pay a tax prepayment of 1,250 ECU [250 ECU] and receive a preliminary net income of 1,250 ECU [2,250 ECU]. Assuming that the subjects do not make any tax-deductible savings in the period, they receive a tax refund [back taxes] of 500 ECU in the tax return.

Bivariate and multivariate analyses are conducted to test our hypotheses. We present t-tests for all bivariate analyses.[8] To control for different sociodemographic variables and subjects' savings incentives, we run random-effects panel regressions.[9]

3.2 Subjects and Data

We recruited our participants through the survey platforms Prolific, Clickworker and Respondi.[10] The experiments were programmed using oTree (Chen et al. 2016) and conducted from June to September 2021. This approach provides us with data from a heterogeneous population, especially in terms of education and age. As an incentive to participate in our experiment, we offered the subjects a fixed compensation of €2.00, a variable compensation that was related to the subjects savings' behavior, and a variable compensation for two post-experimental questions regarding risk taking and loss aversion. The participants received on average a total payment of €4.93 (SD €1.24). The median time to complete the experiment and the questionnaire is 26 minutes yielding a median hourly wage of €11.38.[11]

Before the experiment started, the participants received a detailed introduction to the experimental procedure and tax rules (see online Appendix B.1). All instructions and tasks were written in a neutral language to avoid subjects using individual scripts when interpreting loaded terms. For

[8] In addition, we conducted nonparametric Mann-Whitney U-tests. All main results remain qualitatively unchanged.

[9] In addition to random-effects panel regressions, we run untabulated pooled OLS regressions and robust cross-sectional regressions proposed by Huber (1973, Huber's M-estimator). We cluster the standard errors at the participant level and use robust standard errors. All results remain qualitatively unchanged.

[10] To exclude possible biases regarding the different survey platforms, we conducted additional analyses in which we control for the three platforms (untabulated). All results remain qualitatively unchanged.

[11] We test whether the completion time of the study affects our results. The estimated time to properly complete the study is approximately 20 minutes. Although most participants completed the study in approximately this time, some participants took much less (5% percentile: 13.1 minutes) or much more (95% percentile: 76.5 minutes) time. Therefore, subjects may have either not spent enough time or taken too long to properly complete the study (e.g., due to too long breaks in processing). Although all subjects passed the comprehension test and attention checks, we excluded all subjects who took less than 10 minutes (1.69% of all subjects) or more than 120 minutes (2.72%) to complete the study to check the robustness of our results (untabulated). The results remain qualitatively unchanged.

example, we did not use the terms pension or retirement; instead, we used terms such as income phase, rest phase, savings decision, and payoff. To ensure that the participants fully understood their tasks and the tax treatment, we conducted a training session (see online Appendix B.1.2 and B.2.1) and asked a series of comprehension questions. In addition, we included several attention checks during the experiment. To ensure data quality, only subjects who answered all comprehension questions correctly and passed all attention checks were allowed to participate in the experiment.

A total of 1,433 individuals participated in the experiment. All participants were over 18 years old and native German speakers. Each treatment contains data from on average 102.5 randomly assigned participants (SD 3.4). The majority of the subjects are male (52.7%) and on average 40.1 years old (SD 16.1). The average participant earns between €1,500-2,000 per month after taxes. Half of the participants have a university degree (50.4%). We provide descriptive statistics of the average socio-demographic factors of the participants in online Appendix Table A1.

3.3 Variable Measurement

3.3.1 Dependent Variable

As the dependent variable, we use the effective savings rate. The effective savings rate s_t determines the proportion of after-tax income that a subject effectively contributes to the pension in a given period t. The effective savings rate s_t is calculated as follows:

$$s_t = \frac{S_t(1 - \tau \cdot D)}{Y_t}. \tag{3}$$

The numerator is the after-tax savings amount $S_t(1-\tau \cdot D)$, using the pre-tax savings amount S_t, the tax rate τ and the binary variable D that indicates the taxation treatment (deferred taxation: $D = 1$; immediate taxation: $D = 0$). The denominator is the after-tax income Y_t. Under deferred [immediate] taxation, the effective savings rate considers that savings are made from pre-tax [after-tax] income.

3.3.2 Independent and Control Variables

We use the treatment variables as shown in Table 1 for immediate and deferred taxation as independent variables. These are binary variables that equal one if the observation belongs to the respective treatment and zero otherwise. We also use the dummy variables *Regular*, *Regular+Retroactive*, and *Retroactive*, which take value one if the savings decision in a treatment is made in the income phase, in the income phase and additionally retroactively in the tax return and only retroactively in the tax return, respectively (see the second column of Table 1). Furthermore, we use a dummy variable *TaxRefund* [*BackTax*], which equals one if a tax refund [back tax] results from tax prepayments in the respective treatment (see the last column of Table 1).

To control for basic socio-demographic factors, we consider the following variables: gender (*Male*), age (*Age*), education (*University Degree*), net income (*Income*), marital status (*Married*), occupation (*Self-employed*), tax knowledge (*Tax Knowledge*), cognitive ability (*Cognitive Ability*), tax aversion (*Tax Aversion*), risk attitude (*Non Risk-averse*), loss aversion (*Loss Aversion*) and the preference for prepayment (*Preference for Prepayment*). *Male* is a dummy variable equal to one if the subject is male. *Age* is a categorical variable consisting of five levels: 18-25, 26-35, 36-45, 46-60 and 61 or older. Education is measured with another dummy variable *University Degree* that equals one if a subject has at least a university degree. *Income* is a categorical variable that measures individual net income including less than €1,000, €1,001-2,000, €2,001-3,000, and €3,001 or more. *Married* [*Self-employed*] is also a dummy variable equal to one if the subject is married [self-employed]. Regarding tax knowledge, the subjects rated their personal knowledge on a 9-point scale from 1 = no knowledge at all to 9 = tax expert/ professional. The dummy variable *Tax Knowledge* equals one if the subject chose one of the last four options. To control for tax aversion related to tax misperceptions (Blaufus and Möhlmann 2014), we asked subjects whether they would invest money in either a taxable bond or an economically slightly less favorable tax-free bond. *Tax Aversion* is a dummy variable that takes value one if the subject would invest money in the tax-free bond (Sussman and Olivola 2011). Since decreasing marginal utility is assumed in the life-cycle model, we also control

for subjects who do not meet this assumption.[12] We measured subjects' risk attitudes using an incentivized short lottery task. Subjects chose 20 times between a certain safe payoff and a fixed lottery, with the safe payoff increasing by 5 ECU for each decision. At the 15th decision, the expected value of the lottery was the same as for the certain payoff. A risk-neutral individual would have been indifferent in this case. We define risk-averse individuals as those who had already chosen the safe payoff before the 15th decision. Conversely, the dummy variable *Non Risk-averse* equals one if the individual is not risk averse. At the end of the study, we randomly determined which of the 20 decisions would be used to calculate the payoff for this task. This is a modified and simpler version of the experimental design used by Holt and Laury (2002). We measured cognitive ability with the three-item cognitive reflection test by Frederick (2005) as a simple measure of subjects' cognitive ability. The dummy variable *Cognitive Ability* equals one for subjects who scored 3 out of 3, indicating high cognitive ability.

Since the tax return result may either be perceived as a gain (tax refund) or a loss (back taxes), we further control for individual loss aversion. To measure loss aversion, subjects had to perform another incentivized lottery choice task. Following Gächter et al. (2022), for each of a total of six choices, subjects had to decide whether to accept (i.e., play) or reject a lottery (and receive nothing). In each lottery, the winning price was fixed at 1,200 ECU, and the losing price increases from 400 up to 1,400 ECU. At the end of the experiment, a decision was randomly selected for the payoff. In the case of a lottery, the payoff of the lottery was determined at random (gain or loss). *Loss Aversion* is a binary variable that takes value one if the participant's loss aversion is above the median of all observations.

We also control for the preference for prepayment, since this characteristic is an important factor in saving behavior in various retirement tax systems (Cuccia et al. 2022). Based on Patrick and Park (2006), we asked the subjects to imagine that they plan to be unemployed for a short and fully anticipated period of time in six months. They were then informed that the living expenses would amount to €1,200 and that they could pay for their expenses: (1) in six monthly payments

[12] Rational subjects who are risk-loving should not smooth their income in the current setting but save as much as possible, while risk-neutral subjects should be fully indifferent how to allocate their income over the life-cycle. Thus, their savings behavior should differ from risk-averse subjects. However, in all cases, the additional savings opportunity should not affect rational savings behavior. In addition, we run all analyses only with risk-averse subjects (untabulated). The results remain qualitatively unchanged.

of €200 starting six months before the planned unemployment or (2) in six monthly payments of €200 for six months after the planned unemployment. The dummy variable *Preference for Prepayment* equals one if the payment is chosen before the planned unemployment. Finally, *Period* is a metric variable measuring the decision period (from 1 to 7) to control for the savings trend.

4 Empirical Results

4.1 Additional Retroactive Retirement Savings at Tax Time

In hypothesis 1, we state that the additional retroactive savings opportunity at tax time increases overall retirement savings. In Figure 1, we show the average effective savings rates for the treatments under deferred and immediate taxation.

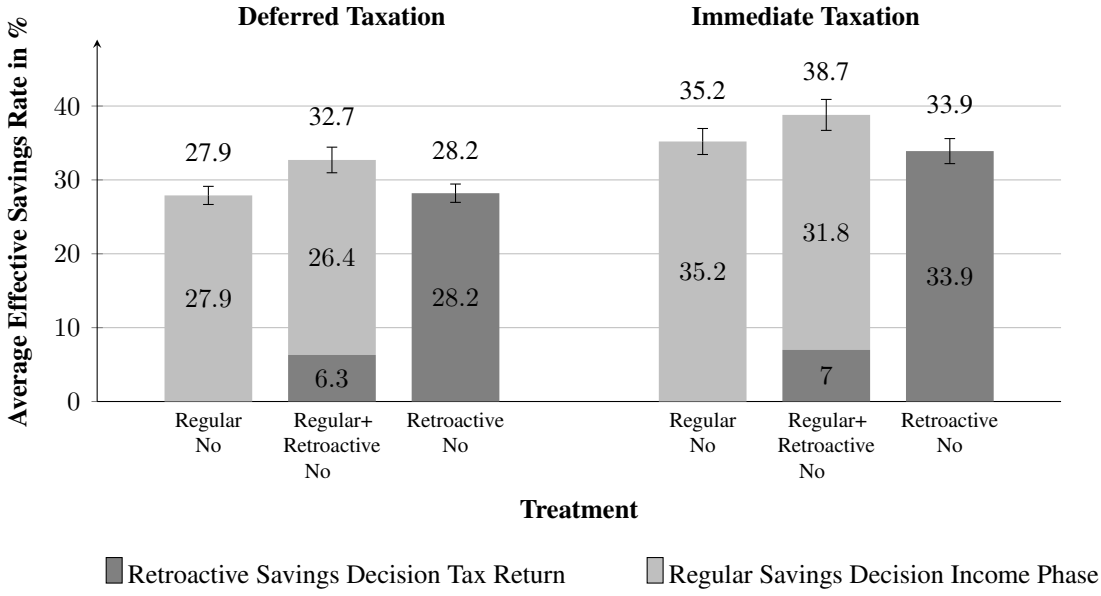

Figure 1: Average Effective Savings Rate by the Time of the Savings Decision

Notes: The figure illustrates the average effective savings rates in % for treatments under deferred and immediate taxation. The effective savings rate determines the proportion of after-tax income that a subject effectively saves for the pension in one respective period and, hence, considers that savings are tax-deductible in the case of deferred taxation. *Regular* [*Regular+Retroactive*] is a treatment with a regular savings decision [and an additional retroactive savings decision in the tax return]. *Retroactive* is a treatment with a retroactive savings decision in the tax return. Note, that the treatments do not have an initial tax refund or back tax from prepayments in the tax return (*No*). The error bars show the 95% confidence intervals.

To analyze the overall effect of the additional savings opportunity at tax time, we first compare the treatments *Regular_No* and *Regular+Retroactive_No* under deferred taxation. We find that the additional savings decision at tax time increases the average effective savings from 27.9% to 32.7%. The 4.8-percentage-point increase (17.2%) is highly significant ($p = 0.006$).

To analyze whether the effect can be explained by the increased salience of the tax benefit from savings, we compare the treatments *Regular_No* and *Retroactive_No* under deferred taxation. These two treatments differ only in the time of the savings decision, namely only in the income phase (*Regular_No*) or only when the tax return is filed (*Retroactive_No*). We find no differences in the average effective savings rates between these two treatments (27.9% vs. 28.2%; $p = 0.874$). Thus, saving behavior is not affected by the higher salience of the tax benefit from savings. Although the tax benefit is very salient due to a live calculation during the tax return subjects do not increase their savings. The result suggests that subjects already correctly perceive the tax benefit from tax-deductible savings without the calculation in the tax return. Accordingly, higher savings in the case of an additional saving decision in the tax return seems to be explained mainly by a nudging effect.

This rationale is confirmed when comparing the treatments under immediate taxation. Although there is no tax benefit from savings in the tax return under immediate taxation, an additional savings decision at tax time significantly increases the average effective savings rate compared to a regular savings decision (35.2% vs. 38.7%; $p = 0.055$). The effect amounts to 3.5 percentage points (9.9%) and does not significantly differ from the observed effect under deferred taxation (panel regression with controls [untabulated]; $p = 0.567$). This further supports the notion that savings behavior at tax time is driven by nudging effects. As expected, we find no tax salience effect under immediate taxation when we compare treatments *Regular_No* and *Retroactive_No* (35.2% vs. 33.9%; $p = 0.466$).

Next, we analyze the savings allocation during the income phase and in the tax return for the treatments with two savings decisions (*Regular+Retroactive_No*). Under deferred [immediate] taxation, subjects effectively save an average of 26.4% [31.8%] in regular saving decisions and 6.3% [7.0%] at tax time. The effective savings at tax time do not differ significantly between

deferred and immediate taxation (6.3% vs. 7.0%; p = 0.428). This finding reinforces our suggestion that the additional savings are not caused by increased salience of tax benefits. In sum, our results imply strong support for H1. An additional savings opportunity at tax time significantly increases overall retirement savings and results in an average after-tax pension increase of 16.7%.

To test our bivariate results, we run two regressions (see Table 2). The results support our bivariate findings. In addition, we find that the control variable *Period* has a significant positive effect. In line with the theoretical model for risk-averse subjects and an increasing income in our research design, the effective savings rate increases over the periods of the experiment.[13]

[13]The rational choice optimum for risk-averse subjects in our experimental design is to consume a constant amount of $C_t^* = 1372\ ECU$ in each life-cycle period. To achieve the optimum, subjects must save an amount of $S_1^* = 540\ ECU$ (an effective savings rate of 21.6%) in the first period of the income phase and increase their savings by the increase in the pre-tax income, i.e., 100 ECU, in each of the following income phase periods.

Table 2: Random-Effects Regression Analyses: Time of the Savings Decision (H1)

VARIABLES	(1) Deferred Taxation Effective Savings Rate	(2) Immediate Taxation Effective Savings Rate
Regular_ No	**Base**	
Regular+Retroactive_No	**0.0496*** **	**0.0398** **
	(0.0165)	**(0.0182)**
Retroactive_No	**-0.00366**	**-0.0232**
	(0.0153)	**(0.0173)**
Male	0.0128	-0.00120
	(0.0152)	(0.0158)
Age 26-35	0.0398*	-0.0143
	(0.0208)	(0.0215)
Age 36-45	0.0199	-0.0183
	(0.0232)	(0.0257)
Age 46-60	-0.000969	-0.00427
	(0.0246)	(0.0278)
Age 61+	-0.0525**	-0.0639**
	(0.0250)	(0.0289)
University Degree	-0.00382	-0.0102
	(0.0144)	(0.0150)
Income €1,001-2,000	-0.00261	0.00632
	(0.0187)	(0.0202)
Income €2,001-3,000	-0.0373*	0.0121
	(0.0204)	(0.0232)
Income €3,001+	-0.0126	0.00640
	(0.0268)	(0.0253)
Married	-0.0213	-0.0323*
	(0.0157)	(0.0184)
Self-employed	-0.00584	-0.0224
	(0.0273)	(0.0224)
Tax Knowledge	0.0284*	-0.0241
	(0.0159)	(0.0168)
Cognitive Ability	0.0108	-0.00394
	(0.0143)	(0.0140)
Tax Aversion	0.0106	0.0179
	(0.0140)	(0.0156)
Non Risk-averse	-0.00231	0.0444**
	(0.0191)	(0.0197)
Loss Aversion	-0.0144	0.00530
	(0.0137)	(0.0155)
Preference for Prepayment	0.00818	0.0487**
	(0.0207)	(0.0226)
Period	0.00996***	0.00479***
	(0.00116)	(0.00114)
Constant	0.231***	0.316***
	(0.0315)	(0.0351)
Observations	2,135	2,198
Number of ID's	305	314
R^2	0.1249	0.0968
Wald-Test (p-value):		
Regular_No vs. Retroactive_No	0.00309	0.00239

Notes: The table shows results of random-effects panel regressions using the effective savings rate as dependent variable. The effective savings rate determines the proportion of after-tax income that a subject effectively saves for the pension in one respective period and, hence, considers that savings are tax-deductible in the case of deferred taxation. The treatment variables are dummy variables that take the value of one if the observation belongs to the respective tax treatment. We define our control variables *Male*, *Age*, *University Degree*, *Income*, *Married*, *Self-employed*, *Tax Knowledge*, *Cognitive Ability*, *Tax Aversion*, *Non Risk-averse*, *Loss Aversion*, *Preference for Prepayment* and *Period* in Section 3.3.2. We report standard errors in parentheses. Significance levels are denoted as: *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

4.2 Tax Return Result and Retirement Savings

In this section, we examine the effects of tax prepayments on retirement savings behavior (H2a, H2b, H2c and H3). Figure 2 shows separately the average effective savings rates for treatments under deferred and immediate taxation.

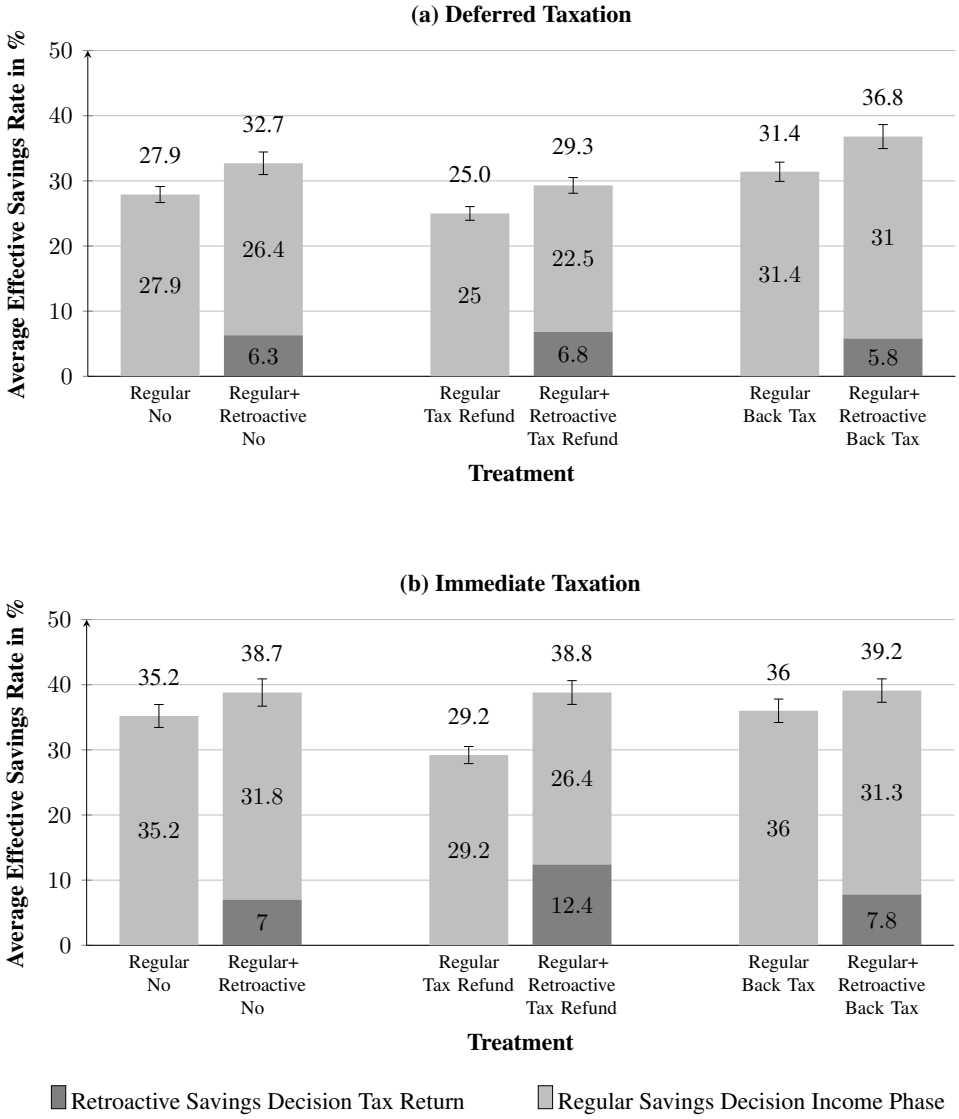

Figure 2: Average Effective Savings Rate by Tax Return Result

Notes: The figure illustrates the average effective savings rates in % for treatments under deferred taxation (a) and immediate taxation (b). The effective savings rate determines the proportion of after-tax income that a subject effectively saves for the pension in one respective period and, hence, considers that savings are tax-deductible in the case of deferred taxation. *Regular* [*Regular+Retroactive*] is a treatment with a regular savings decision [and an additional retroactive savings decision in the tax return]. We distinguish between treatment groups with no initial tax refund or back taxes (*No*), an initial tax refund (*Tax Refund*) and initial back taxes (*Back Tax*) in the tax return. The error bars show the 95% confidence intervals.

At first glance, the results already reveal that the additional savings decision at tax time increases overall retirement savings regardless of the tax system (immediate vs. deferred) or the tax return result (no tax refund/back taxes vs. tax refund vs. back taxes). The question, however, is how tax prepayments affect savings behavior at tax time, during the tax year, and overall.

In H2a, we state that tax refunds [back taxes] increase [reduce] retirement savings at tax time. To test the hypothesis, we compare the average effective savings rate at tax time for treatment *Regular+Retroactive_No* with those of treatments *Regular+Retroactive_TaxRefund* and *Regular+Retroactive_BackTax*. In line with our expectation, we find that a tax refund significantly increases the average effective savings rate at tax time by 5.4 percentage points under immediate taxation (7.0% vs. 12.4%; $p < 0.001$). We also find an increase in savings at tax time under deferred taxation, but it is not significant (6.3% vs. 6.8%; $p = 0.481$). In the case of back taxes, we find that the average effective savings rate does not differ under immediate taxation (7.0% vs. 7.8%; $p = 0.366$) or under deferred taxation (6.3% vs. 5.8%; $p = 0.396$). Overall, we find limited support for H2a. Only in the case of immediate taxation does a tax refund increase the average effective savings rate at tax time.[14]

It seems that loss aversion does not affect saving behavior at tax time because most subjects do not respond more strongly to the loss frame than to the gain frame. Thus, the prospect theory of Kahnemann and Tversky (1979) does not seem operative in this context. To further examine the effect of loss aversion, we divide the subjects in treatment *Regular+Retroactive_BackTax* (deferred and immediate taxation combined) into two groups based on the individual level of loss aversion (see Section 3.3.2 for the measurement of loss aversion). We assign subjects to the group *HighLossAversion* if the subject's loss aversion level is above the median of all observations and to the group *LowLossAversion* otherwise. However, we do not find any significant differences in the average effective savings rate at tax time between the groups (*HighLossAversion* 6.9% vs. *LowLossAversion* 6.8%; $p = 0.897$).

Instead, the results can be explained by the theory of mental accounting (Thaler 1999). Since subjects perceive the tax refund as a bonus payment in a separate mental account, they increase

[14] To exclude the possibility that the effects are biased by the amount of regular savings in the respective period, we additionally controlled for these in untabulated regressions. The results remain qualitatively unchanged.

their retirement savings at tax time. In the case of back taxes, subjects do not see a bonus payment in the respective mental account and thus should not further increase savings contributions. There is no increase in effective savings in the case of back taxes compared to the treatments in which no tax refund or back taxes results from tax prepayments in the income phase. In the case of a tax refund, however, we only observe a significant effect under immediate taxation. This result indicates that the perception of tax refunds resulting from tax-deductible retirement savings under deferred taxation (the tax benefit from savings) and tax refunds from tax prepayments differ. Under deferred taxation, subjects receive a tax refund from both tax prepayments and tax-deductible retirement savings. In the case of immediate taxation, the subjects receive only a tax refund from tax prepayments. Our results for H1 suggest that individuals correctly perceive the tax benefit from tax-deductible savings in their initial savings decision and have no reason to adjust by making additional savings. Therefore, the additional incentive of the tax refund from tax prepayments might vanish under deferred taxation. By contrast, in the case of immediate taxation, the tax refund does not depend on the initial savings decision and becomes visible only in the tax return. Therefore, the incentive effect of the tax refund is higher under immediate than under deferred taxation.

Hypothesis H2b states that higher [lower] tax prepayments yielding tax refunds [back taxes] reduce [increase] retirement savings in the tax year. To test the hypothesis, we compare the average effective savings rate in the income phase for the treatment with tax prepayments that equal the tax burden *(Regular+Retroactive_No)* and the treatments with low tax prepayments *(Regular+Retroactive_TaxRefund)* and high tax prepayments *(Regular+Retroactive_BackTax)*.

Under deferred taxation, we find that the average effective savings rate in the income phase significantly decreases in the case of high tax prepayments (26.4% vs. 22.5%; $p = 0.012$) and significantly increases in the case of low tax prepayments (26.4% vs. 31.0%; $p = 0.007$). As expected, subjects use a simple heuristic and anchor on the preliminary net income to make their initial savings decisions. However, the anchoring and adjustment heuristic (Tversky and Kahneman 1974) proposes that individuals not only anchor on the preliminary net income but also adjust for the expected tax return result. Because we find for H1 that subjects correctly perceive the tax benefit from tax-deductible savings, we assume that the subjects adjust their

initial anchor sufficiently for the expected tax benefit from tax-deductible savings. Thus, the findings indicate that subjects only adjust insufficiently for the expected tax return result from tax prepayments.

In the case of immediate taxation, we similarly find that high tax prepayments significantly reduce the average effective savings rate (31.8% vs. 26.4%; $p = 0.002$). However, we do not find a significant increase in the average effective savings rate with low tax prepayments (31.8% vs. 31.3%; $p = 0.817$). In this case, the anchoring and adjustment heuristic does not lead to a significant effect because the subjects adjust for different amounts of back taxes under immediate and deferred taxation. Because there are no tax-deductible savings under immediate taxation, the back taxes are frequently higher than under deferred taxation. Thus, subjects reduce their spending on savings more under immediate taxation than under deferred taxation to adjust for higher back taxes in their tax returns.

In H2c, we hypothesized that the amount of tax prepayments yielding tax refunds or back taxes affects overall retirement savings in the case of an additional retroactive savings opportunity. In line with our results for H2a and H2b, we find that subjects save overall significantly less in the case of high tax prepayments (32.7% vs. 29.3%; $p = 0.049$) and significantly more in the case of low tax prepayments (32.7% vs. 36.8%; $p = 0.028$) under deferred taxation. Hence, the anchor effect prevails for overall retirement savings. However, the overall effect vanishes under immediate taxation. The overall average effective savings rate does not significantly differ for a tax refund (38.7% vs. 38.8%; $p = 0.986$) or for back taxes (38.7% vs. 39.2%; $p = 0.807$). Thus, the opposing effects balance each other out under immediate taxation.

To verify the bivariate findings and finally examine hypothesis H3, we run several regressions. The results are shown for hypotheses H2a, H2b and H2c in Table 3 and for H3 in Table 4. Our multivariate analyses confirm our findings for H2a (Models 1 and 2), H2b (Models 3 and 4) and H2c (Models 5 and 6).

In H3, we predicted that the positive effect of an additional retroactive savings opportunity at tax time on overall retirement savings increases [decreases] in the case of tax refunds [back taxes]. In line with our prior results, we find no significant effect for the interaction between an

additional savings decision in the tax return and back taxes for both deferred taxation (Model 1 in Table 4; *BackTax* $\times$ *Regular+Retroactive*; $p = 0.894$) and immediate taxation (Model 2 in Table 4; *BackTax* $\times$ *Regular+Retroactive*; $p = 0.950$). By contrast, the interaction between an additional savings decision at tax time and a tax refund is significant in the case of immediate taxation (*Tax Refund* $\times$ *Regular+Retroactive*; $p = 0.001$) and nonsignificant in the case of deferred taxation (*Tax Refund* $\times$ *Regular+Retroactive*; $p = 0.773$).

Overall, we find strong support that the additional savings decision in the tax return increases overall retirement savings regardless of whether the initial tax return result is positive, negative, or zero. In the case of a tax refund under immediate taxation, the effective savings rate can be increased even further.

Table 3: Random-Effects Regression Analyses: Tax Return Result (H2a - H2c)

VARIABLES	(1) Deferred	(2) Immediate	(3) Deferred	(4) Immediate	(5) Deferred	(6) Immediate
	Effective Savings Rate Tax Return		Effective Savings Rate Income Phase		Effective Savings Rate Overall	
No	**Base**					
Tax Refund	**0.00240**	**0.0530*** **	**-0.0378** **	**-0.0548*** **	**-0.0354** **	**-0.00180**
	(0.00675)	**(0.0104)**	**(0.0152)**	**(0.0172)**	**(0.0170)**	**(0.0182)**
Back Tax	**-0.00706**	**0.00701**	**0.0436** **	**0.00560**	**0.0365** **	**0.0126**
	(0.00690)	**(0.00978)**	**(0.0173)**	**(0.0177)**	**(0.0186)**	**(0.0180)**
Male	-0.00434	-0.00516	0.00802	-0.0197	0.00368	-0.0248*
	(0.00573)	(0.00824)	(0.0143)	(0.0147)	(0.0150)	(0.0150)
Age 26-35	0.00526	0.00200	0.0288	-0.0664***	0.0340	-0.0643***
	(0.00801)	(0.0132)	(0.0208)	(0.0218)	(0.0219)	(0.0209)
Age 36-45	0.0160	0.0224	0.0120	-0.0614**	0.0280	-0.0390
	(0.00999)	(0.0149)	(0.0207)	(0.0253)	(0.0231)	(0.0263)
Age 46-60	0.0137	0.0267	0.0165	-0.0696**	0.0302	-0.0430
	(0.0102)	(0.0163)	(0.0246)	(0.0286)	(0.0256)	(0.0274)
Age 61+	0.0107	0.0337**	-0.0163	-0.133***	-0.00561	-0.0996***
	(0.0108)	(0.0136)	(0.0219)	(0.0248)	(0.0246)	(0.0233)
University Degree	-0.00452	-0.00395	0.00300	-0.000527	-0.00152	-0.00448
	(0.00658)	(0.00845)	(0.0148)	(0.0138)	(0.0160)	(0.0147)
Income €1,001-2,000	0.00691	0.00129	-0.00179	0.0411**	0.00511	0.0424**
	(0.00773)	(0.0117)	(0.0186)	(0.0200)	(0.0194)	(0.0197)
Income €2,001-3,000	0.00256	0.00961	-0.0206	0.00857	-0.0180	0.0182
	(0.00830)	(0.0118)	(0.0206)	(0.0205)	(0.0217)	(0.0210)
Income €3,001+	-0.00441	0.0187	-0.0281	0.0155	-0.0325	0.0343
	(0.0103)	(0.0155)	(0.0236)	(0.0265)	(0.0258)	(0.0286)
Married	-0.00168	-0.00483	-0.00323	-0.0256*	-0.00491	-0.0304**
	(0.00665)	(0.00864)	(0.0142)	(0.0143)	(0.0156)	(0.0153)
Self-employed	-0.00144	0.00564	-0.0352	-0.0416**	-0.0367	-0.0359
	(0.0116)	(0.0136)	(0.0236)	(0.0184)	(0.0268)	(0.0223)
Tax Knowledge	0.00203	-0.0106	9.75e-05	0.0150	0.00212	0.00440
	(0.00732)	(0.00909)	(0.0157)	(0.0153)	(0.0169)	(0.0165)
Cognitive Ability	-0.00613	0.00663	0.0117	-0.0202	0.00557	-0.0135
	(0.00621)	(0.00879)	(0.0146)	(0.0140)	(0.0157)	(0.0140)
Tax Aversion	-0.000772	0.0137*	-0.0235*	-0.0123	-0.0242*	0.00135
	(0.00583)	(0.00822)	(0.0137)	(0.0153)	(0.0143)	(0.0152)
Non Risk-averse	0.0162*	-0.00802	0.00846	0.0233	0.0246	0.0153
	(0.00931)	(0.0110)	(0.0187)	(0.0177)	(0.0193)	(0.0182)
Loss Aversion	0.00295	-0.00158	-0.00588	-0.00205	-0.00294	-0.00363
	(0.00568)	(0.00826)	(0.0136)	(0.0139)	(0.0146)	(0.0141)
Preference for Prepayment	-0.00746	0.00313	-0.00650	0.0249	-0.0140	0.0280
	(0.00826)	(0.0112)	(0.0195)	(0.0173)	(0.0204)	(0.0202)
Period	-0.000676	-8.53e-07	0.00827***	0.000555	0.00759***	0.000554
	(0.000631)	(0.000816)	(0.00116)	(0.00124)	(0.00123)	(0.00133)
Constant	0.0669***	0.0493***	0.242***	0.373***	0.309***	0.423***
	(0.0112)	(0.0178)	(0.0285)	(0.0290)	(0.0299)	(0.0311)
Observations	2,086	2,121	2,086	2,121	2,086	2,121
Number of ID's	298	303	298	303	298	303
R^2	0.0292	0.1147	0.1153	0.1559	0.0912	0.0964
Wald-Test (p-value):						
Tax Refund vs. Back Tax	0.182	0.000	0.000	0.000171	0.000	0.369

Notes: The table shows results of random-effects panel regressions using the effective savings rate as dependent variable.We distinguish between the effective savings rate in the tax return (Models 1 and 2), for a regular savings decision in the income phase (Models 3 and 4) and overall (Models 5 and 6). The effective savings rate determines the proportion of after-tax income that a subject effectively saves for the pension in one respective period and, hence, considers that savings are tax-deductible in the case of deferred taxation. The treatment variables are dummy variables that take the value of one if the observation belongs to the respective tax treatment. We define our control variables *Male*, *Age*, *University Degree*, *Income*, *Married*, *Self-employed*, *Tax Knowledge*, *Cognitive Ability*, *Tax Aversion*, *Non Risk-averse*, *Loss Aversion*, *Preference for Prepayment* and *Period* in Section 3.3.2. We report standard errors in parentheses. Significance levels are denoted as: *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Table 4: Random-Effects Regression Analyses: Tax Return Result (H3)

VARIABLES	(1) Deferred Taxation Effective Savings Rate	(2) Immediate Taxation Effective Savings Rate
Regular_No	**Base**	**Base**
Regular+Retroactive	**0.0489*** **	**0.0363** **
	(0.0169)	**(0.0180)**
Tax Refund	**-0.0281***	**-0.0627*** **
	(0.0152)	**(0.0167)**
Back Tax	**0.0372** **	**0.00848**
	(0.0159)	**(0.0173)**
Tax Refund × Regular+Retroactive	**-0.00650**	**0.0616** **
	(0.0226)	**(0.0244)**
Back Tax × Regular+Retroactive	**0.00323**	**0.00156**
	(0.0242)	**(0.0247)**
Male	-0.00571	-0.00965
	(0.0104)	(0.0105)
Age 26-35	0.0155	-0.0346**
	(0.0150)	(0.0148)
Age 36-45	0.0148	-0.0392**
	(0.0171)	(0.0174)
Age 46-60	-0.00126	-0.0331*
	(0.0178)	(0.0197)
Age 61+	-0.0212	-0.0773***
	(0.0186)	(0.0183)
University Degree	0.000611	-0.0172
	(0.0104)	(0.0105)
Income €1,001-2,000	0.0110	0.0221
	(0.0132)	(0.0140)
Income €2,001-3,000	-0.00979	0.0260*
	(0.0143)	(0.0149)
Income €3,001+	-0.00393	0.0320*
	(0.0184)	(0.0186)
Married	-0.000581	-0.0285**
	(0.0113)	(0.0118)
Self-employed	-0.0247	0.000510
	(0.0188)	(0.0178)
Tax Knowledge	0.00326	-0.0146
	(0.0120)	(0.0116)
Cognitive Ability	0.00304	-0.00970
	(0.0104)	(0.0101)
Tax Aversion	-0.00200	0.00643
	(0.0102)	(0.0104)
Non Risk-averse	0.0101	0.0269*
	(0.0128)	(0.0144)
Loss Aversion	8.92e-05	-0.00562
	(0.00999)	(0.0103)
Preference for Prepayment	0.00229	0.0183
	(0.0146)	(0.0148)
Period	0.0105***	0.00539***
	(0.000756)	(0.000901)
Constant	0.233***	0.358***
	(0.0219)	(0.0259)
Observations	4,249	4,361
Number of ID's	607	623
R^2	0.1153	0.1559

Notes: The table shows results of random-effects panel regressions using the effective savings rate as dependent variable. The effective savings rate determines the proportion of after-tax income that a subject effectively saves for the pension in one respective period and, hence, considers that savings are tax-deductible in the case of deferred taxation. The treatment variables are dummy variables that take the value of one if the observation belongs to the respective tax treatment. We define our control variables *Male*, *Age*, *University Degree*, *Income*, *Married*, *Self-employed*, *Tax Knowledge*, *Cognitive Ability*, *Tax Aversion*, *Non Risk-averse*, *Loss Aversion*, *Preference for Prepayment* and *Period* in Section 3.3.2. We report standard errors in parentheses. Significance levels are denoted as: *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

5 Discussion and Conclusion

According to our first result, the additional savings opportunity at tax time significantly increases overall retirement savings. However, this positive effect is not explained by the increased salience of the tax benefit from savings but by impulsive behavior. Thus far, we have only considered the average effect. Although most subjects do not respond to increased tax benefit salience (see Section 4.1), the effect of increased tax salience might be moderated by subjects' tax knowledge, cognitive ability or education. For example, subjects with high tax knowledge might better understand the salient tax calculations in the tax return and be more likely to respond to the additional tax information rather than respond impulsively. To test the moderating effects, we use three additional regressions similar to those in Table 2 for our deferred taxation treatments *Regular_No* and *Retroactive_No* (untabulated). We include interaction terms for *Retroactive* and either *Tax Knowledge*, *Cognitive Ability* or *University Degree*. However, we do not find any evidence that tax knowledge (*Retroactive* $\times$ *Tax Knowledge*; $p = 0.220$), cognitive ability (*Retroactive* $\times$ *Cognitive Ability*; $p = 0.668$) or education (*Retroactive* $\times$ *University Degree*; $p = 0.512$) moderates the effect of tax salience. Thus, the unresponsiveness to the salience of the tax benefit does not depend on tax knowledge, cognitive ability or education.

Another explanation for the lack of responsiveness to the increasing salience of tax benefits could be that subjects simply neglect tax information. To test whether subjects respond to taxes at all, we conducted another treatment without taxes (*NoTax*) along with the other treatments. To make this treatment comparable to the other treatments, subjects received an income of 1,750 ECU in the first period that increases by 70 ECU each period, which is equivalent to the after-tax income in the tax treatments. Of the 100 subjects, 37% were male and their average age was 38.9 years (SD 16.4). They earned on average between €1,500-2,000 per month after taxes; 41.0% have a university degree.

First, we find that average pre-tax savings are higher under deferred taxation (*Regular_No*: 39.9%) than in a system without taxes (36.1%; $p = 0.063$). This result shows that individuals do not ignore the tax benefit from savings. Second, we find further evidence that the salience of the tax benefit from savings does not matter. In the post-experimental questionnaire, we asked our

subjects to assess the perceived difficulty of the savings decisions on a 9-point scale from 1 = very easy to 9 = very difficult. The perceived difficulty of the savings decision should decrease with increasing salience. However, we find that the perceived decision difficulty is the same regardless of the salience of the tax benefit from savings (*Regular_No* 3.7 vs. *Retroactive_No* 4.1; $p = 0.161$).[15]

According to our second result, the positive effect of an additional savings opportunity at tax time on overall savings is not moderated by the tax return result under deferred taxation, while we find a moderating effect of a tax refund under immediate taxation. In particular, we show that a tax refund significantly increases the average effective savings rate at tax time only in the case of immediate taxation, not in the case of deferred taxation. On the one hand, we attribute the result to the fact that the tax refund has a stronger effect in the case of immediate taxation, since in this case the tax refund is rather surprising, whereas in the case of deferred taxation individuals already anticipated a tax refund in the income phase. In this context, we examined the number of decisions in which an additional savings decision is made at all. Under immediate taxation, we find that the probability of using the additional savings opportunity at all increases significantly by approximately 25% with a tax refund (the average marginal effect of an untabulated logistic panel regression with controls). This increase clearly shows that savings incentives in the form of tax refunds are effective in immediate tax systems. This positive effect is clearly different from the behavior under deferred taxation (untabulated logistic panel regression; p = 0.000). Another reason for this finding is that subjects in the additional savings decision anchor on the tax refund. While individuals under immediate taxation have only the tax refund from prepayments, individuals under deferred taxation have also been shown the much smaller tax benefit from savings. In the case of deferred taxation with an additional tax refund from prepayments, for a total of 22% of the decisions, the amount of additional savings is exactly equal to the tax benefit from saving. This, in turn, leads to a 62% decrease in

[15] Although the choices in the no-tax treatment are not biased by taxes, we observe two effects that cannot be explained by our rational choice model: First, we find that consumption is significantly higher in the pension phase than in the income phase. Therefore, subjects do not smooth their consumption across all periods. This behavior in the experimental life-cycle has already been observed in other studies (e.g., Yamamori et al. 2018). Second, consistent with our theoretical model, we find that the savings rate increases over time. Subjects, however, do not adequately adjust their savings to increasing income. Thus, consumption increases during the periods of the income phase. However, since these effects are also observed in the other treatments, this does not affect the reported results.

savings decisions anchored at the total tax refund under deferred taxation compared to immediate taxation (Fisher's exact test; $p = 0.001$).

Recent research indicates a significant gap in savings between immediate and deferred taxation. Blaufus and Milde (2021) find lower effective savings under deferred than under immediate taxation due to subjects that underweight the pension tax under deferred taxation. Because the additional savings decision at tax time significantly increases savings in both tax systems, it might also reduce the gap in *effective* savings. To shed light on this question, we first more closely examined the savings gap in treatments without an additional savings option. The comparison of effective savings in the two tax systems with a regular savings decision confirms previous findings (*Regular_No*: Deferred taxation 27.9 vs. Immediate taxation 35.2; $p < 0.001$). Furthermore, in line with prior research (Blaufus and Milde 2021; Tschinkl et al. 2021), we also find that the savings decisions under immediate taxation do not differ from the no-tax treatment (*NoTax* 36.1 vs. *Regular_No*: Immediate taxation 35.2; $p = 0.628$). By contrast, effective (i.e., after-tax) savings are significantly smaller under deferred taxation than in the no-tax case (*NoTax* 36.1 vs. *Regular_No*: Deferred taxation 27.9; $p < 0.001$). This suggests that subjects neglect the deferred pension tax, although they mostly correctly perceive the tax benefit (Blaufus and Milde 2021). Next, we examine the savings gap in treatments with an additional savings opportunity. However, the savings gap remains statistically unchanged despite the additional savings opportunity (panel regression with controls [untabulated]; $p = 0.567$). We even find that the savings gap increases in the case of a tax refund from tax prepayments (panel regression with controls [untabulated]; $p = 0.051$).

Finally, to sustainably increase retirement savings, it is important that the positive effect of the additional savings opportunity at tax time does not vanish over time. Because subjects are regularly confronted with the additional savings option, the incentive for impulsive saving behavior could diminish over time. Consequently, the efficiency of the additional saving decision to increase retirement savings might decrease over time. To test the effect of time, we use our results in Table 3. The results in Models 1 and 2 indicate that the variable *Period* has no significant effect on the effective savings rate in the tax return under deferred taxation ($p = 0.284$) or immediate taxation ($p = 0.999$). The overall savings also do not decrease over time

(see *Period* in Models 5 and 6). Thus, the additional savings decision can improve savings behavior consistently over time.

This study has several implications for research. Our finding that the introduction of an additional savings opportunity at tax time increases total retirement savings supplements studies that examine ways to encourage private retirement savings using insights from behavioral economics (e.g., Madrian and Shea 2001; Benartzi and Thaler 2013; Dolls et al. 2018; Beshears et al. 2021). In particular, we contribute to the research stream that examines the usage of tax incentives to promote retirement savings. Whereas this research stream mainly investigates how to improve retirement savings made at the time of tax filing (e.g., Tufano 2011; Grinstein-Weiss et al. 2017; Roll et al. 2020), our study addresses the underlying question of whether the additional savings opportunity leads to more total savings at all. Future research could further investigate this finding. For example, it is of interest whether the impulsive savings behavior at tax time results in different investment behavior compared to savings made during the tax year. Moreover, our finding that a deferred taxation of retirement savings may be less effective than an economically equivalent immediate taxation confirms prior findings from lab experiments that have used students as subjects (Blaufus and Milde 2021; Tschinkl et al. 2021). We show that this result is robust to variations in the subject pool and experimental environment. Furthermore, the robustness of this result emphasizes that researchers should consider potential tax misperceptions in the design and analysis of tax incentives as these misperceptions have a large impact on decision making (for a recent literature review see Blaufus et al. 2022). Finally, our results show that the nudging of impulsive savings behavior that has previously been investigated mainly in the context of impulsive buying (e.g., Hausman 2000; Ruvio and Belk 2013; Bellini et al. 2017) could be of great interest for future research.

Regarding the policy implications of this study, we would highlight three important implications: First, the introduction of an additional savings opportunity at tax time can increase savings for retirement. Our results demonstrate that an additional option for retroactive savings in the tax return increases the effective savings rate by almost 5 percentage points. This effect size is similar to that achievable by providing detailed numerical pension tax information as measured by Blaufus and Milde (2021). However, saving at tax time is an easier and less costly way to

promote retirement savings. Second, the positive savings incentive of the additional savings decision seems to be largely independent of the retirement tax system. If anything, we find advantages under immediate taxation. Due to tax misperceptions under deferred taxation, the benefits of immediate taxation should be considered in the policy process. Third, the positive effect of the additional savings opportunity on overall savings seems to be independent of the salience of tax return information as well as the result of the tax return. According to this, the positive savings effect cannot be explained by the fact that the savings decisions were retrospective. Conversely, this means that the same result can also be achieved with prospective savings contributions. In this case, the additional savings in the tax return would only lead to a tax refund in the following year, which would be much easier to implement in practice.

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Online Appendix to:

Saving at Tax Time: Do Additional Retroactive Savings Opportunities Increase Retirement Savings?

A Descriptive Statistics

Table A1: Descriptive Statistics

Variables	Mean	Standard Deviation
Male	52.7%	49.9%
Age 18-25	17.9%	38.4%
Age 26-35	33.1%	47.1%
Age 36-45	17.6%	38.1%
Age 46-60	16.9%	37.5%
Age 61+	14.4%	35.2%
University Degree	50.5%	50.0%
Income €0-1,000	26.3%	44.0%
Income €1,001-2,000	30.7%	46.1%
Income €2,001-3,000	27.8%	44.8%
Income €3,001+	15.1%	35.9%
Married	38.5%	48.7%
Self-employed	8.9%	28.4%
Tax Knowledge	23.8%	42.6%
Cognitive Ability	35.5%	47.9%
Tax Aversion	43.8%	49.6%
Non Risk-averse	14.4%	35.2%
Loss Aversion	40.8%	49.2%
Preference for Prepayment	84.9%	35.8%
Observations	1,433	

Note: We define our control variables *Male*, *Age*, *University Degree*, *Income*, *Married*, *Self-employed*, *Tax Knowledge*, *Cognitive Ability*, *Tax Aversion*, *Non Risk-averse*, *Loss Aversion* and *Preference for Prepayment* in Section 3.3.2.

B Online Experiments

This appendix contains the experimental instructions (Section B.1), screenshots of oTree (Section B.2) and the questionnaire (Section B.3). The presented experimental procedures were originally written in German and translated into English. We show information that is identical for all treatments and display specific treatment manipulations in square brackets.

B.1 Instructions (translated from German)

B.1.1 Welcome Page

Welcome to our Study

Thank you for participating in this study. Before the study begins, please read the following carefully.

1. Procedure and Duration
In this study, several savings decisions have to be made. Furthermore, there are some questions regarding savings behavior and other socio-demographic characteristics. Please answer all questions carefully and pay attention to the control questions, which should sharpen your attention. In total, the study should take about 20 minutes.

Participation in this study is completely voluntary. If you stop the study in between, you will not be penalized, but you will not receive any compensation either.

2. Purpose of this Research Study
This study examines your general savings behavior over a life-cycle.

3. Compensation
You will receive a fixed compensation of €2.00 for completing the study. In addition, you will receive a variable compensation. The amount depends on your decisions and luck. In the following instructions you will learn how your variable compensation is calculated. The average variable compensation is €3.00.

Please note the following: We attach great importance to you conscientiously completing the task in this study and answering the questions honestly. Therefore, we will pay you an appropriate compensation. We will reject your HIT in the following cases:

- **You do not read the instructions carefully.**
- **You do not read the questions carefully or answer not conscientiously.**

4. Benefit of the Study
This study will help the research team to learn more about human behavior. We hope that in the future, other people could benefit from this study through a better understanding of savings behavior.

5. Possible Risks of the Study
In this study, no risks or unfavorable effects are expected beyond what would normally be experienced in daily life.

6. Confidentiality
The information you provide will be kept strictly confidential. Only the project manager and his or her staff will have access to the raw data. Anonymized data from this study may be shared with qualified researchers or research institutions when deemed appropriate in accordance with academic association, journal, or university policies. All reports from this study will be at an aggregate level and/or with individual information anonymized or disguised so that participants cannot be identified. We will not share information that identifies you with others unless we are required to do so by law.

7. Contact Details
This study is conducted by XXX from the YYY university. If you have any questions about the study, please contact me at XXX.

8. Declaration of Consent
By clicking on *Next* you confirm that you have read the points above and that you agree to participate in the study.

B.1.2 Instructions Training Sequence

Structure of the Study

The study consists of a **comprehension test**, a **training sequence**, another **comprehension test**, **a decision sequence** and a subsequent **questionnaire**.

Next you receive instructions for the training sequence, which also applies to the subsequent decision sequence.

Training Sequence

Both the training sequence and the decision sequence are divided into an **income phase** and a **rest phase**. These contain several periods.

The training sequence includes a total of three periods in the income phase and two periods in the rest phase.

You receive a payoff in each period. Payoffs are given in a **fictitious currency** that we call **"ECU"**. 1,000.00 ECU correspond to €1.80. Your actual payoff is calculated at the end of the study from the "earned ECU" and is then converted into Euro.

Income Phase

1. Amount of Income
In each period of the **income phase** you will receive income. In the first period the income is 1,200.00 ECU. The income increases by 100.00 ECU in each period, so that you receive an income of 1,400.00 ECU in the last period.

2. Savings Decision
In each period of the income phase you have to decide again how much of your income you want to save for the rest phase. You will no longer receive any income from us during the rest phase.

3. Payoffs in the Income Phase
The payoffs of periods 1 to 3 in the income phase depend on your savings decisions in the respective periods. The **difference between the income and the savings contribution** is the payoff for the respective period.

Rest Phase

1. Amount of Income
In the rest phase, you will no longer receive any income from us. Your income in periods 4 to 5 depends only on your savings contributions in the income phase. In each period of the rest phase, you will receive the same amount of income that results from your total savings.

2. Information on Income during the Income Phase
You will receive savings information after each period of the income phase. On the one hand, you will be informed about your average savings contributions in the previous periods in the income phase. Based on these average savings contributions, you receive, on the other hand, information on how high your income would be in the rest phase.

Example: *In the previous periods, you saved an average of XXX ECU. If you save until the rest phase as much as you did on average in the last periods, amounting to XXX ECU, your payments in the rest phase resulting from the savings will correspond to YYY ECU.*

3. Payoffs in the Rest Phase
The income is your payoff amount of the respective period.

Comprehension Questions

Before the actual study starts, we would like you to answer the following comprehension questions. If you have any comprehension questions, you can always look at the instructions again.

Please note that we will reject your HIT if you have not read the instructions carefully and consequently do not answer the following question conscientiously.

Question 1: In which periods of this training sequence do you receive an income from us?

- ☐ Periods 1 to 3 (income phase).
- ☐ Periods 4 to 5 (rest phase).
- ☐ Periods 1 to 5 (income- and rest phase).

Question 2: Which of the following statements about the income in a period is correct?

- ☐ The income in the income phase increases with each period.
- ☐ The income in the income phase is the same in each period.

B.1.3 Instructions Decision Sequence

Structure of the Study

After you have become more familiar with the structure and content of the study in the training sequence, the actual study begins.

Next, you start with the **decision sequence** which includes **10 periods**. Otherwise, this decision sequence is identical to the training sequence. **However, your income is now subject to taxation.**

[Regular+Retroactive treatments only: **Furthermore, you have the opportunity to make another savings decision as part of the tax return.**]

[Retroactive treatments only: **Furthermore, you now make the savings decision in the income phase as part of the tax return.**]

You will find more information on this on the following page.

Income Phase

1. Taxation of Income
[Deferred and immediate taxation treatments only: As in the training sequence, you will receive an income from us in each period of the income phase. The gross (pre-tax) income amounts to 2,500.00 ECU in the first period and increases in each period by 100.00 ECU. Thus, you receive an income amounting to 3,100.00 ECU in period seven.

In each period, a tax prepayment will be withhold from your gross income. It is offset against the actual tax payment in the tax return. The actual tax rate is 30%. For example, if your **gross income** is 2,500.00 ECU, your **net income** would be 1,750.00 ECU. All tax payments in this experiment are used for further scientific research as well as for the fees incurred for this study.]

[No tax treatment only: As in the training sequence, you will receive an income from us in each period of the income phase. The income amounts to 1,750.00 ECU in the first period and increases in each period by 70.00 ECU. Thus, you receive an income amounting to 2,170.00 ECU in period seven.]

2. Savings Decision and Savings Product
In each period of the income phase you have to decide again how much of your income you want to save for the rest phase. You will no longer receive any income from us during the rest phase.

One savings product is available to you - **Savings product A**.

3. Taxation of Savings
[Deferred taxation treatments only: **Savings product A**: In the income phase, your savings contributions to the savings product A are tax-deductible in the tax return. Accordingly, you will receive a tax refund in the amount of 30% of the savings contributions, which will additionally be paid to you in the respective period of the income phase.]

[Immediate taxation treatments only: **Savings product A**: In the income phase, your savings contributions to the savings product A are not tax-deductible. Accordingly, you will not receive a tax refund for the savings contributions.]

4. Tax Return
[Regular treatments with deferred taxation only: After you have made your savings decision, the next step is to complete a tax return. To do this, please enter your gross income and the savings contribution for savings product A, which can be claimed for tax purposes, in your tax return.]

[Regular+Retroactive treatments with deferred taxation only: After you have made your savings decision, the next step is to complete a tax return. To do this, please enter your gross income and the savings contribution for savings product A, which can be claimed for tax purposes, in the tax return. You can also make an additional savings decision for the rest phase in your tax return.]

[Retroactive treatments with deferred taxation only: After you have received an information about the amount of your income in the respective period, you must fill out a tax return. To do this, please enter your gross income and the savings contribution for savings product A, which can be claimed for tax purposes, in the tax return. In addition, you must make your savings decision for the rest phase in the tax return.]

[Regular treatments with immediate taxation only: After you have made your savings decision, the next step is to complete a tax return. To do this, please enter your gross income in the tax return.]

[Regular+Retroactive treatments with immediate taxation only: After you have made your savings decision, the next step is to complete a tax return. To do this, please enter your gross income in the tax return. You can also make an additional savings decision for the rest phase in the tax return.]

[Retroactive treatments with immediate taxation only: After you have received an information about the amount of your income in the respective period, you must fill out a tax return. To do this, please enter your gross income in the tax return. In addition, you must make your savings decision for the rest phase in the tax return.]

5. Payoffs in the Income Phase
The payoffs for periods 1 to 7 in the income phase depend on your savings decisions in the respective periods.

[Deferred taxation treatments only: The **difference between the net income and the savings contribution plus the tax refund** yields the payoff amount of the respective period.]

[Immediate taxation treatments only: The **difference between the net income and the savings contribution** yields the payoff amount of the respective period.]

[No tax treatment only: The **difference between the income and the savings contribution** yields the payoff amount of the respective period.]

Rest Phase

1. Taxation of the Income resulting from the Savings Contributions
[Deferred taxation treatments only: The gross income from savings product A is subject to a tax of 30%.]

[Immediate taxation treatments only: The gross income in the rest phase is tax-free.]

2. Payoffs in the Rest Phase
[Deferred taxation treatments only: The gross income less taxes constitutes the payoff for the respective period.]

[Immediate taxation treatments only: The gross income is the payoff for the respective period.]

[No tax treatment only: The income is the payoff for the respective period.]

Compensation

1. Fixed Compensation
You receive a fixed compensation of €2.00.

2. Variable Compensation
Depending on how you have distributed your income, the corresponding remuneration will be paid. A random

generator determines which of the total 10 periods of the decision sequence will be paid out. Consequently, only one period is remunerated! The payoff of the randomly drawn period will be converted in Euro.

You can also earn additional money later in the questionnaire.

Comprehension Questions

Before the actual study starts, we would like you to answer the following questions. If you have any questions about understanding, you can look at the instructions again at any time.

Please note that we will reject your HIT if you have not read the instructions carefully and consequently do not answer the following question conscientiously.

Question 1: Which of the following statements regarding the compensation at the end of the study is correct?

- ☐ The average payoff amount for all periods is paid at the end of the study.
- ☐ The average payoff amount in the rest phase is paid at the end of the study.
- ☐ Only one of the total 10 periods will be remunerated at the end of the study.

[The following questions 2 - 4 were not asked in the no tax treatment]

Question 2: How is the gross income taxed in the income phase?

- ☐ The gross income is subject to a tax of 30%.
- ☐ The gross income is subject to a tax of 15%.
- ☐ The gross income is tax-free.

Question 3: How are the savings contributions taxed in the income phase?

- ☐ The savings contributions can be claimed as tax-deductible. Accordingly, you will receive a tax refund of 30% of the savings contributions.
- ☐ The savings contributions cannot be claimed as tax-deductible. Accordingly, you will not receive any tax refund.

Question 4: How is the gross income resulting from the savings contributions taxed during the rest phase?

- ☐ The gross income in the rest phase is tax-free.
- ☐ The gross income in the rest phase is subject to a tax of 30%.

Question 5: Suppose you save nothing for the entire seven periods of the income phase, and at the end of the study, one period of the rest phase is paid out. What is then your payout in one period of the rest phase?

- ☐ Zero Euro.
- ☐ The average income for periods 1 to 7.

B.2 Screenshots of oTree (translated from German)

B.2.1 Screenshots: Training Sequence

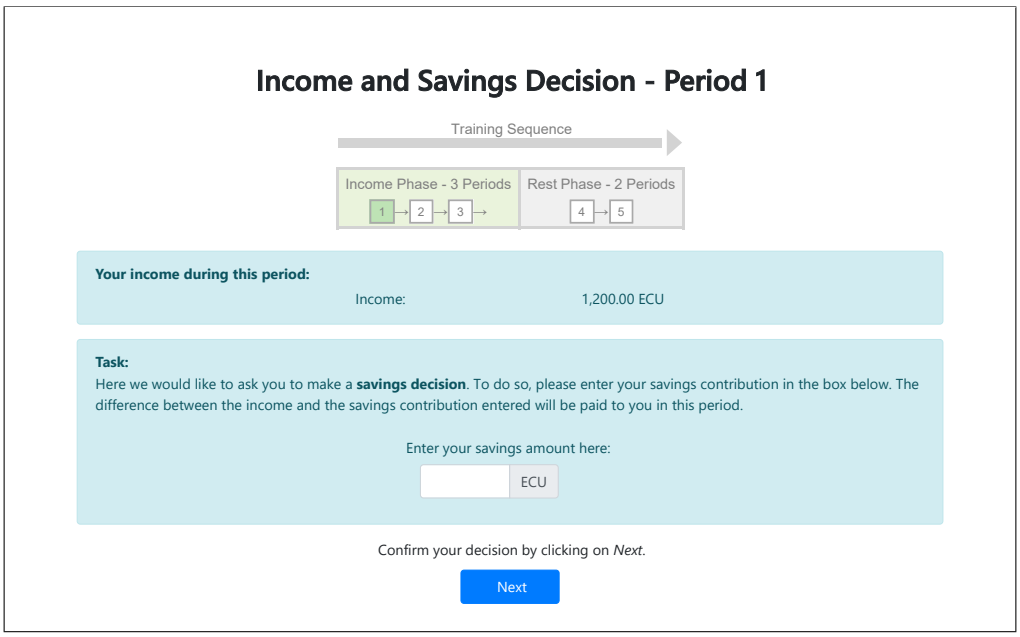


Figure B1: Training Sequence: Savings Decision

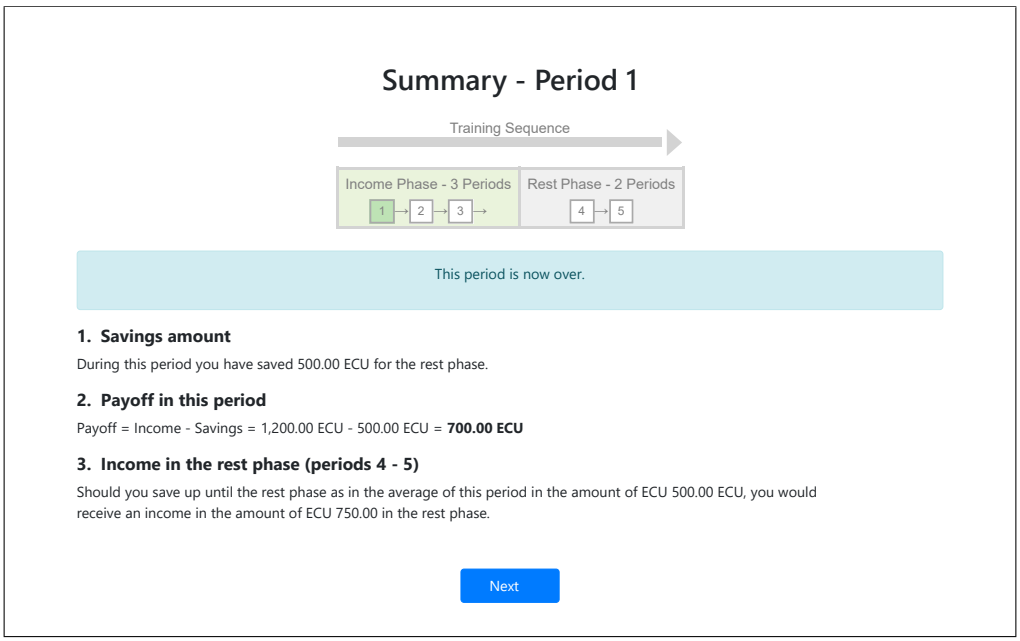


Figure B2: Training Sequence: Period Summary

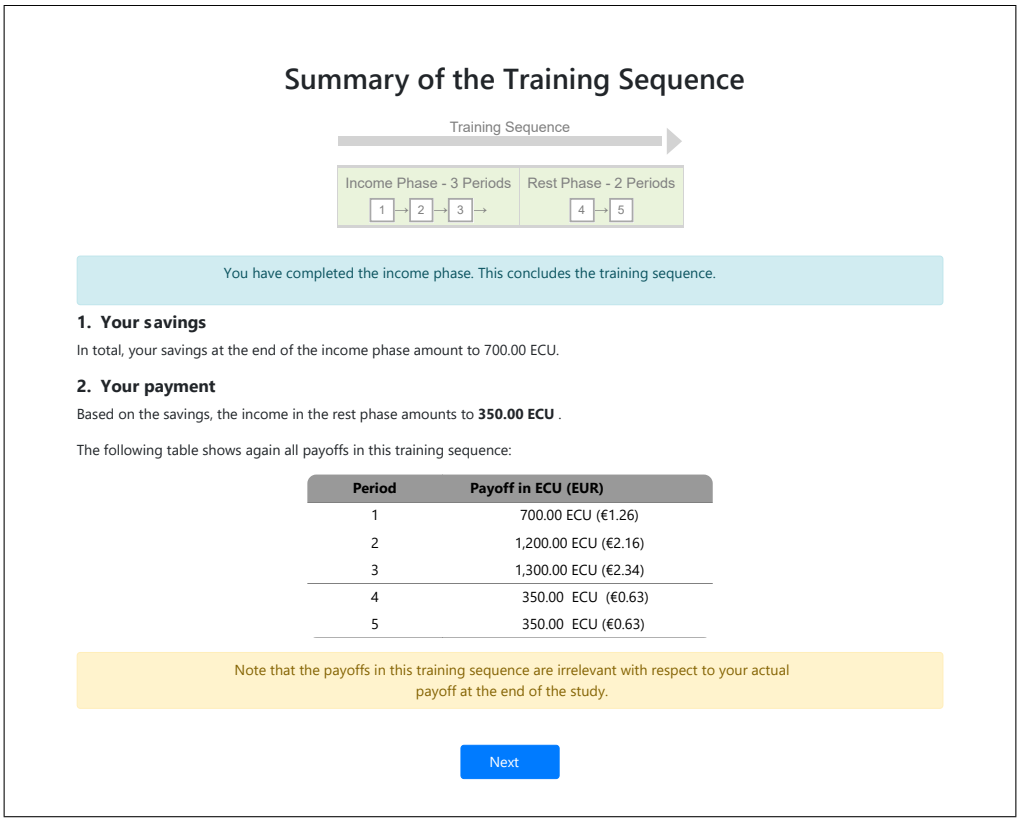


Figure B3: Training Sequence: Summary Training Sequence

B.2.2 Screenshots: Decision Sequence

Savings Decision Income Phase

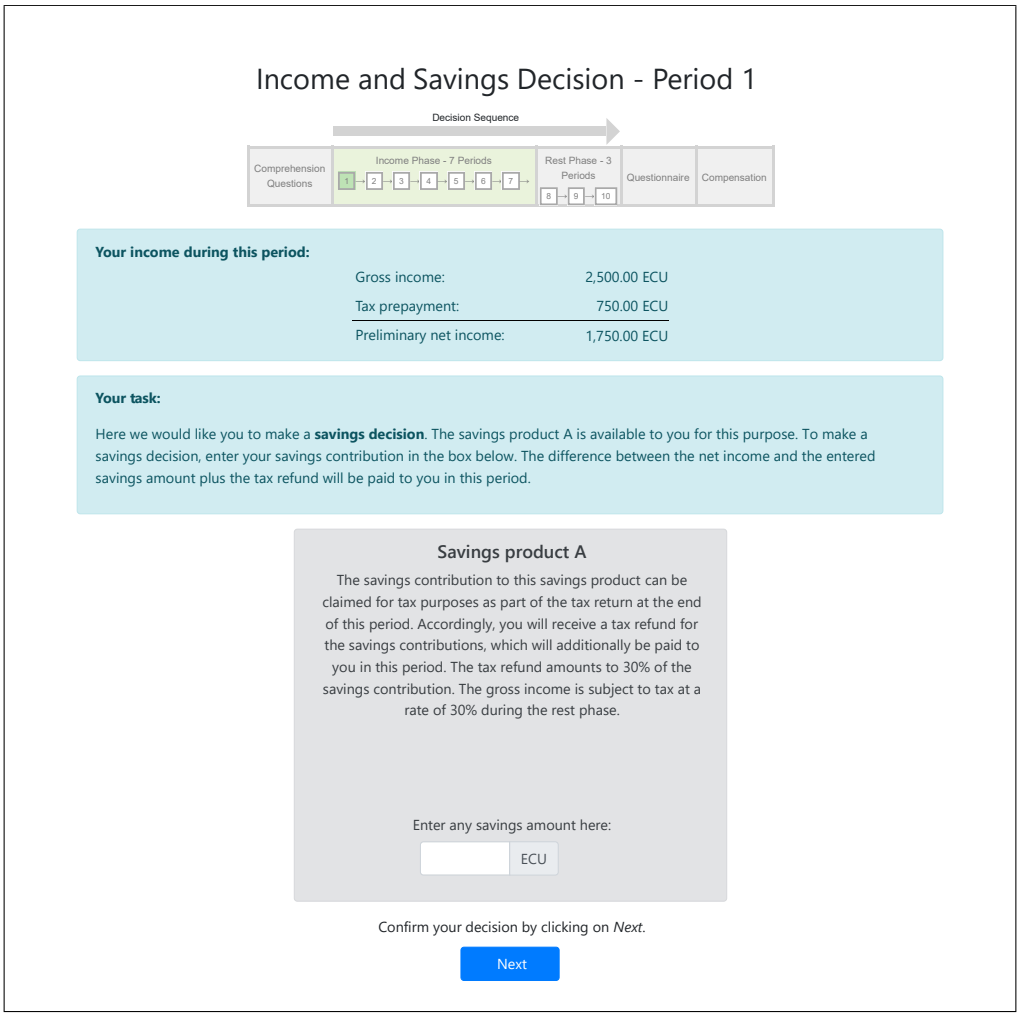


Figure B4: Decision Sequence: Savings Decision Income Phase - Regular and Regular+Retroactive Treatments with Deferred Taxation and No Initial Tax Refund or Back Tax

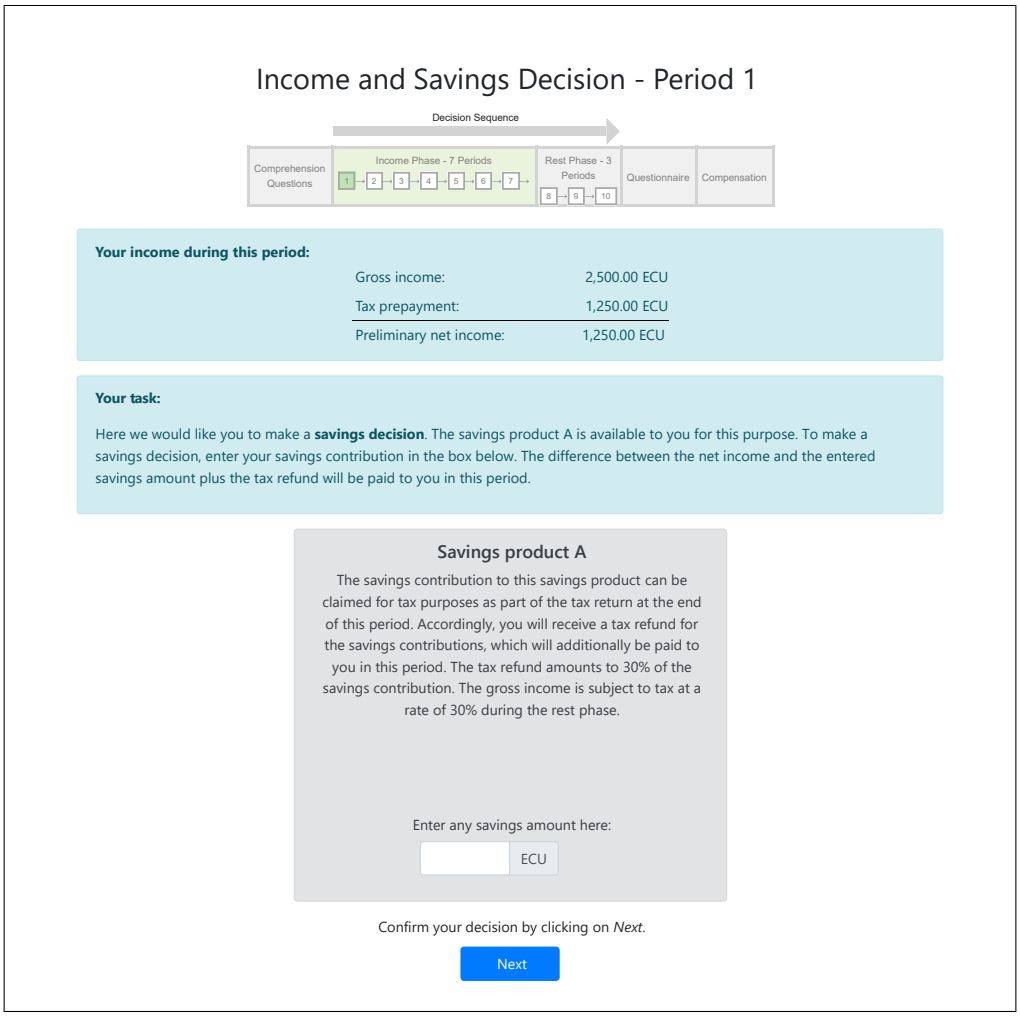


Figure B5: Decision Sequence: Savings Decision Income Phase - Regular and Regular+Retroactive Treatments with Deferred Taxation and Initial Tax Refund

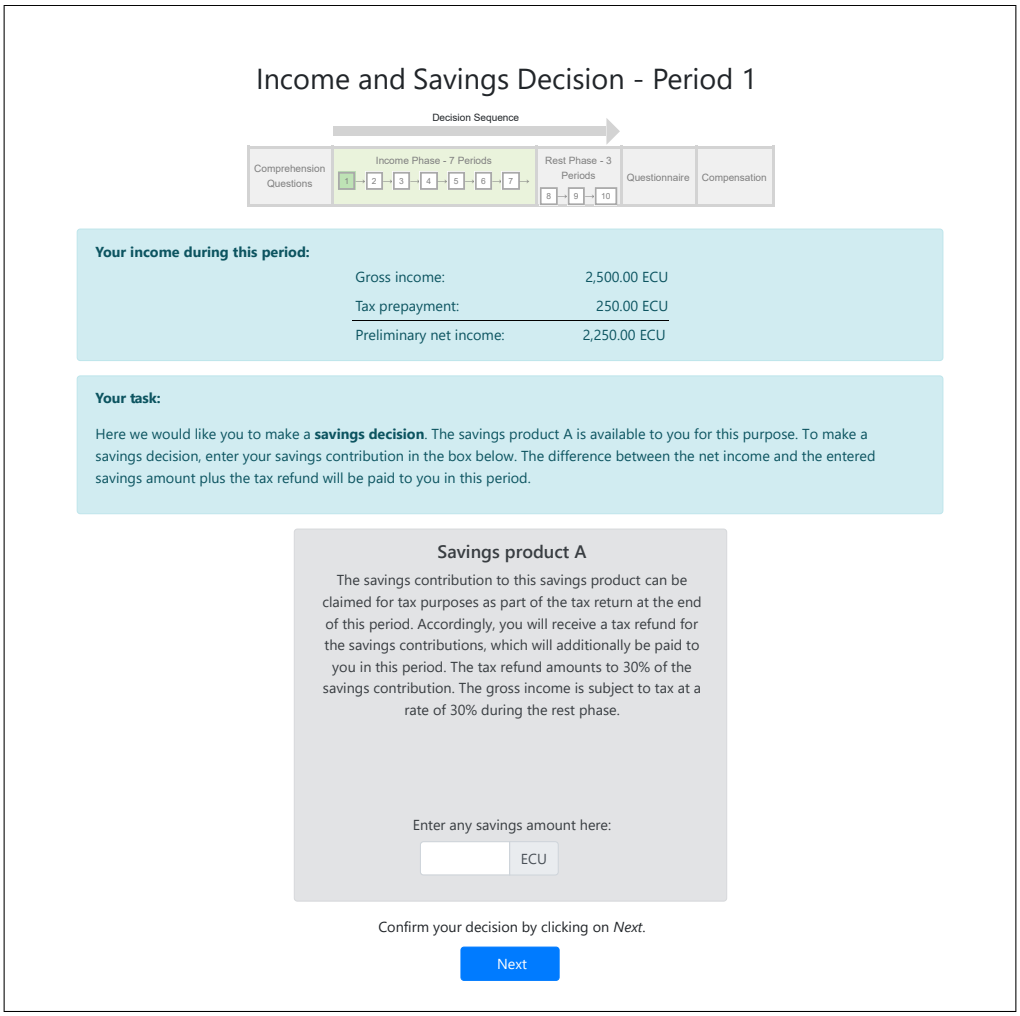


Figure B6: Decision Sequence: Savings Decision Income Phase - Regular and Regular+Retroactive Treatments with Deferred Taxation and Initial Back Tax

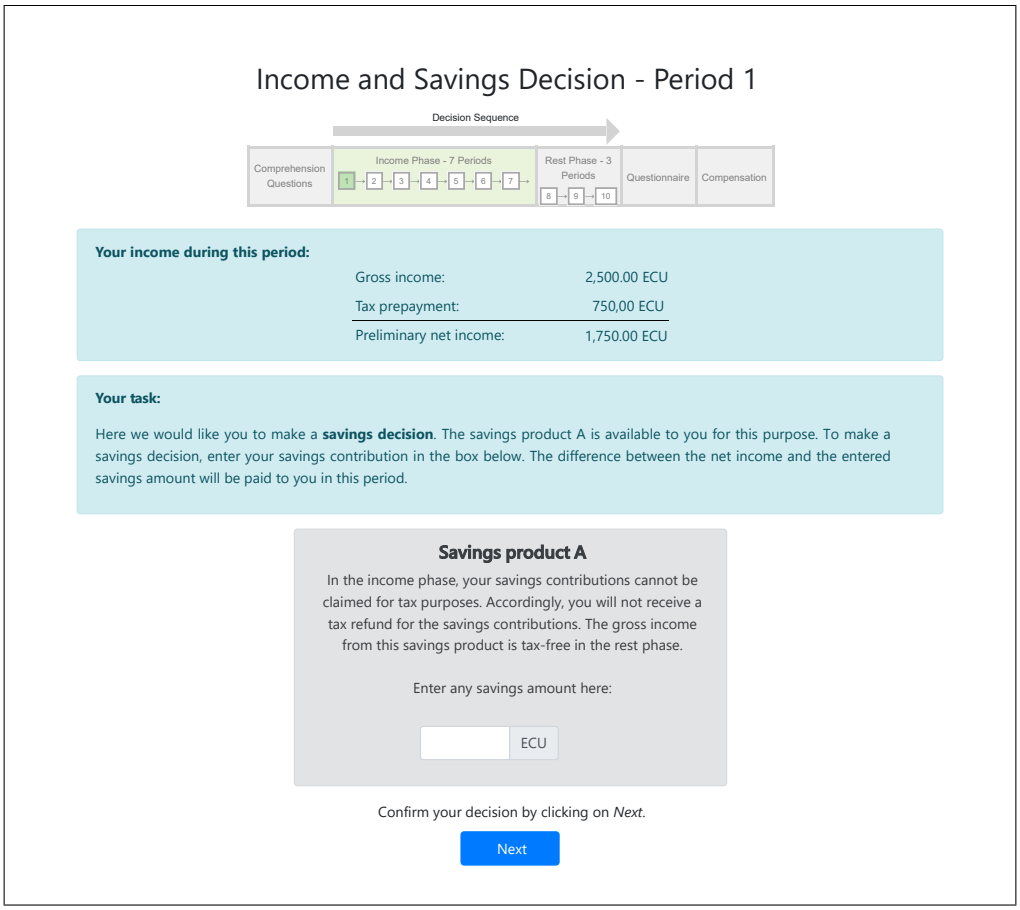


Figure B7: Decision Sequence: Savings Decision Income Phase - Regular and Regular+Retroactive Treatments with Immediate Taxation and No Initial Tax Refund or Back Tax

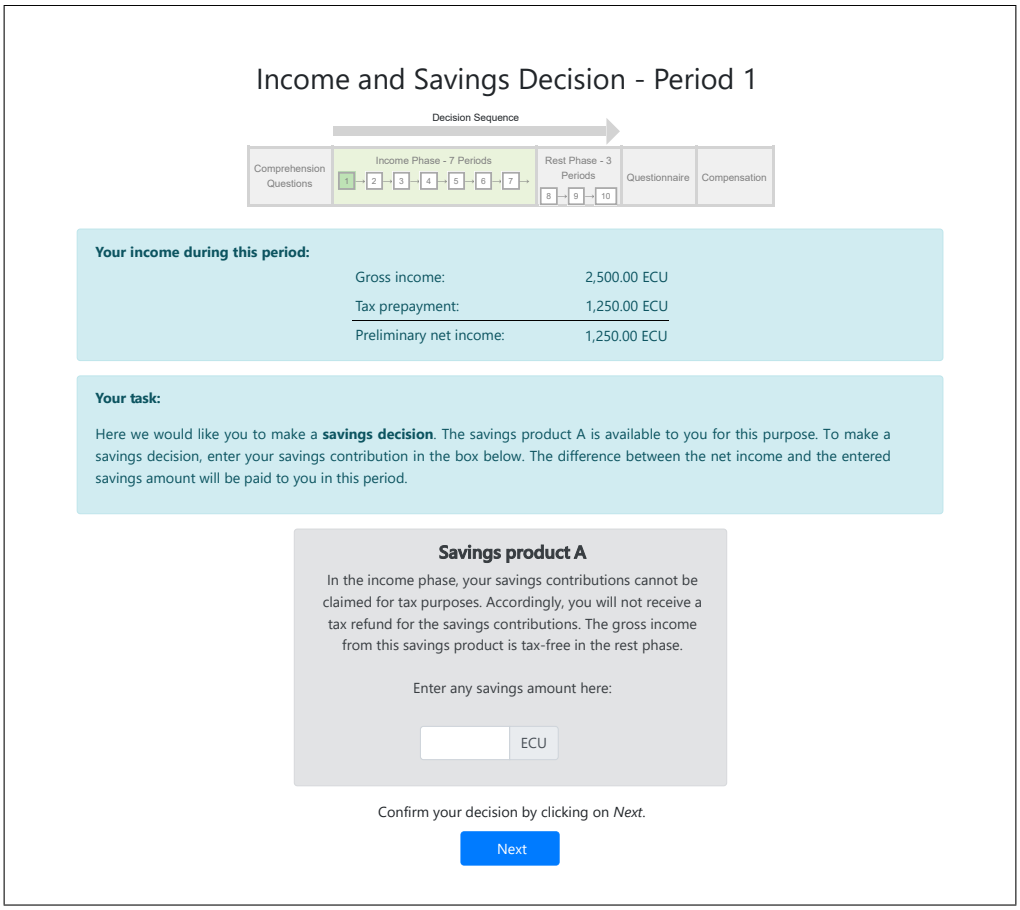


Figure B8: Decision Sequence: Savings Decision Income Phase - Regular and Regular+Retroactive Treatments with Immediate Taxation and Initial Tax Refund

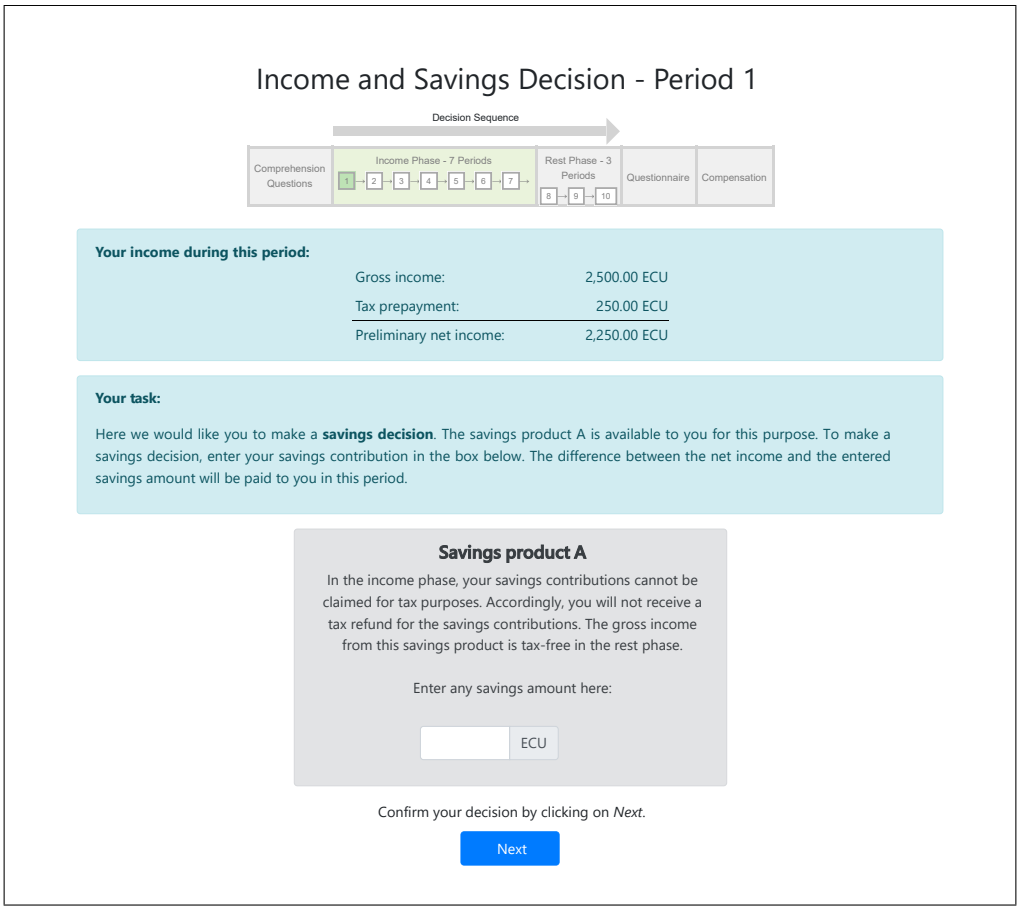


Figure B9: Decision Sequence: Savings Decision Income Phase - Regular and Regular+Retroactive Treatments with Immediate Taxation and Initial Back Tax

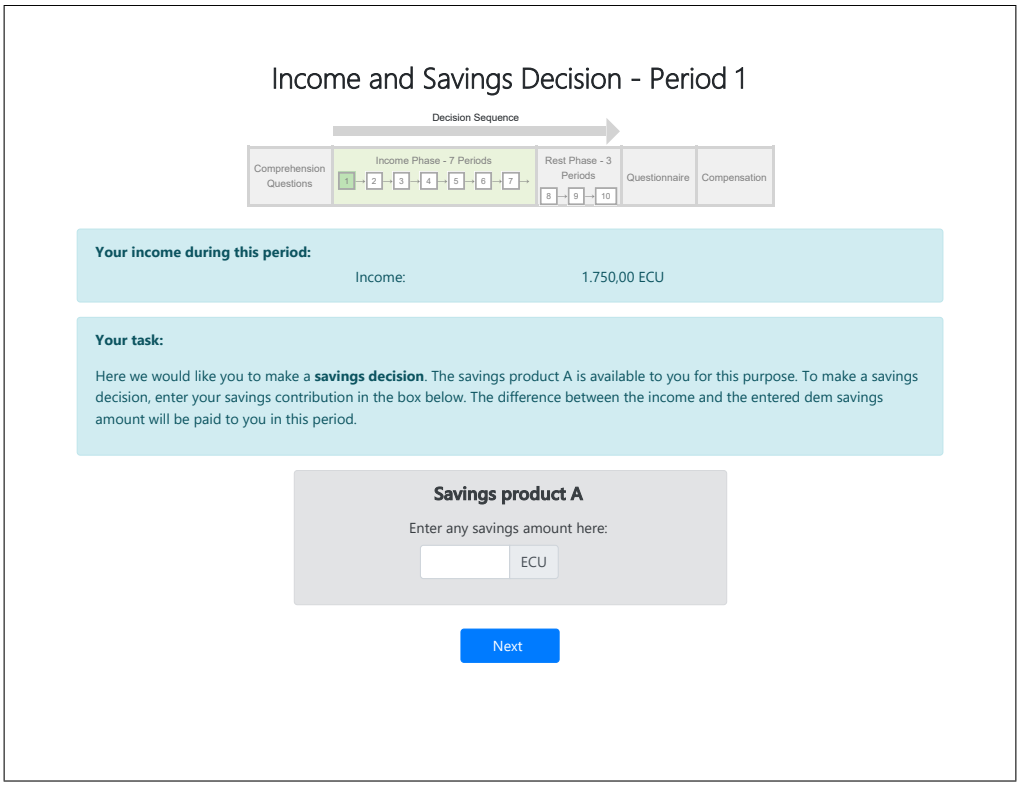


Figure B10: Decision Sequence: Savings Decision Income Phase - No Tax Treatment

Savings Decision Tax Return

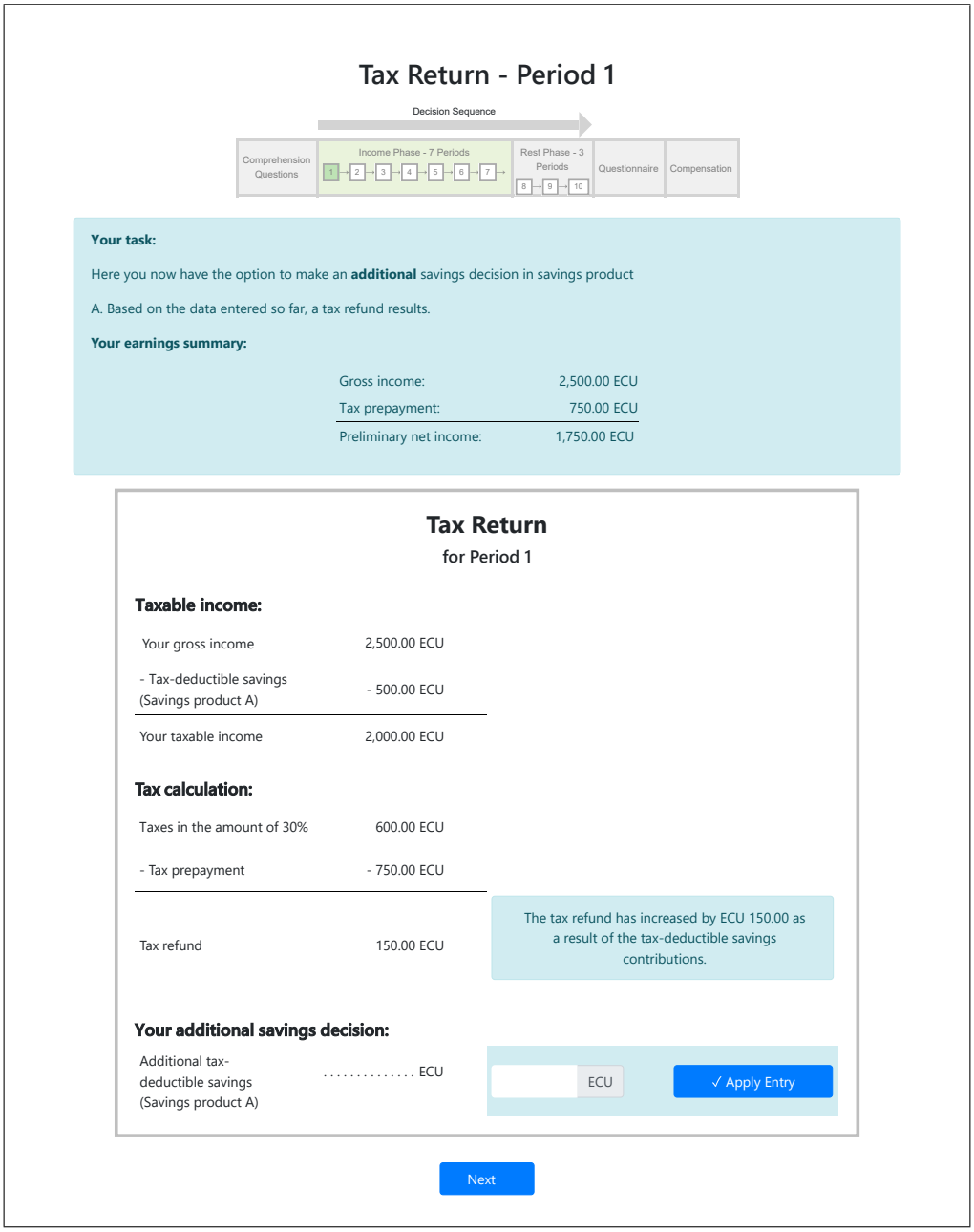


Figure B11: Decision Sequence: Savings Decision Tax Return - Regular+Retroactive Treatments with Deferred Taxation and No Initial Tax Refund or Back Tax

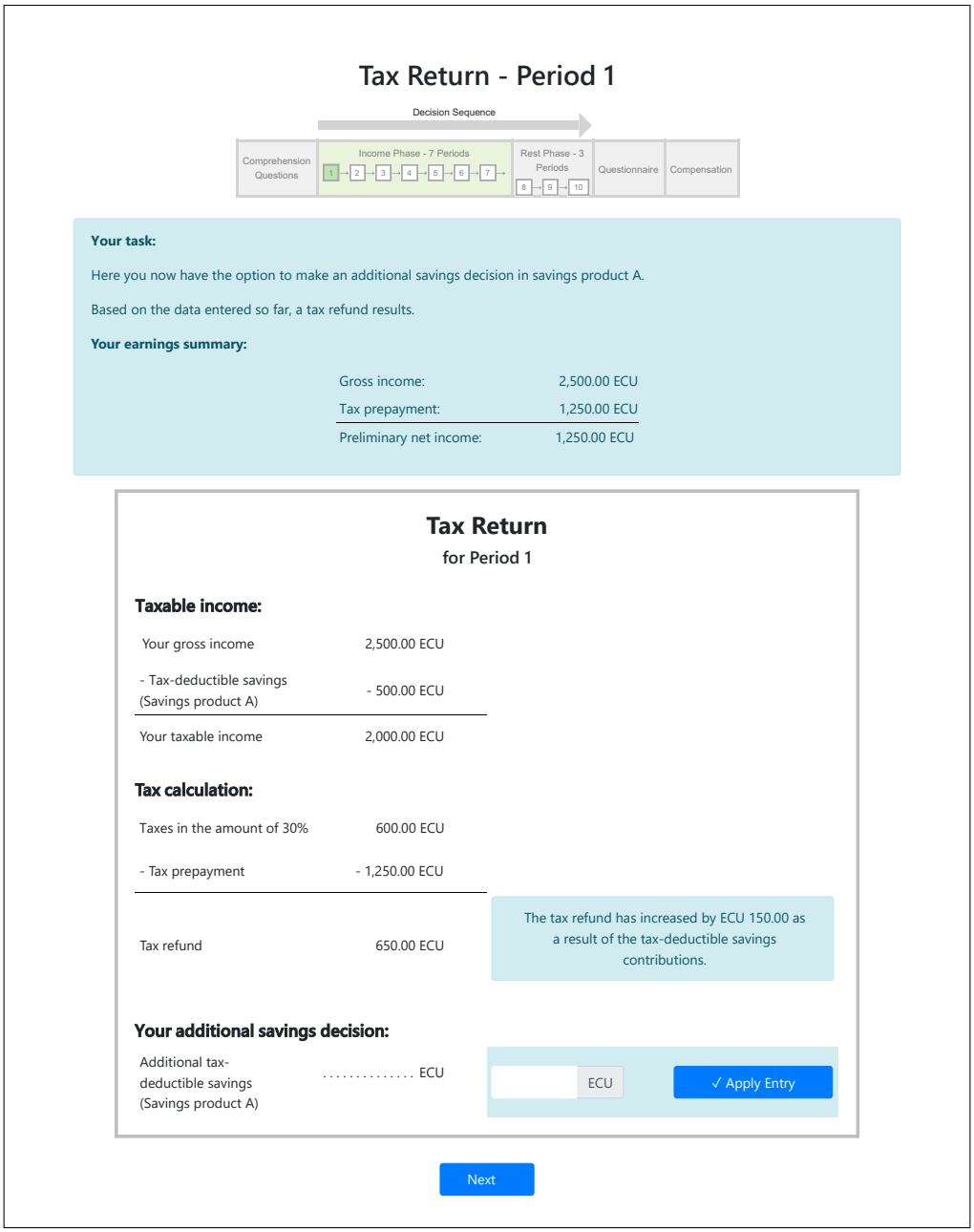


Figure B12: Decision Sequence: Savings Decision Tax Return - Regular+Retroactive Treatments with Deferred Taxation and Initial Tax Refund

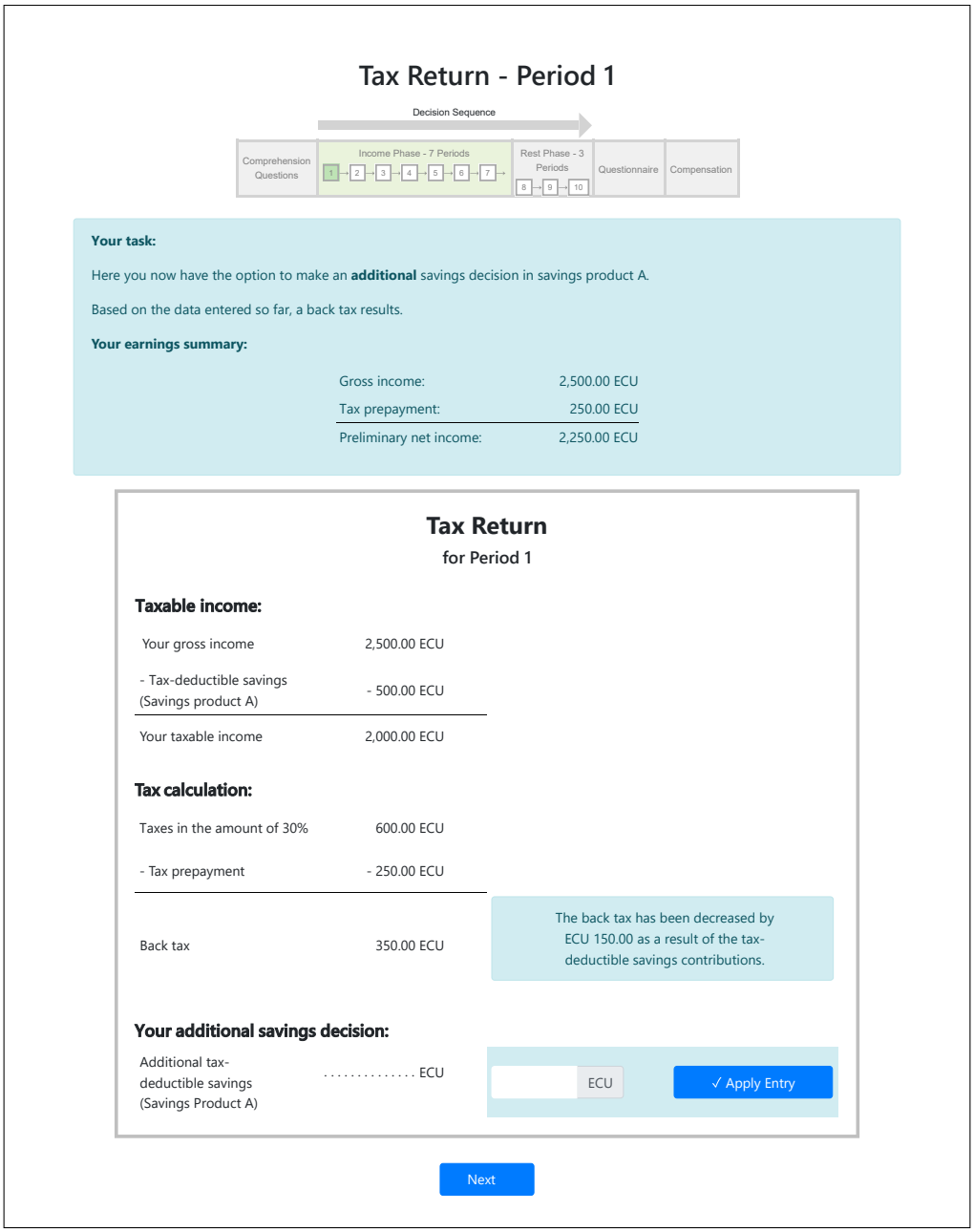


Figure B13: Decision Sequence: Savings Decision Tax Return - Regular+Retroactive Treatments with Deferred Taxation and Initial Back Tax

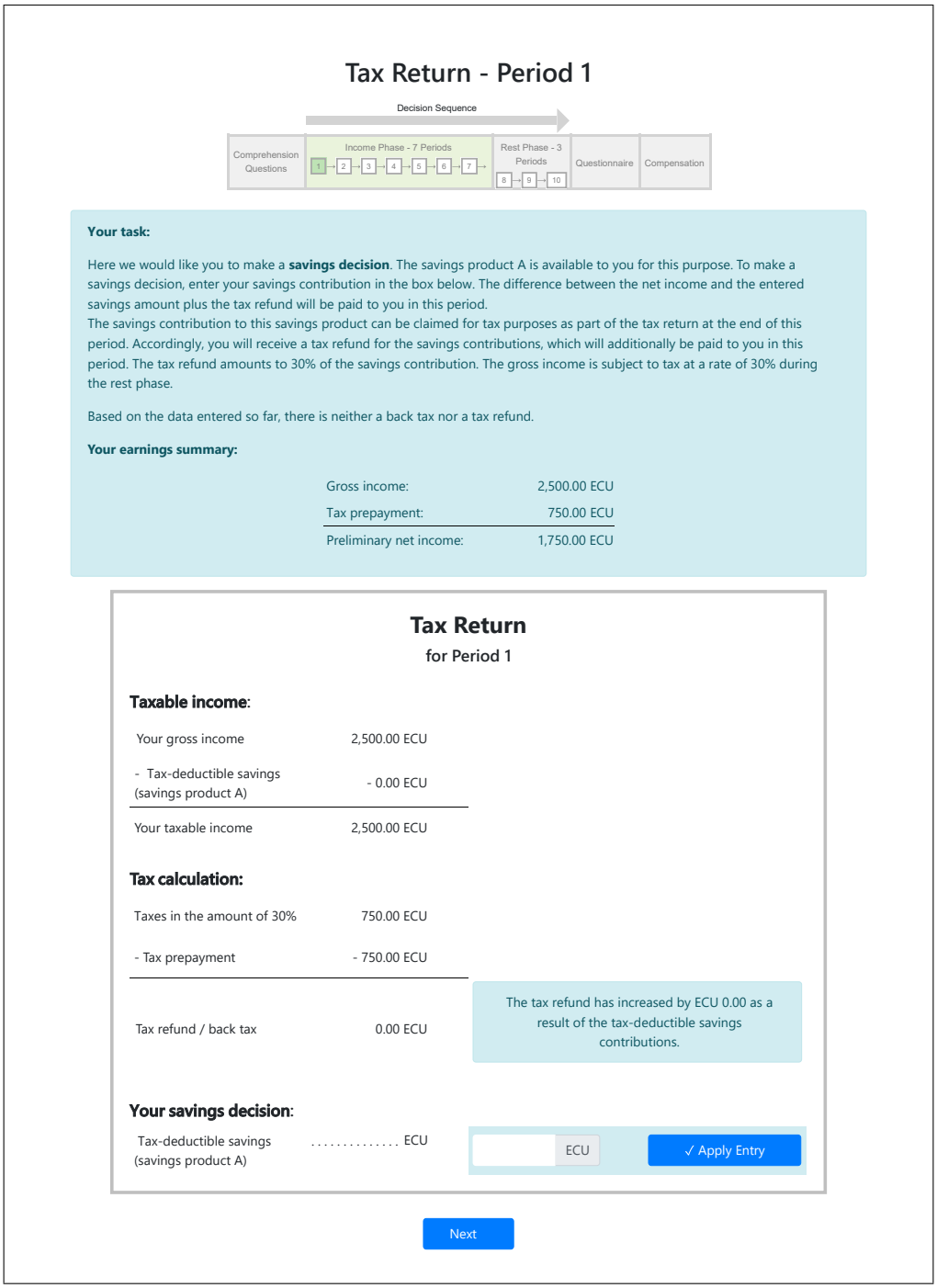


Figure B14: Decision Sequence: Savings Decision Tax Return - Retroactive Treatments with Deferred Taxation and No Initial Tax Refund or Back Tax

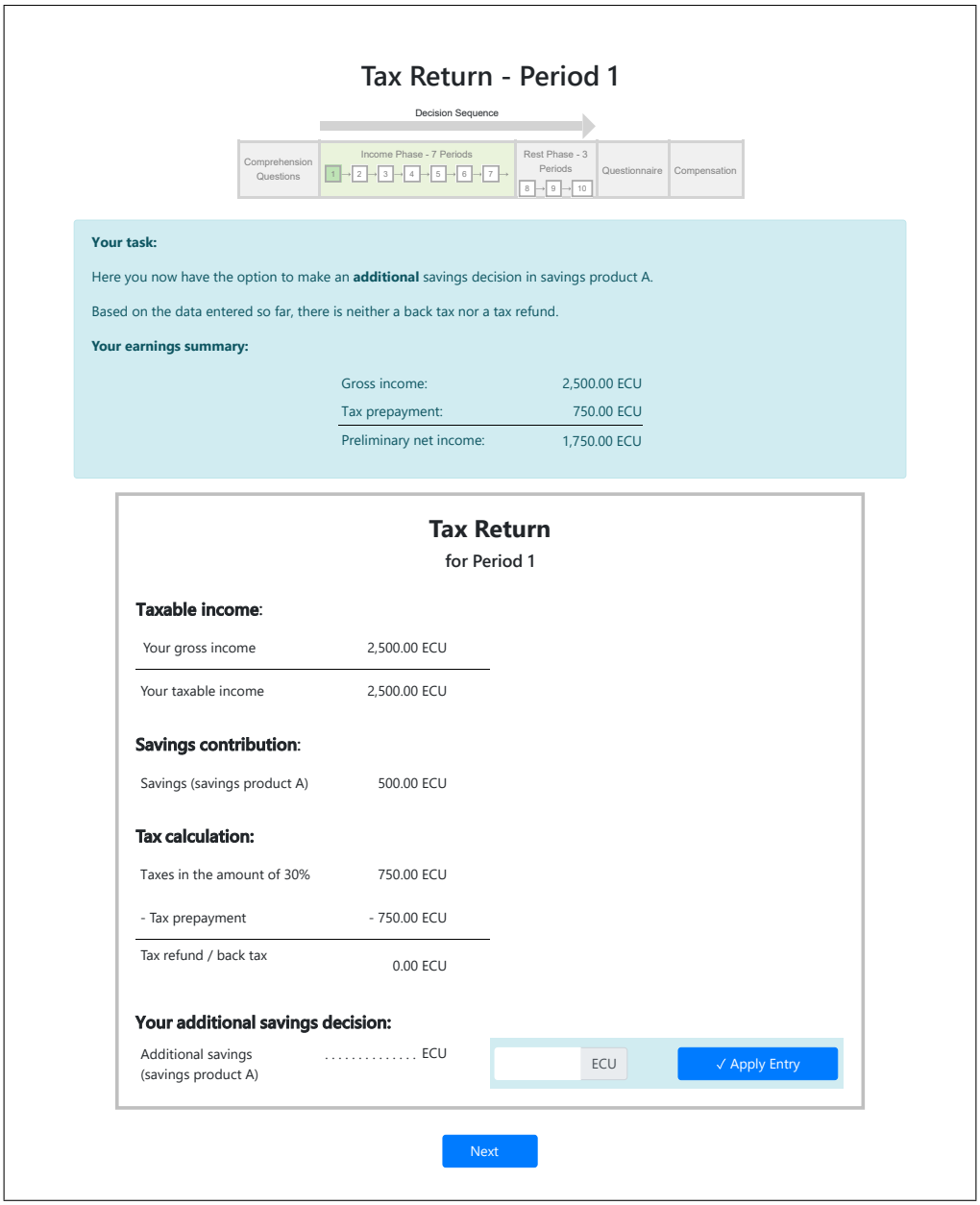


Figure B15: Decision Sequence: Savings Decision Tax Return - Regular+Retroactive Treatments with Immediate Taxation and No Initial Tax Refund or Back Tax

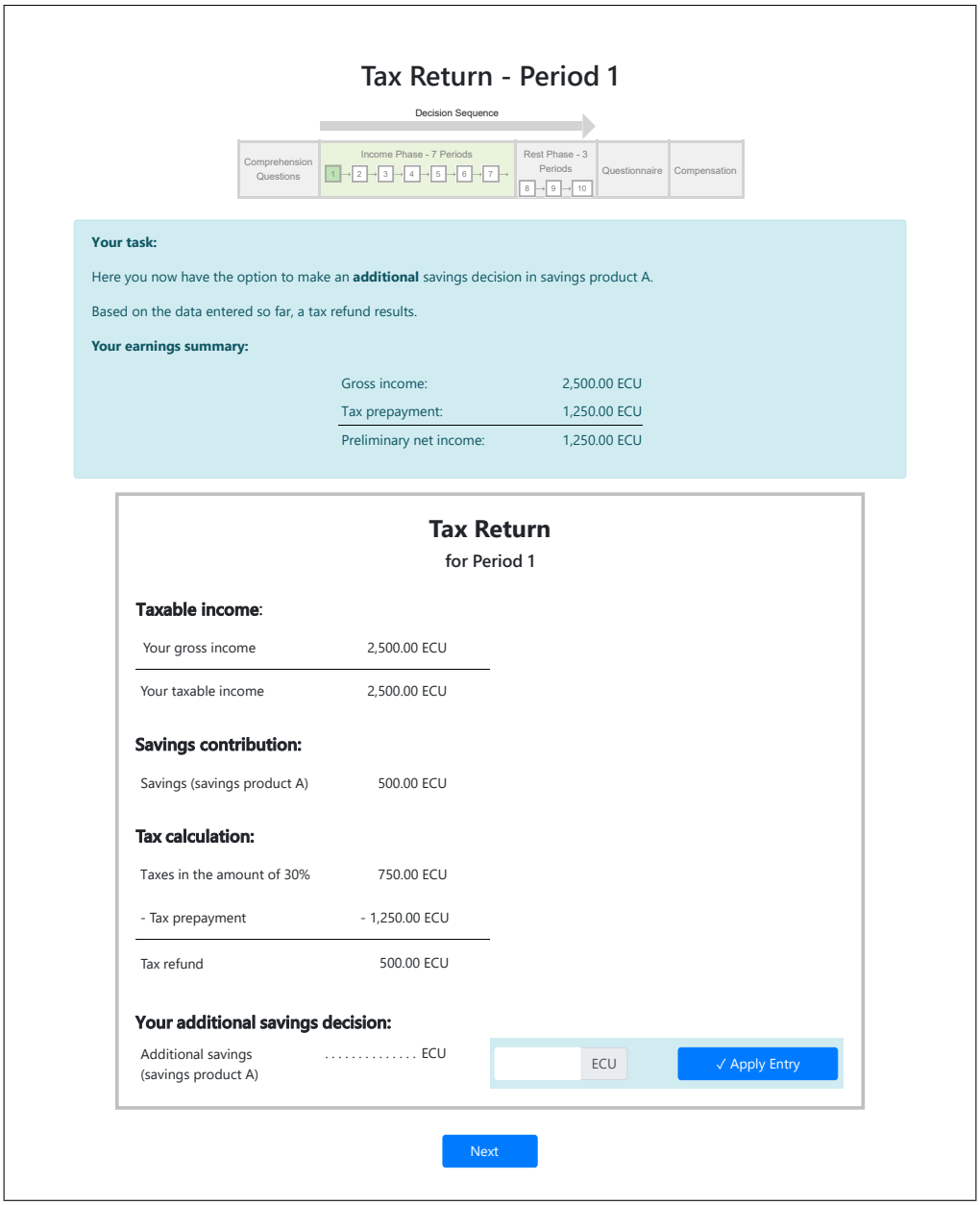


Figure B16: Decision Sequence: Savings Decision Tax Return - Regular+Retroactive Treatments with Immediate Taxation and Initial Tax Refund

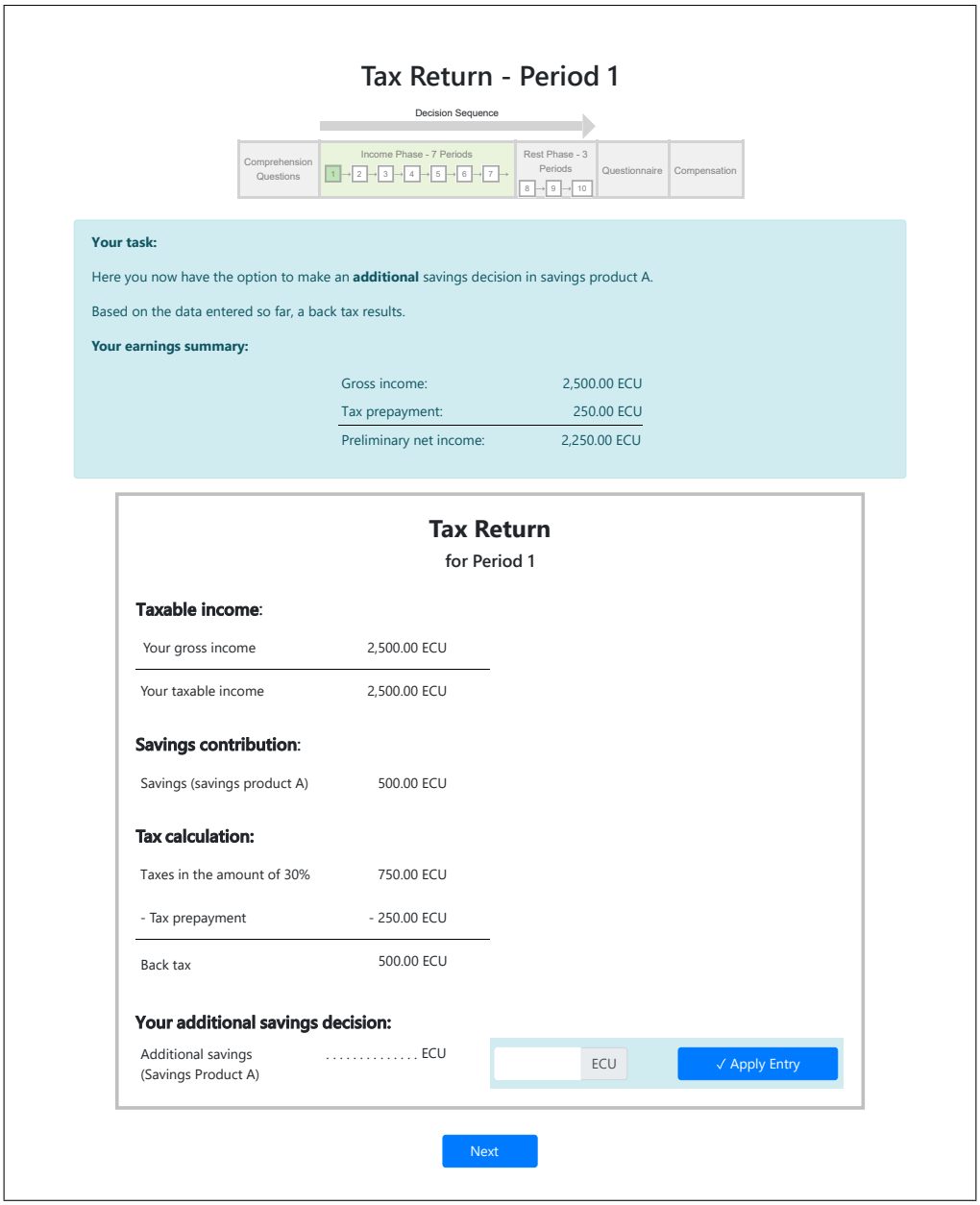


Figure B17: Decision Sequence: Savings Decision Tax Return - Regular+Retroactive Treatments with Immediate Taxation and Initial Back Tax

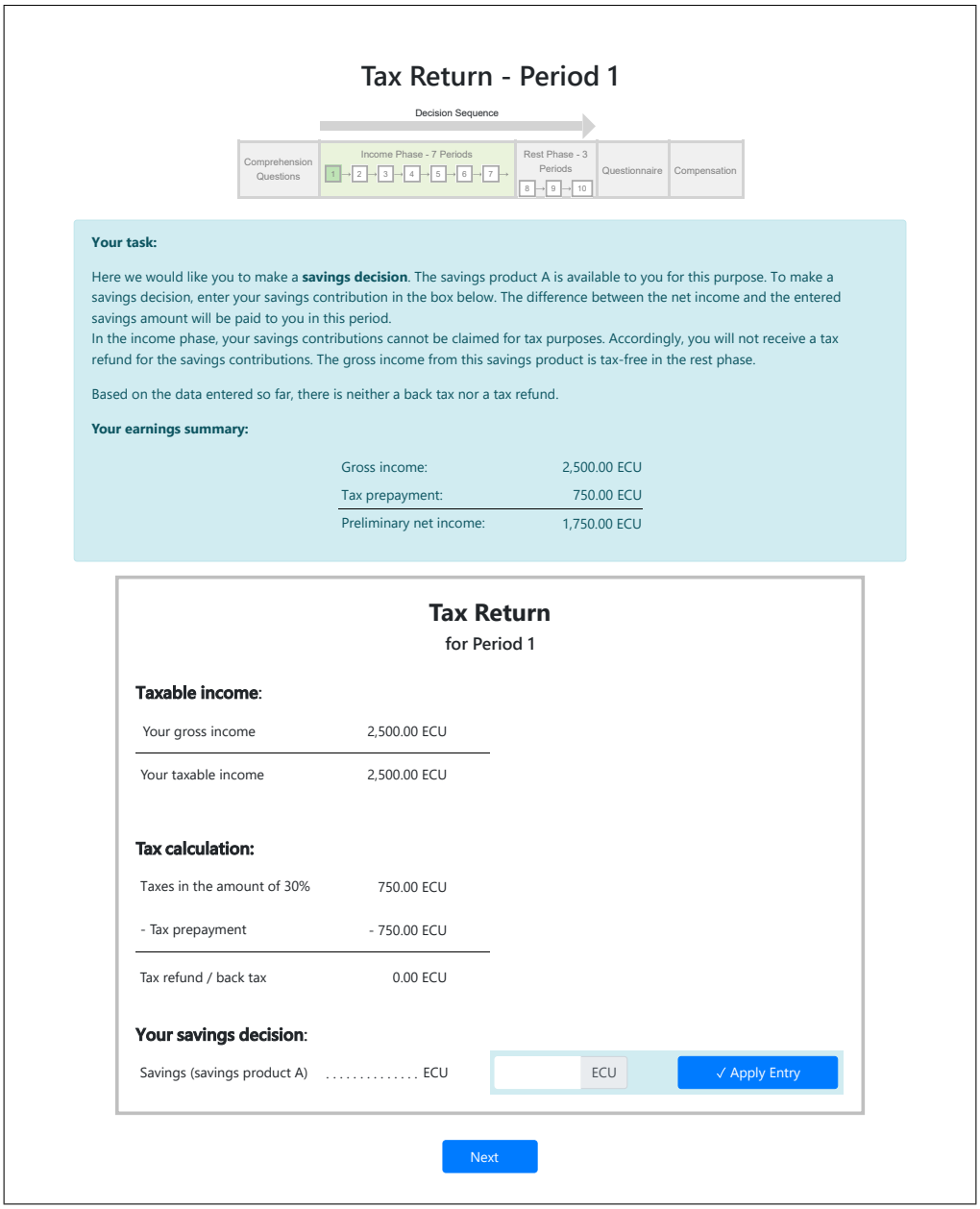


Figure B18: Decision Sequence: Savings Decision Tax Return - Retroactive Treatments with Immediate Taxation and No Initial Tax Refund or Back Tax

Period Summary

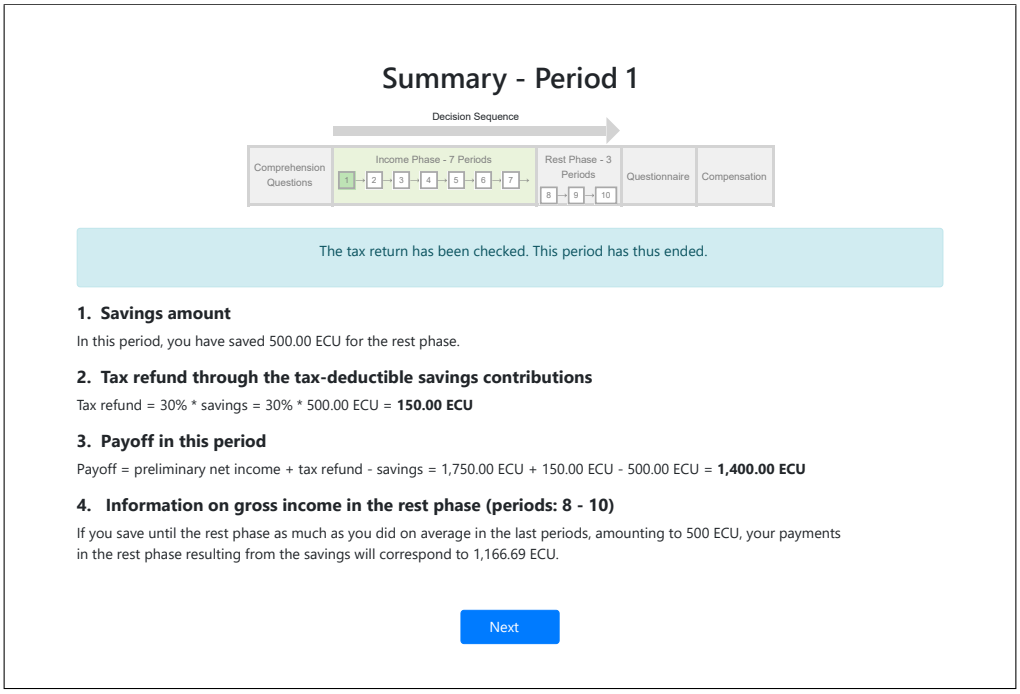


Figure B19: Decision Sequence: Period Summary - Treatments with Deferred Taxation

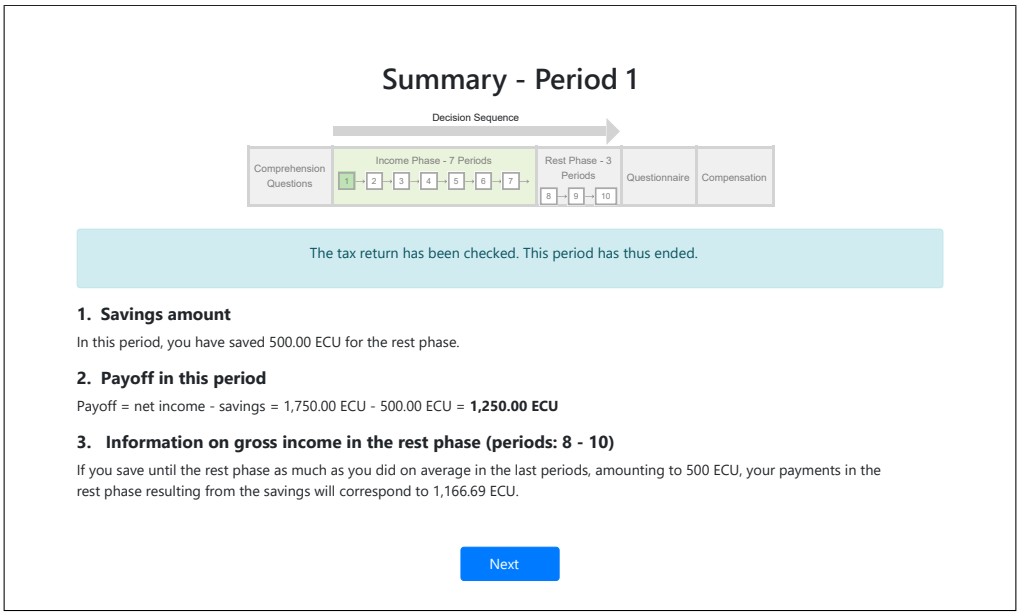
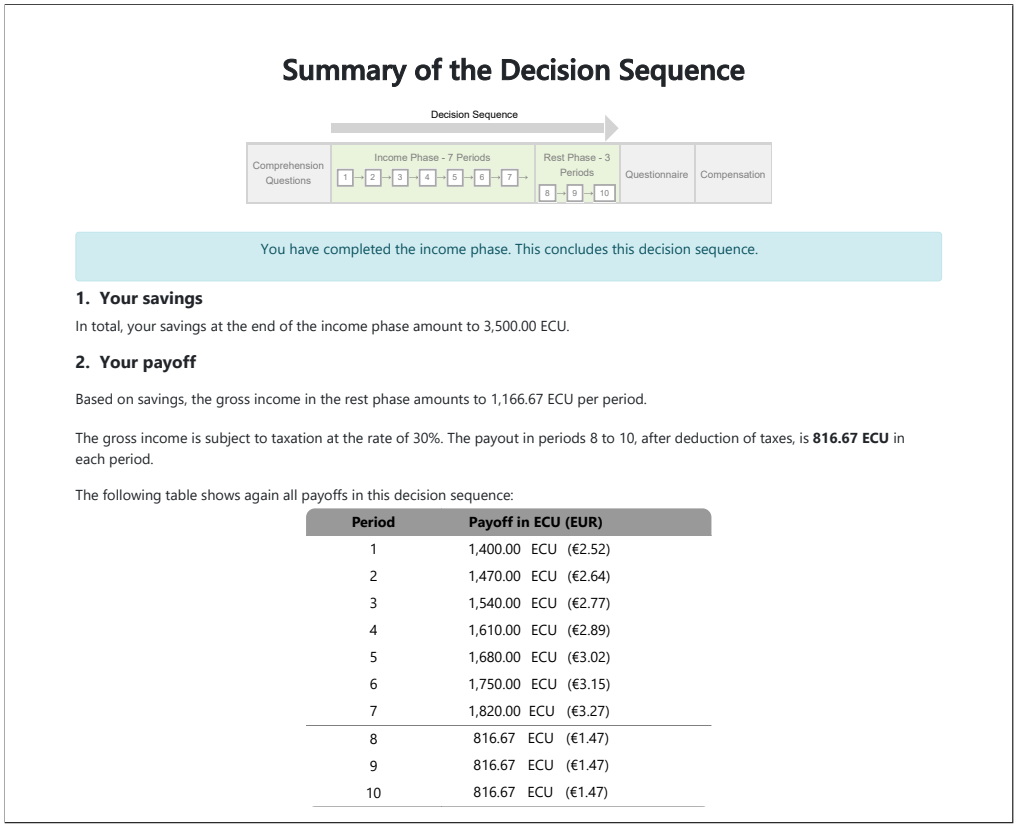


Figure B20: Decision Sequence: Period Summary - Treatments with Immediate Taxation

Decision Sequence Summary



Period	Payoff in ECU (EUR)
1	1,400.00 ECU (€2.52)
2	1,470.00 ECU (€2.64)
3	1,540.00 ECU (€2.77)
4	1,610.00 ECU (€2.89)
5	1,680.00 ECU (€3.02)
6	1,750.00 ECU (€3.15)
7	1,820.00 ECU (€3.27)
8	816.67 ECU (€1.47)
9	816.67 ECU (€1.47)
10	816.67 ECU (€1.47)

Figure B21: Decision Sequence: Decision Sequence Summary - Treatments with Deferred Taxation

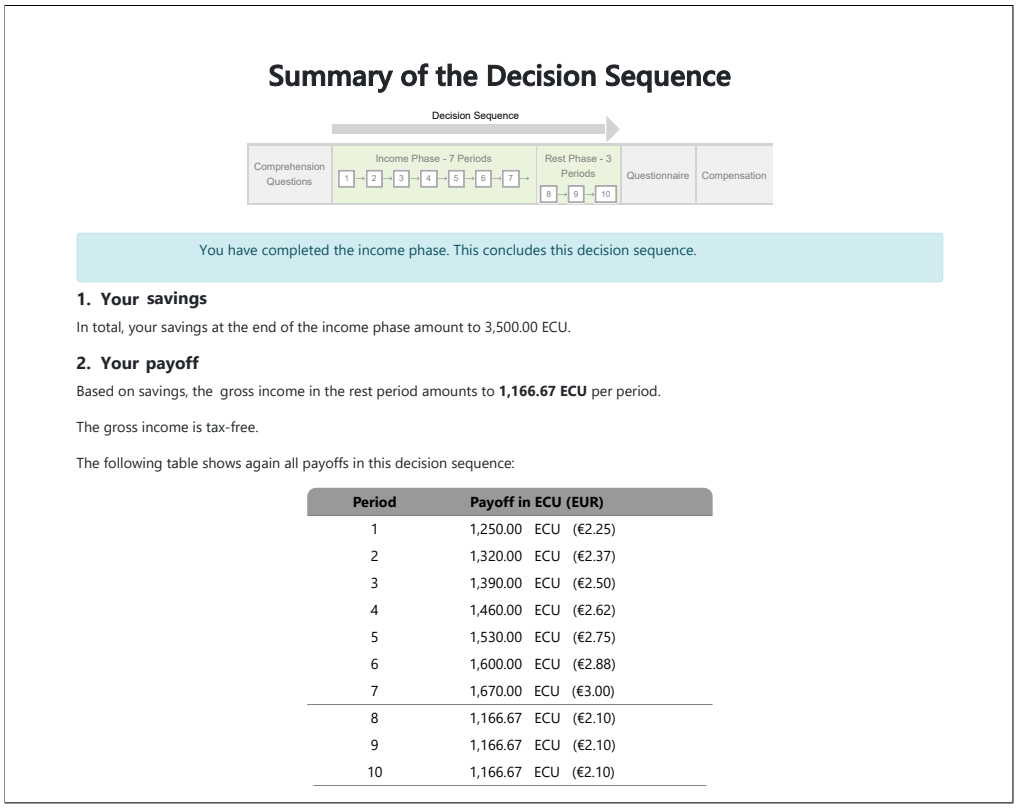


Figure B22: Decision Sequence: Decision Sequence Summary - Treatments with Immediate Taxation

B.3 Questionnaire (translated from German)

B.3.1 Questions before the Experiment

Question 1: Are you female, male or non-binary?

☐ Female
☐ Male
☐ Non-binary

Question 2: In which year were you born (e.g. 1962)?

☐

Question 3: How do you rate yourself personally: Are you generally a person who is willing to take risks or do you try to avoid taking risks?

not at all willing to take risks ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ very willing to take risks

Question 4: Did you file a tax return in the last year?

☐ Yes
☐ No

Question 5: Are you currently paying contributions in a so-called Riester or Rürup pension plan?

☐ Yes
☐ No

B.3.2 Questions after Decision Sequence

Question 1: How satisfied are you with the payoffs in the rest phase in terms of the amount of [payoff] ECU

not at all satisfied ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ perfectly satisfied

Question 2: If you think back to the savings decisions in this sequence, how far does the payoff in the rest phase in terms of the amount of [payoff] ECU meet your expectations

not at all ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ perfect

Question 3: If you had the opportunity to change your savings decision, would you save less or more?

save less ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ save more

Question 4: This question is to check your attention. Please click here on the last answer option (= completely)

not at all ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ completely

B.3.3 Questions at the End of the Experiment

Question 1: How old are you?

☐

Question 2: What kind of employment are you in?

- ☐ Pupil
- ☐ University student
- ☐ Employee
- ☐ Public official
- ☐ Self-employed
- ☐ Homemaker
- ☐ Unemployed/job-seeking
- ☐ No longer working (e.g. retired)

Question 3: What is your highest educational qualification?

- ☐ Secondary modern school qualification
- ☐ Secondary school certificate
- ☐ High-school diploma
- ☐ University of applied sciences degree
- ☐ University degree
- ☐ Dual university degree
- ☐ Doctorate

Question 4: What is your marital status?

- ☐ Married/ long-term relationship
- ☐ Single
- ☐ Divorced/ widowed

Question 5: What is your personal monthly net income after deduction of taxes and social security?

- ☐ less than €500
- ☐ €500-1,000
- ☐ €1,000-1,500
- ☐ €1,500-2,000
- ☐ €2,000-2,500
- ☐ €2,500-3,000
- ☐ €3,000-3,500
- ☐ €3,500-4,000
- ☐ €4,500-5,000
- ☐ €5,000-5,500
- ☐ €5,500-6,000
- ☐ €6,000 and more

Question 6: How would you rate your own tax law knowledge?

no knowledge at all ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ tax expert/professional

[The following question is to be answered only by participants who indicated that they filed a tax return last year.]

Question 7: You have indicated that you filed a tax return last year. Did you receive a tax refund or back taxes as a result?

- ☐ Tax refund
- ☐ Back taxes
- ☐ Not specified

Question 8: Suppose you receive a tax refund of €1,000 after filing your next tax return. What would you use it for (several answers possible)?

- ☐ Saving for a special purpose (e.g. vacation)
- ☐ For current expenses (e.g. groceries, rent)
- ☐ Settling debts (e.g. credit)
- ☐ Saving for retirement
- ☐ Purchase of major purchases (e.g. television)

Question 9: How complicated did you find the taxation in this study?

very easy ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ very complicated

Question 10: How difficult was it for you to make a savings decision?

very easy ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ very difficult

Question 11: Now please imagine that you plan to be unemployed for a short and fully anticipated period of time in six months. To cover various living expenses during this period, you will need €1,200. You have two options to finance these costs. Which of the following options would you choose?

☐ Six monthly payments of €200 each during the six months prior to planned unemployment.

☐ Six monthly payments of €200 each during the six months beginning after the planned unemployment.

Question 12: How important is it to you personally to save taxes?

not at all important ☐—☐—☐—☐—☐—☐—☐—☐—☐—☐ very important

Question 13: Now please imagine that you inherit money and plan to invest it. You are offered two savings products. With the first savings product, you receive €401 every year, but at the same time you have to pay €100 in taxes annually. With the second savings product, the return is lower, €300 annually, but tax-free. Which savings product would you choose?

☐ I would invest the money in the second savings product.

☐ I would invest the money in the first savings product.

Question 14: A bat and a ball cost €22. The bat costs €20 more than the ball. How much does the ball cost (in euros)?

Question 15: If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets (in minutes)?

Question 16: In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake (in days)?

B.3.4 Questions Risk Aversion

In this task you can earn **more money**. Below you will be presented with 20 decisions on the screen. Each of these decisions consists of a choice between ”Option A” and ”Option B”.

- **Option A:** Safe payoff amount, which increases with each decision.
- **Option B:** Two fixed payoff amounts. The probability of getting the high or the low payout amount is 50% each.

After you have made all decisions, one of the 20 decisions will be randomly selected for your payoff. If this selected decision is ”Option B”, then according to the respective probabilities it will be randomly determined whether the low or high amount will be realized for your payoff. If it is ”Option A” you will receive the safe amount.

Option A			**Option B**
55 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
60 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
65 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
70 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
75 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
80 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
85 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
90 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
95 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
100 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
105 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
110 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
115 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
120 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
125 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
130 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
135 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
140 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
145 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise
150 ECU certain	☐	☐	200 ECU with a probability of 50%, 50 ECU otherwise

B.3.5 Questions Loss Aversion

And now for our last task: in this one you can earn **more money** again.

Below you will be presented 6 lotteries. For each of these lotteries you can decide whether you want to participate in it or not. If you participate in the lottery, a random number generator will decide whether you win or lose the lottery.

The profit or loss is then as follows:

- **Profit:** You will receive an additional payoff of 1,200.00 ECU.
- **Loss:** Your payoff will be reduced by a certain amount (see below).

The probability of winning or losing is 50% in each case.

After you have made all the decisions, one of the 6 lotteries will be randomly selected. If you participated in the selected lottery, a random number generator will decide whether you win or lose the lottery.

Please decide now in which lotteries you would like to participate.

Lotteries (probability 50% / 50%)	**Participate**	**Do not participate**
Profit = 1.200 ECU / Loss = -400 ECU	☐	☐
Profit = 1.200 ECU / Loss = -600 ECU	☐	☐
Profit = 1.200 ECU / Loss = -800 ECU	☐	☐
Profit = 1.200 ECU / Loss = -1,000 ECU	☐	☐
Profit = 1.200 ECU / Loss = -1,200 ECU	☐	☐
Profit = 1.200 ECU / Loss = -1,400 ECU	☐	☐

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