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Can Tax Rate Increases Foster Investment under Entry and Exit Flexibility? – Insights from an Economic Experiment

ABSTRACT: It is well-known that taxes affect risky investment decisions. Analytical studies indicate that tax rate increases (decreases) can foster (hinder) investment if there is flexibility, in particular when an exit option is available. We design an experiment based on an analytical model with binomial random walk and entry and exit flexibility. Contrasting the underlying model, we find accelerated investment, which is often considered as an increased willingness to invest, on tax rate increases to be independent of the existence of an exit option. However, we observe this investor reaction only for a tax increase, not for a tax decrease. This behavior is driven possibly by tax salience and the mechanisms known from the theory of irreversible choice under uncertainty. Our empirical evidence suggests that the at-first-sight unexpected tax reform effects are more common than is predicted by the theoretical literature. Policy makers should therefore carefully consider the behavioral aspects when anticipating taxpayer reactions.

JEL Classification: H25, H21, C91

Keywords: *Investment Decisions, Tax Effects, Timing Flexibility, Economic Experiment*

I. INTRODUCTION

There is an ongoing discussion among experts around the world on how to foster investment. This topic has gained relevance in the face of the economic downturn in many countries in the aftermath of the financial and the euro crisis. Because investments, particularly risky investments such as R&D investments, are crucial for economic growth and are sensitive to the economic environment, it is important to identify the drivers and obstacles for efficient investment activities.

It is well known that taxes may significantly affect investment decisions (cf., e.g., Edgerton 2010) and that risky investment projects are often asymmetrically affected by taxation (cf., e.g., Panteghini 2001a and 2001b; Niemann and Sureth 2004; Alvarez and Koskela 2008). We contribute to the discussion on the tax effects on risky investments and study to what extent and under what conditions taxes may distort risky investment decisions.

The effect of taxes on investment decisions has been studied applying different approaches. In their seminal paper, Domar and Musgrave (1944) investigate the influence of taxation on risk-taking in a portfolio decision framework. They find that loss offset provisions increase the investor's propensity to increase the share of risky assets in portfolio decisions, particularly if tax rates are high. Stiglitz (1969), who extended this approach with respect to profitable investments, and subsequent studies identify the ambiguous effects of taxes on risk-taking.

Against the background of these mixed results, another stream of literature emerged that focuses on the single investment decisions that are characterized by uncertainty, flexibility and (partial) irreversibility to clarify the puzzle. Here, investment decisions are reinterpreted as decisions on when to carry out a risky investment rather than on whether to invest. Several papers address this timing question, namely, to what extent taxes affect the decision on whether to invest immediately or later when facing an entry or exit option. Using either continuous-time models with real options, i.e., contingent claims analysis or dynamic programming or discrete-time binomial models to capture the value of flexibility in the decision calculus, a critical investment threshold can be determined. Whereas under certainty it is well known that depreciation allowances, investment credits, loss offset restrictions, wealth taxes, and interest deduction barriers may cause so-called paradoxical effects, the analytical and numerical studies focused on uncertainty find higher taxes may stimulate investment even if the causes that are known from certainty do not exist (see Panteghini 2001a and 2001b; Gries, Prior, and Sureth 2012). These studies typically rely on real option theory (see Myers 1977; Dixit and Pindyck 1994; Trigeorgis 1996). In addition to the continuous-time models, binomial models have been applied and indicate that at first sight, unexpected investor reactions (acceleration upon tax rate increases and deceleration upon tax rate decreases) occur for specific classes of investment only if an exit option is available. Unfortunately, there is no suitable data on investment in the face of tax reforms for the archival studies. An empirical test is still missing.

To close this research gap, we conduct an economic lab experiment. We study investors' reactions to tax reforms under timing flexibility and risk to determine whether the theoretically identified (tax reform- and exit flexibility-driven) reaction patterns can be observed in an experimental setting and if so, how often.

We find both at-first-sight unexpected investor reactions, the accelerating and decelerating tax reform effect. In contrast to the theoretical studies, we find the acceleration upon a tax rate increase occur independently of the existence of an exit option. However, we observe this investor reaction more pronounced for a tax increase, while the presence of an exit option seems to be irrelevant for investment timing in the case of an experienced tax rate decrease. This asymmetric behavior is driven possibly by tax salience (Ackermann, Fochmann, and Mihm 2013) and the mechanisms known from the theory of irreversible choice under uncertainty and prospect theory, whereby bad news affects investment decisions, while good news has a minimal effect or none at all (bad news principle, cf., e.g., Bernanke 1983; Kahneman and Tversky 1979; or Baumeister et al. 2001 for a more general view). Experimental studies provide first insights into the interactions of taxation, risk, and investment decisions. Yet, none of the existing studies to our knowledge provides evidence for the influence of tax rate changes on investment timing in the presence of risk as well as entry and exit flexibility.

Our empirical evidence suggests that such at-first-sight, unexpected tax effects are much more common than can be predicted by the theoretical tax literature. This would imply that policy makers should not only rely on the findings from economics-based models but should deliberately discuss tax reforms and carefully consider the behavioral aspects when anticipating taxpayer reactions.

We review the prior literature in section II. We introduce an analytical discrete-time model with binomial random walk and both an entry and exit option that is well known from the literature in section III. The framework for our experimental design is described in section IV. In section V, we discuss our results and find evidence for the previously only theoretically identified investor reactions, i.e., that tax rate increases can foster (accelerate) investment. Section VI concludes.

II. PRIOR LITERATURE

Whereas many studies are restricted to the numerical examples when identifying the paradoxical investor reactions, Panteghini (2001b) and Gries, Prior and Sureth (2012) demonstrate analytically in a real-option framework with an option to wait that uncertainty itself may cause paradoxical reactions, i.e., accelerate investment on tax rate increases. Other analyses capture exit flexibility. Agliardi and Agliardi (2008 and 2009) employ a continuous-time real option model, which has been extended by Wong (2009), to investigate the impact of progressive taxation on entrepreneurial divestment decisions. The authors find a progressive tax schedule can foster or hinder closure policy in the case of loss-offset restrictions.

Merging both types of options, simultaneous entry and exit flexibility are modeled by Schneider and Sureth (2010) and Niemann and Sureth (2013), who use binomial models. Schneider and Sureth (2010) find that an increased profit tax can foster investor willingness to invest in a project with an abandonment option. While these studies do not focus on option values explicitly, they capture the value of flexibility. Niemann and Sureth (2013) identify the paradoxical effects on real investment timing under profit and capital gains taxation, whereas Alpert (2010) investigates the timing of financial call options, demonstrating that taxes can be decisive for early exercise.

The aforementioned real option-type analytical studies indicate that accelerated investment as a reaction to tax rate increases may occur. In addition, the Domar-Musgrave studies indicate that taxation may increase risk-taking if a complete loss offset is possible. Obviously, the theoretical studies provide different explanations for tax rate increases to stimulate risky investments. Nevertheless, both streams of literature identify the settings for opposite investor reactions to tax reforms. These mixed results call for an empirical test. An experimental study may help to gain evidence on whether the effects are sufficiently important to be accounted for in tax reform discussions. Our results can valuably contribute to the tax reform discussions, as such discussions are mainly characterized by simplified arguments such as those that claim that tax rate cuts are desirable to improve the investment environment.

There are only a few experimental tax studies that focus on the related research questions; for example, Rupert and Wright (1998), Rupert, Single, and Wright (2003), Boylan and Frischmann (2006), Chetty, Looney, and Kroft (2009), and Boylan (2013) study the impact of tax rate transparency and salience on decisions and find that both properties matter. Furthermore, there are experiments on the effects of tax rate changes on taxpayer investment behavior. Swenson (1989) uses the Domar-Musgrave framework and compares the impact of different tax rules on both risky and riskless investments. His experiment indicates that proportional taxation does not significantly increase risk-taking and hence supports only a portion of the prior theoretical findings. Furthermore, King and Wallin (1990) compare investment behavior under a proportional and a progressive tax to a benchmark case without taxation. They find that the progressive tax reduces risk-taking, whereas the proportional tax, as in Swenson (1989), does not lead to a significant increase in risk-taking compared to the benchmark. By contrast, Ackermann et al. (2013) find experimental evidence for a proportional income tax to decrease risk-taking in a Domar-Musgrave type of setting. Anderson and Butler (1997) use an experimental setting to investigate the impact of capital gains taxes with different types of preferential taxation. Their study provides evidence for preferential taxation increasing risk-taking but also indicates that market effects can compensate for these distortions. In addition, Fochmann, Kiesewetter, and Sadrieh (2012) identify the ambiguous effects of loss-offset rules and risk attitude. Income taxation with complete loss deductions induces a sustained bias towards more risky investment decisions, while disaggregated income taxation and tax systems with no loss offset do not. In addition, Falsetta and Tuttle (2011) find behavioral investment reactions to taxes. They offer experimental evidence for the behavioral tax distortions in line with prospect theory in a setting where taxes affect the investments exempt from taxes via common mental accounts.

Recently, Falsetta, Rupert, and Wright (2013) identify timing as an important tax issue.[4] They use an experiment to examine the effect of timing (gradual versus immediate) and the direction of capital gains tax changes on taxpayer preferences for investments in riskier assets. Their findings support the expectations, suggesting that timing matters, i.e., the way in which a tax law change is implemented may impact decisions.

The above-mentioned experimental studies provide evidence for the impact of taxes on risk-taking and the effect of tax reform timing. Thus far, none of the available studies to our knowledge provides evidence on the influence of tax rate changes on both the investment timing and risk-taking under entry and exit flexibility. To fill this void, we perform an experiment on the effects of tax policy on investment timing under conditions of uncertainty and flexibility.

III. THEORETICAL MODEL

We model cash flow uncertainty using a binomial stochastic process to approximate the random walk (Alpert 2010; Schneider and Sureth 2010; Niemann and Sureth 2013). As the structure of the economic forces in the continuous-time models is very complex (Alvarez and Koskela 2008; Gries, Prior, and Sureth 2012), this simple stochastic process enables us to conduct an experiment to determine whether the predicted (accelerating) tax reactions can be observed.[5]

In the following, we assume a risk neutral investor who has an opportunity to invest in a non-depreciable investment project (e.g., corporate stock or property) at either time $t = 0$ (deterministic return) or time $t = 1$ (random return), similar to the model introduced by Schneider and Sureth (2010). Furthermore, the investor is assumed to be non-loss averse. As investors are typically

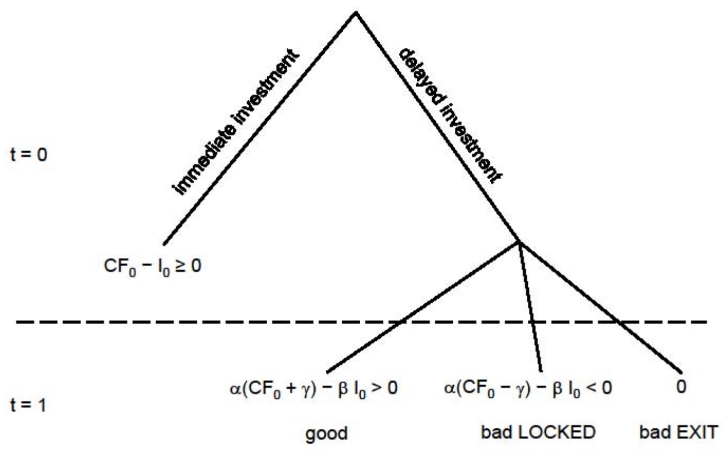
[4] For experiments on options and timing in a tax-free setting cf., e.g., Lèvesque and Schade (2005); List and Haig (2010), 152-153.
[5] Cf. List and Haigh (2010), who also test an option setting experimentally and use a binomial model.

risk averse in reality, we discuss the relevance and possible limitations arising from the risk neutrality assumption later.

In contrast to the real option models, this binomial approach does not explicitly capture the value of the option to wait, but rather the value of flexibility (Schneider and Sureth 2010, 163-164; Niemann and Sureth 2013, 376). Earnings are assumed to be completely distributed, so there are no capital gains (Schneider and Sureth 2010, 152-153).

The risk-neutral investor bases his or her decision to invest either early or late in the relationship between the (expected) after-tax costs and benefits. Figure 1 illustrates the possible outcomes.

Figure 1: Pre-tax binomial tree



The investor can either invest immediately and earn the deterministic return given by the cash flow CF_0 less initial outlay I_0 with $CF_0 \geq I_0$ (left side of the tree) or delay the investment and carry out the risky project at time $t = 1$ with an expected return of $\alpha\,(CF_0 + \gamma) - \beta\,I_0 > 0$ in the good state of the market or $\alpha\,(CF_0 - \gamma) - \beta\,I_0 < 0$ in the bad state of the market, where α and β are some exogenously given independent growth parameters (right side of the tree with or without exit option). Both states of the market are equally likely. The binomial tree is given in Figure 1.

While the investment is a one-period project with initial outlay and instantaneous return, the time span of the investment problem ranges over two periods. Nevertheless, the timing preferences do not have to be considered because the decision on a postponement has to be made at time $t = 0$ based on the expected values of the future cash flows. This model framework allows us to abstract from the timing effects within each investment alternative.

If the initial cash flow is sufficiently high, the investor will invest immediately; otherwise, the project will be postponed to wait for better conditions. At the same time, the investor will "park" the funds in the capital market at the risk-free pre-tax capital market rate of return r. We assume a tax system with a profit tax on income from real investment at a tax rate τ and a final tax on interest income at rate τ_f, which is common for many jurisdictions,[6] and full and complete loss offset. As the tax base for the profit tax system is simply the cash flow, this tax system is similar to a sales tax.[7] Moreover, interest payments are taxable or tax-deductible; thus, the after-tax rate of return is $r_{\tau_f} = r(1 - \tau_f)$.

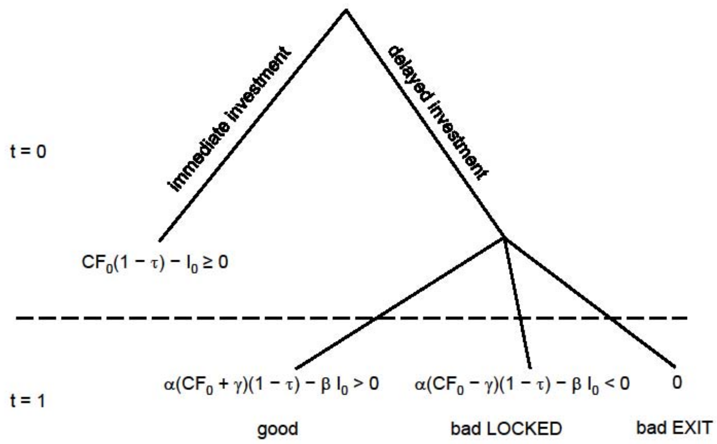
The investor faces the following alternatives (Schneider and Sureth 2010, 155):

(1) to invest immediately and receive the deterministic cash flow at $t = 0$ (invest now) or
(2) to invest later and receive the stochastic cash flow at $t = 1$ (invest later without exit flexibility) or
(3) to invest later and exercise the option to abandon (invest later with exit flexibility to abstain from delayed investment).

[6] Many countries levy a final tax on interest income, e.g., Austria and Germany, similar to the Nordic countries that have a preferential tax rate for all types of capital income.
[7] Cf. Schneider and Sureth (2010), 154, who also explain that the initial outlay I_0 can be considered as the initial effective net investment that implicitly captures the possible liquidation proceeds equal to the book value at time $t = 1$.

We obtain an after-tax decision tree as illustrated in Figure 2.

Figure 2: Post-tax binomial tree



The investor has to make a decision that is characterized by two aspects. First, it is a timing decision (now or later) in line with real option theory; second, it is a risk-taking decision (certain cash flow or uncertain cash flow), which is often studied in the portfolio choice models. In line with the above-mentioned previous studies, we focus on the impact of the tax rate changes on investment timing and risk-taking. Because we do not focus on risk-taking exclusively, we cannot apply a Domar-Musgrave-type model. Rather, we use the approach described above to study the tax effects in this more complex setting with both a timing and risk-taking decision. For reasons of simplicity, in a first step we focus on the timing effect. Later, this proves to be an appropriate approach to our research question. When we discuss the results of our experiment, we will observe that investor attitudes towards risk, in contrast to the prior analytical studies, are not a driving force for the investment decision. By contrast, the investment timing seems to be crucial. Nevertheless, we take the riskiness involved in the decision as a ceteris paribus condition into account and will study its implications in detail.

The delayed investment, which yields an uncertain return, may be particularly attractive if the delayed investment offers the flexibility to react to future developments, i.e., if it includes an exit option (the EXIT scenario). In the underlying theoretical model, the accelerated (decelerated) investment behavior in response to tax rate increases (decreases) is possible in the EXIT scenario for $\alpha < 1 + r_{\tau_f}$ and $\beta > 2\left(1 + r_{\tau_f}\right)$,[8] whereas in this setting, in the absence of an exit option (LOCKED scenario), such tax effects cannot be found.

Real-world examples for such settings are export-oriented industries such as the car manufacturing industry and the oil-producing industry, for which the factor costs and revenues have to be calculated on the basis of different currencies. The differences in currencies may lead to different growth rates for the investment costs and revenues. For example, if a European car manufacturer sells products in the US while facing a weakening US dollar against the euro, the input prices are driven by the euro-based costs such that β will exceed α. Similarly, in the oil-producing countries, the costs are mainly based on the euro, while the revenues are US dollar-based.[9] In addition, the R&D investments are likely to be characterized by these growth structures. Furthermore, the firms in financial distress after misinvestments or crises often have to decide on either investing in long-term high-risk R&D projects to keep up with their competitors in the future (risky future investment) or use scarce liquid funds to redeem loans and thus decrease their insolvency risk and simultaneously the risk premium in capital cost (the riskless immediate use of funds). Overall our setting with a risk-free and risky investment project can also be interpreted as decision on two alternative investments that are characterized by different degrees of risk exposure.

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[8] See also Campbell, Chyz, Dhaliwal, and Schwartz (2013), who find evidence that a small subset of firms decreases investment upon the tax rate cut introduced by the 2003 Tax Act.
[9] Cf. Schneider and Sureth (2010), 156-165.

The present value of the expected after-tax profit from a delayed investment discounted to t = 0 in the LOCKED scenario is given by[10]

$$\frac{E[\tilde{P}_1]}{1+r_{\tau_f}} = 0{,}5\left[(1-\tau)\frac{\alpha}{1+r_{\tau_f}}(CF_0+\gamma)-\frac{\beta}{1+r_{\tau_f}}I_0\right]+0{,}5\left[(1-\tau)\frac{\alpha}{1+r_{\tau_f}}(CF_0-\gamma)-\frac{\beta}{1+r_{\tau_f}}I_0\right] \quad (1)$$

$$= (1-\tau)\frac{\alpha}{1+r_{\tau_f}}CF_0-\frac{\beta}{1+r_{\tau_f}}I_0.$$

Equating the after-tax return P_0 from the immediate investment

$$P_0 = (1-\tau)CF_0 - I_0 \quad (2)$$

and from the delayed investment (eq. (1)) and solving for CF_0 leads to the so-called cash-flow cut-off level CF_0^* with (Schneider and Sureth 2010)

$$CF_0^* = \max\left\{0, \frac{I_0\left(1-\frac{\beta}{1+r_{\tau_f}}\right)}{(1-\tau)\left(1-\frac{\alpha}{1+r_{\tau_f}}\right)}\right\}. \quad (3)$$

The immediate investment is chosen whenever the observable cash flow CF_0 is higher than the cut-off level. By contrast, for $CF_0 < CF_0^*$ the investment will be postponed.

In the EXIT scenario, the second term in eq. (1) vanishes, and we obtain correspondingly

$$\frac{E[\tilde{P}_1]}{1+r_{\tau_f}} = 0{,}5\left[(1-\tau)\frac{\alpha}{1+r_{\tau_f}}(CF_0+y)-\frac{\beta}{1+r_{\tau_f}}I_0\right] \quad (4)$$

and a cut-off level (Schneider and Sureth 2010)

$$CF_0^* = \max\left\{0, \frac{I_0\left(1-0{,}5\frac{\beta}{1+r_{\tau_f}}\right)}{(1-\tau)\left(1-0{,}5\frac{\alpha}{1+r_{\tau_f}}\right)}+0{,}5\frac{\frac{\alpha\gamma}{1+r_{\tau_f}}}{1-0{,}5\frac{\alpha}{1+r_{\tau_f}}}\right\}. \quad (5)$$

[10] Cf. Schneider and Sureth (2010), 157, who provide more details on the real-world examples.

Prior analyses of the effects of a change in the tax rate τ on the cut-off level in both cases and on the corresponding investor behavior clarify that an increasing tax rate always leads to the expected (delaying) tax effects under the given set of assumptions. By contrast, it may induce more early riskless investments when the project includes an exit option. This is often called the "paradoxical" tax effect and is also well-known from real option theory (Panteghini 2001a; Niemann and Sureth 2004; Alvarez and Koskela 2008; Gries, Prior, and Sureth 2012). This reaction, i.e., the accelerated risk-avoiding investment after a tax rate increase in the EXIT scenario, is usually not considered in the tax reform discussions.[11] Obviously, introducing an option to abandon may cause such at-first-sight unexpected investor reactions, particularly if the tax rates are high.

IV. EXPERIMENTAL DESIGN AND PROCEDURE

Experimental Design

The experiment follows a 2x2 design, whereby a treatment is characterized by a high or a low tax rate and the availability or non-availability of an exit option. To identify a clear influence of the tax rate on the timing of the investment and risk-taking, we choose either a low tax rate of 10 % or a high tax rate of 45 %. For each of these tax rates, there is either an option to abandon the real investment or no such option. Using this setting, finally, enables us to study the effect of an increase in the tax rate on investor behavior depending on the existence of an exit option.

As is standard in the related literature[12], the experiment is framed in a business context. Specifically, the participants are told that they are the owners and managers of a small company. They

[11] In a related framework, Domar and Musgrave (1944) find that high taxes are likely to increase the willingness to invest.

[12] Cf., for instance, Falsetta, Rupert, and Wright (2013), who study the effect of the timing of capital gains tax changes on risky investments; Fochmann et al. (2012), who investigate the impact of loss deductibility, and Kirchler and Maciejovsky (2001), who examine tax compliance.

have to decide how to invest the accrued reserves of 30,000 “Taler”, the experimental currency, from the annual surplus. This surplus results from other activities that are not related to the experiment. While we abstract from the accrued reserves available for investment in the theoretical model, we need this assumption to create an experimental surrounding that excludes liquidity constraints from the investors’ decision context.

The participants are offered two ways to invest the accrued reserves in the following two years. The real investment projects are mutually exclusive; in other words, it is not possible to split the investments between both alternatives.[13]

Project A requires an immediate investment of 10,000 Taler and guarantees a return of 25,000 Taler for the first year. For the second year, all assets will be invested as capital investments at a rate of return of 3.75 %.

Project B requires delaying the investment to the second year. In the first year, a rate of return on capital market investments of 3.75 % is paid on the entire amount. In the second year, the real investment project requires an investment of 21,000 Taler. The return depends on how the market develops in the second period.[14] There is a 50 % probability that the market will develop well, and the real investment will generate a return of 52,290 Taler. There is a 50 % chance that the market will develop badly; in this case, the return is 22,410 Taler.

In the low (high) tax treatments, the real investment returns are taxed at 10 (45) %. For simplicity, the interest income is assumed to be tax-exempt. This assumption is equivalent to a final tax on interest income of 25 %, given a market rate of return of 5 % that has already been deducted

[13] The full instructions of the experiment are included in the appendix.
[14] While the investment decision is framed as an intertemporal decision, the subjects make the decision within a short time span and are paid for all their decisions in the experiment at the end of the experimental session. Hence, the subjects do not face the opportunity to arbitrage between the lab and the field, and we do not have to account for the individual discount rates (Coller and Williams 1999).

implicitly in the rate of return on capital investment. Thus, the rate of return of 3.75 % can also be interpreted as the after-tax rate of return on capital investment, r_{τ_f}, in the theoretical model.

In the treatments with the exit option (EXIT), the participants who choose to invest in project B may abandon the investment and retrieve the invested amount of 21,000 Taler *after* the state of the market (good or bad) becomes common knowledge. In the treatments without an exit option (LOCKED), the participants are bound by their decision. The participants are informed about the current tax rate and the availability of an exit option before making their choice.

Accrued reserves *R* of 30,000 are available for the real or capital market investment. The remaining parameters were chosen as follows:

I_0 = 10,000
CF_0= 25,000
τ = 0.1 or 0.45 and τ_f = 0.25 %,
r = 0.05 and $r_{\tau_f} = 0.0375$
α = 1.494 and β = 2.1.

Thereby, we exemplify the assumptions of the theoretical model, e.g., with respect to α and β. This numerical example leads to the accelerating and simultaneously risk-avoiding tax effect known from the underlying theoretical model.

In the LOCKED scenario, the investor will receive a future value of

$$FV_{immediate,LOCKED} = [R - I_0 + CF_0(1-\tau)]\left(1 + r_{\tau_f}\right) \tag{6}$$

for the early investment and obtain

$$\widetilde{FV}_{delayed,LOCKED} = R\left(1 + r_{\tau_f}\right) - \beta I_0 + \alpha \widetilde{CF}_0(1-\tau) \quad \text{with } \widetilde{CF}_0 = (CF_u, CF_d)$$
$$= CF_0 \pm 10{,}000 \tag{7}$$

in case of a postponement of the investment. Facing an exit option, the investor will receive correspondingly

$$FV_{immediate,EXIT} = [R - I_0 + CF_0(1-\tau)]\left(1 + r_{\tau_f}\right) \quad (8)$$

for the early investment and obtain

$$\widetilde{FV}_{delayed,EXIT} = \begin{cases} R\left(1 + r_{\tau_f}\right) - \beta I_0 + \alpha CF_u(1-\tau) & \text{for a good state of nature} \\ R\left(1 + r_{\tau_f}\right) & \text{for a bad state of nature} \end{cases}$$

$$\text{with } CF_u = CF_0 + 10{,}000 \quad (9)$$

for the delayed investment.

Figure 3: Low tax

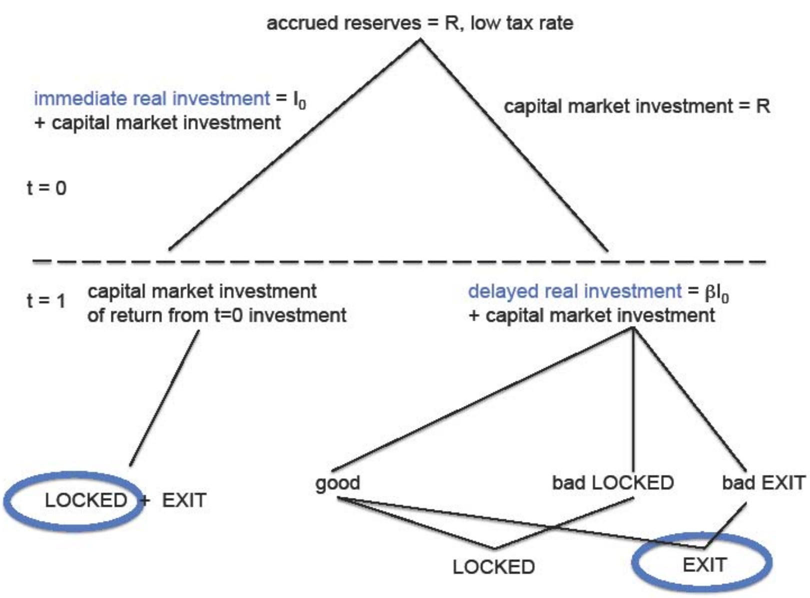
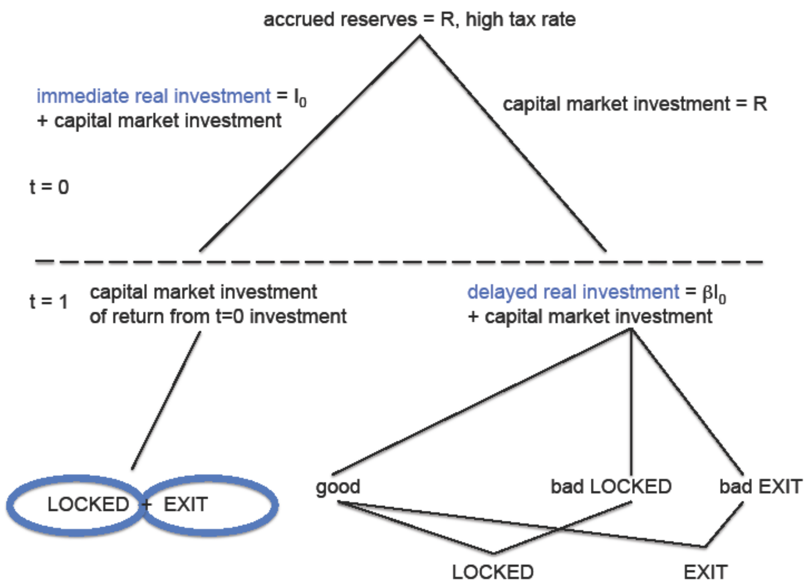


Figure 4: High tax



In Figures 3 and 4, we observe for a low and a high tax rate that the chosen design of the experiment allows us to build a setting that is in line with the framework and prediction provided by theory. Higher tax rates change the investment decision from a delayed risky to an early riskless investment. This experimental setting is appropriate to test for the predicted reactions to the tax reforms. The parameterization of the difference in the final payoff between the case with and without the exit option and between the immediate and the delayed investment is comparatively small. Hence, we consider our design as conservative in the sense that we will identify a lower bound of investment differences. If we can already identify the investment reactions for the small payoff differences, our results indicate that the timing and risk particularly seem to drive the investment behavior. The impact on the investment behavior will be even more pronounced with larger payoff differences.

Hypotheses

While in the low tax scenario (Figure 3) we find that immediate investment should be chosen in the LOCKED case, postponement will be preferred if an exit option is available. Assuming that the tax rate is increased from 10 % to 45 %, we observe an overall tendency to immediately carry out the investment project (Figure 4) regardless of whether the project incurs certain or risky cash flows.

In this example, if the tax rate rises from 10 % to 45 %, in the EXIT scenario the investor will accelerate the investment and switch from postponement to immediate investment under the given set of assumptions and thereby avoid risk. Hence, the exit option and high tax rates favor investment acceleration.

Whereas in the case of the low tax the investor will choose the late risky investment if an exit option is available, the high tax rate makes him or her accelerate the investment decision and avoid risk. Obviously, the numerical example supports the theoretical result that introducing an exit option may lead to investment acceleration if the growth parameters α and β meet the limitations indicated by the model and the tax rates are sufficiently high.

In summary, the predicted behavior of a risk-neutral wealth-maximizing rational decision maker is displayed in Table 1.

Table 1: Predicted investment decisions of experimental model

	No exit option	Exit option
Low tax	Immediate	Delayed
High tax	Immediate	Immediate

Focusing on the first step on timing, we obtain from these predictions the following hypotheses:

Hypothesis 1: Given the availability of an exit option, high taxes in comparison to low taxes induce immediate investment.

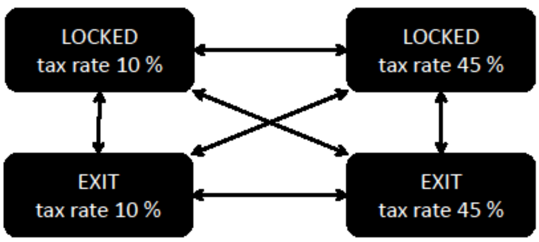
Hypothesis 2a: A tax rate increase will lead to accelerated investments if an exit option is available.

Hypothesis 2b: A tax rate decrease will lead to decelerated investments if an exit option is available.

Experimental Procedure

The experiment was conducted in November 2012 at the Business and Economic Research Laboratory (BaER-Lab) at the University of Paderborn and was computerized using the software z-Tree (Fischbacher 2007). The participants of the eight sessions were recruited using the online recruiting system ORSEE (Greiner 2004) and were only allowed to attend one of the sessions. In total, 208 subjects participated, most of whom were economics and business administration students.[15] Each subject had to make the investment decision for each of the four treatments to allow for analyses of the changes in tax regimes within subjects.

Figure 5: Treatments



[15] Table A1 in the appendix reports descriptive statistics for our sample.

We collect observations for each of the eight possible treatment sequences, which we call treatment order groups (TOGs).[16] This is important for our analysis in two ways. First, this approach enables us to control for the influence of order effects. Second, and more importantly, we can identify the effects of changes in the tax rate and the availability of the exit option within the subjects in both directions. The latter is important as Hypotheses 2a and 2b make statements about the changes in the tax rate. Table 2 displays the treatment sequences and the number of participants for each of the eight treatment order groups. In four sessions, the subjects were randomly assigned to one of the treatment order groups designated by numerals one to four and in the other four sessions to one of the treatment order groups designated by numerals five to eight, as denoted in Table 2.

Table 2: Sequence of treatments and number of subjects by treatment order group (TOG)

Treatment order group (TOG)	**Sequence**	**No. of subjects**
$\mathbf{1}_{L\uparrow E\uparrow}$	LOCKED 10 – LOCKED 45 – EXIT 10 – EXIT 45	26
$\mathbf{2}_{L\uparrow E\downarrow}$	LOCKED 10 – LOCKED 45 – EXIT 45 – EXIT 10	26
$\mathbf{3}_{L\downarrow E\uparrow}$	LOCKED 45– LOCKED 10 – EXIT 10 – EXIT 45	25
$\mathbf{4}_{L\downarrow E\downarrow}$	LOCKED 45 – LOCKED 10 – EXIT 45 – EXIT 10	23
$\mathbf{5}_{E\uparrow L\uparrow}$	EXIT 10 – EXIT 45 - LOCKED 10 – LOCKED 45	28
$\mathbf{6}_{E\uparrow L\downarrow}$	EXIT 10 – EXIT 45 - LOCKED 45 – LOCKED 10	28
$\mathbf{7}_{E\downarrow L\uparrow}$	EXIT 45 – EXIT 10 - LOCKED 10 – LOCKED 45	26
$\mathbf{8}_{E\downarrow L\downarrow}$	EXIT 45 – EXIT 10 - LOCKED 45 – LOCKED 10	26

All subjects were seated in separate cubicles with a computer workplace. They had pen and paper at their disposal throughout the experiment, received the same introductory talk and were told that communication would be prohibited during the experiment. Afterwards, the subjects

[16] Indices at the single TOGs throughout the text indicate the treatment order. The first and second letter indicate if Exit (E) or Locked (L) was played during the first and the last two rounds, respectively, while the arrows indicate whether there was a tax increase from 10 to 45 % (↑) or a tax decrease from 45 to 10 % (↓) in the particular rounds.

received the instructions, and they were given time to read them thoroughly.[17] The net returns for both investments are presented on the screens throughout the experiment to avoid any bias due to the heterogeneity in subjects' numeracy skills and the effects driven by the net wage illusion (e.g., Fochmann, Weimann, Blaufus, Hundsdoerfer, and Kiesewetter 2013; Fochmann and Weimann 2013 and Djanali and Sheehan-Connor 2012). For each of the four decisions, the subjects were endowed with 30,000 Taler. The earnings for each decision consisted of the amount of the endowment not invested, the return on investment after taxes in one of the years, and the interest income in the other year. The earnings for one randomly selected treatment were paid out at the end of the experiment at an exchange rate of 1.75 EUR per 10,000 Taler. Each participant determined individually for which of the four treatments he or she would receive a payoff by rolling a four-sided die. In addition, all participants were paid a show-up fee of 2.50 EUR. After the experiment, the subjects were asked to answer a two-part questionnaire. Part one consisted of a lottery choice framework according to Dohmen et al. (2010) to elicit the subjects' risk preferences.[18] This part of the questionnaire was paid off for two randomly selected subjects in each session. Part two of the questionnaire contained questions regarding the subjects' socio-economic background, their course of study, their risk preferences, and their previous meaningful serious experience with investments and taxes as well as questions regarding their decisions

[17] We did not use control questions after reading aloud the instructions to prevent any kind of anchoring effect within the limited decision set of the experiment. Even so, we are confident that the subjects understood the instructions, because of two reasons. First, student focus groups were used beforehand to rule out any incomprehensibility and inconsistency in the introductions; and second, the answers to questions in the second part of our questionnaire regarding the reasons for the subjects' decisions do not exhibit signs of misinterpretation or misunderstanding of the instructions.
[18] Instructions for the lottery choice are provided in the appendix. In contrast to, e.g., Blaufus and Ortlieb (2009) who choose the method of lottery comparison in line with the Holt and Laury (2002) price list format – see also Lèvesque and Schade (2005), who measure risk preferences in case of timing decisions – we prefer the Dohmen et al. (2010) lottery choice framework to elicit risk preferences. We prefer this approach because Holt and Laury (2002) let subjects choose between two risky options, while Dohmen et al. (2010) let subjects choose between a safe and a risky option. The latter is closer to the experimental design of our main experiment.

during the experiment. Part two of the questionnaire was not incentivized. Each session lasted for approximately one hour, and the subjects earned 10.12 EUR on average.

V. RESULTS

The sample consists of 832 investment decisions because each of the 208 subjects decided in all four treatments. Out of these, 501 investments (60.22 %) were made in the first year, while the remaining 331 (39.78 %) were postponed to the second year. The investment decisions in the separate treatments in Table 3 indicate that this result is driven by the high tax treatments. When taxes are high, only 9.62 % (21.88 %) of the investments are carried out in the second year. The picture changes when taxes are low. Here, the minority of the investment activities were carried out in the first year, while the majority of 59.62 % (62.02 %) were postponed until the second year. [19]

Table 3: Percentage of delayed investments

	No exit option	Exit option
Low tax	59.62 %	62.02 %
High tax	9.62 %	21.88 %

In both cases, the differences in investment behavior are significant regarding the tax height with the Fisher exact test yielding p-values < 0.0001.

The existence of an exit option also seems to influence investment behavior. It appears as if given a constant tax rate, certain investments are postponed until the second year, resulting in a decrease in immediate investments when an exit option is available. However, Fisher's exact test indicates that this effect is only significant in the high tax case with a p-value < 0.0001.

[19] These results are in line with Ackermann et al. (2013), who study the impact of taxes on risk-taking.

Table 3 indicates that taxpayers are likely to make delayed investments if taxes are low and they are locked in the investment once it has been carried out (59.62 %). In contrast to the other three quadrants, this result seems to be opposed to the theoretical and the numerical example. However, it has to be noted that the results in this table do not provide evidence for the effect of a tax rate change but are limited to the effect of different tax-rate levels.

To gain more detailed insights into the tax reform effects, in the next step logistic regressions, still focusing on the tax-rate level, were conducted. The dependent variable in all regressions is *Invest Later*, which equals one if the investment in the second year is chosen. *Exit* equals one if the exit option was available, and *High Tax* equals one if the tax rate was 45 %. Because each subject decided in all four treatments, the robust standard errors were clustered at the level of the individual. Table 4 exhibits the results of the logistic regressions. The first specification exhibits a high negative coefficient of -1.9 for *High Tax* that is significant at the 1 % level. If taxes are high, the probability of switching from the investment in year one to the investment in year two decreases. The tax effect is counteracted by the positive and highly significant coefficient of *Exit*, which indicates that the probability of a later investment increases if there is an option to abandon this investment. An interaction term between the two main explanatory variables is added in the second specification. While the coefficient of *High Tax* stays at its former level of significance, the coefficient of *Exit* is no longer significant. Rather, the interaction term exhibits a highly significant positive effect, indicating that high taxes and the availability of an exit option make a later investment more likely. This is contrary to the predictions of the model, which calls for an immediate investment in the case of high taxes and an available exit option, as exhibited in Table 1.

Table 4: Logistic regression results (data pooled over treatments)

Invest later = yes/no	(1)	(2)	(3)	(4)
Exit	0.534*** (0.141)	0.101 (0.182)	0.085 (0.191)	0.110 (0.197)
High Tax	-1.936*** (0.171)	-2.630*** (0.283)	-2.677*** (0.296)	-2.648*** (0.306)
*Exit*High Tax*		1.190*** (0.327)	1.192*** (0.340)	1.107*** (0.350)
Controls			yes	yes
Risk Preferences				yes
Constant	0.180 (0.122)	0.389*** (0.142)	3.105*** (1.053)	2.699*** (1.030)
Observations	832	832	816	784
Pseudo R^2	0.1531	0.1642	0.1832	0.1848

Note: Estimates of logistic regressions. Robust standard errors in parentheses are clustered at the individual level. The dependent variable *Invest Later* equals 1 if subject postponed the investment to the second year. *Exit* equals 1 if subject exercise the exit option and *High Tax* equals one if the tax rate is 45 percent. See text for more information on other independent variables included in the regressions. Significance at the 10 percent, 5 percent, and 1 percent level is denoted by *, ** and ***, respectively.

The third specification includes several control variables. In addition to the variables for the participants' gender and age, a dummy for the field of study, which equals one if the subject studied economics and management, and a control for the number of terms already completed are added. Dummies for attending courses in finance and investment, taxation, and banking are also used to control for the subjects' specific knowledge. Finally, to control for the subjects' experience with the tax system and risky investments, dummies for filing a tax return, having work experience in the fields of taxation or investment, following economic and financial policy news in the media, and having conducted a risky investment are used. As column (3) in Table 4 indicates, our former results are robust to the inclusion of the additional control variables.[20] Finally, the last speci-

[20] Of these control variables, only the variables for age and the dummy for field of study, which are significant at the 5 % and 10 % levels, respectively, have a negative impact on the probability of a late investment. The complete

fication of Table 4 controls for the subjects' risk preferences because our underlying theoretical model assumes risk neutrality. With the inclusion of the risk preferences among the ceteris paribus conditions, we are able to draw causal inferences of our treatment variations on the timing of investment. Using the subjects' decisions in the Dohmen et al. (2010) lottery choices, we are able to classify the subjects' risk preferences into four risk categories (risk averse, slightly risk averse, risk neutral and risk affine) according to their switching points. Subjects who switch within the first ten choices from lottery to safe payment were classified as risk averse, subjects with switching points from decision eleven to thirteen were classified as slightly risk averse, and subjects who switched from decision 14 to 16 and 16 to 20 were classified as risk neutral and risk affine, respectively.[21] To test if our risk categories were correctly chosen, the maximum likelihood estimations were applied to the lottery choices to derive a parameter for relative risk aversion.[22] The estimations resulted in r-values of 0.5712 for the risk-averse, 0.3743 for the slightly risk-averse, 0.0923 for the risk-neutral and -0.0807 for the risk-loving subjects. While the values for the first three categories are in line with the classification of Holt and Laury (2002), the value of -0.0887 is too high to qualify as risk loving according to their classification[23] and are therefore treated as risk neutral in the following analysis. Surprisingly, the estimation results indicate only a small positive effect for the slightly risk-averse subjects. This effect is significant at the 10 % level, meaning that these subjects are more likely to invest later than their risk-averse peers. We do not find such an effect for the risk-neutral subjects. As demonstrated by the coefficients, con-

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regression tables are available from the authors upon request. A detailed list of control variables included in the regressions is depicted in Table A1 in the appendix.

[21] We omitted eight subjects with irrational decisions (more than one switching point for example) in this and further analyses that take risk preferences into account.

[22] Details on the estimation of the individual risk preferences are reported in the appendix.

[23] The range of the r-value in Holt and Laury (2002) is $-0.49 < r < -0.15$.

trolling for risk preferences does not have a significant influence on the effect of the tax level or on the interaction term.

Additionally, the estimations were conducted with the classification of risk preferences according to the switching points and with a classification according to Goeree, Holt, and Palfrey (2003), whereby the values of 0.5712 and 0.3743 qualify as risk averse, the value of 0.0922 as slightly risk averse and the value of -0.0807 as risk neutral. Again, there are positive significant effects at the 10 % level for the risk neutral in the Goeree, Holt, and Palfrey classification and positive significant effects at the 10 % and 5 % level for the slightly risk averse and the risk loving, respectively, in the switching-point classification. As previously, the effects of the high taxes and the interaction term are robust. For further robustness, the SOEP (2009) questions on risk attitudes concerning work and investment as well as on the overall risk attitude and the financial domain of the DOSPERT (Weber, Blais, and Betz 2002) from the second part of the experiments questionnaire were used as alternative and additional measures to control for the subjects' risk preferences. Although the SOEP overall risk question and the gambling subdomain from the DOSPERT have a positive significant influence at the 5 % level when used instead of the lottery choices (so the more risk loving the subject, the higher the probability to switch from immediate to later investment), the main effects of *High Tax* and the interaction term remain highly significant. Finally, the regressions of Table 4 were re-estimated using only those subjects studying management and economics. However, the main results remained the same. [24]

When looking at the investment timing in the four treatments in Table 5, we find that only in a situation with an exit option and a low tax rate do the risk preferences of the subjects have a significant impact on investment timing at the 1 % level. In this case, it seems that risk-averse sub-

[24] Tables displaying the results of the robustness checks are available from the authors upon request.

jects tend to invest immediately, while slightly risk-averse and risk-neutral subjects choose the later investment.[25] This result is in line with theory, which implies that risk-averse investors will have a higher preference for the risk-free alternative than less risk-averse investors. Surprisingly and in contrast to the findings of Ackermann et al. (2013), the risk attitude only loads if the tax rate is not salient (low tax rate).

In the other three treatments, the chi-squared tests indicate that investment timing is not significantly different with regard to the risk preferences. Nevertheless, to rule out the possibility that our findings are biased by the behavior of the risk-averse subjects, we exclude them from the following analysis.[26]

Table 5: Chi-squared test of investment timing for different treatments across risk preferences

	LOCKED 10		LOCKED 45		EXIT 10		EXIT 45	
	Invest now	Invest later	Invest now	Invest later	Invest now	Invest later	Invest now	Invest later
risk averse	30 42.86 %	40 57.14 %	60 85.71 %	10 14.29 %	38 54.29 %	32 45.71 %	56 80.00 %	14 20.00 %
slightly risk averse	32 43.24 %	42 56.76 %	69 93.24 %	5 6.76 %	24 32.43 %	50 67.57 %	50 67.57 %	24 32.43 %
risk neutral	21 38.18 %	34 61.82 %	51 92.73 %	4 7.27 %	15 27.27 %	40 72.73 %	40 72.73 %	15 27.27 %
Chi²	0.39		2.82		11.42***		2.86	

Note: Significance at the 10 %, 5 %, and 1 % level is denoted by *, ** and ***, respectively.

In the next step, we focus on those participants that at least once changed their decision on the investment timing during the four treatments. Here, we still concentrate on the effect of the tax-

[25] This is confirmed when testing the three risk preferences in this treatment pairwise against each other. Then, the investment behavior of the slightly-averse (neutral) subjects is significantly different from the behavior of the risk-averse subjects at the 5 % (1 %) level, while the investment decisions of the slightly-averse subjects do not significantly differ from the decisions of the risk-neutral subjects.

[26] If we constrain our sample to the risk neutral individuals only, the number of observations is too low for a sound parametric analysis. Even so, the results of a re-estimation of Tables 6 to 8 limited to risk neutral subjects turn out similar to the results presented for the preferred sample.

rate level rather than the tax-rate changes but are able to draw a conclusion for the subgroup of participants that seems to be particularly sensitive in their investment behavior.

The results of the estimations of the pooled conditional logistic models are reported in Table 6. Because of the fixed-effect character of these models, the values of the pseudo R^2 increase compared to estimations (1) and (2) in Table 4, and the observations are reduced by the decisions of the subjects who did not change their decisions between treatments and of course the exclusion of the risk-averse subjects. As in the specifications above, the tax effect is predominant. Again, an added dummy for the high tax rate interacted with the availability of an exit option turns out to be positively significant – in contrast to the theoretical predictions – and even if it does not render the exit dummy insignificant as before, it suffers a loss of magnitude as well as significance. Therefore, we have to reject hypothesis 1. Nevertheless, overall the subjects tend to invest immediately due to the predominant tax effect, which was not predicted by the theoretical model.

Table 6: Conditional logistic estimations (pooled over TOGs)

Invest later = yes/no	(1)	(2)
Exit	1.013*** (0.222)	0.555* (0.287)
High Tax	-2.234*** (0.251)	-2.943*** (0.423)
Exit*High Tax		1.184** (0.477)
Observations	448	448
Pseudo R^2	0.374	0.391

Note: Estimates of conditional logistic regressions. Robust standard errors are in parentheses. The dependent variable *Invest Later* equals 1 if the subject postponed the investment to the second year. *Exit* equals 1 if the subject exercised the exit option and *High Tax* equals one if the tax rate is 45 percent. Significance at the 10 percent, 5 percent, and 1 percent level is denoted by *, ** and ***, respectively.

Our analysis thus far assumes that the impact of the availability of the exit option and changes in the tax system are independent of the order of treatments. The next steps in the analyses focus on the order effects and thereby use the full capacity of the rich experimental design. Furthermore, in contrast to the previous analyses, the treatment order groups (TOGs) allow us to draw conclusions about the influence of the direction of the tax rate changes, i.e., whether the subjects exhibit a different investment behavior depending on the fact that they experience a tax increase versus a tax decrease. By this approach, we are able to investigate hypotheses 2a and 2b.

The estimations are carried out for the different TOGs as indicated in Table 2. The results of the conditional logistic regressions for TOGs $3_{L\downarrow E\uparrow}$ to $6_{E\uparrow L\downarrow}$ and $8_{E\downarrow L\downarrow}$ are presented in Table 7. For the treatment order groups $1_{L\uparrow E\uparrow}$, $2_{L\uparrow E\downarrow}$ and $7_{E\downarrow L\uparrow}$, the estimations do not converge and thus are not reported in this table.[27]

Table 7: Conditional logistic estimations by treatment order group

Invest later = yes/no	TOG $3_{L\downarrow E\uparrow}$	TOG $4_{L\downarrow E\downarrow}$	TOG $5_{E\uparrow L\uparrow}$	TOG $6_{E\uparrow L\downarrow}$	TOG $8_{E\downarrow L\downarrow}$
Exit	-0.451 (0.816)	0.766 (0.981)	-0.000 (0.778)	-0.857 (0.606)	0.274 (0.851)
High Tax	-3.408** (1.632)	-2.558*** (0.986)	-2.367** (1.171)	-2.870** (1.200)	-2.106** (0.952)
*Exit*High Tax*	1.984 (1.906)	0.481 (1.474)	0.813 (0.877)	2.110** (1.027)	0.523 (1.262)
Observations	48	64	52	36	56
Pseudo R^2	0.416	0.399	0.283	0.286	0.266

Note: Estimates of conditional logistic regressions. TOG stands for treatment order group. Results for TOG $1_{L\uparrow E\uparrow}$, $2_{L\uparrow E\downarrow}$ and $7_{E\downarrow L\uparrow}$ are not reported because the estimation does not converge. Robust standard errors are in parentheses. The dependent variable *Invest Later* equals 1 if the subject postponed the investment to the second year. *Exit* equals 1 if the subject exercised the exit option and *High Tax* equals one if the tax rate is 45 percent. Significance at the 10 percent, 5 percent and 1 percent level is denoted by *, ** and ***, respectively.

[27] This is most likely because in these TOGs, there is very little variation left between the different cells due to the small number of observations.

Reviewing Table 7, three things are obvious. Firstly, the effect of *High Tax* is, as before, negative, highly significant and consistent across all of the TOGs. Secondly, the positive slightly significant effect of *Exit* from Table 6 cannot be found in any of the regressions in Table 7, and, thirdly, the interaction term is only significant for the TOG $6_{E\uparrow L\downarrow}$. Based on the results of the previous estimations, one would expect a positive significant influence of the *Exit* dummy and of the interaction term. The inconsistency demonstrates that for those effects, the order of treatments plays an important role.

The estimates for the treatment order groups $3_{L\downarrow E\uparrow}$, $4_{L\downarrow E\downarrow}$, $5_{E\uparrow L\uparrow}$, and $8_{E\downarrow L\downarrow}$ only exhibit the negative effect of the high tax rate but no further effects of the exit option or the interaction term. What three of these TOGs, i.e., TOGs $3_{L\downarrow E\uparrow}$, $4_{L\downarrow E\downarrow}$ and $8_{E\downarrow L\downarrow,}$ as well as TOG $7_{E\downarrow L\uparrow}$, have in common is that the subjects have experienced a decrease in taxes within the first two rounds, independently of the treatment (LOCKED or EXIT). This indicates that the initial experience of a tax cut renders the exit option useless.

In the remaining TOG $6_{E\uparrow L\downarrow}$, the effects are close to those indicated by the regressions with the aggregate data. In this TOG, as well as in TOG $5_{E\uparrow L\uparrow}$, the subjects experienced an initial tax increase with the availability of an exit option. Of course, the results again indicate the significantly negative effect of high taxes, but now there is an additional significant and positive effect from the interaction between the exit option and high taxes in TOG $6_{E\uparrow L\downarrow}$. The latter effect is contrary to the predictions of the theoretical model. Although this effect cannot be found in TOG $5_{E\uparrow L\uparrow}$, it seems that the presence of the exit option only positively affects the probability of investing later in the case of a tax increase. This becomes particularly clear when comparing TOGs $6_{E\uparrow L\downarrow}$ and $8_{E\downarrow L\downarrow}$ because they only differ with respect to the experience of a tax increase in TOG

$6_{E\uparrow L\downarrow}$ and a tax decrease in TOG $8_{E\downarrow L\downarrow}$ [28] The binomial tests conducted to back up the results above qualitatively exhibit the same results.[29]

Next, we observe more closely the impact of a tax rate change. Whereas in the previous table all four decisions of each participant were included and we were only able to identify the tax-level effects, we now restrict the sample to those participants that changed their decision due to the tax rate *increase* during the course of the experiment (Panel I of Table 8).

Table 8: Reactions in investment decisions to changes in tax rate

Panel I: Reaction to increase in tax rate					
TOGs	Exit option	No. of late investments when tax rate is low	Percentage of late investments	No. (%) of switches to early investment	Fisher's exact test
$1_{L\uparrow E\uparrow}$ and $3_{L\downarrow E\uparrow}$	Available	26	76.47 %	20 (76.9 %)	0.000
$5_{E\uparrow L\uparrow}$ and $6_{E\uparrow L\downarrow}$	Available	15	51.72 %	11 (73.3 %)	0.000
$1_{L\uparrow E\uparrow}$ and $2_{L\uparrow E\downarrow}$	Not available	16	42.11 %	16 (100.0 %)	0.000
$5_{E\uparrow L\uparrow}$and $7_{E\downarrow L\uparrow}$	Not available	21	61.76 %	20 (95.2 %)	0.000

Panel II: Reaction to decrease in tax rate					
TOGs	Exit option	No. of early investments when tax rate is high	Percentage of early investments	No. (%) of switches to late investment	Fisher's exact test
$2_{L\uparrow E\downarrow}$ and $4_{L\downarrow E\downarrow}$	Available	18	54.55 %	15 (83.3 %)	0.000
$7_{E\downarrow L\uparrow}$ and $8_{E\downarrow L\downarrow}$	Available	25	75.76 %	17 (68.0 %)	0.000
$3_{L\downarrow E\uparrow}$ and $4_{L\downarrow E\downarrow}$	Not available	26	89.66 %	21 (80.7%)	0.000
$6_{E\uparrow L\downarrow}$ and $8_{E\downarrow L\downarrow}$	Not available	24	85.71 %	14 (58.3 %)	0.000

[28]The results above are supported by the results of the full sample, including the risk-averse subjects. In this case, only the estimation for TOG $7_{E\downarrow L\uparrow}$ does not converge. The dominant effect of the high taxes is again significant in all TOGs. There is an additional significant positive effect of the exit option for TOGs $1_{L\uparrow E\uparrow}$ and $2_{L\uparrow E\downarrow}$, so it seems that the experience of an initial tax increase without the exit option leads decision makers to treat the availability of the exit option as an opportunity to postpone investment independently of the tax rate, at least when risk-averse subjects are also considered. The fact that subjects experience an increase in taxes seems to be the important element, because the effect does not occur when taxes decrease in TOGs $3_{L\downarrow E\uparrow}$ and $4_{L\downarrow E\downarrow}$. For TOG $5_{E\uparrow L\uparrow}$, an additional positive effect for the interaction is found to be comparable to that already found in TOG $6_{E\uparrow L\downarrow}$. Finally, in TOG $6_{E\uparrow L\downarrow}$ an additional slightly significant positive effect for the EXIT occurs, making the estimates for TOG $6_{E\uparrow L\downarrow}$ even more similar to the results of the pooled conditional logistic regressions.

[29] These are available from the authors upon request.

Given the predictions of our theoretical model, which indicate that a sufficient increase in the tax rate may cause investment acceleration, we are interested in the behavior of subjects who invested later when taxes were low. In contrast to the theoretical model, our experimental analysis was thus far restricted to the impact of the tax level regardless of whether the tax rate had been lower or higher in the previous round. The investment timing for late investors, which depends on the respective TOGs and is thus differentiated with respect to the tax rate increases and decreases, is displayed in Panel I of Table 8. For the treatments with an exit option, a rise in the tax rate takes place in TOGs $1_{L\uparrow E\uparrow}$, $3_{L\downarrow E\uparrow}$, $5_{E\uparrow L\uparrow}$ and $6_{E\uparrow L\downarrow}$. In TOGs $1_{L\uparrow E\uparrow}$ and $3_{L\downarrow E\uparrow}$, in which the tax rate rises from round 3 to 4, 26 subjects invested late in case of the low tax treatment. Twenty of these late investors switched to an early investment when the tax rates rose, and only 6 decided to stick to the late investment. In TOGs $5_{E\uparrow L\uparrow}$ and $6_{E\uparrow L\downarrow}$, in which the tax rate already increased between rounds 1 and 2, 15 subjects invested late when taxes were low. Eleven of the late investors changed their decision when taxes increased, and only 4 decided to stick to the late investment. In both cases, the change in investment behavior is significant according to Fisher's exact test at all conventional levels.

To determine the extent to which this behavior is driven by the availability of the exit option, we analyze an increase in the tax rate in the LOCKED treatment in TOGs $1_{L\uparrow E\uparrow}$, $2_{L\uparrow E\downarrow}$, $5_{E\uparrow L\uparrow}$, and $7_{E\downarrow L\uparrow}$. In TOGs $1_{L\uparrow E\uparrow}$ and $2_{L\uparrow E\downarrow}$, taxes rise between the first and second round. There, 16 subjects invested late when taxes were low, and all subjects invested early after the tax increase. In TOGs $5_{E\uparrow L\uparrow}$ and $7_{E\downarrow L\uparrow}$, the participants faced a tax raise between rounds 3 and 4. Only one of the 21 subjects who invested late when the tax rate was 10 % stuck to his or her decision when the tax rate increased to 45 %. The remaining 20 subjects changed to an early investment, which indicates, as for the EXIT treatment, a significant change in behavior. Other factors seem to influence the decision of investors in the treatment without the exit option when taxes are low. Only high taxes induce rational behavior on the side of the participants, which is characterized by immediate investment in this case. An alternative explanation for the observed findings is that high taxes make the risk involved in the decision more salient (Ackermann et al. 2013). In line with their findings, we find the subjects invest immediately when taxes are high. This reaction might be driven by the bad news of high taxes, which seems to influence the investment decisions toward an early riskless investment, while good news leave the investment behavior unaffected (Kahneman/Tversky 1979; Baumeister et al. 2001). The statements of the subjects that are collected after the experiment support this interpretation (see below). In summary, these observations indicate that the tax effect dominates the effect of the availability of the exit option.

The question arises whether we can observe a contrary effect, i.e., if subjects change their behavior and postpone the investment rather than investing immediately after they experience a tax cut. The results are presented in Panel II of Table 8. It is obvious that the number of subjects who switched from an immediate investment when taxes were high to a later investment when the tax rate decreased is economically and statistically significant in all relevant TOGs.

For a clean identification of the influence of the availability of the exit option on investment behavior, we compare the treatments with an increase in the tax rate that differ with respect to the presence of an exit option (TOGs $1_{L\uparrow E\uparrow}$ and $2_{L\uparrow E\downarrow}$ versus TOGs $5_{E\uparrow L\uparrow}$ and $6_{E\uparrow L\downarrow}$, Panel I of Table 8) and the equivalent treatments with a decrease in the tax rate (TOGs $3_{L\downarrow E\uparrow}$ and $4_{L\downarrow E\downarrow}$ versus TOGs $7_{E\downarrow L\uparrow}$ and $8_{E\downarrow L\downarrow}$, Panel II of Table 8). We restrict our analysis to these TOGs because in these groups, the decisions of interest were made in the first two periods. Hence, no effects of the previous decisions have to be taken into account. We find evidence that the presence of an exit option influences the investment decisions in the case of an increase in the tax rate (p-value =

0.0434), according to Fisher's exact test. However, the effect is contrary to the one predicted by the theoretical model. The model predicts that an exit option leads to an early investment when taxes are high. However, as can be observed in Panel I of Table 8, only 11 of 15 possible subjects (73.3 %) switch to an immediate investment when the exit option is present (TOGs $5_{E\uparrow L\uparrow}$ and $6_{E\uparrow L\downarrow}$), whereas all 16 subjects invest early when taxes are high and there is no opportunity to abandon the investment (TOGs $1_{L\uparrow E\uparrow}$ and $2_{L\uparrow E\downarrow}$). Therefore, in accordance with the results of the regression analysis, we have to reject hypothesis 2a. Regarding hypothesis 2b, Fisher's exact test indicates that there is no effect from the exit option when the tax rate decreases (p-value = 0.2347), so this hypothesis must also be rejected.

To shed light on the question as to why participants did not behave according to the predictions of the theoretical model, we consider the second part of the questionnaire. It seems that the main reason for observing such differences from our theoretical predictions lies in the fact that certain participants do not take both the taxation and the availability of an exit option into account. When asked “How did the tax level influence your decision?” approximately 59 % stated that their decision was influenced by the level of taxation, while 29 % stated that this was not the case. However, when asked “How did the option to abandon the delayed investment (investment B) influence your investment decision?” only 33 % stated that the exit option had an influence on their decision, while 47 % did not account for this option in their decision.[30] The impression that the option did not affect the decision becomes even clearer when we consider certain individual answers. One subject stated: “To me, higher taxes mean that I need more security.” Another said, “I chose A when taxes were higher in order to not undercut a certain minimum gain.” This fixation on only one of the decision criteria led these subjects to choose the early investment when

[30] The remaining answers to these two questions were inconclusive.

taxes were high and the delayed investment when taxes were low, which is again in line with the bad news principle. There is also anecdotal evidence for other elements that influenced the decisions of the subjects. For example, one subject stated: “For a higher amount, I would have had to pay more taxes. I therefore chose the alternative in which I have to pay fewer taxes.” This implies tax aversion as a driver.

The individual perceptions of the situation might be another driver, because one subject stated: “I perceived the initial position of investment B as more profitable than that of A.” In summary, it seems that while some subjects clearly state that they use the expected payoff or both, the tax level and the availability of the exit option as the decision criteria, another segment of the subjects tries to implement a simple rule of thumb or merely trust their guts to come to a decision.

VI. CONCLUSIONS

It is well known that taxes may significantly affect investment decisions and that risky investment projects are often asymmetrically impacted by taxation. As risky projects are particularly important for future company performance and economic growth, it is important to determine to what extent and under what conditions taxes may distort risky investment decisions.

The literature provides first insights into the interaction between taxes and investment timing under uncertainty and flexibility and theoretically identifies the conditions for earlier investment as a reaction to the tax rate increases.

Using a rather simple experimental design, we study the investment reactions for different levels of tax rates. Corroborating the results of the underlying economics-based analytical model, an exit option in the case of a high tax rate seems to be the crucial setting for the accelerating tax effect. Concentrating on the impact of the tax rate changes, in the next step we find both the accelerating effect upon a tax rate increase and the decelerating effect upon a tax rate decrease. Moreover, we find evidence that higher taxes foster (accelerate) investment independent of the existence of an exit option. This is surprising and contrasts with the reactions predicted by the theoretical literature on the tax effects on investment timing under simultaneous entry and exit flexibility. High taxes seem to speed up investment. Contrary to the predictions from the theoretical literature, our findings suggest that the presence of an exit option attenuates accelerated investments. However, we observe the latter only in the case of a tax increase, while the presence of an exit option seems to be irrelevant for the timing of investment in the case of a tax rate decrease. This investment behavior is possibly driven by tax salience and the mechanisms known from the theory of irreversible choice under uncertainty, whereby bad news affects investments decisions, while good news does not.

Surprisingly, we find investor risk attitudes do not impact their behavior if the tax rates are high.

Our empirical evidence suggests that at-first-sight unexpected tax effects, which are often called paradoxical investor reactions, are much more common than can be predicted by the economics-based theoretical tax literature. By nature, these results are limited by the underlying set of assumptions. As these assumptions include the specific growth patterns that are typical for R&D-intensive and export-oriented industries, they provide important insights for the discussions on the interplay of taxation (tax rate changes, tax incentives) and economic growth. Our results imply that tax rate changes often may not be likely to induce the intended investment effects. Thus, policy makers should generally be well aware of at-first-sight unexpected outcomes of tax reforms and carefully consider the behavioral aspects that might invoke unexpected reactions of the taxpayers that are often neglected.

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APPENDIX

Instructions (The original instructions were in German)

For the course of the experiment, all amounts of money will be stated in the fictive currency "Taler".

The experiment consists of 4 periods. After the first 2 periods, you will receive further instructions for the remaining 2 periods.

Your payment is in no stage of the experiment dependent on the decisions of the other participants. Furthermore, the payout of one period does not affect the payout of any other period; the results of all the periods are independent of one another.

At the end of the experiment, you will be asked to throw a die to determine which one of the 4 periods is relevant for payment. The result of this period will then be paid out to you.

After the experiment has finished, you will be asked to fill out a questionnaire. You will receive a short set of instructions as soon as the experiment has ended. The answers in this questionnaire do not influence the payout that you will receive from this experiment.

Procedure of a Period

As the owner and manager of a small company, you have accumulated reserves of 30,000 Talers from the annual surplus that are available for investment. The investment horizon is 2 years. Having been well-advised and after thorough consideration of all alternatives, you have identified 2 possible investments; however, you can only choose one of the two:

Investment A: You invest immediately.

In the first year, you invest 10,000 Talers and achieve earnings of 25,000 Talers, which are taxed at the current tax rate.

In the second year, your whole credit balance is tied up and yields interest at a rate of 3.75 %.

Investment B: You invest later.

In the first year, your whole credit balance is tied up and yields interest at a rate of 3.75 %.

In the second year, you invest 21,000 Talers. The revenue of this investment depends on the market situation. With a positive development, you achieve earnings of 52,290 Talers, and with a negative development, you achieve earnings of 22,410 Talers. The positive and negative developments are equally probable, which means that in half the cases the market situation improves, and in the other half of the cases, the market situation worsens. The revenue is then taxed at the current tax rate.

<u>After you have learned how the market situation has developed, you have the option to abort the investment. Thus, you receive a redemption of the invested amount of 21,000 Talers, and your final credit balance amounts to 31,125 Talers.</u>

Tax Payment

You must pay taxes for all revenues that were generated from investment activities. The taxes are deducted from the achieved revenue directly after the investment has been undertaken. At the beginning of each period, the current tax rate will be communicated. You do not have to pay any taxes on the interest income.

Result for one Period

The result for one period consists of the part of the reserves that were not invested, the invested sum (after the deduction of taxes) in one of the years, and the interest income in the other year.

Payout

At the end of the experiment, you will be asked to throw a die to determine which one of the 4 periods is relevant for your payout. The result of this period will then be exchanged at an exchange rate of 1.75 Euro per 10,000 Talers. A show-up fee of 2.50 Euro is added to this amount, which is then directly paid out to you in cash.

Please note:

During the entire experiment, no form of communication is permitted.

All mobile phones must be switched off during the complete duration of the experiment.

The decisions you make within this experiment are anonymous, i.e., none of the other participants learns about the identity of a person who has made a specific decision.

The payments are also handled anonymously. No other participant finds out how much money the other participants have earned and have been paid out.

Please remain seated until the end of the experiment. You will be called forward for your payout through your seat number.

Good luck, and thank you for your participation in this experiment!

Table A1: Descriptive statistics of control variables

	obs	**percent***	**min**	**max**
female	208	50.96	0	1
*age**	208	22.94	18	35
study	208	81.64	0	1
*sem**	208	4.28	0	11
study finance	207	57.00	0	1
good finance	111	65.77	0	1
study tax	208	50.96	0	1
good tax	98	55.10	0	1
study bank	207	15.94	0	1
good bank	35	65.71	0	1
work invest	208	22.12	0	1
work tax	208	27.88	0	1
risky invest	208	32.69	0	1
informed	208	48.56	0	1
tax declaration	208	35.58	0	1

Note: For variables denoted by * the mean is given instead of percent. *female* equals 1 if subject is female, *age* measures the age of subject in years, *study* equals 1 if subject studies economics and management and *sem* measures the number of terms already completed. *study finance*, *study tax* and *study bank* equal 1 if subjects attended courses in the areas of finance and investment, taxation and banking, respectively. *good finance*, *good tax* and *good bank* equal 1 if subjects rate themselves as being good in these courses. *work invest* and *work tax* equal 1 if subjects have work experience in the fields of investment or taxation. *risky invest* equals 1 if subjects have already conducted a risky investment, *informed* equals 1 if subjects follow economic and financial policy news in the media and *tax declaration* equals 1 if they have filed a tax return. All controls are self-reported.

Instructions Questionnaire

- The experiment is over now. The Questionnaire follows.

Instructions questionnaire part 1

- In part 1 of the questionnaire, we would like to know how you would choose between a safe payment (Alternative A) and a lottery (Alternative B).
- The following screen will be presented to you:

Please state for each row if you prefer the safe payment (alternative A) OR the lottery (alternative B):				
1)	Alternative A: €0 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
2)	Alternative A: €1 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
3)	Alternative A: €2 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
4)	Alternative A: €3 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
5)	Alternative A: €4 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
6)	Alternative A: €5 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
7)	Alternative A: €6 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
8)	Alternative A: €7 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
9)	Alternative A: €8 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
10)	Alternative A: €9 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
11)	Alternative A: €10 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
12)	Alternative A: €11 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
13)	Alternative A: €12 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
14)	Alternative A: €13 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
15)	Alternative A: €14 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
16)	Alternative A: €15 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
17)	Alternative A: €16 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
18)	Alternative A: €17 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
19)	Alternative A: €18 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0
20)	Alternative A: €19 for sure	O	O	Alternative B: with 50 % chance €30 and with 50 % chance €0

- In each **line** (from 1 to 20), you have **two options:**
  - A fixed payment you get for sure **(Alternative A)**.
  - An “all-or-nothing” lottery in which you win 30 Euro with a probability of 50 % and win nothing with a probability of 50 % **(Alternative B)**.
- Please choose for **each** line either alternative A or B. Mark the **left** field if you choose **Alternative A** or the **right** field if you choose **Alternative B**.

Additional profit opportunity in part I of the questionnaire:

- In this first part of the questionnaire, you have another chance to earn a payment.
- For this additional chance, **two participants** in this room will be randomly **drawn**.
- For the drawing of the two winners, two cabin numbers will be randomly drawn out of an urn.
- The chosen participants will receive their additional payout when all payoffs are distributed after answering the second part of the questionnaire.
- If you are one of the two chosen participants, you will be asked to cast a twenty-sided die.
- With the first cast of the twenty-sided die, you decide which line will be relevant for your payment.
- If you decided to take Alternative B for the line that will be paid out, you will be asked to cast a twenty-sided die again. With the numbers 1 to 10, you receive 30 Euro, with 11 to 20 you receive nothing. If you decided to take Alternative A, you will receive the safe payout immediately.

When all participants complete the first part of the questionnaire, the second part will follow.
The answers in the second part of the questionnaire are irrelevant for the payout.
Please keep in mind that all questions will be evaluated anonymously and communication is not allowed during the complete experiment.

Thank you very much for your participation in this experiment!

Estimation of individual risk preferences

To derive the risk preferences of the subjects from their lottery choices, we follow Holt and Laury (2002) and Goeree, Holt, and Palfrey (2003). An additive random utility model (ARUM) is used (Cameron and Trivedi 2005) to derive the choice probabilities, from which the corresponding coefficients are determined. In detail, the subjects choose the option with the higher utility between the safe option A and the lottery option B. If the subjects choose the safe option A, they earn the safe payout S with the utility U_s. The subjects choosing the lottery option B earn the expected payoff L with the utility U_L. Then, the ARUM specifies the utilities of the two options as

$$U_S = V_S + \varepsilon_S$$
$$U_L = V_L + \varepsilon_L = 0{,}5 \times V(30) + 0{,}5 \times V(0) + \varepsilon_L$$

where V_S and V_L are the deterministic components of utility, and ε_S and ε_L are the random components of utility. Let y denote the actual decision of the subject. If $U_S > U_L$, the subject chooses the safe option, and y=1. For this case, the probability of a subject to choose the safe option is

$$\begin{aligned} \Pr[y = 1] &= \Pr[U_S > U_L] \\ &= \Pr[V_S + \varepsilon_S > V_L + \varepsilon_L] \\ &= \Pr[\varepsilon_L - \varepsilon_S < V_S - V_L] \\ &= F(V_S - V_L) \end{aligned}$$

where F is the cumulative distribution function of $(\varepsilon_L - \varepsilon_S)$.

Following Luce (1959), a noise parameter λ is introduced to allow for the subjects making mistakes when filling out the choice table, which could be evoked by insensitivity in the payoff differences. Then, the probability of choosing the safe option can be written as

$$\Pr[y = 1] = \frac{1}{1+\exp(\lambda \times (V_L - V_S))}\ .$$

Because the noise parameter is contrarily related to the variance of the error terms, the smaller values of λ result in a choice probability of 0.5 and the large values of λ in a decision for the safe option A.

As utility function with a constant relative risk aversion

$$U(x) = x^{1-r}$$

is employed, which is then normalized by setting

$$U(x) = \frac{x^{1-r}}{30^{1-r}}$$

to prevent scaling effects on λ. Thereby, the utility can only take values between 0 for the lowest possible payoff of zero and 1 for the highest possible payoff of 30 Taler. Because the normalized utility of the lottery option B equals 0.5, the probability of choosing the safe option simplifies to

$$\Pr[y = 1] = \frac{1}{1+\exp(\lambda \times (0.5 - V_S))} = \frac{1}{1+\exp(\lambda \times \left(0.5 - \frac{S^{1-r}}{30^{1-r}}\right))}.$$

Finally, all choices of all subjects were used simultaneously to estimate the r coefficients and the noise parameter λ using maximum likelihood estimations.

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