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List of Abbreviations

ATT	average treatment effect on the treated
BGB	Bürgerliches Gesetzbuch
BMI	body mass index
CDF	cumulative distribution function
CRT	Cognitive Reflection Test
EU-27	the 27 member states of the European Union (without Great Britain)
FE	fixed-effects
GRQ	general risk question
OLS	ordinary least squares
PSM	propensity score matching
SOEP	German Socio-Economic Panel
WTP	willingness to pay

Dedicated to Svenja, my beloved wife

Chapter 1

Synopsis

This dissertation consists of three essays covering different behavioral aspects of risk and insurance: Chapter 2 deals with the question whether and how a person's position in the wealth distribution relative to a peer group affects her individual risk-taking behavior, while holding absolute wealth constant. Chapter 3, on the other hand, focuses on individual decision-making in the loss domain and explores how the awareness of default risk inherent in insurance contracts impacts individuals' willingness to pay (WTP) for insurance. Chapter 4 studies the effects of family events on individuals' smoking behavior and body weight.

To make causal inferences, this dissertation uses randomized laboratory experiments (Chapter 2 and Chapter 3) as well as regression-adjusted matching (Chapter 4). In laboratory experiments, assignment to the different treatment groups takes place randomly, resulting in (nearly) the same distribution in observed and unobserved characteristics across treatment and control groups (at least, for large sample sizes). Randomization, thus, offers an opportunity to determine causal effects in laboratory experiments. Randomization, however, may not be possible in observational studies. Therefore, a systematic bias due to the selection in treatment and control groups may arise. One tool to make treatment and control groups more similar and to provide causal evidence for observational data is regression-adjusted matching, which is applied in Chapter 4.

In Chapter 2 (joint with Petra Steinorth), entitled "**Relative Wealth Placement and Risk-Taking Behavior**", we show that individuals' risk-taking behavior is affected by relative wealth placement—a person's position in the wealth distribution relative to a peer group. Concerns about relative wealth placement, thus, embody a specific type of social preferences in which individuals may care about others' wealth levels. Yet, these changes in relative wealth placement are usually confounded by changes in absolute wealth. To disentangle the impact of relative wealth placement from absolute wealth changes, we introduce a theoretical model in which concerns about relative wealth placement enter utility and test our model in a laboratory experiment. We compare subjects who receive exactly the same absolute wealth but are placed differently within their wealth distribution. When placed at the bottom of the wealth distribution, individuals take on more risk and invest (in a standard portfolio problem) significantly

more into the risky asset than those with the same endowment but a higher placement. When placed at the top, on the other hand, individuals invest significantly less into the risky asset. All in all, relative wealth placement impacts risk-taking behavior strongly and changes the invested amounts by up to 50 percent. Furthermore, we also show that the very introduction of information about others' wealth levels changes risk-taking: people at the bottom increase their risk-taking, whereas people at the top reduce their risk-taking.

Taken together, concerns about relative wealth placement serve as an additional channel how wealth can enter an individual's utility and shape decision-making under risk. This chapter, thus, adds to the literature on how wealth affects decision-making under risk (e. g., Morin and Suarez, 1983; Levy, 1994; Holt and Laury, 2002; Guiso and Paiella, 2008; Chiappori and Paiella, 2011; Chao et al., 2017). Previous research investigating the relationship between risk-taking behavior and relative wealth placement have used multiple-price lists (Linde and Sonnemans, 2012; Chao et al., 2017; Schwerter, 2020) or studied this relationship with a simultaneous change in absolute wealth (Chao et al., 2017). We contribute to this strand of literature by comparing risk-taking behavior between subjects who receive the same absolute wealth, but who differ in their placement in the wealth distribution. And by using the risk-elicitation method of Gneezy and Potters (1997) in our experimental setup, individuals can endogeneously choose investment amounts that allow rank reversals (rather than having a fixed social reference point).

In Chapter 3, entitled "**What Drives the Willingness to Pay for Insurance Contracts with Nonperformance Risk? Experimental Evidence**", I study individuals' WTP for insurance contracts with inherent nonperformance risk. A nonperforming insurance contract results in a situation in which the insured might be worse off than without insurance, since the insured is not only not (fully) compensated, but also loses the paid premium. A recent example is the insolvency of Thomas Cook, a British global travel group, in 2019. In Germany, the sum, against which tour operators must insure themselves for the insolvency case, is legally limited to EUR 110 million (§ 651r BGB). The actual claims, however, exceeded this threshold by far. The policyholders, thus, are only partially reimbursed by their insurance contract.[1] In an incentive-compatible laboratory experiment, subjects state their maximum WTP for three different insurance contracts. These three insurance contracts have the same scope of indemnity (full insurance) and only differ in their probability of default. The probability of default is either 0 percent, 0.1 percent, or 1 percent. While subjects' median WTP is above the actuarially fair premium for the default-free contract, the introduction of nonperformance risk reduces their median WTP below the adjusted actuarially fair premium. When increasing the nonperformance risk from 0.1 percent to 1 percent, subjects reduce their WTP even further. Moreover, I find that the WTP is influenced by age, risk attitude, gender, or framing.

[1]The German government, however, decided to compensate these holiday-makers for the difference between their payments to the tour operator and the sum they receive from the insolvency insurer (Zurich Insurance).

Overall, this chapter can confirm previous studies that find that the presence of nonperformance risk decreases participants' WTP significantly (e. g., Wakker et al., 1997; Zimmer et al., 2009; Zimmer et al., 2018). Although the studies of Wakker et al. (1997) and Zimmer et al. (2009) were hypothetical studies, the results were qualitatively confirmed by Zimmer et al. (2018) in an incentivized experiment, in which the potential loss subjects faced was rather high (EUR 800), but only one out of 181 participants actually faced it. Nonetheless, the reduction in the premium when introducing a nonperformance risk of 1 percent is slightly different between Wakker et al. (1997) and Zimmer et al. (2018): While Wakker et al. (1997) report a 20 percent reduction, subjects in Zimmer et al. (2018) only reduce their adjusted WTP by 8.3 percent in the median. This chapter can validate the previous findings in an experimental setup in which the potential loss is much lower (compared to Zimmer et al. (2018)) but all subjects have to face this potential loss. To compensate for a 1 percent default probability in this study, subjects reduce their adjusted WTP by 29.1 percent in the median compared to the default-free insurance contract. Furthermore, this study also uses a default probability of only 0.1 percent, which is below the one-year probability of default of 0.5 percent the European Solvency II regulation aims at. However, the introduction of nonperformance risk leads to a sharp decrease in subjects' median WTP below the adjusted actuarially fair premium—suggesting that already the awareness of nonperformance risk reduces the WTP significantly, irrespective whether it is 0.1 or 1 percent. Thus, consumers are willing to pay considerably more for default-free insurance policies.

In Chapter 4, entitled "**Impact of Family Events on Smoking Behavior and Body Weight**", I investigate how individuals' smoking behavior and body weight are affected by family events. Smoking and excessive body weight are both still major sources of preventable deaths (eurostat, 2020). Using German Socio-Economic Panel data, I find that changes in family composition, such as moving together with or separating from a partner or the death of a close family member, impact the probability to start or quit smoking and lead to changes in body weight. One empirical problem arising with observational data, however, is that the assignment to treatment (i. e., the occurrence of the family event) may not be random, making causal inference difficult. As a consequence, the covariates may be unbalanced across treatment and control groups. To address this problem, I employ regression-adjusted matching for each family event separately in order to compare similar treatment and control groups in observable characteristics. To further reduce the potential problem that covariates might affect treatment status, I exploit the panel data's time structure and perform entropy balancing as a matching procedure on the set of covariates *before* the family event actually happened. In particular, I find that the formation and dissolution of a household (rather than marriage or divorce) impact smoking behavior and body weight: cohabitation leads to weight gain, whereas separation from a partner leads to weight loss, increased smoking initiation, and decreased smoking cessation.

Taken together, this chapter contributes to previous research examining the effects of

family events on smoking behavior (e. g., McKee et al., 2003; Nystedt, 2006; Cho et al., 2008) and body weight (e. g., Wilcox et al., 2003; Averett et al., 2013; Mata et al., 2015; Mata et al., 2018). While it is commonly accepted that smoking and excessive body weight are associated with longlasting negative health consequences, smoking and obesity have also shown to cause economic consequences: For instance, smoking and obesity increase medical care costs (e. g., Sloan et al., 2004; Finkelstein et al., 2009; Cawley and Meyerhoefer, 2012) or reduce income and wages (e. g., Averett and Korenman, 1996; Cawley, 2004; van Ours, 2004; Auld, 2005; Kline and Tobias, 2008). Furthermore, obesity also reduces the chances of employment (e. g., Morris, 2007) or receiving a job interview (e. g., Rooth, 2009). A key insight from this study is that smoking behavior and body weight are affected by moving together with and separating from one's partner, rather than by marriage or divorce. Thereby, this chapter accounts for differences between treatment and control groups by applying regression-adjusted matching. It also takes advantage of the panel structure of the German Socio-Economic Panel by conditioning on the set of covariates before the family event actually happened. This chapter, therefore, aims at deepening our understanding of factors that contribute to a change in smoking behavior or body weight.

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Chapter 2

Relative Wealth Placement and Risk-taking Behavior*

Marc-André Hillebrandt and Petra Steinorth

2.1 Introduction

Our standing among peers matters to us in multiple dimensions; it defines our self-perception as well as happiness (as shown by van de Stadt et al., 1985; Ferrer-i-Carbonell, 2005).[1] Economic literature provides evidence that relative standing shapes one's utility function (Robson, 1992; Kingdon and Knight, 2007; Clark et al., 2009; van Landeghem and Vandeplas, 2018). Relative standing has also been shown to play a pivotal role in economic decision-making in many areas, such as labor supply (Bracha et al., 2015), job performance (Cohn et al., 2014; Ockenfels et al., 2015), educational performance (Tran and Zeckhauser, 2012), partnership formation (Bhattacharya and Dugar, 2014), and investment behavior (Roussanov, 2010; Dijk et al., 2014; Kirchler et al., 2018). Given that the listed decisions are usually risky, we posit the question whether and how risk-taking is affected by *relative wealth placement*—a person's position in the wealth distribution relative to a peer group.

We argue that relative wealth placement adds an additional dimension to an individual's utility function, which is interdependent with the original, monetary argument. Both – information on relative wealth placement as well as the actual position in the relative

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[1] Frey and Stutzer (2002) and Clark et al. (2008) provide a review of the literature investigating the relationship between happiness and relative income. For example, Luttmer (2005) finds that individuals report lower levels of happiness when others in their neighborhood have higher earnings than they do. Card et al. (2012) find that relative pay comparisons impact job satisfaction. Feedback on relative performance, however, also promotes unethical behavior to improve people's own relative position in their reference group (Charness et al., 2014).

distribution – might change risk-taking. We hypothesize that relative standing impacts decision-making under risk in two ways: There is upside potential as risky decisions provide an opportunity not only to increase wealth, but also to improve relative standing if lucky. At the same time, consumption as well as relative standing are reduced if fortune turns out to be fickle.

As the example above illustrates, relative wealth changes usually occur together with absolute wealth changes, which complicates to isolate the impact of relative wealth changes on risk-taking behavior. We therefore investigate people's risk-taking behavior – both theoretically and in a between-subject laboratory experiment – by comparing individuals with the same absolute wealth but different placement in the wealth distribution. Our setup allows us to disentangle the impact of relative wealth placement from potentially confounding absolute wealth changes. We introduce a theoretical model how concerns about relative wealth enter an individual's utility based on a simple investment decision. Specifically, we focus on individuals at the bottom and at the top of the wealth distribution to tease out how a more prominent upside potential in the relative wealth dimension compares to a situation where the downside potential dominates.

We show that relative wealth placement can change decisions in our framework: individuals placed at the bottom (top) in the relative wealth distribution exhibit more (less) risk-taking. In a laboratory experiment with 420 subjects, we compare subjects' investment behavior depending on placement in the wealth distribution while holding absolute wealth levels constant. Our experimental design allows us to conclude that observed differences in risk-taking are entirely due to changes in relative wealth placement. As predicted by our model, subjects invest more (less) into a risky asset if they are placed at the bottom (top) of the relative wealth distribution. Generally, relative wealth placement has a surprisingly large impact on individual risk-taking behavior, changing invested amounts by up to 50 percent.

Our findings are relevant to the question how an individual's relative standing impacts economic decision-making through changes in risk-taking. We, thus, contribute to an increasing experimental and behavioral literature investigating how peers affect economic decision-making (e. g., Fershtman et al., 2012; Immorlica et al., 2017), especially decision-making under risk (e. g., Apesteguia et al., forthcoming).[2] We show that introducing information about the wealth distribution changes risk-taking: people at the bottom become less risk-averse, people at the top more risk-averse. We also provide evidence that the position in the wealth distribution matters and we show that trying to avoid the last place increases risk-taking most prominently, which Kuziemko et al. (2014) refer to as "last-place aversion". This is consistent with our hypothesis that a

[2]Fershtman et al. (2012) find that people act profit maximizing in dictator and trust games when actions are socially acceptable. In the theoretical model of Immorlica et al. (2017), reference groups for status comparisons are local and individuals focus on upward social comparisons, resulting in welfare losses arising from status seeking. In a similar vein, Apesteguia et al. (forthcoming) show that receiving information on past investment decisions and its success of other traders leads to more risk-taking and that the option to copy trade exabertes this effect.

dominant upside potential in terms of relative wealth placement increases risk-taking behavior. But we also provide evidence that a dominant downside potential, on the other hand, reduces risk-taking behavior.

2.2 Related Literature

This paper is related to the vast empirical and experimental literature on how wealth affects decision-making under risk (e. g., Morin and Suarez, 1983; Levy, 1994; Holt and Laury, 2002; Guiso and Paiella, 2008; Chiappori and Paiella, 2011; Chao et al., 2017). So far, the results are rather mixed: many studies support the hypothesis of Arrow (1965) and Pratt (1964) of increasing relative risk aversion (e. g., Holt and Laury, 2002), whereas a considerable part of empirical work does not.[3] Disentangling the impact of relative and absolute wealth can be a promising direction to shed light on the complex relationship between wealth and risk preferences. We contribute to this literature by providing evidence for the existence of an additional channel how wealth can enter an individual's utility and shape risky decisions: through concerns about relative wealth placement.

Generally, different theoretical approaches address how others can affect utility and, thus, eventually risk-taking. Abel (1990) established the "Catching up with the Joneses' effect" in his seminal work on habit formation. Being placed behind others can enter one's utility also through inequality aversion, as modeled by Fehr and Schmidt (1999) and Bolton and Ockenfels (2000): When comparing two situations where an individual's absolute wealth level is the same, she might experience disutility from having a lower *relative* wealth placement. In these models, however, it is not clear how this effect of lower relative wealth placement might affect risk-taking behavior. To address risk-taking in the presence of peers, we introduce a theoretical model in which utility depends on both wealth and relative wealth placement. We hypothesize that individuals take on more (less) risk when placed at the bottom (top) of the wealth distribution.[4]

In addition, we contribute to the emerging literature investigating the relationship between relative wealth placement and individual risk-taking behavior (e. g., Linde and Sonnemans, 2012; Dijk et al., 2014; Kuziemko et al., 2014; Chao et al., 2017; Schwerter, 2020). In a social comparison setting, Dijk et al. (2014) investigate portfolio choices with differently skewed assets. Their focus is on prudence, whereas we focus on risk

[3] There are studies that show that relative risk aversion either decreases with wealth (e.g., Levy, 1994), that it is constant regardless of wealth (see Chiappori and Paiella, 2011), or that the relationship between wealth and relative risk aversion is nonlinear or inconclusive (e.g., Morin and Suarez, 1983).

[4] Stark (2019) theoretically analyzes how relative wealth influences relative risk aversion. In his model, an individual becomes more risk-averse when improving relative standing if her level of concern about low relative wealth does not change. If this level of concern about low relative wealth, however, intensifies when improving relative standing, the individual may become less risk-averse. Compared to Stark (2019), we do not impose a specific structural form how the second argument enters utility.

aversion.[5] They report that subjects tend to adapt their portfolios to the current relative portfolio: overperformers prefer negatively skewed assets (to maintain a good rank), underperformers positively skewed assets (to improve relative standing).

Kuziemko et al. (2014) show that individuals are more likely to accept a risky lottery when being in the last place, which they refer to as "last-place aversion".[6] We contribute to this literature by showing that not only the aversion to being last changes risk-taking but also that high placement decreases risk-taking: subjects at the top of the wealth distribution take on less risk than those with the same endowment but a lower placement.[7] Furthermore, we do not only compare individuals at different relative wealth positions but also individuals with and without concerns about their placement. Again, we find substantial changes in risk-taking.

Linde and Sonnemans (2012), Chao et al. (2017), and Schwerter (2020) use multiple-price lists (or other binary lotteries) to investigate the relationship between relative wealth placement and individual risk-taking behavior with mixed findings about how relative placement affects risk-taking: Linde and Sonnemans (2012) find subjects to become more risk-averse when ranked lower, while Schwerter (2020) finds the exact opposite.[8] One explanation for the mixed findings can be the use of multiple-price lists: Usually, payouts in both states of the world are fixed, but probabilities of the states vary. Risk preferences are assessed based on people's switching point from the less risky to the riskier choice. The choice of payouts in the two states of the world can induce a framework of social comparison. Individuals may be better off, equal, or worse off than their social reference point in the beginning and they may or may not be able to reverse ranks. By using the risk elicitation method of Gneezy and Potters (1997) instead of multiple-price lists or other binary gambles, subjects in our experiment can decide on the investment amount. This way, payouts and, ultimatively, the decision whether to invest amounts that allow rank reversals in the good or bad state of the world is endogenous to the individuals.

[5] Noussair et al. (2014) show that risk aversion is correlated with prudence.

[6] Camerer et al. (2016) were not able to replicate the findings of Kuziemko et al. (2014). Martinangeli and Windsteiger (forthcoming) point out that a potential reason for this failed replication might be that subjects randomly rotate across ranks at every round. By introducing treatments where ranks are kept across all rounds or where rank reversal is not possible, Martinangeli and Windsteiger (forthcoming) find support for both a great disutility from occupying the last as opposed to higher ranks (like Kuziemko et al., 2014) and for a general dislike of (disadvantageous) rank reversals affecting most ranks (as put forward by Xie et al., 2017).

[7] In an effort task, Gill et al. (2019) find that subjects exhibit "first-place loving" and "last-place loathing". Hence, it is not surprising that subjects pay particular attention to the first and last place in a distribution.

[8] Chao et al. (2017) investigate how subjects adapt their reference point after experiencing absolute and relative wealth changes simultaneously.

2.3 Standard Portfolio Problem and Relative Wealth Concerns

2.3.1 Standard Portfolio Problem Revisited

In this section, we consider a theoretical framework in which individuals face a simple investment decision and might care about the wealth endowment of others. Individuals allocate their wealth between a risk-free asset (with return $r = 0$) and a risky asset. Accordingly, we reinvestigate the standard portfolio problem, which Arrow (1965) and Pratt (1964) analyzed first, while adding relative wealth concerns. This allows us to derive testable hypotheses for our laboratory experiment, while analyzing the risky investment decision in a more general context.

In our model, each individual receives an endowment of w_i and must decide how to allocate this endowment between a safe and a risky asset, in which the fraction allocated into the risky asset is denoted by $\delta \in [0,1]$. The individual keeps $(1-\delta)w_i$, whereas the amount invested is worth $\delta(k+1)w_i$ with probability p and is lost with probability $1-p$. Hence, the payoff is given by

$$w(\delta) = \begin{cases} w_i^+ := (1-\delta)w_i + \delta(k+1)w_i = w_i + \delta k w_i & \text{with probability } p, \\ w_i^- := (1-\delta)w_i = w_i - \delta w_i & \text{with probability } 1-p. \end{cases}$$

By choosing k and p such that $(1-p)(k+1) > 1$, the investment has a positive net present value and risk-neutral (or risk-loving) individuals should invest their entire endowment. Yet, a risk-averse person may invest less.[9]

In an expected utility framework, the decision-maker faces the following optimization problem

$$\max_{\delta} \mathbb{E}u(\cdot) = \max_{\delta \in [0,1]} \left[pu(w_i^+) + (1-p)u(w_i^-) \right], \tag{2.1}$$

in which we assume $u(w)$ to be a twice differentiable utility function with $u' > 0$ and $u'' < 0$. Accordingly, we arrive at the following first-order condition:

$$pkw_i \cdot u'(w_i + k\delta^* w_i) - (1-p)w_i \cdot u'(w_i - \delta^* w_i) = 0 \tag{2.2}$$

Note that the second-order condition for a maximum is satisfied. Let δ^* be the optimal investment amount without concerns about relative wealth placement.

[9] Within the expected utility framework, Gollier (2001) shows that risk-averse agents should invest a positive amount in the risky asset if and only if the expected excess return is positive (Proposition 6).

2.3.2 When Relative Wealth Placement Matters

Now, the utility v of individual i depends on two arguments: wealth endowment w_i and a second term $R(w_i,\mathbf{w}_{-i})$ measuring the position within the wealth distribution, i. e.,

$$v\left(w_i,R(w_i,\mathbf{w}_{-i})\right),$$

where $\mathbf{w}_{-i} = (w_1,\ldots,w_{i-1},w_{i+1},\ldots w_n)$ denotes the vector of wealth levels of all *other* group members of individual i's group.[10] Individuals prefer higher ranks over lower ranks, i. e., $\frac{\partial}{\partial R}v\left(w_i,R(w_i,\mathbf{w}_{-i})\right) \geq 0$. An increase in wealth increases relative wealth placement, i. e., $\frac{\partial}{\partial w_i}R(w_i,\mathbf{w}_{-i}) \geq 0$. And individuals without concerns about relative wealth placements do not gain utility when improving ranks without changes in the wealth argument, i. e., $\frac{\partial}{\partial R}v\left(w_i,R(w_i,\mathbf{w}_{-i})\right) = 0$. Note that the second argument depends on the own wealth level in relation to the static wealth of the environment. We therefore abstract from simultaneous investment opportunities others may pursue while the individual decides about her own investment. Accordingly, the reference point of relative wealth concerns is formed by the others' status quo and is not anticipatory in that sense that it reflects future wealth changes of others. We argue that such "myopic" relative reference point is realistic in many situations in which individuals have relative wealth concerns.[11] To give a simple example, our setup is consistent with an individual trying to save for a better car than their neighbor—neglecting that their neighbor may buy a better car, too. Nevertheless, we consider anticipatory relative wealth concerns to be an interesting direction for future research.

In addition, we assume that a wealth level below or equal to the lowest wealth level within the group does not contribute to any improvement in utility from relative wealth placement, so $\frac{\partial}{\partial w_i}R(w_i,\mathbf{w}_{-i}) = 0$ for all $w_i \leq w^i_{min} := \min \mathbf{w}_{-i}$. If the wealth level is above or equal to the highest wealth level within the group, we make a similar assumption: any further improvement does not lead to a higher utility from relative wealth placement, so $\frac{\partial}{\partial w_i}R(w_i,\mathbf{w}_{-i}) = 0$ for all $w_i \geq w^i_{max} := \max \mathbf{w}_{-i}$. To simplify, we denote $R(w_i,\mathbf{w}_{-i})$ as $R(w_i)$.

Note that we impose minimal structural assumptions on how relative wealth concerns enter someone's utility. As discussed above, we simply assume that $\frac{\partial}{\partial w_i}R(w_i) \geq 0$. An increase in oneself's own wealth position c. p. implies a nonnegative utility gain through the channel of increasing oneself's wealth position compared to peers. In addition, we require $\frac{\partial^2}{\partial w_i^2}R(w_i) \leq 0$ in order to achieve global concavity in expected utility. Abel's (1990) habit utility function can naturally be nested in our general model setup, as the derivative with respect to the habit level is positive.[12] Fehr and Schmidt (1999) assume that individuals can suffer from disadvantageous inequality, but potentially also

[10] This utility function can be considered as a state-dependent utility function where $R(w_i,\mathbf{w}_{-i})$ indicates the state, but states are not independent.

[11] Baillon et al. (2020) empirically analyze which reference point people use in decision-making under risk and find more support for the status quo as a reference point than for an expectations-based reference point.

[12] Assuming that the habit is exclusively set by peer consumption.

from advantageous inequality. Our model does not allow individuals to suffer from advantageous inequality but can capture Fehr and Schmidt (1999)-type preferences in the case of status-seeking individuals, which the authors discuss as an alternative approach to react to advantageous inequality.[13]

Altogether, (2.1) writes as

$$\max_{\delta} \mathbb{E}v\left(\cdot\right) = \max_{\delta\in[0,1]} \left[pv\left(w_i^+, R(w_i^+)\right) + (1-p)v\left(w_i^-, R(w_i^-)\right)\right].$$

Using the total differential, we arrive at the following first-order condition:

$$\begin{aligned} 0 = \frac{\mathrm{d}}{\mathrm{d}\delta}\left(\mathbb{E}v\left(w_i, R(w_i)\right)\right) = p\left[\frac{\partial v}{\partial w_i^+}\frac{\mathrm{d}w_i^+}{\mathrm{d}\delta} + \frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^+}\frac{\mathrm{d}w_i^+}{\mathrm{d}\delta}\right] \\ + (1-p)\left[\frac{\partial v}{\partial w_i^-}\frac{\mathrm{d}w_i^-}{\mathrm{d}\delta} + \frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^-}\frac{\mathrm{d}w_i^-}{\mathrm{d}\delta}\right], \end{aligned}$$

which can be rearranged to

$$pk\frac{\partial v}{\partial w_i^+} - (1-p)\frac{\partial v}{\partial w_i^-} = -pk\frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^+} + (1-p)\frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^-} \tag{2.3}$$

as $\frac{\mathrm{d}w_i^+}{\mathrm{d}\delta} = kw_i$ and $\frac{\mathrm{d}w_i^-}{\mathrm{d}\delta} = -w_i$. Let δ_i^0 be the optimal investment amount for individuals who care about relative wealth placement. The left-hand side of (2.3) is equal to (2.2). Note that the second-order condition and global concavity hold as long as the cross-derivative of $\frac{\partial^2 v}{\partial R \partial w}$ is not too large.[14] In case of additivity of the first and second argument, this cross-derivative is naturally equal to zero. Accordingly, the relationship of δ_i^* and δ_i^0 depends on the sign of the right-hand side of (2.3). If

$$-pk\frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^+} + (1-p)\frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^-} \lesseqgtr 0, \tag{2.4}$$

then it follows that $\delta_i^* \lesseqgtr \delta_i^0$. This is intuitive as the expected marginal increase in utility from the relative wealth placement in the good state of the world exceeds (equals, is less than) the expected decrease in the bad state of the world, respectively. Hence, individuals invest more as they can also gain more utility from an increase in their relative wealth placement.

Now, we focus on an individual with an initial endowment w_i being at the bottom of the wealth distribution. Consequently, we assume that $\frac{\partial}{\partial w_i^-}R(w_i^-) = 0$. First, we derive statements about how the optimal investment changes when relative wealth placement enters the utility function as an argument. From Equation (2.4), we obtain the following hypothesis:

[13] Contrary to Fehr and Schmidt (1999), our model can also capture preferences of status-seeking individuals and we do not impose an additive structure between consumption and other-regarding preferences or linearity in the first argument.

[14] Details on the second-order condition available upon request from the authors.

Hypothesis 2.1. *An individual at the bottom of the wealth distribution will invest more in the risky asset if she has relative wealth concerns c. p.*

Hypothesis 2.1 directly follows from Equation (2.4) as $\frac{\partial}{\partial w_i^-} R(w_i^-) = 0$ implies that

$$-pk\frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^+} + \underbrace{(1-p)\frac{\partial v}{\partial R}\frac{\partial R}{\partial w_i^-}}_{=0} \leq 0.$$

Reversely, we can derive the following hypothesis when assuming that being at the top of the wealth distribution implies $\frac{\partial}{\partial w_i^+} R(w_i^+) = 0$ as individuals have no social standing to gain with higher wealth:

Hypothesis 2.2. *An individual at the top of the wealth distribution will invest less in the risky asset if she has relative wealth concerns c. p.*

When individuals are not being placed at the bottom or the top of their respective wealth distribution, our model does not have unambiguous predictions: expected gains from an increasing wealth position may be higher than, equal to, or lower than the expected decrease in the bad state of the world, depending on how much individuals trade off these two positions.

2.3.3 When Changes in Relative Wealth Placement Matter

Let us now consider the case of comparing two individuals with concerns about relative wealth placement. We assume both have the same baseline utility function and the same absolute wealth level, but different relative wealth placements. Again, we specifically investigate the bottom (Hypothesis 2.3) and the top (Hypothesis 2.4) of the wealth distribution. More precisely, there are two individuals 1 and 2 who only differ in their placement in the wealth distribution. Individual 1 is placed at the bottom of his wealth distribution while individual 2 is not. It holds that $\mathbf{w}_{-1} \neq \mathbf{w}_{-2}$ and $w_1 = w_2 = w_{min}^1 > w_{min}^2$. Let $R_1(w)$ denote the second argument of the utility function for individual 1 and $R_2(w)$ for individual 2, respectively. From the assumptions above, it follows that $\frac{\partial}{\partial w^-} R_1(w^-) = 0$ for individual 1. To make comparative statements about the investment behavior of these two individuals, we compare the right-hand side of (2.3) with each other. If

$$-pk\frac{\partial v}{\partial R_1}\frac{\partial R_1}{\partial w^+} < -pk\frac{\partial v}{\partial R_2}\frac{\partial R_2}{\partial w^+} + (1-p)\frac{\partial v}{\partial R_2}\frac{\partial R_2}{\partial w^-},$$

the right-hand side of (2.3) is smaller for individual 1 for any given δ and he will invest more than individual 2. In particular, this holds true if

$$\frac{\partial v}{\partial R_1}\frac{\partial R_1}{\partial w^+} \geq \frac{\partial v}{\partial R_2}\frac{\partial R_2}{\partial w^+},$$

i. e., if an individual at the bottom values an increase in relative wealth placement higher than an individual with the same wealth but a higher wealth placement. Assuming that this holds, we hypothesize:

Hypothesis 2.3. *An individual at the bottom of the wealth distribution will invest more in the risky asset than an individual with identical absolute wealth who is placed higher in her wealth distribution.*

Again, we also consider the reverse case in which individual 1 is placed at the top of the wealth distribution while individual 2 is not. Accordingly, $\mathbf{w}_{-1} \neq \mathbf{w}_{-2}$, $w_1 = w_2 = w^1_{max} < w^2_{max}$, and $\frac{\partial}{\partial w^+} R_1(w^+) = 0$. Again, $R_1(w)$ denotes the second argument of the utility function for individual 1 and $R_2(w)$ for individual 2. With the reverse reasoning from above and if

$$(1-p)\frac{\partial v}{\partial R_1}\frac{\partial R_1}{\partial w^-} > -pk\frac{\partial v}{\partial R_2}\frac{\partial R_2}{\partial w^+} + (1-p)\frac{\partial v}{\partial R_2}\frac{\partial R_2}{\partial w^-},$$

individual 1 will invest less than individual 2. In particular, this is true if

$$\frac{\partial v}{\partial R_1}\frac{\partial R_1}{\partial w^-} \geq \frac{\partial v}{\partial R_2}\frac{\partial R_2}{\partial w^-},$$

i. e., if an individual at the top values a decrease in relative wealth placement higher than an individual with the same wealth but a lower wealth placement. Given that this holds, we state Hypothesis 2.4 as follows:

Hypothesis 2.4. *An individual at the top of the wealth distribution will invest less in the risky asset than an individual with identical absolute wealth who is placed lower in her wealth distribution.*

2.4 Experimental Design

2.4.1 Setup and Treatments

Our incentivized experiment assesses the impact of relative wealth placement on risk-taking in the investment choice based on Gneezy and Potters (1997): In each investment choice, each subject receives an endowment, w_0, and decides how to allocate this endowment between a safe and a risky asset. With δ denoting the proportion invested into the risky asset, the amount invested is worth $2.5\delta w_0$ with probability 0.5 and is lost otherwise.[15] The amount not invested, $(1-\delta)w_0$, is kept for certain. Endowments and outcomes are disclosed in "Taler", with a convertion rate of 100 Taler = EUR 0.25.

Our experiment consists of two main treatments L (Lower wealth distribution) and H (Higher wealth distribution) and a control treatment C in which subjects do not receive any information on the wealth distribution or any additional information about other

[15] Thus, we follow Charness and Gneezy (2010) and Cohn et al. (2017) and others and choose $p = 0.50$ and $k = 1.5$ in our theoretical framework.

participants.[16] In treatments L and H, we randomly assign subjects to *groups of three* and give each of them different wealth endowments as well as explicit information about the other group members' endowments. Subjects are not aware of who is in their group but they receive information whether they have the lowest, median, or highest wealth endowment in their group and that the allocation took place randomly. Two out of three endowments are identical in both treatments L and H, whereas the third endowment is either below (in treatment L) or above (in treatment H) the other two endowments.

In treatment H, we, thus, shift the wealth distribution to the right compared to treatment L—resulting in higher average wealth. This allocation enables us to examine how subjects' risky investment choices change with a shift in the relative wealth distribution: two thirds of subjects receive identical endowments in L and H but their group members' endowments differ, that is, they place differently in the wealth distribution. Figure 2.1 depicts the chosen endowments:[17]

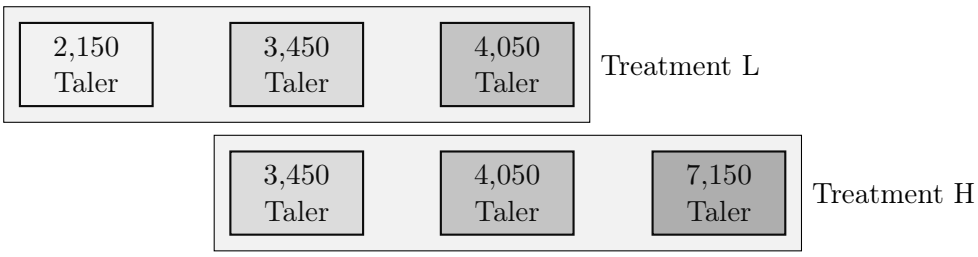

FIGURE 2.1: Endowments in treatments L and H

As illustrated in Figure 2.1, subjects who receive 3,450 Taler or 4,050 Taler in treatment L or H, respectively, have the same absolute wealth compared to those in the other treatment, but they differ in terms of relative wealth placement. Subjects in the control treatment C only receive an initial endowment of either 3,450 Taler or 4,050 Taler without any further information about other participants. We discard observations receiving 2,150 Taler in treatment L and 7,150 Taler in treatment H as we do not have a counterfactual.

In our analysis, we evaluate individual changes in risk-taking behavior with wealth endowments of 3,450 Taler or 4,050 Taler, respectively, with varying relative wealth placement or no information on relative wealth placement. Comparing L and H with C will allow us to draw conclusions about Hypotheses 2.1 and 2.2, respectively, while comparing L with H will provide insights with respect to Hypotheses 2.3 and 2.4. We base our main analysis on a between-subject comparison. All subjects also play the other two treatments, which enables us to conduct a within-subject analysis for additional robustness.[18]

[16] As stated earlier, we assume that information about the wealth distribution is necessary to develop concerns about relative wealth placement.

[17] Endowments are chosen such that they may appear familiar to subjects participating in Germany, where we conducted the experiments: EUR 3,450 and EUR 4,050 are slightly below and above the average monthly (gross) earnings of full-time employees in 2018; EUR 2,150 represents a rather low salary just above the minimum wage; and EUR 7,150 is a relatively high monthly salary.

[18] We provide more information about our experimental structure in Appendix 2.A.

2.4.2 Experimental Procedure

We conducted the experiment at the WiSo-Experimentallabor of Universität Hamburg. In total, 420 subjects (255 women and 165 men) participated in 19 experimental sessions in April to June 2019. No subject participated in more than one session. We varied the treatment order systematically across sessions and used oTree (Chen et al., 2016) for programming and hroot (Bock et al., 2014) for the recruitment of participants. During the experiment, we did not allow interaction or communication between subjects. Subjects received incentive-compatible compensation by playing one randomly selected investment choice for cash but received no show-up fee. Each session lasted for about 34 minutes and subjects' payment was EUR 10.41 (USD 11.76) on average, ranging from EUR 0.00 to EUR 36.80.

2.5 Experimental Results

In our experiment, two out of three subjects in our main treatments L and H received the same absolute endowment, while the third endowment was either below (in treatment L) or above (in treatment H) the other two endowments. At first, by comparing treatments H and L with treatment C, we analyze risk-taking behavior between subjects receiving information on their wealth placement and those who don't. In a second step, by comparing treatment L with treatment H, we analyze risk-taking behavior among subjects receiving the same initial endowment but different relative wealth placements. If we observe differences in risk-taking, relative wealth placement must be the cause.

2.5.1 Summary Statistics

In our experiment, 420 subjects participated. Table 2.1 displays descriptive statistics of our subjects' characteristics. The mean (median) age of our subjects is 25.8 (25) and 60.7 percent are female. Subjects are from different field of studies with a majority coming from economics or related disciplines (43.8 percent) and 19.3 percent have participated the first time in a laboratory experiment.

Table 2.1: Summary statistics

	Observations	Mean	Minimum	1st Quartile	Median	3rd Quartile	Maximum	SD
Age	420	25.93	16	22	25	28	81	(6.27)
Female	420	0.61	0	0	1	1	1	(0.49)
General Risk Question (GRQ)	420	4.85	0	3	5	7	10	(2.19)
CRT	420	3.83	0	2	4	6	7	(2.16)
Overconfidence	420	1.10	-3	0	1	2	7	(1.71)
Financial Literacy	420	2.47	0	2	3	3	3	(0.72)
First Time Participating	420	0.19	0	0	0	0	1	(0.40)
Economic-related Major	420	0.44	0	0	0	1	1	(0.50)

Notes: This table provides summary statistics on the participants in the experiment. The variable "Age" is measured in years; "Female", "First Time Participating", and "Economic-related Major" are dummy variables; "General Risk Question" (GRQ) is a self-reported measure for risk aversion, which ranges from 0 (totally risk averse) to 10 (totally risk seeking); "CRT" is the score of correct answers on the 7-item Cognitive Reflection Test (CRT) on a scale from 0 to 7; "Financial Literacy" ranges from 0 to 3 and is the score of correct answers on the financial literacy test; and "Overconfidence" indicates the difference between the estimated and the actual number of correct answers in the CRT.

As discussed in Section 2.4, subjects made three investment choices: one choice in each of the treatments H, L, and C.[19] A Kruskal-Wallis H test does not reject the null hypothesis of no differences between treatment orders (see Table 2.B.1). Regardless of treatment order, participants in the treatments are similar with regard to observable characteristics. In total, we have 114 subjects playing first with treatment C (54 in treatment order CHL and 60 in treatment order CLH) in round one, and 153 starting with treatment H (78 in treatment order HCL and 75 in treatment order HLC) as well as 153 starting with treatment L (78 in treatment order LCH and 75 in treatment order LHC).

Figure 2.2 displays the average share invested into the risky asset between the treatments C, H, and L by endowments of 3,450 (Panel A) and 4,050 (Panel B). Investigating invested shares with an endowment of 3,450 Taler,[20] we find that the percentage invested in the risky asset is highest in treatment H with 45.9 percent, which exceeds risk-taking in treatments L and C by 15.0 and 14.5 percentage points (Panel A of Figure 2.2).[21] The difference between H and L is significant at the 5 percent level, while the difference between C and H is significant at the 1 percent level ($p = 0.0198$ and $p = 0.0089$, Mann-Whitney U test). We find no statistical difference in the average share invested between C and L ($p = 0.9879$, Mann-Whitney U test).

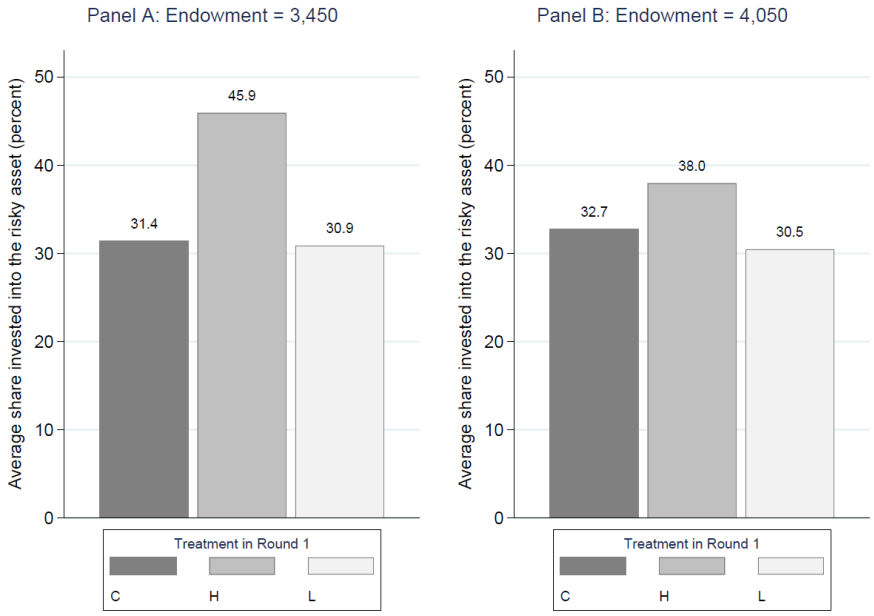

FIGURE 2.2: Average investments in round 1

Notes: This figure shows average share invested into the risky asset (in round one) having received either an endowment of 3,450 (Panel A) or 4,050 (Panel B).

[19] The order in which treatments were presented depended on the experimental session they signed up for. Table 2.B.1 presents summary statistics across treatment order.

[20] Unless otherwise stated, in this subsection we only focus on the investment behavior in round one.

[21] From those endowed with 3,450, five subjects opted to invest nothing (one, two, and two subjects in treatment C, H, and L) and 14 subjects invested their entire endowment (three, nine, and two subjects in treatment C, H, and L).

Given an initial endowment of 4,050 Taler, we observe a similar pattern: subjects in treatment H invested the most with 38.0 percent, followed by investments of 32.7 percent in treatment C and 30.5 percent in treatment L (Panel B of Figure 2.2).[22] Differences are not statistically significant, but become significant when adding covariates.

2.5.2 Impact of Relative Wealth Placement

Statistical evidence is given by a series of ordinary least squares (OLS) regressions, reported in Tables 2.2 and 2.3, that capture treatment differences while controlling for subject-specific characteristics. Table 2.2 shows the regression results: we regress subjects' risk-taking measured by the share invested into the risky asset on dummies for treatments H and L as well as the control variables from the summary statistics.

In total, we have 160 and 158 observations in Panel A (3,450 endowment) and B (4,050 endowment) of Table 2.2, respectively, and 102 in Table 2.3.[23] Columns (1) and (3) do not include any additional controls, while we include additional controls for sociodemographic factors and economic preferences in columns (2) and (4). Note that the adjusted R-squared is substantially higher in all estimations when adding controls.

Following the structure of our theoretical predictions, we first discuss the mere impact of relative wealth placement by comparing risk-taking behavior between subjects in L or H with subjects in C. Subjects endowed with 3,450 in treatment H are at the bottom of their respective wealth distribution. Hypothesis 2.1 predicts more risk-taking for these subjects compared to subjects in the control group who receive the same endowment but no information about the wealth distribution. We would therefore expect a positive and significant coefficient estimate for treatment H in Panel A of Table 2.2. Compared to subjects without information, subjects placed at the bottom indeed increase their invested share by 14.5 percentage points without controls and by 14.9 percentage points with controls (see columns (1) and (2)). This effect is not only statistically highly significant, but also economically: investing about 14.9 percentage points more into the risky asset is equivalent to an increase in invested share of almost 50 percent or about 0.5 standard deviations. Thus, we can confirm Hypothesis 2.1:

Result 2.1. *Individuals at the bottom of the wealth distribution with concerns about relative wealth placement invest more in the risky asset than those without information about relative wealth placement, c.p.*

The dummy for treatment L is not significant in both columns (1) and (2) of Table 2.2. Accordingly, subjects placed at the median of the wealth distribution do not invest more into the risky share than subjects without information on wealth placement. Expected

[22] From those endowed with 4,050, 15 subjects opted to invest nothing (five, four, and six subjects in treatment C, H, and L) and 14 subjects invested their entire endowment (four, seven, and three subjects in treatment C, H, and L).

[23] We had 153 subjects in both treatments H and L, one-third of these subjects (51 each) were endowed with 3,450 or 4,050. In treatment C, 58 subjects were randomly endowed with 3,450 and 56 with 4,050. For full tables with all control variables included see Table 2.B.2 and Table 2.B.3.

TABLE 2.2: Regression results on share invested in risky asset (in percent of the endowment)

Dependent variable:	Share invested in risky asset (in percent)			
	Panel A: Endowment = 3,450		Panel B: Endowment = 4,050	
	(1)	(2)	(3)	(4)
Treatment H	14.549***	14.887***	5.214	1.928
	(5.452)	(5.511)	(5.788)	(5.119)
Treatment L	−0.490	1.618	−2.271	−11.302**
	(4.696)	(4.785)	(5.213)	(4.992)
Controls	No	Yes	No	Yes
Constant	31.379***	10.940	32.738***	11.896
	(3.291)	(15.095)	(3.756)	(28.204)
Observations	160	160	158	158
Adjusted R^2	0.051	0.252	−0.001	0.300

Notes: This table presents results of ordinary least squares regressions. The dependent variable is the share invested in the risky asset (in percent of the endowment) in the first round with robust standard errors in parentheses. Subjects received an endowment of 3,450 (Panel A) or 4,050 (Panel B). It is regressed on dummy variables indicating either treatment H or L (treatment C serves as a reference category) and a set of control variables. "Controls" include 'Female' (gender dummy variable); 'Dummies for GRQ' includes dummy variables for GRQ, which is a self-reported level of risk aversion, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); 'Age' (individual's age in years); 'Dummies for CRT' (indicating the score on the 7-item Cognitive Reflection Test (CRT), ranging from 0 to 7); 'Dummies for Financial Literacy' (indicating the score on the financial literacy test, ranging from 0 to 3); 'First Time' (dummy variable for subjects participating for the first time in a lab experiment); 'Economic-rel. Major' (dummy variable indicating a major in economics or related); and 'Overconfidence' (dummy variable indicating a positive difference between the estimated and the actual number of correct answers in the CRT).
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

gains from an increasing wealth position may approximately equal expected losses from a lower position.

In Panel B of Table 2.2, we compare subjects at the top of the wealth distribution (those subjects that received 4,050 in treatment L) with subjects without information about relative wealth placement in C. Following Hypothesis 2.2, we expect these subjects to take on less risk, investing less than subjects with the same endowment in the control treatment. In column (3) of Table 2.2, the sign for the indicator in treatment L is negative as expected and becomes significant once controlling for covariates. Adjusted R-squared again increases substantially when adding covariates. When including the control variables in column (4), these subjects invest about 11.3 percentage points less into the risky asset, which is equivalent to a reduction in invested share of roughly 35 percent. The effect is significant at the 5 percent level, and economically sizable. Therefore, we find evidence for Hypothesis 2.2:

Result 2.2. *Individuals at the top of the wealth distribution with concerns about relative wealth placement invest less in the risky asset than those without information about relative wealth placement, c.p.*

Note that the dummy variable for treatment H is not significant in columns (1) and (2) of Table 2.2. With an endowment of 4,050 in H, subjects are placed at the median of the wealth distribution as are subjects endowed with 3,450 in treatment L. Again, expected gain from relative placement can approximately equal expected loss. In this case, we would expect an insignificant coefficient estimate.

Overall, individuals change their risk-taking behavior (on aggregate) when receiving information about relative wealth placement. In particular, subjects seem to dislike being last in the wealth distribution as they increase the share invested in the risky asset by 14.9 percentage points on average. When placed at the top of the wealth distribution, subjects take on less risk and decrease investment into the risky asset by 11.3 percentage points. One possible interpretation of the observed behavior is a general dislike of a (disadvantageous) rank reversal, i. e., individuals want to maintain a good placement in the wealth distribution. In summary, individuals adjust risk-taking behavior to stay ahead of others and to avoid disadvantageous rank reversal.[24]

2.5.3 Changes in Relative Wealth Placement

Next we explore subjects' risk-taking behavior for subjects with the same absolute wealth but different relative wealth placement, i. e., those from treatments H and L. Table 2.3 compares subjects in treatment H and L endowed either with 3,450 (Panel A of Table 2.3) or 4,050 (Panel B of Table 2.3) using OLS regressions.

First, we compare subjects with an endowment of 3,450, who are placed at the bottom of their respective wealth distribution in treatment H and in the middle in treatment L. Hypothesis 2.3 predicts that the former invest a higher share into the risky asset as they can only gain ranks in their wealth distribution. We therefore expect a positive coefficient estimate for treatment H.

Columns (1) and (2) in Panel A of Table 2.3 show that subjects who are last in their wealth distribution exhibit significantly more risk-taking than those placed in the middle of their distribution. These subjects invest on average around 15.0 percentage and 13.8 percentage points more from their initial endowment than those with a higher placement. This is equivalent to an increase of approximately 50 percent. So, we can confirm Hypothesis 2.3:

Result 2.3. *An individual at the bottom of her wealth distribution invests more in the risky asset than an individual with the same endowment placed higher in her wealth distribution.*

Subjects endowed with 4,050 in treatment L are placed at the top of their respective wealth distribution. Subjects with the same endowment place in the middle of the wealth distribution in treatment H. Hypothesis 2.4 predicts a lower investment for those placed at the top of the wealth distribution. Given that treatment L is the

[24] We cannot rule out asset integration but it should not cause any systematic bias due to randomization.

TABLE 2.3: Treatment effects between H and L by endowment amount

Dependent variable:	Share invested in risky asset (in percent)			
	Panel A: Endowment = 3,450		Panel B: Endowment = 4,050	
	(1)	(2)	(3)	(4)
Treatment H	15.038***	13.765**	7.485	12.455**
	(5.491)	(5.706)	(5.699)	(5.285)
Controls	No	Yes	No	Yes
Constant	30.889***	−5.985	30.467***	−7.846
	(3.352)	(27.075)	(3.616)	(29.424)
Observations	102	102	102	102
Adjusted R^2	0.060	0.218	0.007	0.349

Notes: This table presents results of ordinary least squares regressions that test for treatment differences in subjects' share invested in the risky asset (in percent) in the first round having either received an endowment of 3,450 (Panel A) or 4,050 (Panel B) (robust standard errors in parentheses). Comparisons are made only between treatment L and H. "Controls" include 'Female' (gender dummy variable); 'Dummies for GRQ' includes dummy variables for GRQ, which is a self-reported level of risk aversion, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); 'Age' (individual's age in years); 'Dummies for CRT' (indicating the score on the 7-item Cognitive Reflection Test (CRT), ranging from 0 to 7); 'Dummies for Financial Literacy' (indicating the score on the financial literacy test, ranging from 0 to 3); 'First Time' (dummy variable for subjects participating for the first time in a lab experiment); 'Economic-rel. Major' (dummy variable indicating a major in economics or related); and 'Overconfidence' (dummy variable indicating a positive difference between the estimated and the actual number of correct answers in the CRT). * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

omitted category, we expect a positive coefficient estimate for the treatment H dummy. Subjects exhibit less risk-taking when they are informed about their top position in the wealth distribution. This information reduces the share invested in the risky asset by 7.5 percentage points without controls and by 12.5 percentage points with controls, see columns (3) and (4) in Panel B of Table 2.3. The coefficient estimate for the treatment H dummy in column (3) is of the expected sign, but not significant. Adding the other controls to the model – as displayed in column (4) – leads to a larger coefficient estimate that is significant at the 5 percentage level. The adjusted R-squared further increases almost 50-fold when adding control variables. This estimate is equivalent to a decrease in invested share of approximately 20 percent. This result confirms Hypothesis 2.4:

Result 2.4. *An individual at the top of her wealth distribution invests less in the risky asset than an individual with the same endowment who is placed lower in the wealth distribution.*

Figure 2.3 depicts the cumulative distribution functions of investment in treatment H and L: With an endowment of 3,450, the cumulative distribution function (CDF) of investment in treatment H *first-order stochastically dominates* the CDF of investment in treatment L (Panel A of Figure 2.3). Thus, a lower placement in the wealth distribution shifts the distribution towards riskier investment behavior. A Kolmogorov-Smirnov test also indicates that the two distributions are different ($p < 0.05$). Interestingly, we see larger differences in the CDFs for smaller and larger invested shares of the

initial endowment compared to median investment. One possible explanation is that investing around 50 percent could be an easy heuristic for some individuals. This heuristic approach may be more dominant for these individuals than the incentives to increase or maintain ranks in the wealth distribution.

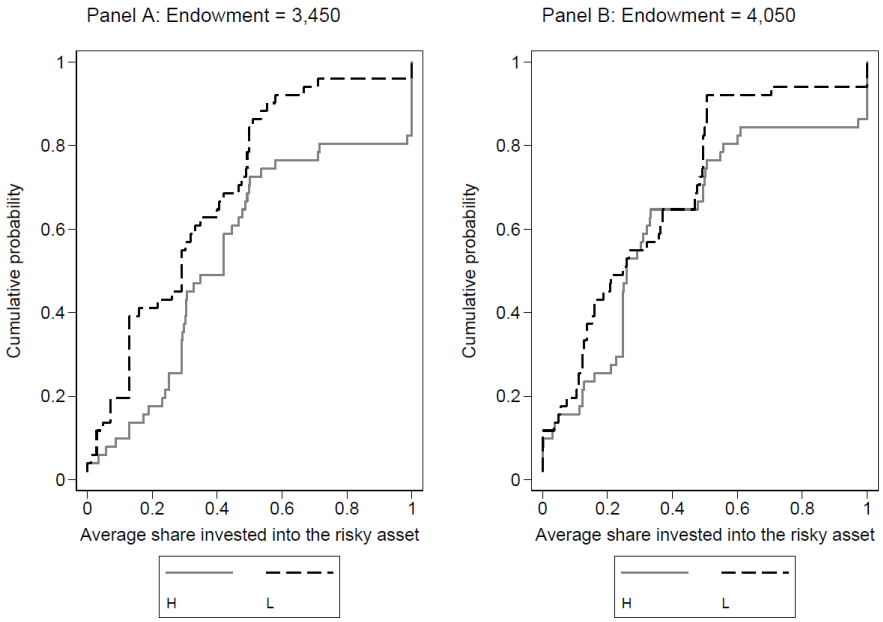

FIGURE 2.3: Cumulative distribution functions of share invested into the risky asset

Notes: This figure shows the cumulative distribution functions of the share invested into the risky asset in round one for treatments H and L, having received either an endowment of 3,450 (Panel A) or 4,050 (Panel B).

Panel B of Figure 2.3 shows endowments of 4,050. The CDFs show a similar pattern as in the case with a lower endowment, i. e., differences are more prevalent for small and large investment shares. Yet, the two CDFs intersect around median invested shares and, thus, the CDF of investment in treatment H *second-order stochastically dominates* the CDF of investment in treatment L (Panel B of Figure 2.3). Accordingly, the differences are less pronounced (Kolmogorov-Smirnov test, $p < 0.10$), which is consistent with our analysis so far.

Overall, placement within the wealth distribution changes risk-taking. Subjects being placed last invest 13.8 percentage points more than subjects placed in the middle of the wealth distribution, which is statistically significant and economically relevant. Those subjects on the top of their wealth distribution, on the other hand, invested on average about 12.5 percentage points less into the risky asset compared to those with the same endowment but a lower placement. This suggests that individuals also care about their placement in the wealth distribution when they are on top; and to maintain this good placement, they seem to reduce the risk they are exposed to.

2.5.4 Robustness Check: Within-subjects Analysis

Subjects make investment decisions for all three treatments in random order. In each treatment, they receive a random wealth endowment, which can match the previous endowment by chance or differ from it. So far, our analysis relied on a comparison of the investment behavior in the first treatment. To increase the robustness of our results, we further present results on the impact of changes in relative wealth placement on risk-taking behavior in a *within-subjects* setting.

We expect smaller coefficient estimates as a certain percentage of subjects will be triggered by the experimental design to stick to their initial decision in the first treatment and invest the same amount throughout all treatments. In addition, results may differ as learning effects may occur. Yet, the within-subject analysis can be useful to confirm qualitative directions of observed effects. We focus on subjects who randomly received the same endowment in both treatments H and L and investigate how investment for the same subjects differs in the aggregate under the two different treatments. To reduce noise and potential bias, we drop those observations where subjects received a different endowment in the control treatment unless the control treatment was in the last round. Out of 420 subjects, we include 25 and 34 subjects who meet the conditions above for endowments of 3,450 and 4,050, respectively.

With an identical endowment of 3,450, subjects invest on average 32.4 percentage points in the risky asset in treatment H, but only 28.1 percentage points in treatment L. This difference is significant at the 1 percent level ($p = 0.0027$, Wilcoxon signed-rank test). This result, thus, supports Hypothesis 2.3: On aggregate, subjects invest different shares into the risky asset when they have the same endowment but a different placement in the wealth placement. In fact, when placed at the bottom of their respective wealth distribution, subjects invest a higher share into the risky asset than when placed in the middle of the wealth distribution. In Panel A of Table 2.4, this result is further confirmed by a fixed-effects regression. Therefore, the placement within the wealth distribution matters and being last in the wealth distribution increases risk-taking.

When analyzing the within-subject effect of subjects endowed with 4,050, subjects still seem to invest more when they have a lower relative wealth placement (33.7 percentage points in treatment H compared to 31.8 percentage points in treatment L), but we cannot reject the null hypothesis that the average share invested into the risky asset is the same ($p = 0.6285$, Wilcoxon signed-rank test) (see also Panel B of Table 2.4). We attribute this to the small sample size. Also note that the coefficient estimates are much smaller in the within-analysis, as we see a non-neglible share of subjects sticking to their initial investment in all three rounds.

TABLE 2.4: Within-subjects fixed-effects regression results on share invested (in percent) by endowment amount

Dependent variable:	Share invested in risky asset (in percent)	
	Panel A: Endowment = 3,450	Panel B: Endowment = 4,050
	(1)	(2)
Treatment H	4.301***	1.917
	(1.453)	(31.801)
Constant	28.130***	31.801***
	(0.726)	(1.693)
Observations	50	68
Subjects	25	34
Within-R^2	0.272	0.010

Notes: This table presents results of fixed-effects regressions that test for treatment differences in subjects' share invested in the risky asset (in percent) having either received an endowment of 3,450 (Panel A) or 4,050 (Panel B) (clustered standard errors at subjects' level in parentheses). We only included subjects who received the same endowment in both treatment H and L, and who either got this endowment in the control treatment C, too, or who played treatment C in round three. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

2.6 Discussion and Conclusion

Previous literature has shown that peer group standing affects economic decision-making in many areas and can change outcomes substantially (e. g., Robson, 1992; Cohn et al., 2014; Bracha et al., 2015; Ockenfels et al., 2015; Kirchler et al., 2018). For instance, Kuhn et al. (2011) show that lottery winnings only had modest impact on consumption of the winners, but quite a sizeable impact on consumption of non-winning neighbors. We show that relative wealth placement also alters risk-taking significantly.

Our theoretical model provides a setup in which relative wealth concerns enter utility through a second argument in the utility function. We specifically investigate individuals at the bottom and at the top of the relative wealth distribution. This way, we can isolate the impact when individuals can only improve or lose ranks in the wealth distribution. We first focus on the comparison of individuals without and with relative wealth concerns and predict that relative wealth concerns increase risk-taking at the bottom of the distribution while it decreases risk-taking at the top. In a second step, we compare individuals with the same absolute wealth but different relative wealth placements. Again, we predict more risk-taking at the bottom compared to a higher placement in the wealth distribution and less at the top (compared to a lower placement).

We are not only able to confirm our theoretical predictions in a laboratory experiment, but also find effect sizes that were economically sizeable: In particular, people at the bottom of the wealth distribution invest on average 14.9 percentage points more into the risky asset than those in our control group who simply received the same endowment without any information about other participants or a potential wealth distribution (Result 2.1). When people are placed at the top of their wealth distribution, the effect

is reversed: they invest about 11.3 percentage points less into the risky asset compared to those in the control treatment (Result 2.2).

When comparing two individuals with the same initial endowment but a different relative wealth placement, individuals who are placed lower in the wealth distribution take more risk than those placed higher: on average, individuals invest 30 percentage more when not placed at the top of their wealth distribution compared to those who have the highest possible wealth level (Result 2.4). This effect is even more pronounced when placed at the bottom: subjects invest on average around 50 percentage more from their initial endowment than those with the same endowment who are placed higher (Result 2.3).

As mentioned, our results are economically relevant where relative wealth concerns trigger additional investments of up to 50 percent of the initial investment. The size of the effects is in line with the argument that social standing can change economic decisions substantially. Summing up, our paper shows that relative wealth concerns play indeed a crucial role in decision-making under risk.

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Appendix

2.A Experimental Structure and Instructions

2.A.1 Structure of the Experiment

The experiment's structure is summarized in Figure 2.A.1. In *investment decision I, II, and III*, subjects faced each investment decision in treatment L, H, and C exactly once in random order to avoid the order effect (Harrison et al., 2005).[25]

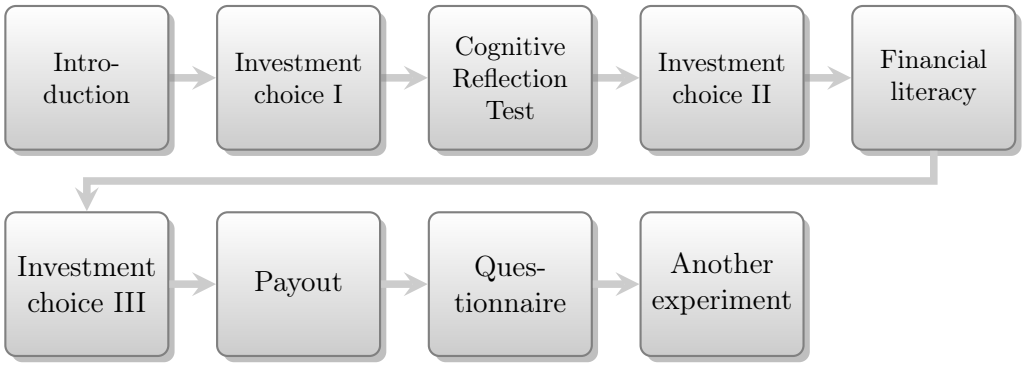

FIGURE 2.A.1: Structure of the experiment

Further, subjects were asked to answer the seven-item *Cognitive Reflection Test* (CRT) (Toplak et al., 2014).[26] Research has shown that the scoring on the CRT significantly relates to risk aversion (Frederick, 2005; Dohmen et al., 2010; Dohmen et al., 2018) and proneness to behavioral biases (Oechssler et al., 2009). After completing the CRT, subjects were asked to estimate their number of correct answers. We measure subjects' overconfidence (following Neyse et al., 2016). We also measured subjects' *financial literacy* according to Lusardi and Mitchell (2011). After completing the third risk elicitation task, this part of the experiment ended and payments were determined.[27] Afterwards, subjects were asked to fill out a *questionnaire*. It contained some demographic questions (e.g., age, gender, major subject), and the general risk question (GRQ) used in the German Socio-Economic Panel.[28]

[25]The order in which treatments were presented depended on the experimental session the subjects signed up for and it was varied systematically across sessions.

[26]The seven-item CRT is an extension of the three-item CRT (Frederick, 2005), which is a measure of the cognitive effort a respondent puts into answering a question and avoiding an intuitive but incorrect answer.

[27]After subjects completed this stage, they received new instructions for an additional stage of another experiment.

[28]The GRQ asks participants to self-assess their general riskiness on a scale from 0 (completely unwilling to take risks) to 10 (completely willing to take risks). Dohmen et al. (2011) validated the reliability of this measure with a field experiment using paid lottery choices.

2.A.2 Experimental Instructions

(translated from German)

Screen 1 – Introduction

Welcome to the Experimental Laboratory of the Universität Hamburg. Thank you for participating in this economic experiment. The experiment will last approximately 45 minutes. Please read the following instructions carefully:

- *Communication* is not permitted during the whole experiment.
- In case of questions, please raise your hand out of your cabin—a laboratory assistant will contact you to answer your questions.
- It is mandatory that you silence your mobile phones and other technical devices and put them away. The use of these devices is not allowed for the entire duration of the experiment. Please put your mobile phone in the blue bag attached to the curtain rod of your cabin. Leave your phone there until your seat number is called to receive your payment at the end of the experiment.
- Please always follow the instructions of the instructor.

Violations of these rules can lead to the exclusion from the experiment and loss of compensation.

You will receive your remuneration at the end of the experiment, which depends on your decisions during the experiment and, to a certain extent, on chance. The currency in this experiment is Taler. The exchange rate is 100 Taler = EUR 0.25. You will not receive any compensation if you decide to leave the experiment early.

This experiment consists of two stages.[29] In each stage, you will need to make several decisions and answer questions. Both stages contribute to your compensation. Your compensation is based on one, randomly selected decisions from each of the two stages, but also depends on chance. Therefore, each of your decisions can determine your remuneration in the experiment.

We will not ask you to reveal any personal information that could identify you, but we ask some socio-demographic questions in the experiment, such as your age or gender. You will receive your individual compensation at the end of the experiment – wait until we call your cabin number.

All decisions in this experiment as well as the payouts at the end remain anonymous. Please do not discuss any details from the experiment with the other participants.

If you have any questions, please raise your hand out of the cabin at any time.

[29] The second stage – after having fully completed Stage I – is part of another experiment.

Screen 2, 5, and 7 – Investment Decision I/II/III

Please note that this part of the experiment is relevant for your payoff in this experiment.

{Treatment C}

In this part of the experiment, you receive an endowment of X_C.[30]

{Treatment H}

You were randomly assigned to two other participants to form a group of three. All participants of your group receive different endowments. The endowments were randomly allocated. Your endowment is X_H.[31]

The other two participants in your group received endowments of $X_{H,1}$ and $X_{H,2}$.[32] Therefore, you received the {lowest; median; highest} initial endowment.[33]

{Treatment L}

You were randomly assigned to two other participants to form a group of three. All participants of your group receive different endowments. The endowments were randomly allocated. Your endowment is X_L.[34]

The other two participants in your group received endowments of $X_{L,1}$ and $X_{L,2}$.[35] Therefore, you received the {lowest; median; highest} initial endowment.

Figure 2.A.2: Graphical illustration of subject's position within the group of three

{All Treatments}

You can invest part of your endowment into a risky asset. *The amount you do not invest will be kept for sure.* You can invest any amount between 0 and X_i ($i \in \{C,H,L\}$). Either you lose the amount invested or you receive an additional dividend of 1.5 times your investment.

If you move the slider (see Figure 2.A.3) back and forth, you will see your possible payouts in both states of the world depending on the chosen investment amount.

The chances in this lottery to win are exactly 50 percent. This is comparable to a coin toss: With head, you lose your investment. With tails, you receive an additional dividend of 1.5 times your investment.

[30] $X_C \in \{3{,}450 \text{ Taler}; 4{,}050 \text{ Taler}\}$.
[31] $X_H \in \{3{,}450 \text{ Taler}; 4{,}050 \text{ Taler}; 7{,}150 \text{ Taler}\}$
[32] $X_{H,1} = \min\{\{3{,}450 \text{ Taler}; 4{,}050 \text{ Taler}\} \setminus X_H\}$ and $X_{H,2} \in \{4{,}050 \text{ Taler}; 7{,}150 \text{ Taler}\} \setminus (X_H \cup X_{H,1})$
[33] This written statement was graphically supported, as shown in Figure 2.A.2
[34] $X_L \in \{2{,}150 \text{ Taler}; 3{,}450 \text{ Taler}; 4{,}050 \text{ Taler}\}$
[35] $X_{L,1} = \min\{\{2{,}150 \text{ Taler}; 3{,}450 \text{ Taler}\} \setminus X_L\}$ and $X_{L,2} \in \{3{,}450 \text{ Taler}; 4{,}050 \text{ Taler}\} \setminus (X_L \cup X_{L,1})$

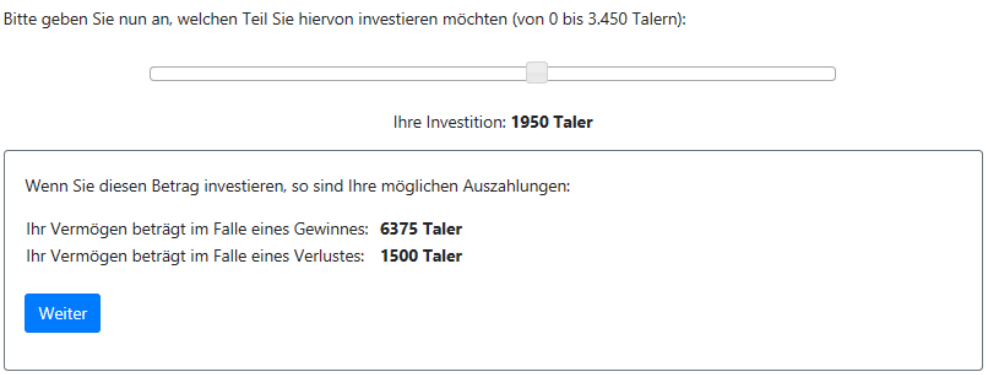

FIGURE 2.A.3: Slider during the investment decisions to illustrate the potential outcomes

Screen 3 – Cognitive Reflection Test

Please answer the following questions.

1. A bat and a ball cost EUR 22 in total. The bat costs EUR 20 more than the ball. How much does the ball cost?
2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?
3. 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?
4. If Johannes can drink one barrel of water in 6 days, and Maria can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together?
5. Michael received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?
6. A man buys a pig for EUR 60, sells it for EUR 70, buys it back for EUR 80, and sells it finally for EUR 90. How much has he made?
7. Simone decided to invest EUR 8,000 in the stock market one day early in 2008. Six months after she invested, on July 17, the stocks she had purchased were down 50%. Fortunately for Simone, from July 17 to October 17, the stocks she had purchased went up 75%. At this point, Simone has:
   - broken even in the stock market.
   - is ahead of where she began.
   - has lost money.

Screen 4 – Overconfidence

Please answer the following questions.

Please estimate how many of the 7 questions above have you answered correctly?

Screen 6 – Financial Literacy

Please answer the following questions.

1. Suppose you had EUR 100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
   - More than EUR 102
   - Exactly EUR 102
   - Less than EUR 102
   - Do not know
   - Refuse to answer
2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After one year, how much would you be able to buy with the money in this account?
   - More than today
   - Exactly the same
   - Less than today
   - Do not know
   - Refuse to answer
3. Please indicate whether this statement is true or false: "Buying a single company's stock usually provides a safer return than a stock mutual fund."
   - True
   - Wrong
   - Do not know
   - Refuse to answer

Screen 8 – Payoff Stage I

Round 1/2/3 was randomly selected to determine your payout. For the selected round, one of the two possible results was realized randomly based on the corresponding probabilities (50 percent each).

Your investment was (not) successful. Your payout is therefore Payoff (y).

Screen 9 – Questionnaire

Please answer the following questions.

- What is your age?
- What is your gender?
- Is this your first participation in a social science experiment?
- What is your highest level of education?
- What is your major studies?
- How do you rate yourself personally? Are you generally a risk-seeking person or are you trying to avoid risks? Please answer using the following scale with 0 (completely unwilling to take risks) and 10 (completely willing to take risks). With the values in between, you can graduate your assessment.

2.B Additional Tables

This section includes Table 2.B.1, which reports descriptive statistics and a randomization check across treatment orders, as well as full tables of Tables 2.2 and 2.3—including all control variables and all dummy variables for categorical variables.

TABLE 2.B.1: Randomization table by treatment order

	CHL	CLH	HCL	HLC	LCH	LHC	**Total**	$\chi^2(5)$	p-value
Age	25.13	25.68	26.06	26.17	25.10	27.20	**25.93**	4.197	0.5214
	(5.573)	(5.607)	(5.067)	(7.199)	(4.448)	(8.576)	(6.275)		
Female	0.611	0.617	0.603	0.613	0.603	0.600	**0.607**	0.068	0.9999
	(0.492)	(0.490)	(0.493)	(0.490)	(0.493)	(0.493)	(0.489)		
General Risk Question	4.481	4.333	5.051	4.853	5.205	4.947	**4.850**	7.969	0.1579
	(2.108)	(1.829)	(2.290)	(2.288)	(2.253)	(2.211)	(2.192)		
CRT	4.019	3.550	3.808	3.533	4.013	4.040	**3.829**	4.192	0.5221
	(2.051)	(2.158)	(2.313)	(2.107)	(2.123)	(2.202)	(2.165)		
Overconfidence	1.056	1.000	0.859	1.387	1.090	1.213	**1.105**	3.253	0.6610
	(1.472)	(1.647)	(1.793)	(1.852)	(1.715)	(1.687)	(1.710)		
Financial Literacy	2.519	2.350	2.385	2.480	2.487	2.600	**2.471**	3.876	0.5674
	(0.693)	(0.840)	(0.825)	(0.665)	(0.659)	(0.615)	(0.719)		
First Time Participating	0.222	0.267	0.167	0.200	0.179	0.147	**0.193**	3.876	0.5675
	(0.420)	(0.446)	(0.375)	(0.403)	(0.386)	(0.356)	(0.395)		
Economic-related Major	0.481	0.400	0.410	0.493	0.474	0.373	**0.438**	3.628	0.6041
	(0.504)	(0.494)	(0.495)	(0.503)	(0.503)	(0.487)	(0.497)		
Observations	54	60	78	75	78	75	**420**		

Notes: This table presents summary statistics across treatment order. In the last two columns, we report the χ^2- and p-value of a Kruskal-Wallis H test to determine treatment differences.

TABLE 2.B.2: Regression results on share invested (in percent) in round one by endowment amount

Dependent variable:	Share invested in risky asset (in percent)			
	Panel A: Endowment = 3,450		Panel B: Endowment = 4,050	
	(1)	(2)	(3)	(4)
Treatment H	14.549***	14.887***	5.214	1.928
	(5.452)	(5.511)	(5.788)	(5.119)
Treatment L	−0.490	1.618	−2.271	−11.302**
	(4.696)	(4.785)	(5.213)	(4.992)
Female		−4.468		−2.480
		(4.690)		(4.638)
GRQ=1		10.328		
		(15.440)		
GRQ=2		15.473*		−20.800
		(8.418)		(19.589)
GRQ=3		20.099***		−0.377
		(7.389)		(19.916)
GRQ=4		27.073***		−1.353
		(7.846)		(20.092)
GRQ=5		25.206***		2.678
		(8.123)		(20.542)
GRQ=6		34.431***		−15.150
		(7.860)		(20.635)
GRQ=7		32.881***		4.906
		(9.144)		(20.505)
GRQ=8		50.083***		−10.314
		(10.386)		(21.371)
GRQ=9		11.679		28.755
		(10.407)		(22.389)
GRQ=10		79.919***		62.215***
		(12.903)		(20.594)
Age		−0.0305		0.210
		(0.456)		(0.236)
CRT=1		15.560*		10.039
		(9.240)		(9.534)
CRT=2		13.047		8.534
		(10.853)		(7.260)
CRT=3		0.268		−2.042
		(10.518)		(7.837)
CRT=4		13.601		5.597
		(9.725)		(9.224)

continued

Table 2.B.2 – continued from previous page

Dependent variable:	Share invested in risky asset (in percent)			
	Panel A: Endowment = 3,450		Panel B: Endowment = 4,050	
	(1)	(2)	(3)	(4)
CRT=5		9.182		6.786
		(10.769)		(8.729)
CRT=6		10.677		−0.356
		(9.747)		(9.317)
CRT=7		24.558**		16.302
		(11.604)		(10.754)
Financial Literacy=1		−18.887		−1.886
		(11.449)		(17.250)
Financial Literacy=2		−25.515***		14.642
		(9.641)		(16.010)
Financial Literacy=3		−19.334*		14.705
		(9.982)		(15.908)
First Time		3.923		4.804
		(4.418)		(5.470)
Economic-rel. Major		−1.626		5.743
		(4.497)		(4.137)
Overconfidence		4.908		0.676
		(5.240)		(5.110)
Constant	31.379***	10.940	32.738***	11.896
	(3.291)	(15.095)	(3.756)	(28.204)
Observations	160	160	158	158
Adjusted R^2	0.051	0.252	−0.001	0.300

Notes: This table presents results of ordinary least squares regressions that test for treatment differences in subjects' share invested in the risky asset (in percent) in the first round having either received an endowment of 3,450 (Panel A) or 4,050 (Panel B) (robust standard errors in parentheses). It reports results for pooled data with dummies for treatments H and L; treatment C is omitted. "Female" is a gender dummy variable; "GRQ" is a self-reported level of risk aversion, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "Age" is the individual's age in years; "CRT" is the score on the 7-item Cognitive Reflection Test (CRT), ranging from 0 to 7; "Financial Literacy" is the score on the financial literacy test, ranging from 0 to 3; "First Time" is a dummy variable for subjects participating for the first time in a lab experiment; "Economic-rel. Major" is a dummy variable indicating a major in economics or related; and "Overconfidence" is a dummy variable indicating a positive difference between the estimated and the actual number of correct answers in the CRT. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 2.B.3: Treatment effects between H and L by endowment amount

Dependent variable:	Share invested in risky asset (in percent)			
	Panel A: Endowment = 3,450		Panel B: Endowment = 4,050	
	(1)	(2)	(3)	(4)
Treatment H	15.038***	13.765**	7.485	12.455**
	(5.491)	(5.706)	(5.699)	(5.285)
Female		−8.490		−0.153
		(6.871)		(6.316)
GRQ=1		21.010		
		(15.880)		
GRQ=2		17.042*		−30.623
		(9.458)		(24.350)
GRQ=3		23.970***		−15.078
		(8.692)		(24.535)
GRQ=4		25.436***		−6.759
		(7.890)		(24.841)
GRQ=5		27.935***		−5.571
		(9.787)		(24.796)
GRQ=6		33.313***		−22.324
		(8.000)		(24.743)
GRQ=7		30.756**		−8.786
		(13.601)		(24.842)
GRQ=8		39.129***		−26.124
		(12.744)		(25.275)
GRQ=9		14.516		10.794
		(14.601)		(26.643)
GRQ=10		91.412***		46.882*
		(6.112)		(24.895)
Age		0.569		0.212
		(0.779)		(0.281)
CRT=1		21.821**		21.424*
		(10.445)		(11.381)
CRT=2		12.029		13.712
		(14.698)		(8.456)
CRT=3		−3.887		4.703
		(11.935)		(10.068)
CRT=4		20.352*		9.078
		(11.186)		(11.512)
CRT=5		8.913		9.645
		(12.819)		(9.022)

continued

Table 2.B.3 – continued from previous page

Dependent variable:	Share invested in risky asset (in percent)			
	Panel A: Endowment = 3,450		Panel B: Endowment = 4,050	
	(1)	(2)	(3)	(4)
CRT=6		14.629		1.604
		(11.555)		(12.126)
CRT=7		24.075*		26.444*
		(13.505)		(13.403)
Financial Literacy=1		−14.704		17.795
		(20.006)		(12.920)
Financial Literacy=2		−21.302		26.469**
		(17.470)		(10.701)
Financial Literacy=3		−14.424		26.010**
		(17.026)		(10.205)
First Time		−3.060		1.246
		(5.988)		(5.922)
Economic-rel. Major		−1.031		7.906
		(6.175)		(5.644)
Overconfidence		3.726		2.450
		(6.663)		(6.797)
Constant	30.889***	−5.985	30.467***	−7.846
	(3.352)	(27.075)	(3.616)	(29.424)
Observations	102	102	102	102
Adjusted R^2	0.060	0.218	0.007	0.349

Notes: This table presents results of ordinary least squares regressions that test for treatment differences in subjects' share invested in the risky asset (in percent) in the first round having either received an endowment of 3,450 (Panel A) or 4,050 (Panel B) (robust standard errors in parentheses). Comparisons are made only between treatment L and H. "Female" is a gender dummy variable; "GRQ" is a self-reported level of risk aversion, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "Age" is the individual's age in years; "CRT" is the score on the 7-item Cognitive Reflection Test (CRT), ranging from 0 to 7; "Financial Literacy" is the score on the financial literacy test, ranging from 0 to 3; "First Time" is a dummy variable for subjects participating for the first time in a lab experiment; "Economic-rel. Major" is a dummy variable indicating a major in economics or related; and "Overconfidence" is a dummy variable indicating a positive difference between the estimated and the actual number of correct answers in the CRTt. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Chapter 3

What Drives the Willingness to Pay for Insurance Contracts with Nonperformance Risk? Experimental Evidence*

Marc-André Hillebrandt

3.1 Introduction

By purchasing an insurance contract, policyholders aim to (partially) hedge an insurable risk. In case of insurer's insolvency, however, the insured might not get (fully) reimbursed in case of a loss—resulting in (partial) contract nonperformance.[1] The insolvency of Thomas Cook, a British global travel group, in 2019 is a very recent and prominent example of contract nonperformance: for German policyholders, the insolvency insurance of Zurich Insurance Group is capped at EUR 110 million (§ 651r BGB) and policyholders are, thus, not (fully) compensated by their insurance contract.[2] This study provides behavioral evidence from incentivized laboratory experiments how individuals adapt and what drives their willingness to pay (WTP) for insurance contracts with nonperformance risk.

*This study is registered in the AEA RCT Registry and the unique identifying number is: "AEARCTR-0004106". The author thanks Sebastian Hinck, Tobias Huber, Tim Jäger, Markus Nöth, and Petra Steinorth for detailed and helpful comments.

[1]Yet, contract nonperformance risk is not limited to insurer default risk and there are many reasons why insurance contracts may fail to perform: events that void insurance coverage or the exclusion of coverage in situations of civil unrest or war (Schlesinger, 2013), delayed payments due to verification and processing periods (Briys et al., 1991), contract complexity and opacity with financial illiterate policyholders (Kubitza et al., 2020), insurers' strategic concerns to deter fraudulent claims (Crocker and Morgan, 1998; Bourgeon and Picard, 2014), or the downside risk inherent in index insurance (Clarke, 2016).

[2]Without acknowledging any legal obligation and without prejudice to the legal situation, the German government has decided to compensate these policyholders for the difference between their payments to the tour operator and what they receive back from Zurich Insurance.

Assuming that insurers always perform, a standard result within expected utility theory states that risk-averse individuals opt for full insurance when offered insurance at actuarially fair premia (Mossin, 1968). If, however, the probability that the insurer totally defaults is positive, less-than-full insurance coverage is purchased at actuarially fair premia (Schlesinger and Graf von der Schulenburg, 1987; Doherty and Schlesinger, 1990).[3] The introduction of contract nonperformance risk, thus, decreases optimal insurance demand in theory. Generally, higher optimal insurance coverage, however, is not necessarily linked to higher WTP for full insurance (e. g., Jaspersen, 2016, p. 242).

Insurance policies with nonperformance risk are also known as probabilistic insurance—a notion introduced by Kahneman and Tversky (1979). Early empirical research on probabilistic insurance relied on hypothetical surveys to examine the effects of default risk on subjects' WTP (Kahneman and Tversky, 1979; Wakker et al., 1997; Albrecht and Maurer, 2000; Zimmer et al., 2009). Although these studies were not incentive-compatible, they agree that people dislike probabilistic insurance and the presence of contract nonperformance risk considerably decreases people's WTP.[4] In fact, Wakker et al. (1997) find that people demand a reduction of their premium of more than 20 percent to make up for a one percent default risk. A major problem with hypothetical surveys, however, is that they are not incentive-compatible and are often considered as unreliable.[5] But Zimmer et al. (2018) confirm this result in an incentive-compatible experiment with high stakes, in which one out of 181 participants was paid.[6] According to Harrison and Ng (2018, p. 71), subjects might have considered this payment method as "effectively hypothetical" given the relatively low probability of payment. Therefore, this study aims to validate the findings of Zimmer et al. (2018) in an incentive-compatible experiment, in which stakes are much smaller but all subjects have a chance of getting paid.

In this study, subjects are exposed to a risk of losing a substantial amount of their previously earned laboratory income. To insure against this potential loss, subjects state their WTP for three different insurance contracts, which only differ in their inherent contract nonperformance risk. So far, the lowest default probability in incentive-compatible experiments studying subjects' WTP for insurance contracts with nonperformance risk is 1 percent. The goal of the European Solvency II regulation, however, is to limit the one-year probability of default to 0.5 percent. A probability of 1 percent, thus, might be considered as too high. On the other hand, individuals seem to be insensitive to variations among low probabilities and have difficulties in distinguishing events with

[3] Under partial default, however, insurance demand may increase.

[4] The results are generally supported both by theoretical (Peter and Ying, forthcoming) and experimental work (Biener et al., 2019) focusing on the effects of ambiguous nonperformance.

[5] See Cummings et al. (1995), Cummings et al. (1997), Camerer and Hogarth (1999), Holt and Laury (2002), and Harrison and Rutström (2008) for a detailed discussion on hypothetical bias and financial incentives in experiments.

[6] The first incentivized experimental study is from Herrero et al. (2006), who investigate probabilistic insurance in the original version from Kahneman and Tversky (1979). Probabilistic insurance as defined by Kahneman and Tversky (1979) differs, however, from modern definitions of probabilistic insurance: in the case of a loss and insurer's default, policyholders get reimbursed their paid premium.

zero probability and very low probabilities (Kunreuther et al., 2001).[7] Therefore, I investigate subjects' WTP for insurance contracts with default probabilities of 0 percent, 0.1 percent, and 1 percent, in which the two latter are slightly below and slightly above 0.5 percent.

While Wakker et al. (1997) report a 20 percent reduction in the premium when introducing the nonperformance risk of 1 percent, subjects in Zimmer et al. (2018) only reduce their adjusted WTP by 8.3 percent (to compensate for a 1 percent probability of default) in the median. This study demonstrates that individuals are very sensitive to the insurer's risk of default—even if that potential risk is as low as 0.1 percent: they reduce their median WTP from well above the actuarially fair premium for a default-free insurance contract by 12.6 percent when introducing a positive nonperformance probability. Interestingly, they are no longer willing to pay the adjusted actuarially fair premium. When the nonperformance probability increases from 0.1 to 1 percent, individuals reduce their WTP by an additional 18.9 percent. Individuals' WTP, thus, significantly decreases both when introducing and increasing nonperformance risk—confirming previous results. In this study, the reduction in the premium when comparing the default-free contract to a contract with default probability of 1 percent is 29.1 percent, which is much higher than the equivalent premium reduction found in Zimmer et al. (2018), but similar to that in Wakker et al. (1997).

Moreover, this study provides evidence that other factors influence subjects' WTP for insurance contracts with nonperformance risk. Among others, I find that individuals with higher self-assessed proneness towards risk are willing to pay less in the median, and I also find that women are willing to pay more (in the median) than men. Interestingly, higher levels of cognitive effort or financial literacy also impact subjects' WTP.

This study proceeds as follows: Section 3.2 describes the experimental design and procedures. Section 3.3 presents the results, focusing on the effects of different default probabilities as well as on other influencing factors on subjects' WTP for insurance contracts. Section 3.4 concludes.

3.2 Experimental Design and Procedures

The complete experiment consists of two stages and this study is based on the second stage.[8] In both stages, "Taler" is used to disclose experimental endowments and earnings with the exchange rate between "Taler" and Euros being 100 Taler = EUR 0.25.

[7] For instance, people tend to underestimate the likelihood of a catastrophic natural event occurring (Kunreuther and Pauly, 2004), resulting in sometimes puzzling insurance-purchasing behavior considering low-probability-high-impact losses compared to high-probability-low-impact losses (e. g., Camerer and Hogarth, 1999; McClelland et al., 1993; Ganderton et al., 2000; Laury et al., 2009). Yet, people overweight small probabilities (Tversky and Kahneman, 1992). Laury et al. (2009) find that the sensitivity to the probability of loss depends on the framing of the loss and whether the choice is incentivized.

[8] See Subsection 3.2.2 for more details about the experimental structure.

3.2.1 Treatment

This study aims to provide experimental evidence how individuals adapt their WTP for insurance contracts with nonperformance risk. The insurance contracts offered are either default-free or have a positive risk of default. In case of a default, these insurance contracts are fully nonperforming. Partially performing contracts are not considered. In this incentive-compatible experiment, subjects state their WTP for three different insurance contracts, which only differ in their probability of default (0 percent, 0.1 percent, and 1 percent default probability).

This experiment on insurance choices is similar to Zimmer et al. (2018): Let w_1 denote the individual's wealth level after completing this experiment's Stage I. Then, subjects in this experiment are told that a part (or all) of their earnings were at risk of theft, namely $L := \min\{w_1; 3{,}500 \text{ Taler}\}$.[9] The remaining earning, denoted by $S := \max\{0; w_1 - 3{,}500 \text{ Taler}\}$, is safe. For all subjects, the probability for a theft equals 5 percent. Contrary to Zimmer et al. (2018), in this study, all subjects who completed Stage I with positive wealth are exposed to the risk of theft.[10]

Subjects then are offered three different insurance contracts for which they state their WTP to protect themselves against the potential loss of L. To mitigate a potential order effect (Harrison et al., 2005), the insurance contracts are presented to each individual in an individually randomized order. All three contracts have the same scope of indemnity (full insurance); the only difference between these insurance contracts is their level of default risk (0 percent, 0.1 percent, and 1 percent). Exactly one of these three contracts is randomly selected for purchase.

Subjects' WTP is elicited by employing the secret price mechanism proposed by Schade and Kunreuther (2001), which modifies the standard Becker-DeGroot-Marschak mechanism (Becker et al., 1964) and is illustrated in Figure 3.1: If subjects' WTP for the selected insurance contract is equal to or higher than a randomly generated premium[11], they purchase the insurance policy at the randomly generated price and the insurance premium is deducted from their payoff in the experiment. In return, subjects receive the insurance coverage specified in the corresponding insurance contract. Depending on the contract, the contract can also default. If, however, their stated WTP is lower than the randomly generated premium, subjects are not allowed to purchase the insurance contract and are exposed to the risk of theft.

[9] This is equivalent to EUR 8.75. Since subjects' average payment prior to the insurance choices was 4,336.64 Taler = EUR 10.84, the potential loss represents a considerable amount of subjects' earnings so far.

[10] In Zimmer et al. (2018), 181 subjects state their WTP for four insurance contracts to insure against a potential loss of EUR 800. In their study, subjects are informed that only one (randomly determined) subject is actually exposed to the risk of theft.

[11] To simplify, premia for all three insurance contracts were randomly generated as a discrete uniformly distributed random variable $P \sim \mathcal{U}\{\lfloor 0.9 \cdot EV_{0\%\,dp} + 0.5 \rfloor, \lfloor 1.25 \cdot EV_{0\%\,dp} + 0.5 \rfloor\}$, in which $EV_{0\%\,dp} := 0.05 \cdot L$. Subjects don't know the premium until final payoff and have to guess the premium's amount.

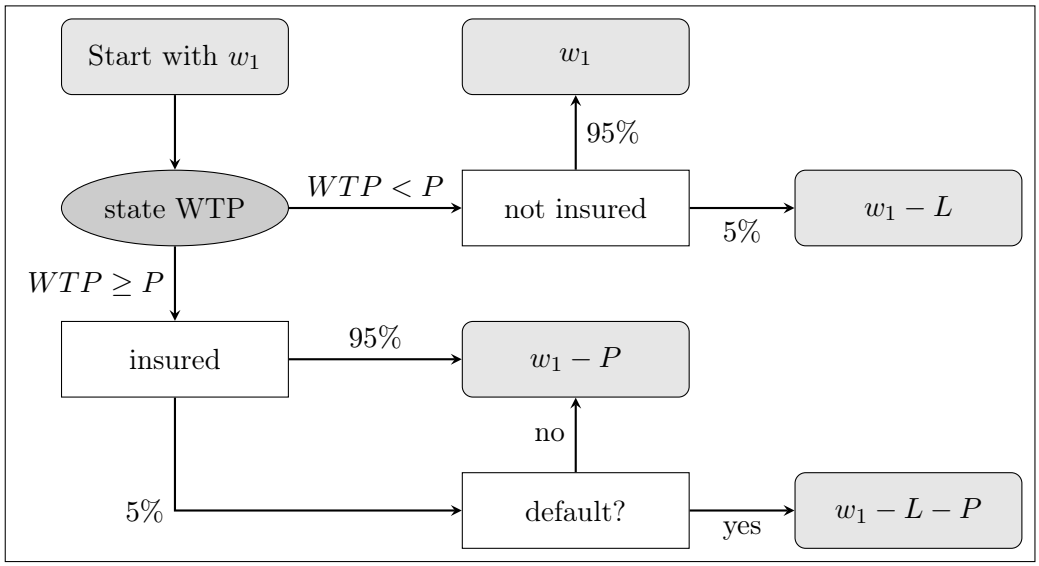

FIGURE 3.1: This study's insurance purchasing decision tree

Furthermore, I present the same information about the insurance contracts in different forms because framing has shown to matter in many different contexts (e. g., Johnson et al., 1993). For instance, Laury et al. (2009) find that the framing of the loss can impact individuals' sensitivity to the probability of the loss. The insurance contracts are either framed positively, negatively, or neutral: In a positive (negative) framing, the probability of default is additionally expressed by the number of cases (not) reimbursed by the insurer. A neutral framing uses both additional expressions of the positive and negative framing (see also Table 3.A.1). Within each subject, the framing remains consistent.

3.2.2 Experimental Structure

In laboratory experiments, subjects can usually not lose more money than they earn due to practical and ethical considerations. Insurance decisions, however, are made in the loss domain. To address this problem, subjects can either earn money in prior tasks or be endowed with a windfall payment. A windfall payment might cause two problems, according to Jaspersen (2016): First, subjects may behave less risk-averse following the windfall payment due to the house money effect (Thaler and Johnson, 1990; Arkes et al., 1994). Second, subjects might behave differently as they may consider all experimental decisions as being in the gain domain, because of (possibly) not having integrated the windfall gain into their own wealth (Harbaugh et al., 2010). For this reason, this study is based on the second stage of a two-stage experiment. In the first stage, subjects are exposed to a risk-taking task in which they gain some money before taking the insurance choices (see also Figure 3.2). Subjects are informed about their experimental earnings before the second stage – the insurance decisions – started. This way, subjects have already earned some money—resulting in more realistic insurance decisions since the risk of losing money is real.

The structure of the experimental procedure for this study is summarized in Figure 3.2. In the first stage (Stage Ia), Hillebrandt and Steinorth (2020) examine how relative wealth placement affects risk-taking behavior. More specifically, subjects make three investment choices in a standard portfolio problem, in which they may care about their placement in the wealth distribution relative to a peer group. In all three choices, they receive an endowment and decide how to allocate the endowment between a safe and a risky asset.[12]

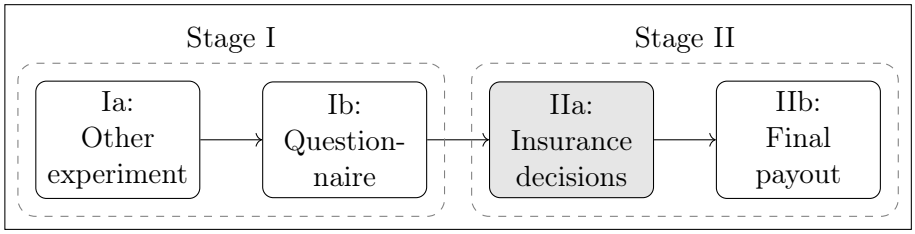

FIGURE 3.2: Structure of the experiment

Furthermore, between the first and second investment decision (in Stage Ia), subjects' cognitive effort is measured by the seven-item Cognitive Reflection Test (CRT) (Toplak et al., 2014), with the seven-item CRT being an extension of the three-item CRT (Frederick, 2005). To control for subjects' potential overconfidence (Neyse et al., 2016), subjects have to estimate their number of correct answers in the CRT. Between the second and third investment decision (in Stage Ia), subjects' financial literacy is measured according to Lusardi and Mitchell (2011). Previous research has indicated that cognitive skills matter in decisions involving risks (see e. g., Falk et al., 2018).

In the questionnaire (Stage Ib), some socioeconomic characteristics are assessed, including age, gender, subjects' highest level of education, their field of study, as well as subjects' self-assessed general willingness to take risks—the "general risk question" (GRQ).[13] In this study, risk attitudes are measured through the GRQ for two reasons: First, Jaspersen et al. (2020) find that the GRQ correlates meaningfully with risk attitudes concerning financial losses. Second, risk attitudes have to be measured at the same wealth level as the decision of interest such that it is not confounded by wealth effects. Since earnings are realized prior to the GRQ, subjects have the same wealth level when answering the GRQ and stating their WTP for the insurance contracts. The three insurance choices (Stage IIa) come after having realized prior earnings from the risk-taking task, and are presented to each individual in an individually randomized order.

[12]Subjects randomly (and depending on the treatment) receive an endowment, w_0, of 2,150 Taler, 3,450 Taler, 4,050 Taler, or 7,150 Taler, which can differ in each of these three investment decisions. The money invested into the risky asset, as denoted by δw_0, is either worth $2.5\delta w_0$ or is lost with equal probability, whereas the money not invested, $(1-\delta)w_0$, is kept for sure. Before Stage II with the insurance decisions started, one of these three investment choices is randomly selected and played out.

[13]Subjects are asked to self-assess their general riskiness on a scale from 0 (completely unwilling to take risks) to 10 (completely willing to take risks). The GRQ's reliability has been validated using paid lottery choices by Dohmen et al. (2011). Furthermore, Lönnqvist et al. (2015) showed its high test-retest stability. Mata et al. (2018) also confirmed this high temporal stability of stated risk preferences (compared to revealed measures of risk preferences) in their meta-study.

Subjects are offered incentive-compatible compensation in both stages of this experiment: each subject is paid for one randomly selected choice from each stage, and earnings for the risk-taking task are realized prior to the insurance task. Stage II, thus, starts with a differentiated wealth distribution, in which wealth ranges from 0 Taler to 14,875 Taler. As subjects are already informed about the success or failure of their investment decision, this may also impact subjects' emotional state.

3.2.3 Experimental Procedure

The experiment was programmed with oTree (Chen et al., 2016) and conducted at the WiSo-Experimentallabor of Universität Hamburg. In total, I conducted 19 experimental sessions from April to June 2019 and hroot (Bock et al., 2014) was used for recruiting. No subject was allowed to participate in more than one session and the number of subjects in each session ranged from 12 to 30 with a total of 420 subjects (255 women and 165 men). On average, sessions lasted 34 minutes and subjects' average payment was EUR 10.41 (USD 11.76), ranging from EUR 0.00 to EUR 36.80. Once seated, the experimenter read aloud an introduction to provide details about the experiment and subjects could read the text simultaneously on their screens. To start the experiment, subjects had to enter a code. During the experiment, interaction or communication between subjects was not allowed.

3.3 Results

To provide incentive-compatible experimental evidence on individuals' WTP for insurance under contract nonperformance risk, subjects state their maximum WTP for three different insurance contracts, which only differ in terms of the inherent default risk: while all three contracts have the same scope of indemnity, contract A, contract B, and contract C have different default probabilities of 0 percent, 0.1 percent, and 1 percent.

3.3.1 Descriptive Statistics

Out of the 420 subjects, 18 were left with no money after Stage I and, thus, could not make any insurance decision. Table 3.1 reports summary statistics for the remaining 402 subjects. Subjects' mean (median) age is 25.9 (25) and 62.4 percent are female.

Out of this final sample of 402 subjects, 34 subjects (8.46 percent) reported to not buy any insurance, i. e., $\text{WTP}_{dp=0\%} = \text{WTP}_{dp=0.1\%} = \text{WTP}_{dp=1\%} = 0$. From the remaining 368 subjects (91.54 percent) who demand insurance protection in general, 71 subjects (19.29 percent) violated the standard assumption of a monotonically increasing utility function (Quirk and Saposnik, 1962), that is, they violated Equation (3.1):

$$\text{WTP}_{dp=0\%} \geq \text{WTP}_{dp=0.1\%} \geq \text{WTP}_{dp=1\%} \tag{3.1}$$

TABLE 3.1: Summary statistics

	Mean	Minimum	1st Quartile	Median	3rd Quartile	Maximum	SD
Age	25.92	16	22	25	28	81	(6.345)
Female (in %)	62.44	0	0	100	100	100	(48.489)
GRQ	4.74	0	3	4	6	10	(2.142)
CRT	3.81	0	2	4	6	7	(2.158)
Overconfidence	1.11	−3	0	1	2	7	(1.728)
Financial Literacy	2.47	0	2	3	3	3	(0.713)
First Time (in %)	19.65	0	0	0	0	100	(39.786)
Economic-related Major (in %)	43.28	0	0	0	100	100	(49.609)
Positive Investment (in %)	56.72	0	0	100	100	100	(49.609)
Wealth	4530.82	110	2750	4045	5625	14875	(2484.894)
Observations	402						

Notes: This table provides summary statistics on the participants in the experiment. The variables "Age" is measured in years; "Female", "First Time", "Economic-related Major", "Positive Investment" are dummy variables; "GRQ" is a self-reported measure for general riskiness, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "CRT" is the score of correct answers on the 7-item CRT on a scale from 0 to 7; "Financial Literacy" ranges from 0 to 3 and is the score of correct answers on the financial literacy test; "Overconfidence" is the difference between the estimated and the actual number of correct answers in the CRT; and "Wealth" indicates the wealth with which the subjects emerged from Part I of these experiments.

Despite this larger share of subjects who stated their WTP inconsistently (19.29 percent compared to 6.5 percent in Zimmer et al. (2018)), subjects' behavior towards the different insurance contracts is quite similar to that in Zimmer et al. (2018): 11 subjects (2.99 percent) only accept a default-free insurance contract, i. e., $\text{WTP}_{dp=0\%} > 0$ and $\text{WTP}_{dp=0.1\%} = \text{WTP}_{dp=1\%} = 0$; 15 subjects (4.08 percent) do not accept insurance contracts with 1 percent default probability ($\text{WTP}_{dp=0\%} \geq \text{WTP}_{dp=0.1\%} > 0$ and $\text{WTP}_{dp=1\%} = 0$); and 271 subjects (73.64 percent) consistently stated a positive WTP for all levels of default risk.

This study's experimental setup ensures that each individual had to state their WTP for each of the three insurance contracts. To account for possible order effects (Harrison et al., 2005), the order in which contracts were presented was randomly determined. This randomization may also (partially) explain the higher share of inconsistently answering subjects since Zimmer et al. (2018) displayed all contracts on the computer screen simultaneously and in the same order. Table 3.B.1 presents subjects' average WTP (in percent of the risk they face) across the three rounds. Overall, a Kruskal-Wallis H test cannot reject the null hypothesis that there are no differences between treatment orders (see Table 3.B.1). In light of this finding, subjects' WTP for contract A, B, and C are pooled. Descriptive results are reported in Table 3.2.

TABLE 3.2: Participants' willingness to pay (in percent)

	Observations	Mean	Minimum	1st Quartile	Median	3rd Quartile	Maximum	SD
Contract A (0% dp)	402	10.77	0	2.44	5.71	14.29	100	(14.73)
Contract B (0.1% dp)	402	9.12	0	1.43	4.99	13.71	100	(12.63)
Contract C (1% dp)	402	7.88	0	0.87	4.04	10.00	100	(12.21)

Notes: This table reports the descriptive statistics of willingness to pay (in percent of the risk they are exposed to) for all three insurance contracts with different default probabilities of 0 percent (contract A), 0.1 percent (contract B), and 1 percent (contract C).

3.3.2 Impact of Default Probability on WTP

To account for different actuarially fair premia, the *adjusted WTP* is calculated as the ratio between the WTP for a given insurance contract and the actuarially fair premium for the respective contract. This adjustment allows to compare subjects' WTP across different levels of default risk. The median adjusted WTP, thus, are 1.142, 0.999, and 0.810 for contract A, contract B, and contract C, respectively. Interestingly, subjects' adjusted WTP is only greater or equal to 1 for the default-free contract A, although it is only slightly lower than 1 for contract B. Subjects, thus, are only willing to pay more than the actuarially fair premium (in median values) if the insurance contract offered is default-free (median WTP of 5.71 to an actuarially fair premium of 5.00 percentage points).

Compared to a default-free insurance contract, subjects sharply decrease their WTP for insurance once the nonperformance risk is positive. Even with a default probability of only 0.1 percent, the median WTP reduces to 4.99 percent of the risk subjects face. The mere existence of default probability, thus, has resulted in the median WTP to be (slightly) less than the actuarially fair premium, resulting in an adjusted WTP of 0.999 (median WTP of 4.99 percentage points compared to an actuarially fair premium of 4.995 percentage points). In fact, this decline in median values is equivalent to a premium reduction (of the actuarially fair premium) of 12.6 percent ($p < 0.001$, Wilcoxon signed-rank test).

For both contracts with positive default probability, subjects' adjusted WTP is smaller than 1—strongly indicating that individuals dislike probabilistic insurance contracts. By further increasing the default probability to 1 percent, the median WTP now only amounts to 4.04 percentage points, which is – adjusted for the different levels of default probability – an additional reduction of 18.9 percent ($p < 0.001$, Wilcoxon signed-rank test). In total, when comparing the WTP for the default-free insurance contract (adjusted WTP of 1.142) and one with a default probability of 1 percent (adjusted WTP of 0.810), the adjusted median WTP decreases by 29.1 percent ($p < 0.001$, Wilcoxon signed-rank test).

To control for individual characteristics and to assess impacting factors on subjects' WTP for insurance contracts with nonperformance risk, I perform two main statistical analyses (each with and without control variables): first, I estimate linear regressions using ordinary least squares (OLS) (Panel A of Table 3.3); second, I also estimate median regressions (Panel B of Table 3.3) as these are more robust to outliers.[14] Specifically, I estimate the following model

$$WTP_i = \beta_0 + \beta_1 \cdot \text{Contract A (0\% dp)}_i + \beta_2 \cdot \text{Contract C (1\% dp)}_i + \gamma \cdot \mathbf{X}_i + \delta \cdot \mathbf{Z}_i + \epsilon_i,$$

[14] As a robustness check, I also perform the analyses by excluding those 23 observations with an adjusted WTP of more than 10 (see Table 3.B.4).

in which I regress the adjusted WTP, WTP_i, on treatment dummies indicating the insurance contracts with an inherent default risk of 0 and 1 percent. Contract B is chosen as the baseline to analyze subjects' WTP when introducing and when increasing default risk. $\mathbf{X}_i$ includes dummies for different framings of the insurance contracts. $\mathbf{Z}_i$ is the set of control variables for subjects' socio-economic and individual characteristics, including subjects' age, gender, self-reported risk attitude[15], cognitive ability measured by the seven-item CRT (Toplak et al., 2014), a dummy for overconfidence (according to Neyse et al., 2016), financial literacy (in the spirit of Lusardi and Mitchell, 2011), wealth level after completing this experiment's Stage I, a dummy variable indicating an economic-related major, first time participation in a laboratory experiment, and whether their investment in Stage I was successful.[16] Finally, ϵ_i is the idiosyncratic error term.[17]

Since contract B (0.1% default probability) is the omitted category, I expect a positive coefficient estimate for contract A (0% default probability) and a negative coefficient estimate for contract C (1% default probability). Indeed, subjects react to a positive default probability by reducing their WTP: The coefficient estimates for contract A are positive in all four specifications. Subjects increase their adjusted WTP on average by 0.328 ($p < 0.10$, columns (1) and (2)) and in the median by 0.142 (insignificant, column (3)) and 0.166 ($p < 0.10$, column (4)), respectively.

The results also show that an increase in the probability of default amplifies the general dislike for probabilistic insurance. While the coefficient estimate for contract C (-0.235) is negative as expected, it is insignificant in the OLS regression (columns (1) and (2)). In the median, subjects reduce their adjusted WTP by 0.176 ($p < 0.10$, column (3)) and even 0.201 when controlling for the covariates ($p < 0.01$, column (4)). When comparing the differences between the default-free contract A and contract C, the differences become clearer and are each statistically significant at the 1 percent level. Overall, the results indicate that both introducing and increasing contract nonperformance risk decreases subjects' WTP (in the median), which supports the findings from past research (like Wakker et al., 1997; Zimmer et al., 2009; Zimmer et al., 2018).

Result 3.1a. *Individuals decrease their WTP for insurance contracts with nonperformance risk compared to default-free insurance contracts.*

Result 3.1b. *Individuals decrease their WTP for insurance contracts with nonperformance risk when the risk of default increases.*

[15] Self-reported risk attitude was assessed after determining the first payout and constructing a differentiated wealth distribution. With this, I ensure that both subjects' WTP for insurance contracts and self-assessed risk attitude have the same underlying wealth level.

[16] Multicollinearity does not seem to be a problem since the variance inflation factor is at most 1.81.

[17] The variables "Age", "GRQ", "CRT", "Financial Literacy", and "Wealth" are standardized. The results also remain mostly qualitatively unchanged when encoding the categorical variables "GRQ", "CRT", and "Financial Literacy" as dummy variables (see Table 3.B.2). Compared to the results in Table 3.3, the coefficient estimates for contract A and contract C are slightly lower and statistically less significant (column (4) of Table 3.B.2)

TABLE 3.3: OLS and median regression of adjusted WTP for probabilistic insurance

	Panel A: OLS regression		Panel B: Median regression	
	(1)	(2)	(3)	(4)
Contract A (0% dp)	0.328*	0.328*	0.142	0.166*
	(0.194)	(0.185)	(0.132)	(0.093)
Contract C (1% dp)	−0.235	−0.235	−0.176*	−0.201***
	(0.176)	(0.169)	(0.102)	(0.060)
Negative Framing		−0.033		0.193**
		(0.144)		(0.095)
Positive Framing		0.555***		0.095
		(0.197)		(0.087)
Age (standardized)		−0.264***		−0.112***
		(0.047)		(0.025)
GRQ (standardized)		0.083		−0.063**
		(0.095)		(0.028)
Economic-related Major		−0.101		−0.164**
		(0.150)		(0.071)
CRT (standardized)		−0.178*		0.118**
		(0.106)		(0.060)
Overconfidence		0.323*		0.187**
		(0.185)		(0.091)
Financial Literacy (standardized)		−0.441***		−0.200**
		(0.112)		(0.078)
First Time		0.027		0.081
		(0.185)		(0.129)
Wealth (standardized)		−0.090		−0.045
		(0.095)		(0.037)
Female		0.087		0.347***
		(0.191)		(0.083)
Positive Investment		0.683***		0.577***
		(0.170)		(0.094)
Constant	1.826***	1.065***	1.001***	0.425***
	(0.126)	(0.261)	(0.081)	(0.106)
Observations	1,206	1,206	1,206	1,206
Adjusted/Pseudo R^2	0.006	0.090	0.004	0.045

Notes: This table presents results of OLS (Panel A) and median regressions (Panel B) that test for differences in participants' WTP for each of the three insurance contracts using 1,206 observations from 402 subjects. The dependent variable is the adjusted WTP as a ratio of WTP with a given default risk and the actuarially fair premium for the corresponding contract. "Contract A" and "Contract C" are dummy variables indicating the insurance contract, with "Contract B" (0.1% dp) serving as a reference category; in "Neg. Framing" and "Pos. Framing", contract conditions were displayed negatively or positively, respectively – in the baseline, contract conditions were formulated both positively and negatively; "Age" is the individual's age in years; "GRQ" is a self-reported measure for general riskiness, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "Economic-rel. Major" is a dummy variable indicating a major in economics or related; "CRT" is the score on the 7-item CRT, ranging from 0 to 7; "Overconfidence" is a dummy variable indicating a positive difference between the self-assessed and the actual number of correct answers in the CRT; "Financial Literacy" is the score on the financial literacy test, ranging from 0 to 3; "First Time" is a dummy variable for subjects participating for the first time in a lab experiment; "Wealth" reports subjects' wealth level at the end of this experiment's Stage I; "Female" is a gender dummy variable; and "Positive Investment" is a dummy variable that indicates whether the subject's investment in Stage I was successful. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.3.3 Robustness Checks

So far, the analyses include all subjects who completed Stage I with a positive earning. Nevertheless, some subjects violated the assumption of a monotonically increasing utility function (Quirk and Saposnik, 1962). Furthermore, there are subjects stating an unrealistically high WTP, such as stating a WTP of 3,500 when the insurable risk was also equal to 3,500—suggesting that they possibly misunderstood the instructions. Therefore, I also perform the analyses with several specifications to strengthen the results that introducing as well as increasing nonperformance risk both reduces individuals' WTP sharply.

At first, I exclude those 71 subjects who stated their WTP inconsistently and, thus, violated Equation (3.1), resulting in a sample consisting of 331 subjects answering consistently. Those excluded subjects behaving inconsistently do not differ with respect to age, gender, self-assessed risk attitude, overconfidence, or participating for the first time in a lab experiment. Compared to those stating their WTP consistently, they differ, however, in terms of cognitive ability (inconsistent subjects answered only 3.10 questions correctly in the CRT compared to 3.96 ($p < 0.01$, t-test)) and financial literacy (only 2.27 compared to 2.51 correct answers ($p < 0.01$, t-test)). The results are given in Table 3.B.3.

Accordingly, the results are much clearer: On average, subjects significantly decrease their WTP once the nonperformance risk is present (-0.468, $p < 0.05$) and they reduce the adjusted WTP by 0.402 ($p < 0.05$, column (1); $p < 0.01$, column (2)) with increasing nonperformance risk. Similarly, subjects also decrease their WTP in the median when introducing nonperformance risk by 0.171 (insignificant, column (3)) and by 0.221 when including controls ($p < 0.05$, column (4)). Interestingly, the adjusted median WTP is below the actuarially fair premium for these subjects (Constant = 0.972 in column (3)). Again, the adjusted WTP sharply decreases with increasing nonperformance risk by 0.316 ($p < 0.01$, column (3)) and 0.239 with controls ($p < 0.01$, column (4)).

Moreover, I exclude subjects who stated an unrealistically high adjusted WTP, that is, whose adjusted WTP was greater than 10 (see Table 3.B.4). Since the median regression is by construction robust to extreme outliers, it is not surprising that the results remain qualitatively unchanged for the median regression. Compared to the OLS regression in Table 3.3, the coefficient estimates for contract A and contract C are less pronounced, but become more statistically significant (see Panel A of Table 3.B.4). Overall, the results from Table 3.B.4 support the result that introducing and increasing nonperformance risk both decreases subjects' adjusted WTP.

Finally, I also perform the analyses without those subject where the insurable risk was below 2,000 Taler due to a negative investment in Stage I of the experiment. This excludes 35 subjects. Like before, the introduction of nonperformance risk leads to a decrease in subjects' adjusted WTP by 0.337 on average ($p < 0.10$, columns (1) and (2)) and by 0.147 (insignificant, column (3)) and 0.206 ($p < 0.05$, column (4)) in the median.

An increase in nonperformance risk reduces their WTP even further; with coefficient estimates of -0.279 ($p < 0.10$, columns (1) and (2)), -0.168 (insignificant, column (3)), and -0.160 ($p < 0.10$, column (4)).

Taken together, these results suggest that the very introduction of nonperformance risk sharply decreases subjects' median WTP below the actuarially fair premium. This supports previous results (e. g., Wakker et al., 1997; Zimmer et al., 2009; Zimmer et al., 2018) that the awareness of nonperformance risk influences subjects' WTP—seemingly irrespective of the size of the nonperformance risk. These results also indicate that an increase in nonperformance risk reduces subjects' median WTP even further.

3.3.4 Further Drivers of WTP

In the following, I discuss in more detail how subjects' WTP for insurance is potentially driven by selected covariates. Table 3.3 shows that age impacts subjects' WTP. This is not surprising as age has been shown to be an important determinant in an individual's risk attitude (e. g., Dohmen et al., 2017; Mata et al., 2018). Nonetheless, one has to be cautious interpreting the age coefficient as the majority of subjects is in a similar age range. Moreover, I find a strong gender effect, at least in the median: female subjects are in the median willing to pay more for insurance protection (0.347, $p < 0.01$, column (4)). As it might be argued that increasing the WTP is a sign for a higher degree of risk aversion, this result lends support that women act (in the median) more risk-averse than men.

While Zimmer et al. (2018) do not find any significant effect for self-assessed risk attitude on subjects' WTP, in this study, individuals who report higher levels of proneness towards risks in the GRQ are in the median willing to pay less:[18] a standard deviation-increase in the GRQ reduces the adjusted WTP by 0.063 ($p < 0.05$, column (4) of Table 3.3).

Table 3.3 also shows that the framing of information about the insurance contract[19] has a strong impact on subjects' WTP for insurance contracts: If the contract is framed positively, that is, if the contract indicates how often the insurer can actually pay, subjects increase their adjusted WTP on average by 0.555 compared to neutral-framed contracts ($p < 0.01$). Subjects also increase their adjusted WTP in median values by 0.193 for a negative framing.

Turning the attention to cognitive and intellectual properties, I find an interesting pattern with respect to cognitive effort: while subjects with a standard deviation-higher level of cognitive effort are willing to pay less on average (-0.177, $p < 0.10$); in the median, however, they are willing to pay more (0.118, $p < 0.05$). More financial literate people are found to be willing to pay less (-0.438, $p < 0.01$, column (2); -0.198, $p < 0.05$, column (4)). Furthermore, overconfident subjects, i. e., those who overestimated

[18] See Subsection 3.3.3 for more details on the GRQ and its validity.
[19] See Table 3.A.1 for differences in framing.

their correct answers in the CRT, are willing to pay more for insurance policies (0.323, $p < 0.10$, column (2); 0.187, $p < 0.05$, column (4)).

Subjects participating for the first time in a laboratory experiment seem to not behave differently. Students from an economic-related major, however, reduce their WTP in the median (-0.164, $p < 0.05$, column (4)). Finally, prior stages of experiments can impact behavior in later stages: in this study, those subjects who experienced a positive investment decision in the first stage increase their WTP both on average (0.683, $p < 0.01$) and in the median (0.577, $p < 0.01$). This might be due to loss-averse behavior since subjects may not want to lose their money earned so far and, thus, might increase their WTP for an insurance contract.

3.4 Conclusion

Insurance contracts aim at protecting policyholders in case of a loss. An often neglected aspect of insurance contracts is, however, their inherent contract nonperformance risk. The current case of Thomas Cook's insolvency demonstrates that even in a country like Germany where insurance regulation limits the one-year probability of default, contract nonperformance risk has to be considered to ensure customer protection. This study, thus, set out to determine how individuals adapt and what drives their WTP for insurance contracts with nonperformance risk.

Therefore, I revisit the impact of contract nonperformance risk on individuals' WTP for insurance in an incentive-compatible laboratory experiment, controlling for a variety of covariates. This study also aims to validate findings from previous research (Wakker et al., 1997; Albrecht and Maurer, 2000; Herrero et al., 2006; Zimmer et al., 2009; Zimmer et al., 2018). While the lowest positive nonperformance risk in Wakker et al. (1997) and Zimmer et al. (2018) is 1 percent, the lowest positive nonperformance risk in this study is 0.1 percent. Nonetheless, individuals decrease their WTP for insurance contracts with inherent nonperformance risk compared to default-free insurance contracts. In fact, the *mere existence* of nonperformance risk of 0.1 percent leads to a sharp decrease in subjects' median WTP from well above the actuarially fair premium to an amount below the adjusted actuarially fair premium. Individuals, thus, are willing to pay considerably more for default-free insurance contracts. This effect amplifies as the default risk increases and individuals decrease their WTP even further—indicating that individuals react sensitively to an increase in nonperformance risk.

Finally, I also provide insights about different drivers influencing subjects' WTP for insurance contracts with nonperformance risk. The present analysis confirms the impression that economic and socio-demographic factors are crucially important determinants of individuals' WTP for insurance contracts with nonperformance risk. Thereby, this study contributes to a better understanding of individuals' WTP for probabilistic insurance contracts. Indeed, individuals with higher levels of self-assessed riskiness are willing to pay less for (probabilistic) insurance contracts. The findings suggest that

financial literacy as well as cognitive effort both seem to impact individuals' WTP for insurance contracts (see also Kubitza et al., 2020). For insurance regulators, it might be promising to increase the effort of reducing contract complexity and, thus, making insurance policies better understandable.

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Appendix

3.A Experimental Instructions

(translated from German)

The complete experiment consisted of two parts. This article is based on the second part. In a previous task, individuals are equipped with different endowments and then face three investment decisions of how much of their endowment they want to invest in a risky asset. Before starting the second part, one out of these three investment decisions is actually played out, resulting in different wealth levels: PRE_INSURANCE_PAYOFF. Afterwards, all subjects state their willingness for pay for three different insurance contracts, which only differ in their level of default risk. The order in which the insurance contracts are presented is randomized.

Screen 9 – Questionnaire

Please answer the following questions.

- What is your age?
- What is your gender?
- Is this your first participation in a social science experiment?
- What is your highest level of education?
- What is your major studies?
- How do you rate yourself personally? Are you generally a risk-seeking person or are you trying to avoid risks? Please answer using the following scale with 0 (completely unwilling to take risks) and 10 (completely willing to take risks). With the values in between, you can graduate your assessment.

Screen 10 – Description of Insurance Choices

Please note that this part of the experiment is relevant for your payoff in this experiment.

In this part of the experiment, you are exposed to the risk of theft.

- Imagine you have left part of your experimental payoff X[20] in your house. That money is now threatened by the risk of theft.
- The probability that a theft will occur is 5 percent. This risk of theft is comparable to the chance of drawing ball #1 out of 20 numbered balls.
- Your remaining money of Y[21] is safe.
- You can, however, take out insurance against the risk of theft.
- During your research on theft insurance contracts, you read an article stating that insurance contracts can be exposed to the risk of default, i. e., there might a small probability that the policyholder will not be reimbursed by the insurer in case of a loss.

[20] $X := \min\{3{,}500 \text{ Taler}; \text{PRE\_INSURANCE\_PAYOFF}\}$.
[21] $Y := \max\{0; X - \text{PRE\_INSURANCE\_PAYOFF}\}$.

Screen 11 – Description of Insurance Choices

Please note that this part of the experiment is relevant for your payoff in this experiment.

The selling procedure for an insurance policy is organized as follows:

- You do not know the price of the insurance contract. The selling price for the insurance contract is generated secretly and randomly. Please note that the secret selling price may differ for each participant.
- Please state a buying price equal to your maximum willingness to pay for the insurance contract. This is the maximum amount you are willing to pay for the insurance contract.
- At the end of the experiment, the secret selling price will be announced. If your stated willingness to pay is equal to or higher than the secret selling price, you purchase the insurance policy at the secret selling price. The insurance premium paid will be deducted from your payoff in the experiment. In return, you are entitled to the insurance coverage specified in the corresponding insurance contract.
- Important: In this case, you only have to pay the secret selling price, not your willingness to pay you actually stated.
- If your stated willingness to pay is lower than the secret selling price, you will not be allowed to purchase the insurance contract. In this case, you have to bear the risk of theft.
- In this situation, it is best to indicate your maximum willingness to pay for the insurance contract:
  - On the one hand, it does not make sense to state a buying price higher than your maximum willingness to pay since you may end up paying this high price.
  - On the other hand, it does not make sense to state a buying price lower than your maximum willingness to pay: if your stated willingness to pay is lower than the secret selling price, you will not be permitted to purchase the insurance contract—even if you were willing to pay the secret selling price.
- If you do not want to buy the insurance contract, state 0 as your maximum willingness to pay.

Screen 12 – Description of Insurance Choices

Please note that this part of the experiment is relevant for your payoff in this experiment.

Three insurance contracts are presented below.

- Please indicate your maximum willingness to pay for each insurance contract.
- All three contracts have the same scope of indemnity, but the contracts differ in their level of default risk.
- Yet, you can purchase *only one* of the three insurance contracts. The relevant contract will be randomly selected.
- The secret selling price of this contract is randomly determined and may differ for each participant.
- Thus, keep in mind that each purchase decision you make could turn out to be the relevant one.

Screen 13, 14, 15 – Insurance Decision I/II/III

Please note that this part of the experiment is relevant for your payoff in this experiment.

TABLE 3.A.1: Information about the insurance contract with contract B as an example

Contract B	
Risk to be insured:	Loss of 3,500 Taler in case of theft
Risk of theft:	5 percent
Insurance:	One-year theft insurance
Scope:	Theft loss
Insured sum:	3,500 Taler
Probability of default: *(positive framing)*	0.1 percent, i. e. the insurer pays his claims in 999 out of 1,000 cases
Probability of default: *(negative framing)*	0.1 percent, i. e. the insurer cannot pay his claims in 1 out of 1,000 cases
Probability of default: *(positive and negative framing)*	0.1 percent, i. e. the insurer pays his claims in 999 out of 1,000 cases and the insurer cannot pay in 1 out of 1,000 cases

Notes: This table displays information presented to subjects regarding contract B (with 0.1 percent default probability). The only difference of the other two contracts A and C is their level of default probability being either 0 percent (contract A) or 1 percent (contract C), respectively. For each participant, the probability of default is (for all three contracts in a consistent manner) further described using a positive, a negative, or a positive and negative framing.

Please indicate below your maximum willingness to pay for the insurance contract above.

3.B Additional Tables

TABLE 3.B.1: Randomization table by treatment order

	Round 1	Round 2	Round 3	$\chi^2(2)$	p-value
Contract A (0% dp)	11.22	10.27	10.91	0.008	0.9962
	(14.32)	(14.30)	(15.64)		
	[$n = 123$]	[$n = 147$]	[$n = 132$]		
Contract B (0.1% dp)	7.84	9.87	9.81	1.015	0.6019
	(10.17)	(12.45)	(15.02)		
	[$n = 144$]	[$n = 128$]	[$n = 130$]		
Contract C (1% dp)	8.56	8.58	6.59	3.057	0.2168
	(12.27)	(14.95)	(8.91)		
	[$n = 135$]	[$n = 127$]	[$n = 140$]		

Notes: This table presents average willingness to pay (in percent) across rounds to control for a possible order effect. Standard deviation is reported in brackets. In the last two columns, we report the χ^2- and p-value of a Kruskal-Wallis H test to determine potential order effects in which the contracts were presented.

TABLE 3.B.2: OLS and median regression of adjusted WTP for probabilistic insurance with dummies for categorical variables

	Panel A: OLS regression		Panel B: Median regression	
	(1)	(2)	(3)	(4)
Contract A (0% dp)	0.328*	0.328*	0.142	0.146
	(0.194)	(0.184)	(0.132)	(0.094)
Contract C (1% dp)	−0.235	−0.235	−0.176*	−0.119**
	(0.176)	(0.168)	(0.102)	(0.058)
Negative Framing		−0.042		0.196**
		(0.147)		(0.085)
Positive Framing		0.501***		0.080
		(0.188)		(0.083)
Age (standardized)		−0.264***		−0.142***
		(0.047)		(0.022)
GRQ=1		1.100*		1.199***
		(0.633)		(0.345)
GRQ=2		0.446		0.648***
		(0.562)		(0.233)
GRQ=3		0.756		0.663***
		(0.555)		(0.188)
GRQ=4		0.451		0.862***
		(0.537)		(0.195)
GRQ=5		0.492		0.455**
		(0.579)		(0.183)
GRQ=6		0.684		0.857***
		(0.568)		(0.170)
GRQ=7		0.315		0.627***
		(0.544)		(0.179)
GRQ=8		1.155		0.571***
		(0.706)		(0.186)
GRQ=9		−0.128		0.684*
		(0.607)		(0.408)
GRQ=10		1.489		0.024
		(1.126)		(0.614)
Economic-related Major		−0.127		−0.179**
		(0.152)		(0.075)
CRT=1		0.273		−0.324
		(0.465)		(0.307)
CRT=2		0.304		−0.187
		(0.401)		(0.309)
CRT=3		0.103		−0.292

continued

Table 3.B.2 – continued from previous page

	Panel A: OLS regression		Panel B: Median regression	
	(1)	(2)	(3)	(4)
		(0.401)		(0.372)
CRT=4		−0.091		0.024
		(0.387)		(0.290)
CRT=5		−0.304		−0.222
		(0.371)		(0.293)
CRT=6		−0.103		−0.038
		(0.374)		(0.287)
CRT=7		−0.128		0.291
		(0.404)		(0.299)
Overconfidence		0.367*		0.307***
		(0.196)		(0.099)
Financial Literacy=1		0.129		−0.683
		(1.001)		(1.659)
Financial Literacy=2		−1.283		−1.270
		(0.861)		(1.625)
Financial Literacy=3		−1.548*		−1.508
		(0.861)		(1.623)
First Time		0.030		0.113
		(0.183)		(0.104)
Wealth (standardized)		−0.105		−0.007
		(0.091)		(0.049)
Female		0.094		0.367***
		(0.184)		(0.086)
Positive Investment		0.740***		0.553***
		(0.172)		(0.112)
Constant	1.826***	1.735	1.001***	1.123
	(0.126)	(1.083)	(0.081)	(1.650)
Observations	1,206	1,206	1,206	1,206
Adjusted/Pseudo R^2	0.006	0.099	0.004	0.056

Notes: This table presents results of OLS (Panel A) and median regressions (Panel B) that test for differences in participants' WTP for each of the three insurance contracts using 1,206 observations from 402 subjects. The dependent variable is the adjusted WTP as a ratio of WTP with a given default risk and the actuarially fair premium for the corresponding contract. "Contract A" and "Contract C" are dummy variables indicating the insurance contract, with "Contract B" (0.1% dp) serving as a reference category; in "Neg. Framing" and "Pos. Framing", contract conditions were displayed negatively or positively, respectively – in the baseline, contract conditions were formulated both positively and negatively; "Age" is the individual's age in years; "GRQ" is a self-reported measure for general riskiness, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "Economic-rel. Major" is a dummy variable indicating a major in economics or related; "CRT" is the score on the 7-item CRT, ranging from 0 to 7; "Overconfidence" is a dummy variable indicating a positive difference between the self-assessed and the actual number of correct answers in the CRT; "Financial Literacy" is the score on the financial literacy test, ranging from 0 to 3; "First Time" is a dummy variable for subjects participating for the first time in a lab experiment; "Wealth" reports subjects' wealth level at the end of this experiment's Stage I; "Female" is a gender dummy variable; and "Positive Investment" is a dummy variable that indicates whether the subject's investment in Stage I was successful. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 3.B.3: OLS and median regression of adjusted WTP for probabilistic insurance excluding inconsistent subjects

	Panel A: OLS regression		Panel B: Median regression	
	(1)	(2)	(3)	(4)
Contract A (0% dp)	0.468**	0.468**	0.171	0.221**
	(0.202)	(0.191)	(0.131)	(0.098)
Contract C (1% dp)	−0.402**	−0.402***	−0.316***	−0.239***
	(0.158)	(0.153)	(0.084)	(0.064)
Negative Framing		−0.022		0.171**
		(0.141)		(0.082)
Positive Framing		0.522***		0.111*
		(0.182)		(0.064)
Age (standardized)		−0.212***		−0.102***
		(0.043)		(0.018)
GRQ (standardized)		−0.182**		−0.130***
		(0.083)		(0.034)
Economic-related Major		−0.027		−0.170***
		(0.153)		(0.057)
CRT (standardized)		−0.218**		0.111**
		(0.104)		(0.055)
Overconfidence		0.299		0.263***
		(0.182)		(0.075)
Financial Literacy (standardized)		−0.380***		−0.072
		(0.117)		(0.080)
First Time		−0.025		0.098
		(0.168)		(0.105)
Wealth (standardized)		−0.143		−0.050
		(0.092)		(0.035)
Female		−0.206		0.264***
		(0.202)		(0.078)
Positive Investment		0.740***		0.542***
		(0.178)		(0.098)
Constant	1.660***	1.078***	0.972***	0.369***
	(0.123)	(0.271)	(0.064)	(0.107)
Observations	993	993	993	993
Adjusted/Pseudo R^2	0.020	0.105	0.011	0.049

Notes: This table presents results of OLS (Panel A) and median regressions (Panel B) that test for differences in participants' WTP for each of the three insurance contracts using all observations excluding subjects who stated their WTP inconsistently, resulting in 993 observations from 331 subjects. The dependent variable is the adjusted WTP as a ratio of WTP with a given default risk and the actuarially fair premium for the corresponding contract. "Contract A" and "Contract C" are dummy variables indicating the insurance contract, with "Contract B" (0.1% dp) serving as a reference category; in "Neg. Framing" and "Pos. Framing", contract conditions were displayed negatively or positively, respectively – in the baseline, contract conditions were formulated both positively and negatively; "Age" is the individual's age in years; "GRQ" is a self-reported measure for general riskiness, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "Economic-rel. Major" is a dummy variable indicating a major in economics or related; "CRT" is the score on the 7-item CRT, ranging from 0 to 7; "Overconfidence" is a dummy variable indicating a positive difference between the self-assessed and the actual number of correct answers in the CRT; "Financial Literacy" is the score on the financial literacy test, ranging from 0 to 3; "First Time" is a dummy variable for subjects participating for the first time in a lab experiment; "Wealth" reports subjects' wealth level at the end of this experiment's Stage I; "Female" is a gender dummy variable; and "Positive Investment" is a dummy variable that indicates whether the subject's investment in Stage I was successful. Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 3.B.4: OLS and median regression of adjusted WTP for probabilistic insurance without extreme outliers

	Panel A: OLS regression		Panel B: Median regression	
	(1)	(2)	(3)	(4)
Contract A (0% dp)	0.261**	0.260**	0.095	0.195***
	(0.132)	(0.126)	(0.105)	(0.074)
Contract C (1% dp)	−0.185	−0.191*	−0.176*	−0.137**
	(0.121)	(0.115)	(0.092)	(0.064)
Negative Framing		0.012		0.215***
		(0.115)		(0.077)
Positive Framing		0.104		0.040
		(0.125)		(0.075)
Age (standardized)		−0.247***		−0.105***
		(0.041)		(0.024)
GRQ (standardized)		−0.043		−0.082**
		(0.059)		(0.034)
Economic-related Major		−0.246**		−0.172***
		(0.101)		(0.060)
CRT (standardized)		−0.032		0.148***
		(0.068)		(0.044)
Overconfidence		0.178		0.217***
		(0.128)		(0.071)
Financial Literacy (standardized)		−0.249***		−0.148**
		(0.070)		(0.069)
First Time		0.159		0.072
		(0.137)		(0.127)
Wealth (standardized)		−0.048		−0.066**
		(0.070)		(0.029)
Female		0.240**		0.350***
		(0.113)		(0.070)
Positive Investment		0.673***		0.605***
		(0.130)		(0.085)
Constant	1.558***	0.967***	0.984***	0.323***
	(0.087)	(0.172)	(0.070)	(0.084)
Observations	1,181	1,181	1,181	1,181
Adjusted/Pseudo R^2	0.009	0.100	0.005	0.051

Notes: This table presents results of OLS (Panel A) and median regressions (Panel B) that test for differences in participants' WTP for each of the three insurance contracts excluding those observations stating extreme adjusted WTP (adjusted $WTP \geq 10$ are excluded), resulting in 1,181 observations. The dependent variable is the adjusted WTP as a ratio of WTP with a given default risk and the actuarially fair premium for the corresponding contract. "Contract A" and "Contract C" are dummy variables indicating the insurance contract, with "Contract B" (0.1% dp) serving as a reference category; in "Neg. Framing" and "Pos. Framing", contract conditions were displayed negatively or positively, respectively – in the baseline, contract conditions were formulated both positively and negatively; "Age" is the individual's age in years; "GRQ" is a self-reported measure for general riskiness, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "Economic-rel. Major" is a dummy variable indicating a major in economics or related; "CRT" is the score on the 7-item CRT, ranging from 0 to 7; "Overconfidence" is a dummy variable indicating a positive difference between the self-assessed and the actual number of correct answers in the CRT; "Financial Literacy" is the score on the financial literacy test, ranging from 0 to 3; "First Time" is a dummy variable for subjects participating for the first time in a lab experiment; "Wealth" reports subjects' wealth level at the end of this experiment's Stage I; "Female" is a gender dummy variable; and "Positive Investment" is a dummy variable that indicates whether the subject's investment in Stage I was successful. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

TABLE 3.B.5: OLS and median regression of adjusted WTP for probabilistic insurance with insurable risk between 2,000 and 3,500 Taler

	Panel A: OLS regression		Panel B: Median regression	
	(1)	(2)	(3)	(4)
Contract A (0% dp)	0.337*	0.337*	0.147	0.206**
	(0.192)	(0.184)	(0.144)	(0.101)
Contract C (1% dp)	−0.279*	−0.279*	−0.168	−0.160*
	(0.164)	(0.158)	(0.109)	(0.082)
Negative Framing		−0.013		0.208**
		(0.149)		(0.099)
Positive Framing		0.347*		0.036
		(0.194)		(0.099)
Age (standardized)		−0.276***		−0.109***
		(0.048)		(0.023)
GRQ (standardized)		0.012		−0.094**
		(0.097)		(0.042)
Economic-related Major		−0.155		−0.137*
		(0.135)		(0.081)
CRT (standardized)		−0.200*		0.116*
		(0.105)		(0.062)
Overconfidence		0.280		0.260***
		(0.176)		(0.099)
Financial Literacy (standardized)		−0.242**		−0.160**
		(0.096)		(0.076)
First Time		0.216		0.165
		(0.202)		(0.157)
Wealth (standardized)		−0.006		−0.031
		(0.089)		(0.047)
Female		0.086		0.334***
		(0.185)		(0.088)
Positive Investment		0.709***		0.567***
		(0.167)		(0.097)
Constant	1.804***	1.071***	0.996***	0.330***
	(0.123)	(0.273)	(0.084)	(0.115)
Observations	1,101	1,101	1,101	1,101
Adjusted/Pseudo R2	0.009	0.082	0.004	0.047

Notes: This table presents results of OLS (Panel A) and median regressions (Panel B) that test for differences in participants' WTP for each of the three insurance contracts excluding those subjects for whom the insurable risk was below 2,000 Taler, resulting in 1,101 observations from 367 subjects. The dependent variable is the adjusted WTP as a ratio of WTP with a given default risk and the actuarially fair premium for the corresponding contract. "Contract A" and "Contract C" are dummy variables indicating the insurance contract, with "Contract B" (0.1% dp) serving as a reference category; in "Neg. Framing" and "Pos. Framing", contract conditions were displayed negatively or positively, respectively – in the baseline, contract conditions were formulated both positively and negatively; "Age" is the individual's age in years; "GRQ" is a self-reported measure for general riskiness, which ranges from 0 (completely unwilling to take risks) to 10 (completely willing to take risks); "Economic-rel. Major" is a dummy variable indicating a major in economics or related; "CRT" is the score on the 7-item CRT, ranging from 0 to 7; "Overconfidence" is a dummy variable indicating a positive difference between the self-assessed and the actual number of correct answers in the CRT; "Financial Literacy" is the score on the financial literacy test, ranging from 0 to 3; "First Time" is a dummy variable for subjects participating for the first time in a lab experiment; "Wealth" reports subjects' wealth level at the end of this experiment's Stage I; "Female" is a gender dummy variable; and "Positive Investment" is a dummy variable that indicates whether the subject's investment in Stage I was successful. Robust standard errors are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Chapter 4

Impact of Family Events on Smoking Behavior and Body Weight*

Marc-André Hillebrandt

4.1 Introduction

This study examines the effects of family events on smoking behavior and body weight. An important aspect in the evaluation of the effectiveness of public health interventions is whether avoidable mortality can be reduced. Avoidable mortality can be classified either as *treatable* (i. e., they could have been avoided through better healthcare systems) or *preventable* (i. e., they could have been prevented through better public health interventions) (eurostat, 2020). In the EU-27, 645,000 people aged less than 75 years died in 2016 due to preventable deaths (eurostat, 2020). Among these preventable deaths, the two leading causes were ischaemic heart diseases and lung cancer. These preventable deaths, however, can be influenced through one's behavior. Risky health behaviors such as tobacco smoking and excessive body weight, thus, are still a major source of preventable deaths.

Worldwide, tobacco use causes more than seven million deaths per year (World Health Organization, 2017). Obesity and excess body weight are major risk factors for several diseases, including cardiovascular diseases (mainly heart disease and stroke), diabetes, and certain forms of cancer (World Health Organization, 2020). Better understanding the underlying factors influencing individuals' risky health behavior is of great interest to assess the effectiveness of future public health interventions. So far, research has shown that stressful life events, such as unemployment, health shocks, or macroeconomic shocks, impact people's smoking behavior and body weight (e. g., Ruhm, 2000; Falba et al., 2005; Deb et al., 2011; Sundmacher, 2012; Marcus, 2014). The focus of this study

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is to investigate whether and how smoking behavior and body weight are affected by family events.

Specifically, I examine the effects of cohabitation, marriage, separation from a partner, divorce, and the death of a partner or parent on smoking behavior and body weight. Thereby, I distinguish between smoking initiation (or relapse) and smoking cessation. Since treatment and control groups differ with respect to several characteristics, such as age, I apply regression-adjusted matching and control for a wide set of potentially confounding characteristics. To justify the unconfoundedness assumption, I exploit the panel data's time structure and perform entropy balancing as a matching procedure on the full set of covariates *before* the family event actually happened.

The findings emphasize that the formation and dissolution of a household (rather than marriage or divorce) impact smoking behavior and body weight: Individuals gain weight after moving together and lose weight after separating from their partner. Separation from a partner also increases smoking initiation, decreases smoking cessation, and increases smoking intensity. Furthermore, the partner's death is linked to decreased smoking initiation. Moreover, the findings indicate that men are more likely to quit smoking, reduce their smoking intensity, and lose weight after spousal bereavement. While I fail to find any significant effects other than females' decreased smoking cessation after the death of their father, both men and women are less likely to quit smoking after the death of the mother.

The remainder of this study is structured as follows. Section 4.2 reviews the related literature. Section 4.3 describes the data and Section 4.4 discusses the empirical strategy. Section 4.5 presents the results of the effects of family events on smoking behavior and body weight. Section 4.6 concludes.

4.2 Related Literature

In this study, I analyze how family events impact individuals' risky health behavior. More specifically, I consider the effects of cohabitation, marriage, separation from a partner, divorce, and the death of a close family member (spouse, mother, and father) on smoking behavior and body weight. Other (undesirable) life events, such as unemployment, health shocks, or macroeconomic shocks, are not considered.

4.2.1 Family Events and Health

First of all, this study contributes to previous research examining the effects of family events on smoking behavior or body weight. Most closely related to this study is Mata et al. (2018) who investigate how changes in relationship status affect individuals' body weight. Like this study, they rely on the German Socio-Economic Panel. Their findings (based on a multilevel framework) indicate that both marriage and divorce lead to significant weight gain. In line with this present study, they find that cohabitation, however, is a stronger predictor of weight gain than marriage. Yet, a potential caveat

with observational data is that treatment and control group might differ with respect to several characteristics. To address this issue, this study employs regression-adjusted matching and, thus, adds to previous findings analyzing the effects of family events on body weight. Like Mata et al. (2018), I find that moving together with and separating from a partner leads to weight gain and weight loss, respectively. Furthermore, moving together seems to strongly reduce the likelihood of becoming underweight, whereas separations slightly reduce the likelihood of becoming overweight and obese. Unlike Mata et al. (2018), I do not find any weight changes after marriage or divorce, although divorce increases the likelihood of becoming obese.

Using cross-sectional data from nine countries, Mata et al. (2015) report small differences between married and never married respondents, in which married respondents have a higher body mass index (BMI) than their never married counterpart. Averett et al. (2008), Averett et al. (2013), and Meltzer et al. (2013) also observe weight gains after transition to marriage using longitudinal data—consistent with the marriage market hypothesis, which states that those individuals gain weight who are no longer on the marriage market and, thus, no longer concerned with attracting a mating partner (e. g., Averett et al., 2013).[1] With a similar reasoning, individuals strive to lose weight with increasing risk of divorce or after divorce (Lundborg et al., 2007; Averett et al., 2008).[2] Oliveira et al. (2013), however, identify divorced or widowed individuals as having a higher risk of becoming obese than those who remained married, although women have a lower risk of obesity following a change in marital status. Given these contradicting findings, this study aims to add to this literature how changes in marital status affect body weight by employing regression-adjusted matching on a large panel dataset. The results from the present study indicate that changes in body weight are primarily driven by the formation and dissolution of a household—and not by marriage or divorce. Nevertheless, I also find some support that individuals are more likely to becoming obese after divorce, supporting the result of Oliveira et al. (2013).

With regard to smoking, McKee et al. (2003), Nystedt (2006), and Cho et al. (2008) investigate the relation between marital status and smoking behavior. Using Swedish longitudinal data, the findings from Nystedt (2006) suggest that transition to marriage is associated with low smoking risk, whereas marital disruption indicates high smoking risk. In addition, the likelihood to quit smoking seems to be strongly connected to cohabitation for men (Nystedt, 2006). According to Nystedt (2006), losing one's partner, either through divorce or bereavement, increases the probability of smoking initiation, with stronger effects for women. Similarly, Cho et al. (2008) find that married men and women are less likely to smoke than their unmarried counterparts. Relatedly, McKee et al. (2003) analyze the impact of undesirable life events, such as interpersonal loss

[1] Dinour et al. (2012) presents a review examining marital transitions and changes in body weight. Overall, they find transitions to marriage to be associated with weight gain and transitions out of marriage to be associated with weight loss.

[2] In their meta-analysis, Sbarra et al. (2011) find significant increases in mortality risk among separated and divorced compared to their married counterparts.

events like divorce or the death of a relative, on changes in smoking status and find that these interpersonal loss events are associated with continued abstinence by former smokers. In this study, I distinguish between cohabitation and marriage as well as between separation and divorce. The results indicate that personal losses change smoking behavior: while separation from one's partner leads to increased smoking initiation and decreased smoking cessation, the partner's death leads to decreased smoking initiation and the mother's death to decreased smoking cessation.

In recent years, there has also been an increasing amount of literature on the effects of spousal bereavement on health-related outcomes. Wilcox et al. (2003) examine the relation between widowhood and body weight. Their findings indicate that women are more likely to unintentionally lose weight after transition to widowhood. Furthermore, Tseng et al. (2018) estimate the impact of spousal bereavement on hospital inpatient days. Comparing a sample of surviving bereaved with a matched non-bereaved control group, they find that those surviving bereaved are more likely to be admitted and to stay longer in hospital (Tseng et al., 2018). The bereaved also have a higher mortality rate than the comparable non-bereaved cohort (Tseng et al., 2018), which further supports previous findings that spousal bereavement causes increases in mortality (e. g., Espinosa and Evans, 2008; van den Berg et al., 2011). Interestingly, the bereavement effect seems stronger for men than for women (Espinosa and Evans, 2008). Apparently, spousal bereavement can cause stress with negative health-related consequences. Since smoking is considered to relieve stress, it seems likely that spousal bereavement also has an impact on the likelihood of quitting or starting smoking.

This study contributes to previous research on the links between family events and smoking behavior and body weight in several ways: First, this study employs regression-adjusted matching to make treatment and control groups comparable. To lend further support to the unconfoundedness assumption, treatment and control groups are matched based on their characteristics *before* the family event occurred. Second, I also exploit the time structure of the underlying panel data by conditioning on a large set of covariates *before* the family event occurred and use the generated weights to estimate the impact of the family event on smoking behavior and body weight. This estimator is also robust against (time-invariant) selection on unobservables. Third, I show – among others – that smoking behavior and body weight are affected by the formation and dissolution of a household (i. e., moving together with and separating from a partner), rather than by marriage and divorce.

4.2.2 Other Stressful Life Events and Health

This study also relates to previous studies investigating the impact of other stressful life events (e. g., health shocks or job loss) on health-related outcomes in general and risky health behaviors in specific. There exists empirical evidence that health shocks influence the likelihood of smoking cessation (e. g., Sundmacher, 2012; Bünnings, 2017).

For instance, Bünnings (2017) shows that physical health shocks increase the probability to quit smoking, whereas the opposite seems to hold true for mental health shocks.

Apart from studies focusing on family events or health shocks, there are numerous studies examining associations between health and health behaviors and unemployment. Roelfs et al. (2011), Browning and Heinesen (2012), and Cygan-Rehm et al. (2017) identify negative effects of unemployment on mortality, hospitalization, or mental health. Existing research has further shown that unemployment affects individuals' risky health behaviors like smoking or body weight (e. g., Morris et al., 1992; Montgomery et al., 1998; Falba et al., 2005; Deb et al., 2011; Marcus, 2014; Everding and Marcus, 2020). Among these studies, Falba et al. (2005) show that job loss increases the probability of both smoking relapse and smoking intensity among older individuals. Everding and Marcus (2020) find that one spouse's unemployment increases both spouses' smoking probability and intensity, whereby the effects are mainly driven by smoking relapses and decreased smoking cessation. Another specific example is Marcus (2014) who shows that job loss increases the likelihood of non-smokers to start smoking.

Losing one's job is further linked to increases in body weight (e. g., Deb et al., 2011; Marcus, 2014; Monsivais et al., 2015).[3] Taken together, these studies provide evidence that smoking behavior and body weight both vary in response to job loss, a specific type of stressful life event. I contribute to this literature by showing that family events also alter smoking behavior and body weight.

4.2.3 Stressful Life Events and Risk Attitudes

Finally, there is ample evidence that major events in life, such as negative economic shocks (Malmendier and Nagel, 2011; Cohn et al., 2015; Guiso et al., 2018), natural catastrophes (Cameron and Shah, 2015; Hanaoka et al., 2018), violent conflicts (Voors et al., 2012; Callen et al., 2014; Moya, 2018; Brown et al., 2019; Jakiela and Ozier, 2019), unemployment (Hetschko and Preuss, 2020), or (undesirable) health shocks (Decker and Schmitz, 2016; Li et al., 2019), alter individuals' risk preferences. Despite some notable exceptions (e. g., Voors et al., 2012; Hanaoka et al., 2018), the findings suggest an increase in risk aversion after having experienced such undesirable life events. And if risk attitudes respond to major changes in an individual's *wider* environment, it seems plausible that risk attitudes also alter due to major events in an individual's *closer* environment. Indeed, prior literature indicates that some stressful family events – like marriage, childbirth, the separation from the partner, or bereavement of a loved one – lead to changes in risk preferences (e. g., Chaulk et al., 2003; Wang et al., 2009; Kettlewell, 2019; Browne et al., 2020; Görlitz and Tamm, 2020).

Since risk attitudes seem to be positively correlated to risky health behaviors, such as smoking or being overweight (e. g., Barsky et al., 1997; Anderson and Mellor, 2008),

[3] Deb et al. (2011) only find this effect for individuals who already had unhealthy behaviors prior to job loss.

it seems worthwhile to analyze whether and how stressful family events might impact individuals' risky health behaviors.

4.3 Data

The data come from the German Socio-Economic Panel (SOEP, version 35), in which currently more than 30,000 respondents in almost 15,000 households are surveyed every year (Wagner et al., 2007; Goebel et al., 2019). The SOEP covers a broad range of information both at the individual and the household level, including socio-economic and demographic characteristics or details about education, work, and personal attitudes. In even-numbered years from 2002 onwards, the SOEP includes detailed health-related questions, such as the individuals' smoking status or BMI. Since these are our variables of interest, I rely on the even-numbered years from 2002 to 2018.

4.3.1 Outcome Variables

In this study, I analyze two different types of health behavior: smoking and body weight. Specifically, I am interested whether family events lead to changes in these risky health behaviors. Changes in smoking behavior are measured by smoking intensity and changes in smoking status. Smoking intensity is measured by the daily number of cigarettes smoked; a change in smoking status is indicated by a dummy variable. For this change in smoking status, I further distinguish between smoking cessation, i. e., those who previously smoked and then decide to quit smoking, and smoking initiation/relapse, i. e., those who previously did not smoke but then decide to start smoking (again) (like DeCicca et al., 2008). Similar to prior studies (e. g., Marcus, 2014), I exclude individuals who only smoke pipes or cigars.

For the body weight outcome, I use the BMI, which is defined as the individual's body weight (in kg) divided by the individual's height squared (in m^2), measured in kg/m^2. Individuals are further classified either as underweight ($BMI < 18.5$), healthy ($18.5 \leq BMI < 25$), overweight ($BMI \geq 25$), or obese ($BMI \geq 30$). In particular, this study analyzes whether specific family events induce a change in body weight. But since weight gain cannot always considered as unhealthy, I also run an additional analysis in which the dependent variable is being classified as underweight, overweight, or obese (see Table 4.6).

4.3.2 Family Event Variables

In addition to these health-related variables, the SOEP includes information on past family events. In particular, I analyze the effects of cohabitation, marriage, separation from one's partner, divorce, and the death of a close family member (partner, mother, and father) on individuals' risky health behaviors. For all these family events, the respondents are asked whether they occurred during the last calendar year, which is then captured by a dummy variable. Since this study examines the impact of these

family events on individuals' risky health behavior, I use the dummy variable indicating a specific family event, such as marriage, as an independent variable in the analyses.

Table 4.1 provides information on frequencies for these events during our sampled period. The frequencies for the family events range from 176 person-year observations for "Death of partner" to 1,808 person-year observations for "Separation from a partner", which is equivalent to 0.19% and 1.92% of the total sample size.

Table 4.1: Frequencies of family events

Life event	**Year**								
	2004 ($n = 14{,}122$)	**2006** ($n = 12{,}491$)	**2008** ($n = 12{,}098$)	**2010** ($n = 10{,}378$)	**2012** ($n = 8{,}439$)	**2014** ($n = 10{,}075$)	**2016** ($n = 14{,}153$)	**2018** ($n = 12{,}540$)	**Total** ($n = 94{,}296$)
Cohabitation	291	215	191	195	140	175	210	198	1,615
	(2.06%)	(1.72%)	(1.58%)	(1.88%)	(1.66%)	(1.74%)	(1.48%)	(1.58%)	(1.71%)
Marriage	187	197	210	178	143	157	211	200	1,483
	(1.32%)	(1.58%)	(1.74%)	(1.72%)	(1.69%)	(1.56%)	(1.49%)	(1.59%)	(1.57%)
Separation	254	273	223	212	167	164	279	236	1,808
	(1.80%)	(2.19%)	(1.84%)	(2.04%)	(1.98%)	(1.63%)	(1.97%)	(1.88%)	(1.92%)
Divorce	84	91	71	73	45	56	71	60	551
	(0.59%)	(0.73%)	(0.59%)	(0.70%)	(0.53%)	(0.56%)	(0.50%)	(0.48%)	(0.58%)
Death of partner	27	22	22	21	23	19	15	27	176
	(0.19%)	(0.18%)	(0.18%)	(0.20%)	(0.27%)	(0.19%)	(0.11%)	(0.22%)	(0.19%)
Death of mother	139	166	138	128	103	136	188	196	1,194
	(0.98%)	(1.33%)	(1.14%)	(1.23%)	(1.22%)	(1.35%)	(1.33%)	(1.56%)	(1.27%)
Death of father	160	189	148	134	122	164	235	193	1,345
	(1.13%)	(1.51%)	(1.22%)	(1.29%)	(1.45%)	(1.63%)	(1.66%)	(1.54%)	(1.43%)

Notes: Pooled sample size is 94,296 person-year observations from 30,345 individuals. Data are from the even-numbered years from 2002 to 2018 of the SOEP. The questions on family events are part of the annual questionnaire of the SOEP. For all of these family events, the respondents are asked whether they occurred during the last calendar year. Since this study requires pre- and post-treatment observations, this table presents the occurrences for the life events for the even-numbered years from 2004 onwards.

4.3.3 Sample Selection

Table 4.2 describes the sample selection and data cleaning procedure. Initially, the SOEP contains 76,725 individuals with 433,634 person-year observations in the years from 2002 to 2018. Since health-related questions are only included in even-numbered years from 2002 onwards, I drop observations in the odd-numbered years from 2003 to 2017. I also drop observations with missing smoking status, number of cigarettes smoked per day, BMI, or family status. Moreover, I also drop observations with missing smoking status, smoking intensity, and BMI in the *penultimate wave* to ensure matching based on the pre-treatment conditions. I only consider individuals aged between 18 and 62 in the *penultimate wave* and drop those with missing family status in that wave. Finally, observations with missing data in our set of control variables (in the current wave) as well as in our set of matching variables (in the penultimate wave) are dropped. Beyond that, no further restrictions are imposed on the sample. This results in an unbalanced panel dataset comprising 94,296 person-year observations from 30,345 individuals, of whom 14,186 are males (46.75%) and 16,159 are females (53.25%).

Table 4.2: Sample selection and data cleaning

All person-year observations in the years from 2002 to 2018	**433,634**
Reason for dropping	*Number of person-year observations dropped*
observations in the odd-numbered years from 2003 to 2017	204,664
missing outcome variable	30,115
missing family status	799
missing outcome variable in penultimate wave	61,213
missing family status in penultimate wave	179
not aged between 18 and 62 in penultimate wave	34,318
missing control variable	5,595
missing matching variable in penultimate wave	2,455
Final sample	**94,296**

Notes: This table presents the sample selection procedure. The final sample consists of 94,296 person-year observations of 30,345 individuals.

4.3.4 Control Variables Selection

A major strength of the SOEP is the rich set of available information. Therefore, this study exploits a broad set of covariates that might impact health-related outcomes, such as risky health behaviors, or risk attitudes (and, thus, eventually risky health behaviors) (e. g., Barsky et al., 1997; Donkers et al., 2001; Halek and Eisenhauer, 2001; Dohmen and Falk, 2010; Dohmen and Falk, 2011; Dohmen et al., 2017; Ayaita and Stürmer, 2020) as well as those used in similar studies (e. g., Falba et al., 2005; Marcus, 2014).

The covariates used in this study are drawn from a number of domains and can be assigned to the following domains: demographics, work-related covariates, educational attainment, and health. Table 4.3 reports summary statistics for all control variables (but federal states) used in our analyses. Demographic control variables include age, gender, migration status, home ownership, marital status, family structure (i. e., whether children live in same household), and self-assessed risk attitude. In this study, marital status is quite important for two reasons: first, the analyzed family events are often accompanied by a change in marital status; and second, marital status may account for (potential) peer pressure with regards to risky health behaviors. To account for regional differences, I also include federal state dummys in the analyses, which are not presented in Table 4.3 due to space limitations.

Regarding work-related variables, I control for tenure, annual log labor earnings, unemployment history, perceived job security, full-time work experience, and company size. Since wealth and income may be important determinants with respect to smoking behavior and diet, labor earnings – together with a dummy for homeownership – are used to approximate income and wealth. To account for habits at work, peer behavior, and company regulations, I control for labor force participation. Further, I explicitly distinguish the occupational position between unemployed, blue-collar employees, civil servants, and self-employed individuals as research has shown that they differ in terms of risk attitude (e. g., Dohmen and Falk, 2010; Falk et al., 2018; Ayaita and Stürmer, 2020).

Educational attainment is generally correlated with healthier behaviors, especially with regards to smoking, diet, and obesity (e. g., Cutler and Lleras-Muney, 2010). This study, thus, controls for educational covariates comprising secondary schooling, vocational training, and having received a university degree.

Moreover, I control for health-related variables, such as mental and physical health, self-rated health, height, BMI, and smoking behavior and intensity. Smoking-related variables are only included if the outcome variable of interest is related to body weight; weight-related variables are only included if the outcome variable of interest is individuals' smoking behavior.

Table 4.3: Summary statistics and definition of conditioning variables

Variable	Definition	Mean	SD	Min	Max
Demographics					
Age	in years (third-order polynomial in analyses)	42.37	11.84	18.00	62.00
Female$^+$	1=female, 0=male	53.63	49.87	0.00	100.00
Non-German$^+$	1=foreign citizenship, 0=German	13.53	34.21	0.00	100.00
Migrant$^+$	1=individual or parents moved to Germany, 0=else	18.73	39.01	0.00	100.00
Home owner$^+$	1=home owner, 0=tenant	51.91	49.96	0.00	100.00
Married$^+$	1=married, 0=else	60.94	48.79	0.00	100.00
Single$^+$	1=single, 0=else	26.09	43.92	0.00	100.00
Separated$^+$	1=separated, 0=else	2.50	15.61	0.00	100.00
Divorced$^+$	1=divorced, 0=else	8.86	28.42	0.00	100.00
Widowed$^+$	1=widowed, 0=else	1.60	12.55	0.00	100.00
Children$^+$	1=children under 18 in household, 0=else	43.52	49.58	0.00	100.00
Risk attitude	self-assessed risk attitude, ranging from 0 (completely unwilling to take risks) to 10 (completely willing to take risks)	4.80	2.28	0.00	10.00
Labor market					
Tenure	in years	10.70	9.91	0.00	47.90
Log labor earnings	logarithm of annual earnings (in EUR)	8.18	3.86	0.00	13.77
Never unemployed$^+$	1=never unemployed, 0=ever unemployed	61.27	48.71	0.00	100.00
Unemployed$^+$	1=unemployed, 0=working	23.99	42.70	0.00	100.00
Blue-collar worker$^+$	1=blue-collar worker, 0=else	19.12	39.32	0.00	100.00
Self-employed$^+$	1=self-employed, 0=else	7.09	25.66	0.00	100.00
Civil servant$^+$	1=civil servant, 0=else	5.67	23.13	0.00	100.00
Small company$^+$	1 if company size: employees $<$ 20, 0=else	19.42	39.56	0.00	100.00
Small to medium company$^+$	1 if company size: 20 $\leq$ employees $<$ 200, 0=else	19.81	39.86	0.00	100.00
Medium company$^+$	1 if company size: 200 $\leq$ employees $<$ 2,000, 0=else	14.92	35.63	0.00	100.00
Large company$^+$	1 if company size: 2,000 $\leq$ employees, 0=else	17.15	37.70	0.00	100.00
No company info$^+$	1=no company info; 0=else	28.70	45.23	0.00	100.00
Major job worries$^+$	1=major job worries, 0=else	10.08	30.10	0.00	100.00
Some job worries$^+$	1=some job worries, 0=else	27.79	44.80	0.00	100.00
No job worries$^+$	1=no job worries, 0=else	38.07	48.56	0.00	100.00
No job worries info$^+$	1=no job worries info, 0=else	24.07	42.75	0.00	100.00

continued

Table 4.3 – continued from previous page

Variable	Definition	Mean	SD	Min	Max
Years full-time	full-time work experience	14.32	11.69	0.00	47.60
Education					
Basic schooling^{+}	1=no degree/basic school, 0=else	25.23	43.43	0.00	100.00
Intermediate schooling^{+}	1=intermediate/other school, 0=else	41.99	49.36	0.00	100.00
Technical college^{+}	1=technical school, 0=else	6.25	24.21	0.00	100.00
Highest secondary^{+}	1=academic school track (Abitur), 0=else	25.11	43.36	0.00	100.00
No school degree yet^{+}	1=no school degree yet, 0=else	1.42	11.82	0.00	100.00
Vocational training^{+}	1=vocational training, 0=no vocational training	68.87	46.30	0.00	100.00
University^{+}	1=university degree, 0=no university degree	23.88	42.64	0.00	100.00
Health					
Mental health	based on SF12 questionnaire	49.96	9.72	0.56	79.43
Physical health	based on SF12 questionnaire	51.61	8.93	10.11	78.11
Good health^{+}	self-rated health: very good/good	56.66	49.56	0.00	100.00
Medium health^{+}	self-rated health: satisfactory	30.11	45.88	0.00	100.00
Poor health^{+}	self-rated health: poor/bad	13.23	33.88	0.00	100.00
Height in centimeters	height (in centimeters)	172.26	9.37	107.00	220.00
Body mass index	body mass index, in kg/m^2	25.76	4.82	11.63	68.73
Underweight^{+}	1 if BMI < 18.5, 0=else	2.10	14.32	0.00	100.00
Overweight or obese^{+}	1 if BMI ≥ 25, 0=else	50.12	50.00	0.00	100.00
Obese^{+}	1 if BMI ≥ 30, 0=else	16.37	37.00	0.00	100.00
Heavy smoker^{+}	1 if number of cigarettes/day ≥ 20, 0=else	11.96	32.45	0.00	100.00
Log no. of cigarettes/day^{a}	log(daily number of cigarettes + 1)	0.82	1.27	0.00	5.30
Baseline smoker^{+}	1=smoker, 0=else	31.30	46.37	0.00	100.00

Notes: Descriptive statistics. $^{+}$ Mean represents a percentage share. ^{a} Includes non-smokers.

4.4 Empirical Strategy

This study aims to estimate the average treatment effect on the treated (ATT) of family events on individuals' smoking behavior and body weight. Following the counterfactual framework of Rubin (1974), I aim at estimating the effect of a treatment D (a family event) on an observed outcome Y (risky health behavior). Let Y_1 and Y_0 denote the outcome with and without treatment. Since we cannot observe the counterfactual outcome, the observed outcome is given by $Y = D \cdot Y_1 + (1 - D) \cdot Y_0$. A difficulty in estimating causal effects in observational studies is that treatment may not be random if randomization is not possible. For this reason, treatment groups (defined by the occurrence of the specific family events) might differ with respect to several other characteristics than the mere treatment compared to the control group. In this study, for instance, treated and control groups – as well as the treated groups for each family event – significantly differ with respect to age (see balancing tables in Appendix 4.A). To estimate the ATT in non-randomized observational studies, regression-adjusted matching can be applied (Rubin, 1979).

A crucial condition to provide consistent estimates is that the unconfoundedness assumption holds, i. e., Y_1,$Y_0 \perp\!\!\!\perp D|\mathbf{X}$, that is, assignment to treatment is random conditional on controls. Under this identifying assumption for the ATT, there exist no unobserved variables that simultaneously influence the family event and a change in risky health behavior. Therefore, it is important to control for all potentially confounding covariates (such as age). Afterwards, the average outcome Y between the treatment and the control group can be compared.

This study uses panel data from the German Socio-Economic Panel, in which respondents are asked annually whether specific family events occurred during the last calender year and in which health-related questions are only included in even-numbered years from 2002 onwards. To support the unconfoundedness assumption, I control for a wide range of potentially confounding variables (see Table 4.3) and I also exploit the panel data's time structure as presented in Figure 4.1: since outcomes are measured at $t = -2$ and $t = 0$ but a change in treatment status only occurs between periods $t = -2$ and $t = 0$ (see Subsection 4.3.2), I condition on a large set of covariates in $t = -2$. As such, the estimator is also robust against time-invariant effects of unobservables.

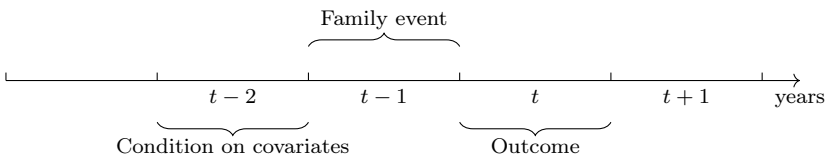

FIGURE 4.1: Time structure

Assuming that the unconfoundedness assumption holds, I apply regression-adjusted matching (Rubin, 1979). First, I perform entropy balancing (Hainmueller, 2012) on the full set of covariates to make treatment and control groups comparable. Then,

these estimated weights are used to run weighted probit and ordinary least squares (OLS) regressions.[4] The applied regression-adjusted matching estimator benefits from the double robustness property (Bang and Robins, 2005): the estimates from regression-adjusted matching remain consistent and unbiased if either the set of variables predicting treatment (the matching function) or the set of variables predicting changes in the outcome (the regression function) is correctly specified.

To account for differences between treatment and control groups across the different family events, matching is performed for each family event separately. This ensures that treatment and control groups are indeed similar in observable characteristics. The tables in Appendix 4.A present the balancing tables for all family events. The matching quality can be assessed through the standardized bias, which Rosenbaum and Rubin (1985) define for each control variable C as

$$SB_C = 100 \cdot \frac{\bar{x}_1 - \bar{x}_0}{\sqrt{0.5 \cdot \left(\sigma_{x1}^2 - \sigma_{x0}^2\right)}},$$

where $\bar{x}_1$ and $\bar{x}_0$ are the means of treated ($\bar{x}_1$) and controls ($\bar{x}_0$), respectively, and σ_{x1}^2 and σ_{x0}^2 denote the corresponding variances.

After the matching procedure, the standardized bias for all covariates is significantly reduced, as can be seen from the tables in Appendix 4.A, resulting in balanced treatment and control groups on these covariates. In all but two specifications (*divorce* and *death of one's spouse*), the standardized bias does not exceed 5% for all covariates, which is considered a critical value for good balancing (Caliendo and Kopeinig, 2008). With regard to divorce, the covariate "No school degree yet" has a standardized bias of -5.34%. With regard to losing one's partner, there remain differences in the covariates "Risk attitude" (-5.98%) and "Height" (6.58%). I attribute this to the low number of occurrences for these two family events (see also Table 4.1).

4.5 Results

This study investigates how family events influence individuals' smoking status, smoking intensity (if they are baseline smokers), and body weight. To assess the impact of family events on smoking behavior and body weight and to compare treatment and control groups with similar characteristics, this study employs regression-adjusted matching. Before addressing the statistical analyses, Figure 4.2 and Figure 4.3 show how average smoking participation and average BMI change over time relative to the specific family events. Figure 4.2 and Figure 4.3 highlight possible changes in risky health behaviors between time $t = -5$ and $t = 5$, in which the family event occurs at time $t = 0$.

As can be seen from Figure 4.2, separation from one's partner seems to increase smoking participation (Panel C). In fact, mean smoking participation increases from 37.74%

[4] The Stata ado-file `ebalance` is used to compute the matching weights (Hainmueller and Xu, 2013).

before to 43.31% after separation. For the remaining family events, we cannot observe a clear trend after experiencing the family event. To provide more accurate predictions, we, thus, distinguish in the following between smoking cessation and smoking initiation/relapse as these family events may trigger smoking participation differently.

With regard to body weight, Figure 4.3 presents an increasing trend for nearly all specifications. Thus, age matters, which strengthens the argument to use regression-adjusted matching in the main analysis in Subsection 4.5.1. In fact, it seems like cohabitation (Panel A), marriage (Panel B), and divorce (Panel D) all lead to significant increases in body weight. On average, moving together increases the BMI from 24.07 kg/m^2 to 24.57 kg/m^2. This difference in BMI of 0.5 kg/m^2 amounts to an average increase in body weight of about 1.5 kg for an average-sized person (1.72 m in this sample). This increasing trend also continues before (BMI of 24.97 kg/m^2) and after (BMI of 25.63 kg/m^2) marriage. Interestingly, separation from one's partner leads to a short-term reduction of body weight with a mean BMI of 25.11 kg/m^2 and 24.67 kg/m^2, whereas divorce leads to a weight gain from 25.16 kg/m^2 to 25.64 kg/m^2. For the remaining family events, there is no clear trend to be discerned.

Table 4.4 presents the results of probit regressions on individuals' decision to begin or quit smoking (columns (1) and (2)), OLS and fixed-effects regressions on smoking intensity (columns (3) and (4)), as well as OLS and fixed-effects regressions on changes in body weight (columns (5) and (6)).[5] Note that the fixed-effects regressions take advantage of the dataset's panel structure and address potential unobserved heterogeneity. Overall, these results without matching on pre-treatment covariates support the graphical results found in Figures 4.2 and 4.3.

Panel A of Table 4.4 shows that moving together changes both smoking behavior and body weight: individuals are more likely to quit smoking (0.108, $p < 0.10$) and reduce their cigarettes smoked per day (-0.097, $p < 0.05$), but they also gain weight. This effect of weight gain amounts to a change in BMI of 0.248 kg/m^2 and is significant at the 1 percent level. I also find a positive and significant weight gain after marriage (Panel B of Table 4.4). This change in BMI of 0.260 kg/m^2 is again significant at the 1 percent level.

In contrast, separation from one's partner has quite opposite effects (Panel C of Table 4.4): separated individuals are more likely to start smoking (0.325, $p < 0.01$) and slightly increase smoking intensity, but also lose weight. The coefficient estimates for a change in BMI are -0.397 kg/m^2 and -0.465 kg/m^2 for the OLS and fixed-effects regression, respectively. And while individuals change their behavior after separation, I do not find any significant changes in smoking behavior and body weight after divorce (Panel D of Table 4.4). This supports the idea that the formation or dissolution of a household are the driving forces.

[5]The Hausman test supports the fixed-effects model over the random-effects model in all specifications.

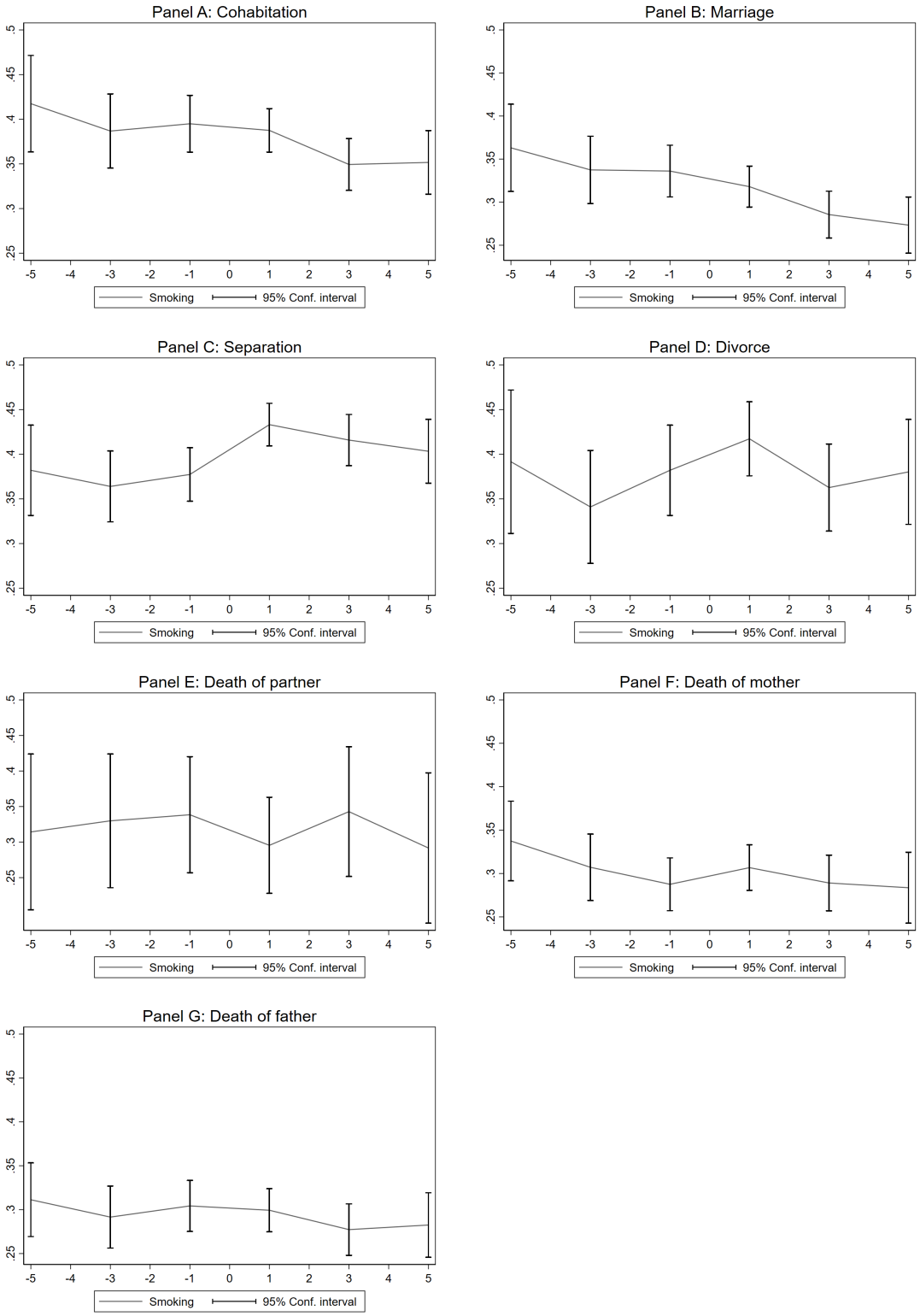

FIGURE 4.2: Average smoking participation over time (in years relative to family event)

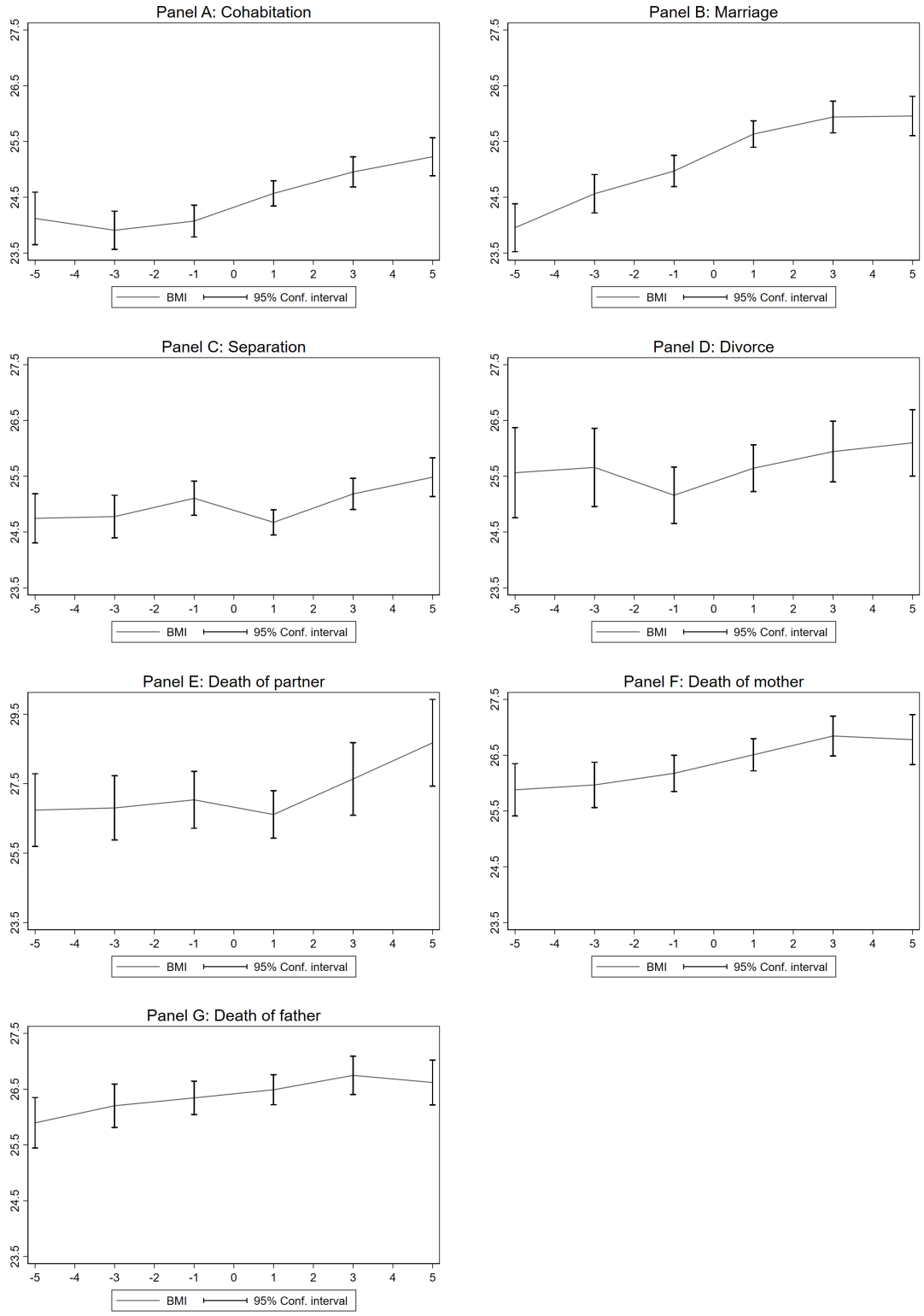

FIGURE 4.3: Average BMI over time (in years relative to family event)

With regards to the death of a close family member, we can observe a weight loss after the death of one's partner (Panel E of Table 4.4). There are no changes observable after the death of the father (Panel G), whereas the death of the mother slightly reduces the likelihood to quit smoking and, at the same time, increases smoking intensity (Panel F).

Table 4.4: Effects of family events on smoking behavior and body weight without matching

	Begin smoking	Quit smoking	Δ Log(cigarettes)		Δ BMI	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Cohabitation						
Cohabitation	0.012	0.108*	−0.059	−0.097**	0.247***	0.248***
	(0.063)	(0.060)	(0.043)	(0.045)	(0.052)	(0.064)
Pseudo/Adjusted R^2	0.061	0.029	0.059	0.054	0.009	0.009
Panel B: Marriage						
Marriage	−0.043	0.056	−0.024	0.053	0.310***	0.260***
	(0.074)	(0.066)	(0.050)	(0.049)	(0.051)	(0.064)
Pseudo/Adjusted R^2	0.061	0.029	0.059	0.054	0.009	0.009
Panel C: Separation						
Separation	0.325***	−0.080	0.073*	0.061	−0.397***	−0.465***
	(0.056)	(0.067)	(0.040)	(0.038)	(0.060)	(0.077)
Pseudo/Adjusted R^2	0.062	0.029	0.059	0.054	0.009	0.010
Panel D: Divorce						
Divorce	0.093	0.123	−0.036	−0.005	0.097	0.029
	(0.106)	(0.107)	(0.073)	(0.079)	(0.090)	(0.119)
Pseudo/Adjusted R^2	0.061	0.029	0.059	0.054	0.009	0.009
Panel E: Death of partner						
Death of partner	0.162	0.191	0.010	−0.223	−0.562***	−0.606***
	(0.199)	(0.227)	(0.168)	(0.153)	(0.171)	(0.212)
Pseudo/Adjusted R^2	0.061	0.029	0.059	0.054	0.009	0.009

continued

Table 4.4 – continued from previous page

	Begin smoking	Quit smoking	Δ Log(cigarettes)		Δ BMI	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel F: Death of mother						
Death of mother	0.098	−0.181*	0.091*	0.093**	0.049	0.051
	(0.081)	(0.093)	(0.050)	(0.043)	(0.055)	(0.069)
Pseudo/Adjusted R^2	0.061	0.029	0.059	0.054	0.009	0.009
Panel G: Death of father						
Death of father	0.024	−0.020	0.021	0.052	0.012	−0.026
	(0.077)	(0.078)	(0.051)	(0.045)	(0.054)	(0.068)
Pseudo/Adjusted R^2	0.061	0.029	0.059	0.054	0.009	0.009
Observations	64.781	29.515	29.515	29.515	94.296	94.296

Notes: This table shows the results of probit (columns (1) and (2)), OLS (column (3) and (5)), and fixed-effects (FE) regressions (columns (4) and (6)) of family events on individuals' risky health behaviors. Robust standard errors are presented in parentheses. Row names indicate the family event. In columns (1) and (2), I run a probit regression and regress the indicator that a family event occurred in the past calender year on a dummy variable indicating the decision to begin (column (1)) or quit smoking (column (2)). In columns (3) and (4), I regress the family events on the difference in smoking intensity using OLS (column (3)) and FE regression (column (4)), measured by log(number of cigarettes). In columns (5) and (6), I regress the family events on the difference in body weight using OLS (column (5)) and FE regression (column (6)). *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

4.5.1 Effects of Family Events on Smoking Behavior and Body Weight

So far, the analyses have not taken into account differences between treatment and control groups. As can be seen from the tables in Appendix 4.A, unmatched treatment and control groups differ with respect to several characteristics (like age). To estimate the ATT of family events on smoking behavior and body weight, I employ regression-adjusted matching. Hereby, I exploit the panel data's time structure and condition on a large set of covariates before treatment to ensure that the unconfoundedness assumption holds. Since treatment and control groups vary strongly between the treatment variables (i. e., the indicators for the family events), entropy balancing is used for each treatment separately to generate balanced treatment and control groups.[6] These generated weights are then used to estimate the effects of the family events on smoking behavior and body weight. Before I discuss the results in more detail, I would like to emphasize that the pseudo and adjusted R-squared are substantially higher in all estimations (within the same models) when performing regression-adjusted matching (see Table 4.5).

The results from Table 4.5 suggest that only some family events induce a change in smoking behavior or body weight. First, I find strong and significant effects that smoking behavior and body weight are affected by the formation (Panel A) and dissolution (Panel C) of a household; I do not find any significant changes for the delayed effects of marriage (Panel B) or divorce (Panel D). This is in line with Musick and Bumpass (2012) and Kohn and Averett (2014) who find a positive health effect of cohabitation relative to marriage. Those who formed a new household in the previous calender year (Panel A), on the other hand, experience an increase in BMI of about 0.166 kg/m^2, which is equivalent to an increase of about 0.5 kg and significant at the 1 percent level. Moreover, separating from one's partner changes smoking behavior and body weight in multiple dimensions (Panel C): individuals are more likely to begin smoking (by about 38.6 percent, $p < 0.01$), less likely to quit smoking (by about 18.8 percent, $p < 0.01$), intensify smoking if they are smokers ($p < 0.05$), and reduce weight by about 1 kg for the average-sized person ($p < 0.01$). Nonetheless, one has to keep in mind that weight loss might also be a consequence of reduced smoking cessation as smoking cessation increases the chances of weight gain (Aubin et al., 2012).[7]

Regarding the death of one's partner (Panel E), individuals are 40.2 percent less likely to begin smoking ($p < 0.05$). Again, I do not find any effects after the death of one's father (Panel G). After the death of the mother (Panel F), however, individuals are 25.8 percent less likely to quit smoking ($p < 0.01$), resulting in slightly increased smoking intensity among smokers ($p < 0.10$). This effect of increased smoking intensity is mainly driven by male individuals, which I discuss in more detail in the following section in Table 4.7.

[6] Entropy balancing resulted in well balanced treatment and control groups, as can be seen from the matching quality tables in Appendix 4.A.

[7] Cawley et al. (2004) also show that the desire to lose weight increases smoking initiation among females.

TABLE 4.5: Effects of family events on smoking behavior and body weight (based on regression-adjusted matching with entropy balancing)

	Begin smoking	Quit smoking	Δ Log(cigarettes)	Δ BMI
	(1)	(2)	(3)	(4)
Panel A: Cohabitation				
Cohabitation	−0.012	0.052	−0.051	0.166***
	(0.063)	(0.062)	(0.042)	(0.052)
Pseudo/Adjusted R^2	0.112	0.076	0.133	0.035
Panel B: Marriage				
Marriage	−0.149	−0.049	−0.019	0.036
	(0.102)	(0.098)	(0.068)	(0.078)
Pseudo/Adjusted R^2	0.107	0.107	0.160	0.043
Panel C: Separation				
Separation	0.386***	−0.188***	0.103**	−0.330***
	(0.069)	(0.071)	(0.042)	(0.069)
Pseudo/Adjusted R^2	0.096	0.063	0.095	0.032
Panel D: Divorce				
Divorce	0.198	0.006	0.037	−0.117
	(0.155)	(0.137)	(0.086)	(0.121)
Pseudo/Adjusted R^2	0.143	0.160	0.146	0.037
Panel E: Death of partner				
Death of partner	−0.402**	0.275	−0.074	−0.460
	(0.157)	(0.244)	(0.190)	(0.295)
Pseudo/Adjusted R^2	0.379	0.267	0.269	0.103
Panel F: Death of mother				
Death of mother	0.031	−0.258***	0.079*	0.060
	(0.076)	(0.084)	(0.046)	(0.055)
Pseudo/Adjusted R^2	0.118	0.073	0.086	0.019
Panel G: Death of father				
Death of father	−0.040	−0.071	0.024	0.016
	(0.073)	(0.076)	(0.049)	(0.053)
Pseudo/Adjusted R^2	0.094	0.091	0.083	0.020
Observations	64.781	29.515	29.515	94.296

Notes: This table shows the effect of family events on individuals' risky health behaviors. Each cell presents the ATT from separate estimations and its robust standard errors in parentheses. Row names indicate the family event. In all estimations, I perform entropy balancing with regression adjustment. In columns (1) and (2), I run a probit regression and regress the indicator that a family event occurred in the past calender year on a dummy variable indicating the decision to begin (column (1)) or quit smoking (column (2)). In column (3), I regress the family events on the difference in smoking intensity, measured by log(number of cigarrettes +1). In column (4), I regress the family events on the difference in body weight. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

4.5.2 Effects of Family Events on Body Weight Types

A gain in body weight, however, is not necessarily bad. To provide more details whether family events adversely affect changes in body weight, I estimate the effects of family events on dummy variables indicating being underweight, overweight, or obese (Table 4.6).[8] Again, I perform regression-adjusted matching with the weights being generated by entropy balancing. The weight gain associated with cohabitation (see again column (4) of Panel A in Table 4.5), however, does not seem to be unhealthy: while individuals moving together with a partner are 22.8 percent less likely of becoming underweight (Panel A; $p < 0.01$), I do not detect such effects with regard to becoming overweight or obese. Separation from a partner (Panel C), on the other hand, slightly reduces the probability of becoming overweight (-6.9 percent, $p < 0.10$) or obese (-9.8 percent, $p < 0.10$). Like Oliveira et al. (2013), I also find that individuals are more likely to becoming obese after divorce (Panel D; 16.9 percent, $p < 0.10$). Moreover, the probability of becoming obese after the partner's death is strongly reduced (Panel E; -41.9 percent, $p < 0.01$). The remaining coefficient estimates are mostly close to zero and insignificant.

4.5.3 Gender Differences in Smoking Behavior and Body Weight

To further address potential group heterogeneity, I also run the models with subsamples stratified by gender (Table 4.7).[9] When moving together with a partner, both men and women show an increase in body weight, but this effect is only significant for women (Panel A). Men, however, seem to be less willing to change their smoking behavior after marriage as they are both less likely to begin and less likely to quit smoking (Panel B). In contrast, separation from a partner changes behavior for both sexes quite similarly (Panel C) and the effects after divorce remain insignificant and close to zero (Panel D).

Interestingly, men and women change their smoking behavior differently after spousal bereavement (Panel E): women are less likely to start smoking (and seem to be less likely to quit smoking as well), men are more likely to quit, reduce their daily number of cigarettes smoked, and decrease their body weight substantially. After the death of the mother (Panel F), men and women are less likely to quit smoking, but only men increase their smoking intensity. Women, however, are also less likely to quit smoking after their father has passed away (Panel G).

[8] Note that the estimation in column (1) of Panel E could not be conducted due to too few observations.

[9] Due to too few observations, the estimation in column (2) of Panel E was not possible.

TABLE 4.6: Effects of family events on body weight types (based on regression-adjusted matching with entropy balancing)

	Underweight	Overweight	Obese
	(1)	(2)	(3)
Panel A: Cohabitation			
Cohabitation	−0.228***	0.040	−0.020
	(0.067)	(0.034)	(0.046)
Pseudo R^2	0.158	0.101	0.118
Panel B: Marriage			
Marriage	−0.002	−0.072	0.031
	(0.161)	(0.052)	(0.066)
Pseudo R^2	0.152	0.094	0.107
Panel C: Separation			
Separation	−0.004	−0.069*	−0.098*
	(0.065)	(0.039)	(0.052)
Pseudo R^2	0.139	0.093	0.091
Panel D: Divorce			
Divorce	−0.147	0.094	0.169*
	(0.136)	(0.081)	(0.098)
Pseudo R^2	0.259	0.116	0.142
Panel E: Death of partner			
Death of partner		−0.189	−0.419***
		(0.181)	(0.158)
Pseudo R^2		0.157	0.154
Panel F: Death of mother			
Death of mother	−0.031	0.025	0.016
	(0.087)	(0.038)	(0.043)
Pseudo R^2	0.212	0.110	0.092
Panel G: Death of father			
Death of father	−0.067	−0.002	0.006
	(0.093)	(0.035)	(0.040)
Pseudo R^2	0.198	0.091	0.086
Observations	94.296	94.296	94.296

Notes: This table shows the effect of family events on individuals' risky health behaviors regarding body weight. Each cell presents the ATT from separate estimations and its robust standard errors in parentheses. Row names indicate the family event. In all estimations, I perform entropy balancing with regression adjustment and run a probit regression in which I regress the indicator that a family event occurred in the past calender year on a dummy variable indicating being underweight (column (1)), overweight (column (2)), or obese (column (3)). *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

TABLE 4.7: Gender-specific effects of family events on smoking behavior and body weight (based on regression-adjusted matching with entropy balancing)

	Begin smoking		Quit smoking		Δ Log(cigarettes)		Δ BMI	
	(1) Female	(2) Male	(3) Female	(4) Male	(5) Female	(6) Male	(7) Female	(8) Male
Panel A: Cohabitation								
Cohabitation	−0.059	−0.032	0.112	−0.091	−0.082	0.008	0.212***	0.124
	(0.085)	(0.089)	(0.085)	(0.088)	(0.057)	(0.060)	(0.069)	(0.076)
Pseudo/Adjusted R^2	0.120	0.175	0.119	0.079	0.164	0.116	0.051	0.036
Panel B: Marriage								
Marriage	−0.067	−0.382***	0.051	−0.233*	−0.124	0.107	−0.018	0.082
	(0.143)	(0.125)	(0.133)	(0.139)	(0.094)	(0.089)	(0.115)	(0.096)
Pseudo/Adjusted R^2	0.124	0.163	0.156	0.116	0.187	0.148	0.069	0.037
Panel C: Separation								
Separation	0.385***	0.348***	−0.172*	−0.276**	0.070	0.132**	−0.370***	−0.263**
	(0.084)	(0.112)	(0.090)	(0.113)	(0.053)	(0.064)	(0.086)	(0.114)
Pseudo/Adjusted R^2	0.113	0.161	0.090	0.097	0.106	0.111	0.034	0.053
Panel D: Divorce								
Divorce	0.237	0.157	0.066	−0.217	0.007	0.087	−0.222	−0.000
	(0.202)	(0.203)	(0.175)	(0.194)	(0.106)	(0.123)	(0.157)	(0.168)
Pseudo/Adjusted R^2	0.243	0.337	0.270	0.237	0.213	0.200	0.049	0.073
Panel E: Death of partner								
Death of partner	−0.273*		−0.253	0.728**	0.160	−0.529***	−0.203	−1.647***
	(0.160)		(0.213)	(0.303)	(0.127)	(0.159)	(0.289)	(0.466)
Pseudo/Adjusted R^2	0.452		0.307	0.455	0.319	0.491	0.128	0.279

continued

Table 4.7 – continued from previous page

	Begin smoking		Quit smoking		Δ Log(cigarettes)		Δ BMI	
	(1) Female	(2) Male	(3) Female	(4) Male	(5) Female	(6) Male	(7) Female	(8) Male
Panel F: Death of mother								
Death of mother	0.049	−0.049	−0.226**	−0.418***	0.001	0.148**	0.061	0.089
	(0.097)	(0.113)	(0.102)	(0.120)	(0.062)	(0.062)	(0.082)	(0.072)
Pseudo/Adjusted R^2	0.149	0.173	0.145	0.098	0.122	0.099	0.030	0.033
Panel G: Death of father								
Death of father	−0.141	−0.018	−0.402***	0.127	0.088	−0.050	−0.013	0.057
	(0.095)	(0.106)	(0.101)	(0.103)	(0.058)	(0.074)	(0.077)	(0.068)
Pseudo/Adjusted R^2	0.135	0.135	0.152	0.108	0.119	0.112	0.025	0.037
Observations	36.232	28.549	14.340	15.175	14.340	15.175	50.572	43.724

Notes: This table shows the effect of family events on individuals' risky health behaviors, stratified by gender. Each cell presents the ATT from separate estimations and its robust standard errors in parentheses. Row names indicate the family event. In all estimations, I perform entropy balancing with regression adjustment. In columns (1) to (4), I run a probit regression and regress the indicator that a family event occurred in the past calender year on a dummy variable indicating the decision to begin (columns (1) and (2)) or quit smoking (columns (3) and (4)). In columns (5) and (6), I regress the family events on the difference in smoking intensity, measured by log(number of cigarettes +1). In columns (7) and (8), I regress the family events on the difference in body weight. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

4.5.4 Robustness and Anticipatory Effects

To ensure that the results are not driven by the matching procedure, I also apply propensity score matching (PSM)[10] instead of entropy balancing and use the generated weights to perform the analyses.[11] Specifically, I perform PSM based on an Epanechnikov kernel with bandwidth $k = 0.01$.[12] The analysis is restricted to the region of common support, that is, only those observations that have positive density within both the treated and untreated distribution are considered (Smith and Todd, 2005). The region of common support prevents to compare treated and untreated observations that are not comparable. As a result, I only compare individuals with broadly similar observable characteristics. Since for each treated observation only control observations within a specific interval are matched, the Epanechnikov kernel further ensures the common support condition. Due to the fact that the majority of the analyzed family events depends on the individuals' marriage and smoking status, the weights are computed within different subsets defined by marriage and smoking status, which is equivalent to exact matching on these two variables. PSM also results in well balanced treatment and control groups, which can also be seen in the tables in Appendix 4.B. Entropy balancing, however, results in overall lower standardized bias than PSM.[13] Nonetheless, Table 4.B.1 shows that the results are robust to applying PSM instead of entropy balancing, which indicates that the results are not driven by a specific matching procedure when applying regression-adjusted matching.

Furthermore, I perform an estimation in which I check whether the family events change smoking behavior and body weight *before* actually happening to provide insights with regard to anticipatory effects. I conduct a similar analysis to that from Table 4.5: while the family event still occurs at $t = 0$, matching is based on the set of covariates in $t = -4$ and the generated weights are then used to perform the analyses at $t = -2$. The results are presented in Table 4.8.

From Table 4.8, we see that people lose weight years before moving together with a partner (Panel A, column (4)), which supports the marriage market hypothesis as individuals might lose weight in order to attract a partner at all. Individuals also seem to be more likely to quit smoking and reduce smoking intensity at least two years before marriage (Panel B). Divorce, on the other hand, might not come at surprise and individuals are less likely to quit smoking (Panel C). In line with Lundborg et al. (2007), individuals with greater risk of divorce are more inclined to lose weight. Similar might be true for the death of a partner (Panel E): The death of a partner can – at least in

[10] The propensity score is the probability of receiving the treatment conditional on the covariates (Rosenbaum and Rubin, 1983).

[11] To compute the matching weights, I use the Stata ado-file `psmatch2` (Leuven and Sianesi, 2003).

[12] The results also remain to hold in the same direction, equivalent magnitude, and equivalent statistical significance when applying PSM with different kernel bandwidths of $k = 0.02$ and $k = 0.06$, respectively. The matching quality, however, slightly worsens with increasing bandwidth (especially with respect to age and age-related variables like tenure or full-time work experience). For this reason, I only present the results and balancing tables from PSM based on an Epanechnikov kernel with bandwidth $k = 0.01$.

[13] See Appendices 4.A and 4.B.

TABLE 4.8: Anticipatory effects of family events on smoking behavior and body weight

	Begin smoking	Quit smoking	Δ Log(cigarettes)	Δ BMI
	(1)	(2)	(3)	(4)
Panel A: Cohabitation				
Cohabitation	0.116	−0.120	0.044	−0.163**
	(0.074)	(0.080)	(0.050)	(0.072)
Pseudo/Adjusted R^2	0.111	0.093	0.148	0.033
Panel B: Marriage				
Marriage	−0.042	0.134*	−0.106*	0.002
	(0.080)	(0.080)	(0.057)	(0.062)
Pseudo/Adjusted R^2	0.110	0.118	0.153	0.029
Panel C: Separation				
Separation	0.064	0.011	0.007	−0.006
	(0.072)	(0.070)	(0.049)	(0.060)
Pseudo/Adjusted R^2	0.087	0.064	0.104	0.031
Panel D: Divorce				
Divorce	0.240	−0.258*	0.051	−0.252*
	(0.171)	(0.133)	(0.084)	(0.137)
Pseudo/Adjusted R^2	0.248	0.128	0.156	0.053
Panel E: Death of partner				
Death of partner	−0.193	−0.584***	0.213**	−0.050
	(0.153)	(0.152)	(0.089)	(0.158)
Pseudo/Adjusted R^2	0.301	0.239	0.220	0.093
Panel F: Death of mother				
Death of mother	−0.097	−0.088	0.012	−0.012
	(0.082)	(0.089)	(0.058)	(0.051)
Pseudo R^2	0.136	0.083	0.086	0.015
Panel G: Death of father				
Death of father	0.009	−0.120	0.028	0.044
	(0.078)	(0.086)	(0.054)	(0.060)
Pseudo/Adjusted R^2	0.117	0.097	0.088	0.033
Observations	46.861	21.357	21.357	68.218

Notes: This table shows the results of a placebo regression to detect anticipatory effects. Thereby, the analyses are performed at $t = -2$, whereas the family event happened at $t = 0$, and matching is based on the covariates at $t = -4$, Row names indicate the family event. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

some cases – be the result of a worsening health situation. Those individuals who will mourn a bereavement are less likely to quit smoking and, at the same time, increase smoking intensity.

In contrast, separation (Panel C) and the death of a parent (Panels F and G) may not be known more than two years beforehand. The estimated effects in Table 4.8 are insignificant and close to zero, which further supports that the unconfoundedness assumption holds.

4.6 Conclusion

This study estimates the impact of family events on individuals' smoking behavior and (excessive) body weight—still two of the leading causes of preventable deaths. Despite this, smoking and obesity have shown to cause economic consequences, such as increased medical care costs (e. g., Sloan et al., 2004; Finkelstein et al., 2009; Cawley and Meyerhoefer, 2012) or reduced income and wages (e. g., Averett and Korenman, 1996; Cawley, 2004; van Ours, 2004; Auld, 2005; Kline and Tobias, 2008); obesity also reduces the chances of employment (e. g., Morris, 2007) or receiving a job interview (e. g., Rooth, 2009). Prior literature suggests that people's smoking behavior and body weight are affected by undesirable life events, such as unemployment (Falba et al., 2005; Deb et al., 2011; Marcus, 2014), health shocks (Sundmacher, 2012), or macroeconomic shocks (Ruhm, 2000). This study shows that family events also impact smoking behavior and body weight. Thereby, it adds to a better understanding of factors that contribute to a change in smoking behavior or body weight.

To investigate the effects of family events on smoking behavior and body weight, this study takes advantage of the panel structure of the German Socio-Economic Panel. To account for differences between treatment and control groups, I apply regression-adjusted matching. Thereby, I exploit the data's time structure and condition on a large set of potentially confounding covariates *before* the family event actually happened. This procedure is done for each family event separately, resulting in comparable treatment and control groups.

I find that cohabitation (and not marriage) leads to a weight gain, whereas separation from a partner (rather than divorce) leads to a strong weight loss. Like Mata et al. (2018), I find that cohabitation is a stronger predictor for weight gain than marriage. But unlike Mata et al. (2018), there are no differences with regard to body weight (or smoking behavior) when analyzing the effects of marriage and divorce between comparable treatment and control groups. I also provide evidence that separation causes (at least temporarily) weight loss not only among women, but also among men. Moreover, separating from a partner increases smoking initiation and decreases smoking cessation. These results indicate that the formation and dissolution of a household offer great intervention windows for prevention and protection policies regarding smoking behavior and body weight.

Since smoking and excessive body weight are still associated with longlasting negative health consequences, these family transitions are periods of special vulnerability to engage in unhealthy behavior. Therefore, health policies should aim at offering help to those trying to quit smoking after breaking up with their partner and protecting those who previously quitted to prevent a smoking relapse. Public health policies aiming at divorcees might come too late. To implement adequate public health interventions, these interventions should address recently separated individuals as these are the ones most likely to change their behavior.

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Appendix

4.A Entropy Balancing: Matching Quality

TABLE 4.A.1: Means of treated, unmatched controls, and matched controls (based on entropy balancing) – before cohabitation

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	31.71	42.55	31.77	−98.16	−0.55
Female^{+}	56.35	53.58	56.33	5.55	0.03
Non-German^{+}	8.61	13.62	8.64	−15.99	−0.10
Migrant^{+}	16.22	18.77	16.23	−6.71	−0.01
Home owner^{+}	30.34	52.29	30.44	−45.72	−0.22
Married^{+}	6.44	61.89	6.87	−144.11	−1.72
Single^{+}	69.47	25.34	69.08	98.52	0.86
Separated^{+}	7.49	2.41	7.46	23.56	0.10
Divorced^{+}	15.48	8.74	15.43	20.75	0.13
Widowed^{+}	1.11	1.61	1.16	−4.27	−0.41
Children^{+}	26.19	43.82	26.27	−37.59	−0.19
Risk attitude	5.38	4.79	5.30	26.34	3.47
Labor market					
Tenure	5.39	10.80	5.42	−64.47	−0.37
Log labor earnings	8.40	8.18	8.39	6.04	0.08
Never unemployed^{+}	59.63	61.30	59.60	−3.41	0.05
Unemployed^{+}	22.48	24.01	22.45	−3.64	0.06
Blue-collar worker^{+}	14.18	19.21	14.19	−13.51	−0.03
Self-employed^{+}	5.76	7.11	5.77	−5.52	−0.05
Civil servant^{+}	5.63	5.67	5.65	−0.17	−0.07
Small company^{+}	19.13	19.43	19.13	−0.74	0.02
Small to medium company^{+}	21.55	19.78	21.54	4.37	0.01
Medium company^{+}	13.56	14.94	13.60	−3.95	−0.12
Large company^{+}	18.14	17.14	18.15	2.64	−0.01
No company info^{+}	27.62	28.71	27.58	−2.44	0.07
Major job worries^{+}	10.71	10.06	10.71	2.12	0.02
Some job worries^{+}	26.93	27.80	26.92	−1.94	0.03
No job worries^{+}	39.26	38.05	39.26	2.49	−0.00
No job worries info^{+}	23.10	24.09	23.11	−2.34	−0.04
Years full-time	7.14	14.45	7.19	−70.44	−0.48
Education					
Basic schooling^{+}	17.77	25.36	17.80	−18.53	−0.08
Intermediate schooling^{+}	38.45	42.06	38.45	−7.35	−0.00
Technical college^{+}	7.99	6.22	8.03	6.89	−0.14
Highest secondary^{+}	33.75	24.96	33.69	19.39	0.12
No school degree yet^{+}	2.04	1.41	2.03	4.90	0.08
Vocational training^{+}	57.40	69.07	57.45	−24.39	−0.11
University^{+}	20.31	23.95	20.35	−8.77	−0.10
Health					
Mental health	48.41	49.99	48.39	−16.04	0.21
Physical health	54.46	51.57	54.41	33.94	0.61
Good health^{+}	67.37	56.47	67.26	22.58	0.23
Medium health^{+}	21.80	30.26	21.88	−19.38	−0.19
Poor health^{+}	10.84	13.27	10.86	−7.48	−0.09
Height in centimeters	173.15	172.25	173.04	9.67	1.15

continued

Table 4.A.1 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Body mass index	23.93	25.79	23.93	−40.25	0.10
Underweight^{+}	4.09	2.06	4.07	11.75	0.08
Overweight or obese^{+}	31.21	50.45	31.29	−39.91	−0.17
Obese^{+}	8.36	16.51	8.39	−24.88	−0.11
Heavy smoker^{+}	14.55	11.92	14.54	7.77	0.03
Log no. of cigarettes/day^{a}	1.06	0.82	1.06	18.50	0.13
Baseline smoker^{+}	41.11	31.13	41.04	20.90	0.14

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *cohabitation*. Matching is based on entropy balancing. Columns (1), (2), and (3) display the means of the control variables before *cohabitation* for treated, unmatched controls, and matched controls, respectively. $^{+}$ Mean represents a percentage share. ^{a} Includes non-smokers.

TABLE 4.A.2: Means of treated, unmatched controls, and matched controls (based on entropy balancing) – before marriage

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	34.47	42.49	34.46	−74.47	0.10
Female$^+$	53.94	53.63	53.91	0.64	0.07
Non-German$^+$	9.51	13.60	9.52	−12.81	−0.03
Migrant$^+$	18.27	18.74	18.27	−1.19	−0.00
Home owner$^+$	26.70	52.32	26.72	−54.28	−0.05
Married$^+$	2.83	61.87	2.95	−162.68	−0.70
Single$^+$	71.75	25.36	71.62	104.74	0.27
Separated$^+$	4.45	2.47	4.49	10.85	−0.18
Divorced$^+$	20.57	8.67	20.54	34.15	0.08
Widowed$^+$	0.40	1.62	0.40	−12.17	0.01
Children$^+$	30.55	43.72	30.58	−27.52	−0.07
Risk attitude	5.04	4.80	5.06	10.62	−1.09
Labor market					
Tenure	6.63	10.77	6.63	−47.05	−0.05
Log labor earnings	8.96	8.17	8.95	22.43	0.15
Never unemployed$^+$	60.49	61.28	60.46	−1.63	0.05
Unemployed$^+$	16.25	24.11	16.25	−19.67	0.02
Blue-collar worker$^+$	17.67	19.14	17.67	−3.81	0.00
Self-employed$^+$	6.07	7.10	6.07	−4.18	0.00
Civil servant$^+$	6.34	5.66	6.34	2.85	−0.00
Small company$^+$	19.62	19.42	19.62	0.52	0.02
Small to medium company$^+$	19.69	19.81	19.68	−0.31	0.02
Medium company$^+$	17.67	14.88	17.70	7.57	−0.08
Large company$^+$	21.38	17.09	21.37	10.90	0.02
No company info$^+$	21.65	28.81	21.64	−16.55	0.02
Major job worries$^+$	10.38	10.07	10.39	1.03	−0.00
Some job worries$^+$	29.87	27.75	29.86	4.68	0.03
No job worries$^+$	42.82	37.99	42.80	9.85	0.04
No job worries info$^+$	16.93	24.19	16.96	−18.04	−0.09
Years full-time	9.12	14.41	9.12	−50.52	−0.02
Education					
Basic schooling$^+$	20.57	25.31	20.56	−11.29	0.01
Intermediate schooling$^+$	38.71	42.05	38.69	−6.81	0.03
Technical college$^+$	6.61	6.24	6.65	1.49	−0.17
Highest secondary$^+$	33.92	24.97	33.89	19.73	0.05
No school degree yet$^+$	0.20	1.44	0.20	−13.72	0.00
Vocational training$^+$	66.08	68.92	66.06	−6.06	0.05
University$^+$	27.58	23.82	27.57	8.60	0.01
Health					
Mental health	49.72	49.97	49.69	−2.66	0.28
Physical health	53.41	51.59	53.38	21.25	0.38
Good health$^+$	65.27	56.52	65.23	18.01	0.09
Medium health$^+$	24.21	30.21	24.25	−13.51	−0.09
Poor health$^+$	10.52	13.27	10.52	−8.51	−0.01
Height in centimeters	173.46	172.24	173.36	12.94	1.01
Body mass index	24.98	25.77	24.97	−17.09	0.27
Underweight$^+$	2.70	2.09	2.69	4.00	0.02
Overweight or obese$^+$	42.35	50.24	42.34	−15.88	0.01
Obese$^+$	12.00	16.44	12.00	−12.72	−0.00
Heavy smoker$^+$	13.69	11.94	13.68	5.24	0.02

continued

Table 4.A.2 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.93	0.82	0.93	8.52	0.06
Baseline smoker[+]	35.33	31.24	35.30	8.70	0.06

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *marriage*. Matching is based on entropy balancing. Columns (1), (2), and (3) display the means of the control variables before *marriage* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.A.3: Means of treated, unmatched controls, and matched controls (based on entropy balancing) – before separation

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	35.83	42.50	35.91	−58.86	−0.69
Female$^+$	59.68	53.51	59.62	12.46	0.12
Non-German$^+$	9.24	13.61	9.27	−13.79	−0.10
Migrant$^+$	15.65	18.79	15.65	−8.31	0.00
Home owner$^+$	35.73	52.23	35.85	−33.71	−0.25
Married$^+$	37.44	61.40	37.65	−49.35	−0.42
Single$^+$	46.68	25.69	46.44	44.75	0.49
Separated$^+$	3.76	2.48	3.75	7.40	0.05
Divorced$^+$	11.23	8.81	11.22	8.05	0.03
Widowed$^+$	0.88	1.62	0.95	−6.58	−0.63
Children$^+$	46.79	43.45	46.64	6.72	0.30
Risk attitude	5.17	4.79	5.17	16.73	0.41
Labor market					
Tenure	7.05	10.77	7.09	−41.71	−0.57
Log labor earnings	8.29	8.18	8.28	2.86	0.18
Never unemployed$^+$	55.25	61.39	55.26	−12.46	−0.01
Unemployed$^+$	23.67	23.99	23.68	−0.75	−0.02
Blue-collar worker$^+$	14.44	19.21	14.46	−12.79	−0.07
Self-employed$^+$	8.74	7.06	8.73	6.24	0.02
Civil servant$^+$	5.70	5.67	5.70	0.11	−0.03
Small company$^+$	19.86	19.41	19.83	1.12	0.05
Small to medium company$^+$	17.92	19.85	17.92	−4.92	−0.00
Medium company$^+$	14.55	14.93	14.54	−1.07	0.02
Large company$^+$	18.25	17.13	18.28	2.93	−0.08
No company info$^+$	29.42	28.68	29.42	1.64	0.01
Major job worries$^+$	10.51	10.07	10.54	1.45	−0.12
Some job worries$^+$	27.82	27.79	27.79	0.08	0.08
No job worries$^+$	38.05	38.07	38.04	−0.03	0.02
No job worries info$^+$	23.62	24.08	23.63	−1.09	−0.03
Years full-time	9.33	14.42	9.39	−47.51	−0.64
Education					
Basic schooling$^+$	19.69	25.34	19.76	−13.55	−0.16
Intermediate schooling$^+$	41.10	42.01	41.07	−1.86	0.05
Technical college$^+$	7.80	6.22	7.83	6.19	−0.13
Highest secondary$^+$	29.48	25.02	29.42	10.02	0.14
No school degree yet$^+$	1.94	1.41	1.92	4.13	0.08
Vocational training$^+$	64.71	68.96	64.74	−9.02	−0.05
University$^+$	21.90	23.92	21.91	−4.81	−0.03
Health					
Mental health	47.28	50.02	47.27	−27.29	0.09
Physical health	53.05	51.59	52.99	16.56	0.64
Good health$^+$	58.74	56.62	58.63	4.30	0.22
Medium health$^+$	28.65	30.14	28.68	−3.28	−0.07
Poor health$^+$	12.61	13.24	12.69	−1.88	−0.23
Height in centimeters	172.42	172.26	172.31	1.70	1.16
Body mass index	24.78	25.78	24.78	−20.89	0.08
Underweight$^+$	3.48	2.07	3.47	8.63	0.07
Overweight or obese$^+$	40.32	50.31	40.41	−20.16	−0.18
Obese$^+$	11.95	16.45	11.99	−12.94	−0.15
Heavy smoker$^+$	14.33	11.92	14.30	7.13	0.06

continued

Table 4.A.3 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	1.04	0.82	1.04	16.89	0.17
Baseline smoker[+]	40.27	31.13	40.17	19.16	0.19

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *separation*. Matching is based on entropy balancing. Columns (1), (2), and (3) display the means of the control variables before *separation* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.A.4: Means of treated, unmatched controls, and matched controls (based on entropy balancing) – before divorce

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	41.97	42.37	41.90	−3.85	0.86
Female$^+$	60.98	53.59	60.88	14.98	0.20
Non-German$^+$	9.98	13.55	9.97	−11.09	0.04
Migrant$^+$	15.06	18.75	15.05	−9.85	0.05
Home owner$^+$	35.93	52.01	35.88	−32.80	0.11
Married$^+$	28.31	61.14	28.27	−69.91	0.10
Single$^+$	0.18	26.25	0.19	−83.39	−0.27
Separated$^+$	66.79	2.12	66.82	185.52	−0.07
Divorced$^+$	4.72	8.88	4.72	−16.59	0.02
Widowed$^+$	0.00	1.61	0.00	−18.09	−0.69
Children$^+$	50.82	43.47	50.73	14.75	0.18
Risk attitude	5.04	4.80	5.02	10.48	0.63
Labor market					
Tenure	9.40	10.71	9.36	−13.93	0.40
Log labor earnings	8.66	8.18	8.65	13.25	0.43
Never unemployed$^+$	57.53	61.29	57.44	−7.65	0.19
Unemployed$^+$	18.15	24.02	18.13	−14.43	0.05
Blue-collar worker$^+$	17.06	19.13	17.04	−5.38	0.05
Self-employed$^+$	7.44	7.09	7.43	1.37	0.03
Civil servant$^+$	6.72	5.67	6.71	4.35	0.03
Small company$^+$	19.60	19.42	19.58	0.46	0.06
Small to medium company$^+$	20.15	19.81	20.12	0.84	0.06
Medium company$^+$	15.43	14.92	15.41	1.42	0.05
Large company$^+$	20.15	17.14	20.24	7.73	−0.24
No company info$^+$	24.68	28.72	24.65	−9.13	0.07
Major job worries$^+$	13.07	10.06	13.05	9.42	0.04
Some job worries$^+$	30.49	27.77	30.45	5.98	0.10
No job worries$^+$	37.75	38.07	37.69	−0.66	0.12
No job worries info$^+$	18.69	24.10	18.81	−13.21	−0.30
Years full-time	13.34	14.33	13.32	−9.14	0.24
Education					
Basic schooling$^+$	24.86	25.23	24.83	−0.85	0.08
Intermediate schooling$^+$	42.29	41.99	42.22	0.60	0.14
Technical college$^+$	7.99	6.24	7.98	6.79	0.03
Highest secondary$^+$	24.86	25.11	24.83	−0.57	0.07
No school degree yet$^+$	0.00	1.43	0.14	−17.00	−5.34
Vocational training$^+$	77.68	68.82	77.57	20.09	0.25
University$^+$	22.50	23.89	22.48	−3.28	0.07
Health					
Mental health	45.62	49.99	45.55	−40.59	0.65
Physical health	52.35	51.61	52.26	8.15	0.94
Good health$^+$	54.26	56.67	54.18	−4.84	0.18
Medium health$^+$	29.76	30.12	29.87	−0.77	−0.23
Poor health$^+$	15.97	13.21	15.95	7.82	0.05
Height in centimeters	171.72	172.27	171.43	−5.77	3.00
Body mass index	25.21	25.76	25.17	−11.26	0.85
Underweight$^+$	2.54	2.09	2.54	2.98	0.01
Overweight or obese$^+$	41.56	50.17	41.49	−17.33	0.14
Obese$^+$	14.16	16.38	14.14	−6.19	0.04
Heavy smoker$^+$	19.96	11.92	19.94	22.10	0.06

continued

Table 4.A.4 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	1.18	0.82	1.18	26.70	0.14
Baseline smoker[+]	43.38	31.23	43.30	25.30	0.15

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *divorce*. Matching is based on entropy balancing. Columns (1), (2), and (3) display the means of the control variables before *divorce* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.A.5: Means of treated, unmatched controls, and matched controls (based on entropy balancing) – before death of partner

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	52.94	42.35	52.66	105.09	3.53
Female$^+$	76.70	53.59	76.46	49.95	0.59
Non-German$^+$	13.07	13.53	13.04	−1.36	0.09
Migrant$^+$	16.48	18.73	16.49	−5.92	−0.02
Home owner$^+$	53.41	51.91	53.14	3.00	0.55
Married$^+$	80.68	60.91	80.24	44.50	1.13
Single$^+$	3.41	26.14	3.68	−67.58	−1.45
Separated$^+$	7.39	2.49	7.60	22.69	−0.82
Divorced$^+$	3.98	8.87	3.96	−20.03	0.08
Widowed$^+$	4.55	1.60	4.52	17.12	0.10
Children$^+$	20.45	43.56	20.46	−51.06	−0.02
Risk attitude	4.19	4.80	4.33	−25.76	−5.98
Labor market					
Tenure	15.45	10.69	15.36	43.85	0.80
Log labor earnings	6.82	8.18	6.79	−32.10	0.57
Never unemployed$^+$	52.84	61.28	52.68	−17.09	0.33
Unemployed$^+$	40.34	23.96	40.23	35.58	0.22
Blue-collar worker$^+$	14.20	19.13	14.17	−13.23	0.10
Self-employed$^+$	7.39	7.09	7.37	1.15	0.08
Civil servant$^+$	5.68	5.67	5.67	0.04	0.07
Small company$^+$	11.93	19.43	11.91	−20.72	0.05
Small to medium company$^+$	15.34	19.82	15.31	−11.77	0.09
Medium company$^+$	12.50	14.92	12.48	−7.04	0.07
Large company$^+$	14.77	17.16	14.98	−6.51	−0.58
No company info$^+$	45.45	28.66	45.32	35.25	0.27
Major job worries$^+$	5.68	10.08	5.95	−16.37	−1.15
Some job worries$^+$	18.18	27.80	18.15	−22.99	0.07
No job worries$^+$	35.80	38.07	35.67	−4.71	0.27
No job worries info$^+$	40.34	24.04	40.23	35.37	0.23
Years full-time	19.34	14.31	19.21	40.92	0.98
Education					
Basic schooling$^+$	38.64	25.21	38.44	29.07	0.39
Intermediate schooling$^+$	39.20	42.00	39.05	−5.69	0.31
Technical college$^+$	5.68	6.25	5.96	−2.40	−1.19
Highest secondary$^+$	16.48	25.12	16.49	−21.40	−0.05
No school degree yet$^+$	0.00	1.42	0.05	−16.97	−3.10
Vocational training$^+$	75.57	68.86	75.23	14.99	0.79
University$^+$	20.45	23.89	20.39	−8.27	0.16
Health					
Mental health	49.62	49.96	49.44	−3.36	1.71
Physical health	48.53	51.62	48.39	−32.82	1.48
Good health$^+$	39.20	56.69	39.19	−35.50	0.03
Medium health$^+$	43.18	30.09	42.97	27.38	0.43
Poor health$^+$	17.61	13.22	17.84	12.17	−0.59
Height in centimeters	167.79	172.27	167.21	−49.16	6.58
Body mass index	27.02	25.76	26.92	26.48	2.25
Underweight$^+$	0.57	2.10	0.58	−13.36	−0.19
Overweight or obese$^+$	63.64	50.09	63.31	27.57	0.68
Obese$^+$	26.70	16.35	26.59	25.36	0.25
Heavy smoker$^+$	12.50	11.96	12.48	1.64	0.07

continued

Table 4.A.5 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.84	0.82	0.84	1.39	0.20
Baseline smoker[+]	30.68	31.30	30.62	−1.34	0.13

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *death of partner*. Matching is based on entropy balancing. Columns (1), (2), and (3) display the means of the control variables before *death of partner* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.A.6: Means of treated, unmatched controls, and matched controls (based on entropy balancing) – before death of mother

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	49.00	42.28	48.81	63.33	2.00
Female$^+$	54.27	53.62	54.23	1.30	0.09
Non-German$^+$	12.40	13.55	12.38	−3.42	0.04
Migrant$^+$	16.16	18.76	16.20	−6.85	−0.11
Home owner$^+$	60.64	51.80	60.50	17.87	0.28
Married$^+$	71.19	60.81	70.83	22.03	0.80
Single$^+$	14.15	26.25	14.54	−30.46	−1.11
Separated$^+$	2.51	2.50	2.55	0.08	−0.27
Divorced$^+$	9.88	8.85	9.83	3.56	0.19
Widowed$^+$	2.26	1.59	2.25	4.86	0.10
Children$^+$	36.26	43.61	36.28	−15.03	−0.04
Risk attitude	4.72	4.80	4.74	−3.59	−0.70
Labor market					
Tenure	14.24	10.65	14.20	33.92	0.41
Log labor earnings	8.33	8.18	8.31	3.84	0.45
Never unemployed$^+$	60.64	61.28	60.66	−1.31	−0.06
Unemployed$^+$	22.03	24.01	22.14	−4.71	−0.28
Blue-collar worker$^+$	20.27	19.10	20.22	2.92	0.12
Self-employed$^+$	7.45	7.08	7.42	1.43	0.13
Civil servant$^+$	8.54	5.64	8.50	11.34	0.15
Small company$^+$	16.50	19.46	16.49	−7.71	0.03
Small to medium company$^+$	20.35	19.80	20.31	1.37	0.10
Medium company$^+$	15.58	14.91	15.58	1.86	−0.02
Large company$^+$	20.52	17.11	20.46	8.73	0.15
No company info$^+$	27.05	28.72	27.16	−3.71	−0.24
Major job worries$^+$	9.30	10.09	9.35	−2.67	−0.17
Some job worries$^+$	26.13	27.81	26.09	−3.78	0.10
No job worries$^+$	41.29	38.02	41.18	6.68	0.21
No job worries info$^+$	23.28	24.08	23.38	−1.88	−0.23
Years full-time	19.04	14.26	18.92	40.27	0.97
Education					
Basic schooling$^+$	28.39	25.19	28.30	7.23	0.20
Intermediate schooling$^+$	42.80	41.98	42.71	1.65	0.17
Technical college$^+$	5.53	6.26	5.58	−3.10	−0.24
Highest secondary$^+$	23.28	25.13	23.29	−4.32	−0.01
No school degree yet$^+$	0.00	1.43	0.11	−17.06	−4.72
Vocational training$^+$	72.86	68.82	72.61	8.90	0.57
University$^+$	27.55	23.84	27.43	8.52	0.27
Health					
Mental health	49.37	49.97	49.34	−6.13	0.35
Physical health	49.44	51.64	49.45	−24.28	−0.06
Good health$^+$	46.48	56.79	46.62	−20.73	−0.28
Medium health$^+$	36.35	30.03	36.28	13.43	0.14
Poor health$^+$	17.17	13.18	17.09	11.14	0.20
Height in centimeters	171.77	172.27	171.66	−5.38	1.11
Body mass index	26.25	25.75	26.22	10.29	0.70
Underweight$^+$	1.34	2.11	1.37	−5.88	−0.24
Overweight or obese$^+$	55.19	50.05	54.99	10.31	0.41
Obese$^+$	18.09	16.35	18.02	4.62	0.18
Heavy smoker$^+$	12.73	11.95	12.70	2.36	0.10

continued

Table 4.A.6 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.82	0.82	0.82	−0.41	0.06
Baseline smoker[+]	30.49	31.31	30.48	−1.79	0.02

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *death of mother*. Matching is based on entropy balancing. Columns (1), (2), and (3) display the means of the control variables before *death of mother* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.A.7: Means of treated, unmatched controls, and matched controls (based on entropy balancing) – before death of father

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	45.35	42.32	45.28	28.28	0.84
Female$^+$	53.31	53.64	53.28	−0.66	0.05
Non-German$^+$	12.19	13.55	12.19	−4.05	0.02
Migrant$^+$	16.13	18.77	16.15	−6.94	−0.04
Home owner$^+$	55.39	51.86	55.33	7.07	0.13
Married$^+$	67.51	60.85	67.34	13.92	0.36
Single$^+$	18.29	26.21	18.44	−19.12	−0.39
Separated$^+$	2.45	2.50	2.49	−0.31	−0.25
Divorced$^+$	10.63	8.83	10.61	6.07	0.07
Widowed$^+$	1.12	1.61	1.12	−4.26	−0.00
Children$^+$	44.54	43.50	44.49	2.08	0.10
Risk attitude	4.66	4.80	4.71	−6.31	−2.28
Labor market					
Tenure	12.58	10.67	12.57	18.65	0.10
Log labor earnings	8.73	8.17	8.72	15.16	0.34
Never unemployed$^+$	60.82	61.27	60.81	−0.94	0.02
Unemployed$^+$	18.22	24.07	18.28	−14.37	−0.16
Blue-collar worker$^+$	18.29	19.13	18.27	−2.16	0.05
Self-employed$^+$	9.00	7.06	8.97	7.13	0.07
Civil servant$^+$	6.25	5.66	6.23	2.46	0.05
Small company$^+$	18.22	19.44	18.21	−3.13	0.03
Small to medium company$^+$	22.01	19.78	21.98	5.48	0.07
Medium company$^+$	17.77	14.88	17.78	7.83	−0.03
Large company$^+$	18.59	17.13	18.56	3.80	0.07
No company info$^+$	23.42	28.77	23.48	−12.21	−0.13
Major job worries$^+$	11.08	10.06	11.12	3.31	−0.12
Some job worries$^+$	31.60	27.73	31.55	8.47	0.10
No job worries$^+$	37.32	38.08	37.28	−1.55	0.09
No job worries info$^+$	20.00	24.13	20.05	−9.97	−0.13
Years full-time	16.50	14.29	16.45	19.35	0.41
Education					
Basic schooling$^+$	24.83	25.24	24.81	−0.93	0.06
Intermediate schooling$^+$	41.78	42.00	41.75	−0.43	0.08
Technical college$^+$	7.36	6.23	7.35	4.48	0.02
Highest secondary$^+$	25.72	25.10	25.72	1.44	0.02
No school degree yet$^+$	0.30	1.43	0.38	−12.28	−1.35
Vocational training$^+$	73.61	68.81	73.47	10.61	0.30
University$^+$	29.37	23.80	29.30	12.62	0.15
Health					
Mental health	48.94	49.98	48.92	−10.59	0.28
Physical health	50.80	51.63	50.78	−9.17	0.21
Good health$^+$	52.04	56.72	52.07	−9.40	−0.05
Medium health$^+$	33.53	30.07	33.53	7.45	0.00
Poor health$^+$	14.42	13.21	14.40	3.51	0.07
Height in centimeters	172.74	172.26	172.64	5.18	1.12
Body mass index	26.23	25.75	26.20	9.92	0.50
Underweight$^+$	0.74	2.12	0.77	−11.57	−0.36
Overweight or obese$^+$	54.50	50.05	54.39	8.90	0.21
Obese$^+$	18.44	16.34	18.40	5.54	0.09
Heavy smoker$^+$	12.12	11.96	12.11	0.48	0.04

continued

Table 4.A.7 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.83	0.82	0.83	0.65	0.05
Baseline smoker[+]	31.38	31.30	31.36	0.16	0.03

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *death of father*. Matching is based on entropy balancing. Columns (1), (2), and (3) display the means of the control variables before *death of father* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

4.B Propensity Score Matching: Results and Matching Quality

TABLE 4.B.1: Effects of family events on smoking behavior and body weight (based on regression-adjusted matching with propensity score matching)

	Begin smoking	Quit smoking	Δ Log(cigarettes)	Δ BMI
	(1)	(2)	(3)	(4)
Panel A: Cohabitation				
Cohabitation	−0.011	0.068	−0.062	0.164***
	(0.064)	(0.061)	(0.042)	(0.052)
N	64.268	29.489	29.489	93.757
Pseudo/Adjusted R^2	0.111	0.075	0.127	0.037
Panel B: Marriage				
Marriage	−0.145	−0.060	0.007	0.017
	(0.110)	(0.096)	(0.064)	(0.081)
N	55.994	26.689	26.689	82.683
Pseudo/Adjusted R^2	0.111	0.105	0.155	0.041
Panel C: Separation				
Separation	0.371***	−0.167**	0.088**	−0.327***
	(0.068)	(0.072)	(0.042)	(0.069)
N	64.758	29.507	29.507	94.265
Pseudo/Adjusted R^2	0.097	0.062	0.091	0.033
Panel D: Divorce				
Divorce	0.209	−0.000	0.023	−0.092
	(0.172)	(0.134)	(0.084)	(0.125)
N	62.570	20.341	20.341	82.911
Pseudo/Adjusted R^2	0.149	0.154	0.147	0.046
Panel E: Death of partner				
Death of partner	−0.610***	0.593*	−0.345	−0.492
	(0.141)	(0.331)	(0.228)	(0.334)
N	62.966	27.419	27.419	90.385
Pseudo/Adjusted R^2	0.344	0.274	0.284	0.108
Panel F: Death of mother				
Death of mother	0.018	−0.257***	0.082*	0.052
	(0.076)	(0.085)	(0.047)	(0.054)
N	63.611	29.303	29.303	92.914
Pseudo/Adjusted R^2	0.118	0.073	0.087	0.021
Panel G: Death of father				
Death of father	−0.029	−0.088	0.033	0.013
	(0.074)	(0.075)	(0.049)	(0.053)
N	64.765	29.282	29.282	94.047
Pseudo/Adjusted R^2	0.095	0.091	0.085	0.020

continued

Table 4.B.1 – continued from previous page

	Begin smoking	Quit smoking	Δ Log(cigarettes)	Δ BMI
	(1)	(2)	(3)	(4)

Notes: This table shows the effect of family events on individuals' risky health behaviors. Each cell presents the ATT from separate estimations and its robust standard errors in parentheses. Row names indicate the family event. In all estimations, I perform propensity score matching with regression adjustment (Epanechnikov kernel, bandwith $k = 0.01$). In columns (1) and (2), I run a probit regression and regress the indicator that a family event occurred in the past calender year on a dummy variable indicating the decision to begin (column (1)) or quit smoking (column (2)). In column (3), I regress the family events on the difference in smoking intensity, measured by log(number of cigarettes +1). In column (4), I regress the family events on the difference in body weight. *, **, *** denote statistical significance at the 0.10, 0.05, and 0.01 level, respectively.

TABLE 4.B.2: Means of treated, unmatched controls, and matched controls (based on propensity score matching) – before cohabitation

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	31.71	42.56	32.06	−98.16	−3.33
Female$^+$	56.35	53.37	56.00	5.99	0.70
Non-German$^+$	8.61	13.58	8.91	−15.88	−1.06
Migrant$^+$	16.22	18.75	16.53	−6.66	−0.84
Home owner$^+$	30.34	52.24	31.12	−45.62	−1.68
Married$^+$	6.44	61.69	6.44	−143.46	0.00
Single$^+$	69.47	25.48	69.23	98.13	0.53
Separated$^+$	7.49	2.43	7.55	23.49	−0.22
Divorced$^+$	15.48	8.79	15.61	20.59	−0.37
Widowed$^+$	1.11	1.62	1.17	−4.34	−0.50
Children$^+$	26.19	43.70	26.04	−37.36	0.35
Risk attitude	5.38	4.80	5.20	26.13	8.29
Labor market					
Tenure	5.39	10.80	5.62	−64.55	−3.41
Log labor earnings	8.40	8.19	8.34	5.83	1.67
Never unemployed$^+$	59.63	61.27	60.00	−3.35	−0.77
Unemployed$^+$	22.48	23.95	22.90	−3.48	−1.00
Blue-collar worker$^+$	14.18	19.27	14.52	−13.67	−0.96
Self-employed$^+$	5.76	7.12	5.69	−5.54	0.31
Civil servant$^+$	5.63	5.67	5.53	−0.17	0.46
Small company$^+$	19.13	19.42	19.28	−0.73	−0.37
Small to medium company$^+$	21.55	19.81	20.87	4.28	1.67
Medium company$^+$	13.56	14.97	14.04	−4.02	−1.38
Large company$^+$	18.14	17.15	18.01	2.60	0.34
No company info$^+$	27.62	28.65	27.81	−2.29	−0.43
Major job worries$^+$	10.71	10.10	10.57	2.00	0.44
Some job worries$^+$	26.93	27.83	26.88	−2.00	0.13
No job worries$^+$	39.26	38.04	38.85	2.50	0.83
No job worries info$^+$	23.10	24.03	23.69	−2.21	−1.41
Years full-time	7.14	14.48	7.38	−70.68	−2.66
Education					
Basic schooling$^+$	17.77	25.43	18.10	−18.69	−0.86
Intermediate schooling$^+$	38.45	42.07	38.87	−7.38	−0.86
Technical college$^+$	7.99	6.22	7.74	6.90	0.92
Highest secondary$^+$	33.75	24.87	33.18	19.59	1.19
No school degree yet$^+$	2.04	1.41	2.10	4.84	−0.43
Vocational training$^+$	57.40	69.13	57.65	−24.52	−0.52
University$^+$	20.31	23.88	20.15	−8.60	0.40
Health					
Mental health	48.41	49.99	48.47	−16.04	−0.62
Physical health	54.46	51.55	54.35	34.11	1.29
Good health$^+$	67.37	56.41	67.00	22.70	0.79
Medium health$^+$	21.80	30.29	22.19	−19.45	−0.95
Poor health$^+$	10.84	13.30	10.81	−7.56	0.07
Height in centimeters	173.15	172.27	173.18	9.42	−0.30
Body mass index	23.93	25.83	24.02	−41.31	−1.98
Underweight$^+$	4.09	1.53	4.08	15.52	0.02
Overweight or obese$^+$	31.21	50.72	32.13	−40.48	−1.97
Obese$^+$	8.36	16.60	8.42	−25.12	−0.24
Heavy smoker$^+$	14.55	11.98	14.62	7.57	−0.20

continued

Table 4.B.2 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	1.06	0.82	1.06	18.15	−0.20
Baseline smoker[+]	41.11	31.30	41.11	20.53	0.00

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *cohabitation*. Matching is based on propensity score matching with an Epanechnikov kernel with bandwidth $k = 0.01$ and exact matching on marriage and smoking status. Columns (1), (2), and (3) display the means of the control variables before *cohabitation* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.B.3: Means of treated, unmatched controls, and matched controls (based on propensity score matching) – before marriage

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	34.48	41.92	34.74	−68.13	−2.51
Female$^+$	53.88	54.62	54.02	−1.48	−0.28
Non-German$^+$	9.52	13.45	9.35	−12.33	0.59
Migrant$^+$	18.30	18.82	18.14	−1.34	0.42
Home owner$^+$	26.74	50.55	27.77	−50.43	−2.31
Married$^+$	2.70	56.46	2.70	−145.75	0.00
Single$^+$	71.84	28.96	71.42	94.91	0.94
Separated$^+$	4.46	2.82	4.52	8.75	−0.32
Divorced$^+$	20.59	9.90	20.92	30.07	−0.81
Widowed$^+$	0.41	1.85	0.43	−13.72	−0.41
Children$^+$	30.52	42.53	30.60	−25.14	−0.17
Risk attitude	5.03	4.82	5.16	9.72	−5.57
Labor market					
Tenure	6.63	10.32	6.78	−42.28	−1.92
Log labor earnings	8.95	8.03	8.89	26.26	2.19
Never unemployed$^+$	60.50	60.50	60.31	−0.01	0.38
Unemployed$^+$	16.21	25.64	16.66	−23.35	−1.23
Blue-collar worker$^+$	17.69	18.97	17.46	−3.29	0.59
Self-employed$^+$	6.01	7.58	6.02	−6.25	−0.03
Civil servant$^+$	6.35	5.52	6.41	3.51	−0.24
Small company$^+$	19.65	21.09	19.56	−3.57	0.24
Small to medium company$^+$	19.72	21.44	19.72	−4.27	0.00
Medium company$^+$	17.69	8.50	17.46	27.49	0.60
Large company$^+$	21.40	18.24	21.32	7.93	0.19
No company info$^+$	21.54	30.73	21.94	−21.03	−0.98
Major job worries$^+$	10.40	9.85	10.41	1.82	−0.03
Some job worries$^+$	29.91	27.23	29.68	5.95	0.51
No job worries$^+$	42.88	37.26	42.68	11.48	0.39
No job worries info$^+$	16.81	25.66	17.23	−21.76	−1.11
Years full-time	9.12	13.87	9.31	−45.38	−1.94
Education					
Basic schooling$^+$	20.59	25.76	20.76	−12.25	−0.40
Intermediate schooling$^+$	38.62	43.10	38.29	−9.13	0.69
Technical college$^+$	6.62	3.68	6.63	13.34	−0.05
Highest secondary$^+$	33.96	25.82	34.11	17.85	−0.30
No school degree yet$^+$	0.20	1.64	0.22	−15.08	−0.34
Vocational training$^+$	66.10	67.91	66.23	−3.85	−0.27
University$^+$	27.62	22.82	27.77	11.05	−0.35
Health					
Mental health	49.72	50.04	49.76	−3.33	−0.39
Physical health	53.40	52.00	53.33	16.50	0.88
Good health$^+$	65.23	58.11	64.85	14.67	0.79
Medium health$^+$	24.24	31.02	24.64	−15.21	−0.92
Poor health$^+$	10.53	10.87	10.51	−1.08	0.06
Height in centimeters	173.46	172.15	173.42	13.96	0.40
Body mass index	24.98	25.69	24.95	−15.47	0.65
Underweight$^+$	2.63	2.01	2.65	4.16	−0.10
Overweight or obese$^+$	42.34	49.42	42.13	−14.25	0.42
Obese$^+$	11.95	16.05	11.64	−11.84	0.98
Heavy smoker$^+$	13.71	12.09	13.60	4.84	0.30

continued

Table 4.B.3 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.93	0.84	0.93	6.80	0.10
Baseline smoker[+]	35.38	32.25	35.38	6.61	0.00

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *marriage*. Matching is based on propensity score matching with an Epanechnikov kernel with bandwidth $k = 0.01$ and exact matching on marriage and smoking status. Columns (1), (2), and (3) display the means of the control variables before *marriage* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.B.4: Means of treated, unmatched controls, and matched controls (based on propensity score matching) – before separation

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	35.83	42.50	36.32	−58.85	−4.42
Female$^+$	59.68	53.51	58.89	12.46	1.60
Non-German$^+$	9.24	13.61	9.51	−13.79	−0.94
Migrant$^+$	15.65	18.79	15.95	−8.31	−0.82
Home owner$^+$	35.73	52.23	36.82	−33.71	−2.27
Married$^+$	37.44	61.40	37.44	−49.35	0.00
Single$^+$	46.68	25.69	46.31	44.75	0.74
Separated$^+$	3.76	2.48	3.90	7.40	−0.71
Divorced$^+$	11.23	8.81	11.34	8.05	−0.35
Widowed$^+$	0.88	1.62	1.01	−6.58	−1.28
Children$^+$	46.79	43.45	45.76	6.72	2.06
Risk attitude	5.17	4.79	5.11	16.73	2.65
Labor market					
Tenure	7.05	10.77	7.35	−41.71	−3.90
Log labor earnings	8.29	8.18	8.27	2.86	0.46
Never unemployed$^+$	55.25	61.38	55.59	−12.46	−0.67
Unemployed$^+$	23.67	23.99	23.86	−0.75	−0.44
Blue-collar worker$^+$	14.44	19.21	14.76	−12.79	−0.92
Self-employed$^+$	8.74	7.06	8.51	6.24	0.82
Civil servant$^+$	5.70	5.67	5.72	0.11	−0.10
Small company$^+$	19.86	19.41	19.89	1.12	−0.09
Small to medium company$^+$	17.92	19.85	18.10	−4.92	−0.46
Medium company$^+$	14.55	14.93	14.41	−1.07	0.39
Large company$^+$	18.25	17.13	18.14	2.93	0.30
No company info$^+$	29.42	28.68	29.46	1.64	−0.08
Major job worries$^+$	10.51	10.07	10.50	1.45	0.03
Some job worries$^+$	27.82	27.79	27.66	0.08	0.36
No job worries$^+$	38.05	38.07	38.14	−0.03	−0.17
No job worries info$^+$	23.62	24.08	23.70	−1.08	−0.21
Years full-time	9.33	14.42	9.72	−47.51	−4.02
Education					
Basic schooling$^+$	19.69	25.34	20.13	−13.56	−1.09
Intermediate schooling$^+$	41.10	42.01	41.09	−1.86	0.01
Technical college$^+$	7.80	6.22	7.77	6.19	0.11
Highest secondary$^+$	29.48	25.02	29.08	10.02	0.87
No school degree yet$^+$	1.94	1.41	1.93	4.14	0.06
Vocational training$^+$	64.71	68.96	64.53	−9.02	0.38
University$^+$	21.90	23.92	22.08	−4.81	−0.42
Health					
Mental health	47.28	50.02	47.64	−27.29	−3.44
Physical health	53.05	51.59	52.94	16.56	1.25
Good health$^+$	58.74	56.62	59.05	4.30	−0.63
Medium health$^+$	28.65	30.14	28.47	−3.28	0.41
Poor health$^+$	12.61	13.24	12.49	−1.88	0.38
Height in centimeters	172.42	172.26	172.46	1.69	−0.42
Body mass index	24.78	25.78	24.86	−20.89	−1.53
Underweight$^+$	3.48	2.07	3.36	8.63	0.69
Overweight or obese$^+$	40.32	50.31	41.09	−20.16	−1.57
Obese$^+$	11.95	16.45	12.10	−12.94	−0.47
Heavy smoker$^+$	14.33	11.92	14.38	7.13	−0.15

continued

Table 4.B.4 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	1.04	0.82	1.04	16.89	−0.15
Baseline smoker[+]	40.27	31.13	40.27	19.16	0.00

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *separation*. Matching is based on propensity score matching with an Epanechnikov kernel with bandwidth $k = 0.01$ and exact matching on marriage and smoking status. Columns (1), (2), and (3) display the means of the control variables before *separation* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.B.5: Means of treated, unmatched controls, and matched controls (based on propensity score matching) – before divorce

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	42.05	43.66	42.72	−16.37	−7.58
Female$^+$	60.88	54.04	59.51	13.86	2.79
Non-German$^+$	10.05	14.30	10.16	−12.99	−0.34
Migrant$^+$	15.17	18.94	15.25	−10.01	−0.23
Home owner$^+$	36.01	54.24	37.60	−37.24	−3.29
Married$^+$	28.52	69.55	28.52	−89.97	0.00
Single$^+$	0.18	17.93	1.42	−65.03	−13.92
Separated$^+$	66.54	2.41	66.63	182.63	−0.18
Divorced$^+$	4.75	10.10	3.43	−20.51	6.68
Widowed$^+$	0.00	0.00	0.00		
Children$^+$	50.82	45.37	49.91	10.93	1.82
Risk attitude	5.04	4.73	4.96	13.50	3.22
Labor market					
Tenure	9.46	11.18	9.87	−18.18	−4.54
Log labor earnings	8.65	8.33	8.51	8.91	3.98
Never unemployed$^+$	57.77	62.03	56.62	−8.70	2.33
Unemployed$^+$	18.28	22.53	19.78	−10.55	−3.82
Blue-collar worker$^+$	17.00	19.18	18.15	−5.67	−3.00
Self-employed$^+$	7.50	7.44	7.66	0.20	−0.62
Civil servant$^+$	6.76	6.10	6.70	2.72	0.26
Small company$^+$	19.74	19.50	20.20	0.62	−1.14
Small to medium company$^+$	20.11	20.12	19.09	−0.02	2.56
Medium company$^+$	15.54	15.34	16.21	0.55	−1.84
Large company$^+$	19.93	17.79	18.43	5.47	3.79
No company info$^+$	24.68	27.26	26.06	−5.87	−3.17
Major job worries$^+$	13.16	10.01	12.70	9.85	1.39
Some job worries$^+$	30.16	28.32	30.30	4.05	−0.29
No job worries$^+$	37.84	38.98	36.48	−2.34	2.83
No job worries info$^+$	18.83	22.69	20.53	−9.52	−4.28
Years full-time	13.39	15.22	13.88	−17.00	−4.96
Education					
Basic schooling$^+$	24.86	25.02	26.90	−0.37	−4.66
Intermediate schooling$^+$	42.41	42.75	41.85	−0.68	1.15
Technical college$^+$	8.04	6.22	6.96	7.08	4.12
Highest secondary$^+$	24.68	26.00	24.29	−3.04	0.90
No school degree yet$^+$	0.00	0.00	0.00		
Vocational training$^+$	77.70	70.49	75.78	16.50	4.54
University$^+$	22.67	25.60	22.89	−6.84	−0.53
Health					
Mental health	45.76	50.14	46.56	−41.05	−6.93
Physical health	52.34	51.38	52.16	10.55	2.00
Good health$^+$	54.11	55.93	54.79	−3.65	−1.36
Medium health$^+$	29.80	30.67	29.63	−1.89	0.37
Poor health$^+$	16.09	13.40	15.58	7.58	1.40
Height in centimeters	171.67	172.10	171.84	−4.61	−1.83
Body mass index	25.24	25.90	25.37	−13.50	−2.69
Underweight$^+$	2.38	1.79	2.42	4.14	−0.29
Overweight or obese$^+$	41.86	51.66	43.47	−19.72	−3.24
Obese$^+$	14.26	16.74	15.24	−6.85	−2.75
Heavy smoker$^+$	19.93	10.08	19.92	27.82	0.01

continued

Table 4.B.5 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	1.18	0.65	1.17	40.47	0.16
Baseline smoker[+]	43.33	24.41	43.33	40.78	0.00

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *divorce*. Matching is based on propensity score matching with an Epanechnikov kernel with bandwidth $k = 0.01$ and exact matching on marriage and smoking status. Columns (1), (2), and (3) display the means of the control variables before *divorce* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.B.6: Means of treated, unmatched controls, and matched controls (based on propensity score matching) – before death of partner

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	52.94	42.91	48.73	101.61	45.03
Female$^+$	76.70	53.23	65.01	50.71	25.92
Non-German$^+$	13.07	12.56	13.93	1.52	−2.52
Migrant$^+$	16.48	17.62	17.84	−3.03	−3.61
Home owner$^+$	53.41	52.43	54.38	1.95	−1.95
Married$^+$	80.68	63.27	80.68	39.48	0.00
Single$^+$	3.41	24.13	8.33	−63.02	−21.02
Separated$^+$	7.39	2.36	4.47	23.43	12.36
Divorced$^+$	3.98	8.65	4.14	−19.28	−0.83
Widowed$^+$	4.55	1.59	2.38	17.16	11.83
Children$^+$	20.45	43.64	34.69	−51.24	−32.22
Risk attitude	4.19	4.78	4.53	−25.04	−14.21
Labor market					
Tenure	15.45	10.84	13.19	42.45	19.89
Log labor earnings	6.82	8.31	7.51	−35.37	−15.39
Never unemployed$^+$	52.84	61.09	56.53	−16.69	−7.42
Unemployed$^+$	40.34	22.69	32.63	38.62	16.04
Blue-collar worker$^+$	14.20	19.33	16.87	−13.73	−7.36
Self-employed$^+$	7.39	7.26	6.91	0.47	1.85
Civil servant$^+$	5.68	5.87	6.33	−0.80	−2.73
Small company$^+$	11.93	19.65	15.61	−21.27	−10.69
Small to medium company$^+$	15.34	20.14	17.41	−12.57	−5.59
Medium company$^+$	12.50	15.22	13.49	−7.87	−2.94
Large company$^+$	14.77	17.53	16.36	−7.49	−4.38
No company info$^+$	45.45	27.45	37.12	38.01	16.96
Major job worries$^+$	5.68	10.15	7.55	−16.59	−7.50
Some job worries$^+$	18.18	28.28	22.60	−24.05	−10.98
No job worries$^+$	35.80	38.72	37.06	−6.05	−2.62
No job worries info$^+$	40.34	22.85	32.79	38.24	15.70
Years full-time	19.34	14.70	17.55	37.84	14.23
Education					
Basic schooling$^+$	38.64	25.49	33.06	28.40	11.63
Intermediate schooling$^+$	39.20	42.51	40.10	−6.72	−1.83
Technical college$^+$	5.68	6.39	5.86	−2.96	−0.76
Highest secondary$^+$	16.48	25.61	20.98	−22.52	−11.55
No school degree yet$^+$	0.00	0.00	0.00		
Vocational training$^+$	75.57	70.37	73.22	11.72	5.37
University$^+$	20.45	24.51	23.43	−9.70	−7.19
Health					
Mental health	49.62	50.03	49.94	−3.99	−3.12
Physical health	48.53	51.51	49.86	−31.67	−13.85
Good health$^+$	39.20	56.27	47.00	−34.63	−15.78
Medium health$^+$	43.18	30.49	37.81	26.51	10.95
Poor health$^+$	17.61	13.24	15.19	12.11	6.54
Height in centimeters	167.79	172.29	169.94	−49.38	−23.85
Body mass index	27.02	25.94	26.50	22.89	10.78
Underweight$^+$	0.57	0.55	0.60	0.20	−0.45
Overweight or obese$^+$	63.64	51.40	57.78	24.90	11.99
Obese$^+$	26.70	16.82	22.09	24.08	10.74
Heavy smoker$^+$	12.50	11.74	12.65	2.31	−0.45

continued

Table 4.B.6 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.84	0.80	0.84	3.18	0.38
Baseline smoker[+]	30.68	30.35	30.68	0.72	0.00

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *death of partner*. Matching is based on propensity score matching with an Epanechnikov kernel with bandwidth $k = 0.01$ and exact matching on marriage and smoking status. Columns (1), (2), and (3) display the means of the control variables before *death of partner* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.B.7: Means of treated, unmatched controls, and matched controls (based on propensity score matching) – before death of mother

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	49.00	42.63	47.90	60.94	11.43
Female$^+$	54.27	53.66	54.22	1.23	0.11
Non-German$^+$	12.40	13.64	12.93	−3.71	−1.61
Migrant$^+$	16.16	18.72	16.83	−6.74	−1.80
Home owner$^+$	60.64	51.58	59.08	18.32	3.18
Married$^+$	71.19	61.70	71.19	20.20	0.00
Single$^+$	14.15	25.18	15.03	−28.00	−2.47
Separated$^+$	2.51	2.54	2.38	−0.16	0.86
Divorced$^+$	9.88	8.97	9.36	3.11	1.77
Widowed$^+$	2.26	1.62	2.05	4.68	1.49
Children$^+$	36.26	43.53	38.29	−14.87	−4.19
Risk attitude	4.72	4.79	4.76	−3.07	−1.68
Labor market					
Tenure	14.24	10.67	13.47	33.75	7.00
Log labor earnings	8.33	8.27	8.29	1.50	0.89
Never unemployed$^+$	60.64	60.72	60.54	−0.18	0.19
Unemployed$^+$	22.03	23.05	22.54	−2.45	−1.24
Blue-collar worker$^+$	20.27	19.33	20.21	2.37	0.14
Self-employed$^+$	7.45	7.18	7.36	1.06	0.34
Civil servant$^+$	8.54	5.72	7.47	10.99	3.94
Small company$^+$	16.50	19.69	17.39	−8.30	−2.36
Small to medium company$^+$	20.35	20.05	20.26	0.75	0.22
Medium company$^+$	15.58	15.11	15.39	1.29	0.51
Large company$^+$	20.52	17.35	19.68	8.10	2.11
No company info$^+$	27.05	27.80	27.28	−1.67	−0.52
Major job worries$^+$	9.30	10.22	9.51	−3.12	−0.72
Some job worries$^+$	26.13	28.18	26.68	−4.60	−1.25
No job worries$^+$	41.29	38.43	40.32	5.83	1.97
No job worries info$^+$	23.28	23.17	23.49	0.28	−0.49
Years full-time	19.04	14.47	18.24	38.60	6.59
Education					
Basic schooling$^+$	28.39	25.56	28.26	6.39	0.29
Intermediate schooling$^+$	42.80	42.60	42.93	0.41	−0.28
Technical college$^+$	5.53	6.35	5.67	−3.48	−0.61
Highest secondary$^+$	23.28	25.50	23.14	−5.16	0.34
No school degree yet$^+$	0.00	0.00	0.00		
Vocational training$^+$	72.86	69.81	72.83	6.75	0.08
University$^+$	27.55	24.18	26.48	7.70	2.43
Health					
Mental health	49.37	49.98	49.54	−6.21	−1.70
Physical health	49.44	51.56	49.83	−23.34	−4.16
Good health$^+$	46.48	56.43	48.40	−20.00	−3.85
Medium health$^+$	36.35	30.26	35.14	12.95	2.52
Poor health$^+$	17.17	13.31	16.46	10.74	1.91
Height in centimeters	171.77	172.24	171.81	−5.08	−0.43
Body mass index	26.25	25.81	26.20	9.15	1.16
Underweight$^+$	1.34	1.99	1.39	−5.09	−0.43
Overweight or obese$^+$	55.19	50.58	54.69	9.25	1.01
Obese$^+$	18.09	16.55	17.96	4.08	0.34
Heavy smoker$^+$	12.73	12.11	12.56	1.88	0.52

continued

Table 4.B.7 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.82	0.83	0.81	−1.03	0.23
Baseline smoker[+]	30.49	31.57	30.49	−2.35	0.00

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *death of mother*. Matching is based on propensity score matching with an Epanechnikov kernel with bandwidth $k = 0.01$ and exact matching on marriage and smoking status. Columns (1), (2), and (3) display the means of the control variables before *death of mother* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

TABLE 4.B.8: Means of treated, unmatched controls, and matched controls (based on propensity score matching) – before death of father

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Demographics					
Age	45.35	42.32	44.74	28.30	6.07
Female$^+$	53.31	53.58	53.47	−0.54	−0.32
Non-German$^+$	12.19	13.55	12.68	−4.06	−1.49
Migrant$^+$	16.13	18.76	16.83	−6.93	−1.87
Home owner$^+$	55.39	51.87	54.78	7.06	1.23
Married$^+$	67.51	60.76	67.51	14.12	0.00
Single$^+$	18.29	26.27	19.14	−19.26	−2.18
Separated$^+$	2.45	2.51	2.40	−0.35	0.33
Divorced$^+$	10.63	8.85	9.76	5.99	2.89
Widowed$^+$	1.12	1.61	1.19	−4.29	−0.71
Children$^+$	44.54	43.49	44.51	2.11	0.05
Risk attitude	4.66	4.80	4.78	−6.37	−5.09
Labor market					
Tenure	12.58	10.67	12.12	18.63	4.47
Log labor earnings	8.73	8.18	8.58	15.07	4.34
Never unemployed$^+$	60.82	61.30	60.89	−0.98	−0.15
Unemployed$^+$	18.22	24.04	19.85	−14.29	−4.17
Blue-collar worker$^+$	18.29	19.13	18.83	−2.15	−1.39
Self-employed$^+$	9.00	7.06	8.34	7.13	2.33
Civil servant$^+$	6.25	5.67	6.24	2.42	0.00
Small company$^+$	18.22	19.44	18.70	−3.13	−1.24
Small to medium company$^+$	22.01	19.78	21.23	5.48	1.88
Medium company$^+$	17.77	14.89	16.80	7.80	2.57
Large company$^+$	18.59	17.15	18.42	3.74	0.44
No company info$^+$	23.42	28.74	24.86	−12.14	−3.35
Major job worries$^+$	11.08	10.07	10.71	3.27	1.20
Some job worries$^+$	31.60	27.73	30.14	8.47	3.16
No job worries$^+$	37.32	38.10	38.16	−1.61	−1.72
No job worries info$^+$	20.00	24.09	21.00	−9.88	−2.47
Years full-time	16.50	14.29	16.01	19.33	4.30
Education					
Basic schooling$^+$	24.83	25.19	25.36	−0.83	−1.22
Intermediate schooling$^+$	41.78	42.00	42.19	−0.44	−0.82
Technical college$^+$	7.36	6.24	6.85	4.45	1.98
Highest secondary$^+$	25.72	25.13	25.13	1.36	1.37
No school degree yet$^+$	0.30	1.44	0.47	−12.30	−2.81
Vocational training$^+$	73.61	68.80	72.85	10.62	1.70
University$^+$	29.37	23.82	27.51	12.58	4.12
Health					
Mental health	48.94	49.99	49.37	−10.67	−4.31
Physical health	50.80	51.63	50.96	−9.24	−1.75
Good health$^+$	52.04	56.75	53.27	−9.45	−2.46
Medium health$^+$	33.53	30.07	32.39	7.44	2.44
Poor health$^+$	14.42	13.19	14.34	3.59	0.23
Height in centimeters	172.74	172.26	172.55	5.10	2.07
Body mass index	26.23	25.77	26.13	9.52	2.02
Underweight$^+$	0.74	1.88	0.92	−10.01	−1.95
Overweight or obese$^+$	54.50	50.17	53.57	8.66	1.87
Obese$^+$	18.44	16.38	17.82	5.44	1.61
Heavy smoker$^+$	12.12	11.89	12.10	0.71	0.07

continued

Table 4.B.8 – continued from previous page

		Controls		Standardized bias (in %)	
Variable	(1) Treated	(2) Unmatched	(3) Matched	(4) Unmatched	(5) Matched
Log no. of cigarettes/day[a]	0.83	0.82	0.83	1.00	0.09
Baseline smoker[+]	31.38	31.14	31.38	0.52	0.00

Notes: This table presents summary statistics for treated, all controls, and matched controls with the treatment variable being *death of father*. Matching is based on propensity score matching with an Epanechnikov kernel with bandwidth $k = 0.01$ and exact matching on marriage and smoking status. Columns (1), (2), and (3) display the means of the control variables before *death of father* for treated, unmatched controls, and matched controls, respectively. [+] Mean represents a percentage share. [a] Includes non-smokers.

Abstracts and Current Status of Papers (§6 (6) PromO 2014)

Chapter 2:
Relative Wealth Placement and Risk-taking Behavior

Abstract (English): This study provides evidence that relative wealth placement substantially impacts risk-taking. We derive predictions on risk-taking in a standard portfolio problem in which individuals care about their placement in the wealth distribution relative to peers. In an incentivized laboratory experiment, we compare investment decisions between subjects who receive the same absolute endowment but who differ in relative wealth placement. Consistent with our theoretical predictions, we find that introducing information on other subjects' endowments significantly changes risk-taking; and individuals placed at the bottom (top) of their wealth distribution exhibit more (less) risk-taking—changing invested amounts by up to 50 percent.

Abstract (German): Diese Studie zeigt, dass die relative Positionierung in der Vermögensverteilung einen wesentlichen Einfluss auf das Risikoverhalten eines Individuums hat. In einem Standard-Portfolioproblem leiten wir theoretische Erklärungsansätze zum individuellen Risikoverhalten ab, bei denen der Nutzen auch von der Platzierung in der Vermögensverteilung im Vergleich zu einer Referenzgruppe abhängt. In einem anreizkompatiblen Laborexperiment werden dann Investitionsentscheidungen zwischen Probanden verglichen, die das gleiche absolute Vermögen erhielten, sich jedoch in Hinblick auf ihre relative Vermögensplatzierung unterscheiden. Hierbei können wir – konsistent mit unseren theoretischen Vorhersagen – feststellen, dass sich das Risikoverhalten der Probanden signifikant verändert, wenn diese über die Vermögensverteilung informiert werden. Darüber hinaus weisen Personen, die am unteren (oberen) Ende der relativen Vermögensverteilung platziert sind, eine höhere (geringere) Risikobereitschaft auf. Dabei verändern sich die Investitionsbeträge um bis zu 50 Prozent.

Current status: To be submitted to the journal "Management Science"

Chapter 3:
What Drives the Willingness to Pay for Insurance Contracts with Nonperformance Risk? Experimental Evidence

Abstract (English): An insurance contract may be nonperforming—resulting in a situation in which the insured might be worse off than without insurance since the insured also loses the premium. This study analyzes different drivers influencing the willingness to pay for insurance contracts with inherent contract nonperformance risk. In an incentive-compatible laboratory experiment, subjects state their maximum willingness to pay for three different insurance contracts, which only differ in their risk of insurer nonperformance. While the median willingness to pay for no-default contracts is above the actuarially fair premium, both the mere existence of default risk (only 0.1 percent) and an increase in default risk sharply decrease participants' median willingness to pay below the actuarially fair premia. Individuals, thus, are willing to pay considerably more for default-free insurance policies. Among others, the willingness to pay is influenced by framing, age, self-assessed risk attitude, and gender.

Abstract (German): Ein Versicherungsvertrag kann ausfallen, was zur Folge haben kann, dass der Versicherte schlechter gestellt ist als ohne Versicherungsvertrag, da der Versicherungsnehmer nicht (oder nur teilweise) entschädigt wird und zusätzlich die Kosten der Versicherungsprämie tragen muss. In dieser Studie werden verschiedene Einflussfaktoren analysiert, die die Zahlungsbereitschaft für Versicherungsverträge mit innewohnendem Vertragsausfallrisiko beeinflussen. In einem anreizkompatiblen Laborexperiment geben die Probanden ihre maximale Zahlungsbereitschaft für drei verschiedene Versicherungsverträge an, die sich nur in ihrem Ausfallrisiko unterscheiden. Während die Zahlungsbereitschaft für den ausfallfreien Versicherungsvertrag im Median über der versicherungsmathematisch fairen Prämie liegt, senken sowohl die bloße Existenz eines Ausfallrisikos (von nur 0,1 Prozent) als auch ein weiteres Ansteigen des Ausfallrisikos die Zahlungsbereitschaft der Probanden im Median. Diese Zahlungsbereitschaft sinkt hierbei im Median unter die versicherungsmathematisch fairen Prämien. Die Probanden sind somit bereit, einen Aufschlag für ausfallfreie Versicherungsverträge zu bezahlen. Weitere Einflussfaktoren der Zahlungsbereitschaft sind u. a. Framing, das Alter, die selbst eingeschätzte Risikobereitschaft und das Geschlecht.

Current status: Submitted to the journal "Journal of Risk and Uncertainty"

Chapter 4:
Impact of Family Events on Smoking Behavior and Body Weight

Abstract (English): This study examines whether and how family events affect individuals' smoking behavior and body weight using German Socio-Economic Panel data. Changes in family composition, such as moving together with or separating from the partner or the death of a family member, impact the probability to start or quit smoking and lead to changes in body weight. To account for differences between treatment and control groups, regression-adjusted matching is employed. In particular, I find that smoking behavior and body weight are predominantly affected by forming or dissolving a household, rather than by marriage or divorce: cohabitation leads to weight gain; separation from a partner leads to weight loss, increased smoking initiation, and decreased smoking cessation.

Abstract (German): Diese Studie untersucht anhand von Daten des Sozio-oekonomischen Panels, ob und wie Familienereignisse das Rauchverhalten und das Körpergewicht beeinflussen. Die Wahrscheinlichkeit, mit dem Rauchen zu beginnen oder aufzuhören, als auch Veränderungen im Körpergewicht werden dabei durch Veränderungen in der Familienzusammensetzung, wie beispielsweise dem Zusammenziehen mit dem Lebenspartner, der Trennung vom Lebenspartner oder vom Tod eines nahen Familienangehörigen, beeinflusst. Um die Unterschiede zwischen Versuchs- und Kontrollgruppen zu berücksichtigen, wird Regression-adjusted-Matching verwendet. Dabei kann festgestellt werden, dass das Rauchverhalten und das Körpergewicht maßgeblich durch die Gründung und Auflösung eines gemeinsamen Haushalt mit dem Lebenspartner beeinflusst werden; und nicht etwa durch Heirat oder Scheidung. Das Zusammenziehen mit dem Lebenspartner führt dabei zu Gewichtszunahmen, während die Trennung vom Lebenspartner zu einer Gewichtsabnahme führt, die Wahrscheinlichkeit, mit dem Rauchen anzufangen, erhöht und die Wahrscheinlichkeit, mit dem Rauchen aufzuhören, reduziert.

Current status: Submitted to the journal "Journal of Health Economics"

Statement of Personal Contribution (§ 6 (4) PromO 2014)

Chapter 2, entitled "Relative Wealth Placement and Risk-taking Behavior", is co-authored with Petra Steinorth (PS). Chapter 3, entitled "What Drives the Willingness to Pay for Insurance Contracts with Nonperformance Risk? Experimental Evidence", and Chapter 4, entitled "Impact of Family Events on Smoking Behavior and Body Weight", are single-authored papers written by Marc-André Hillebrandt (MH).

The table below presents the author contributions in this dissertation's co-authored papers.

	Chapter 2	
	MH	PS
Development of research idea	✓	✓
Literature review	✓	✓
Formal model	✓	✓
Experimental design	✓	✓
Execution of experiment	✓	
Methodology & data curation	✓	✓
Writing – original draft	✓	✓
Writing – review & editing	✓	✓
Funding acquisition	✓	✓

Notes: This table presents the author contributions in this dissertation's co-authored papers. MH: Marc-André Hillebrandt; PS: Petra Steinorth.

List of Publications (§ 6 (6) PromO 2014)

Conference Presentations

Hillebrandt, Marc-André and Petra Steinorth (2020): "Relative Wealth Placement and Risk-taking Behavior". European Economic Association. Virtual *[presented by co-author]*.

Hillebrandt, Marc-André and Petra Steinorth (2020): "Relative Wealth Placement and Risk-taking Behavior". World Risk and Insurance Economics Congress. Virtual.

Hillebrandt, Marc-André and Petra Steinorth (2019): "Relative Wealth Placement and Risk-taking Behavior". Nordic Conference on Behavioral and Experimental Economics. Kiel, Germany.

Hillebrandt, Marc-André and Petra Steinorth (2019): "Relative Wealth Placement and Risk-taking Behavior". European Group of Risk and Insurance Economists. Rome, Italy.

Hillebrandt, Marc-André and Petra Steinorth (2018): "Relative Wealth Placement and Risk-taking Behavior". 2nd Frankfurt Insurance Research Workshop. Frankfurt, Germany.

Working Papers

Hillebrandt, Marc-André and Petra Steinorth (2020): "Relative Wealth Placement and Risk-taking Behavior". Working Paper.

Hillebrandt, Marc-André (2020): "What Drives the Willingness to Pay for Insurance Contracts with Nonperformance Risk? Experimental Evidence". Working Paper.

Hillebrandt, Marc-André (2020): "Impact of Family Events on Smoking Behavior and Body Weight". Working Paper.

Affidavit

I hereby declare, Marc-André Hillebrandt (geb. Müller), in lieu of an oath, that I have written the dissertation entitled

"Essays on Behavioral Aspects of Risk and Insurance"

autonomously – and if in cooperation with other scientists as described in the attached statement according to § 6 (4) of the doctoral regulations of the Faculty of Business Administration dated July 9, 2014 – and that I did not use any other aids than those I indicated herein. The parts taken literally or by sense from other works than mine are marked as such.

I assure that I did not take advantage of any commercial doctoral consultation nor was my work accepted or judged insufficient in an earlier doctoral procedure at home or abroad.

Place, Date	Signature