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Risk-taking under Different Welfare-state Regimes: Some Experimental Evidence

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Abstract In this paper we investigate risk-taking under different welfare-state regimes. We provide a simple model of the welfare state where individuals have to meet a minimum income in order to enable social participation. We analyze optimum investment behavior under different need-based redistribution schemes. The model is tested in a laboratory experiment where subjects have to decide from under a veil of ignorance on how much of their initial endowments they want to invest into a risky and productive asset. We show that need-based redistribution generally decreases inequality and increases efficiency by stimulating higher investments. Means-tested need-based redistribution is most efficient but leads to more inequality than lump-sum transfer.

Keywords: Need, Minimum Income, Redistribution, Inequality, Experiment

JEL classification: H2, D31, D8

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1 Introduction

Welfare states have two main functions: providing insurance against income and cost risk (social insurance) and pure redistribution (social assistance) (Barr 2012). In this paper, we focus on the insurance function of the welfare state. According to the theory by Sinn (1996), the welfare state has both an insurance and an income effect. These two effects might induce an increase in productive risk taking, thereby increasing the sum of lifetime incomes, but potentially also their inequality. For a welfare state to be considered sustainable, its redistribution processes should increase efficiency, while decreasing inequality.

However, the general definition of social insurance does not guarantee that possible losses in lifetime income due to risk taking are sufficiently covered in order to reach a certain income threshold that is *needed* for social participation. Therefore, Raphael (1980), Nussbaum (2000, 2011) and Benbaji (2006) developed slightly differing concepts of specified need thresholds, which the state should provide for. However, the effect of (not) covering such needs has largely been neglected in current research. With this experimental study, we add to the literature by modeling the existence of needs for social participation in the context of risky investment decisions under different welfare-state regimes.

For this purpose, we expand Traub and Krügel's (2017) model of a society of eight impartial observers in the Harsanyian sense (Harsanyi 1953, 1955, 1978) by the constraint of a threshold income needed for social participation, as well as different welfare systems and parametrizations. In our experiment, subjects face a lottery where possible outcomes are determined by a risky investment. If the lottery payoff falls short of the threshold income, we model need by setting all payoffs below the threshold to zero, implying that there is no utility in this case.

Our results show that investments differ significantly between our different parametrizations of social insurance. A means-tested minimum income leads to the highest efficiency as it prevents subjects from experiencing need, but is not very effective in reducing inequality. Progressive tax schemes perform better in reducing inequality, but cannot prevent some subjects from experiencing need. Thus, it seems important not to reduce welfare states to their insurance function alone, but rather to design them in such way that ensures social participation and effectively reduces inequality.

In Section 2, we start our study with a short overview on the literature on investment and redistribution in welfare states and under need. We continue introducing the experiment and our working hypotheses in Section 3. The results are presented in Section 4. Section 5 concludes the paper.

2 Literature Review

The welfare state redistributes income from higher to lower income positions, which is possible since a society's income distribution is typically positively skewed. This is a core element of many income-redistribution models in the political economy (e.g., the Meltzer-Richard model (Meltzer and Richard (1981); for a literature overview, see Moene and Wallerstein (2001)) and also in line with the findings of empirical observations (see, for example, Mincer (1970); Castañeda et al. (2003); and Atkinson and Bourguignon (2015)). Gibrat (1931) showed that the distribution of personal incomes can be modeled as the outcome of a multiplicative stochastic process, which considers relative income change as a time-independent random variable ("law of proportional effect").

Friedman (1953) explained the existence of these differences in lifetime income and the resulting distribution as a consequence of individuals' risk choices that aim to maximize expected utility. His individualistic approach was criticized by Kanbur (1979), who demonstrated that greater diversity in risk preferences does not necessarily lead to more societal inequality in a general equilibrium framework, and that the relationship between risk taking and inequality is not necessarily monotonic. Nevertheless, Friedman's (1953) individualistic concept of social welfare has influenced many other authors.

Around the same time, Harsanyi (1953, 1955, 1978) developed his concept of utilitarianism, which proves that under interpersonally comparable cardinal utility, expected utility maximization (Friedman and Savage 1948) equals welfare maximization. Assuming that people do not know the future, they consider all future income positions as equally likely ("equiprobability model"). Therefore, they have to maximize their utility from under a veil of ignorance which makes them act as impartial welfare maximizers. This implies that in the Friedman-Harsanyi framework, individual risk aversion and societal inequality aversion completely amalgamate.[1]

This notion is challenged by experiments that show that individual risk and social inequality are perceived differently, e.g. by Amiel and Cowell (2002), Kroll and Davidovitz (2003) and Traub et al. (2009). The latter study also shows that, unlike randomizing uninvolved social planners, involved social planners behave inequality averse. This highlights that inequality aversion in groups is an important aspect of welfare states.

Other strands of the welfare state literature consider the effects of taxation and redistribution, which is relevant for our focus on sustainability of a welfare state. While a vast amount of literature focuses on optimum taxation (e.g. Chamley

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[1] Harsanyi's model has attracted a lot of criticism. See, for example, Diamond (1967), Rawls (1971, 1974) and Harsanyi's reply (Harsanyi 1975a,b).

(1986) and Diamond et al. (1980)) or induced welfare losses due to moral hazard issues (e.g. Arnott and Stiglitz (1991) and Lindbeck (1995)), others focus on the influence of redistribution on investments. [2] Our study focuses on the influence of (different) redistribution schemes on risk-taking. According to Domar and Musgrave (1944), investments increase under redistribution, since redistribution reduces the variance in incomes.

However, the inclusion of needs is mostly neglected in the analysis of the welfare state, which is especially surprising as the existence of needs is a well established concept in the economic literature.[3] Deaton and Muellbauer (1980) established the by now common concept that necessities or basic needs are those goods for which people have an income elasticity less than one. Defining basic needs as food, energy, clothing and housing, Baxter and Moosa (1996) use macro level data to show that basic needs expenditure is indeed stable whereas other consumption is volatile and varies with time and income.

These findings, however, do not allow for a single uniform definition of basic goods, since the given diversity of people implies that needs within a society are heterogeneous (see Doyal and Gough (1991)). How to define needs is therefore a major point of discussion in the literature on social justice, especially since needs encompass not only a biological minimum, but also goods and activities that make up a normal human life. While the actual definition of needs is disputed, it is often commonly agreed upon that the coverage of basic needs is a mandatory criterion for social justice (see e.g. (Lindenberg 2013), and, for an overview, Konow (2003)). This can also be confirmed by redistribution experiments, e.g. by Cappelen et al. (2013). Therefore, redistribution to ensure the coverage of basic needs may be understood as a common goal of welfare states. Which needs are actually ensured within a welfare state should, according to Nussbaum (2000, 2011), depend on a consensus within the society on the recognition of needs and the extent of their realization. Furthermore, the author suggested the concept of need thresholds, which she interprets as “certain threshold level of combined capability in the sense [...] of substantial freedom to choose and act”(Nussbaum 2011, p. 24).

The concept of a need threshold seems related to the idea of a means-tested minimum income, which might be an adequate solution to cover basic needs, even though it does not allow for heterogeneity. Raphael (1980) suggests to first ensure a basic minimum for all individuals above which they might decide freely over efficiency. That society’s consensus might actually result in a Raphaelian concept is suggested by the findings of Frohlich and Oppenheimer’s (1990) experimental

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[2] See e.g. Alan et al. (2010) and Feldstein (1969), who analyze how taxation under uncertainty influences asset choices.

[3] See, for example, Marx (1875, p. 27) (“[...] to each according to their needs”) or Smith (1759), who argues that *necessities* are not only goods needed for survival but also to be respected by equal society members.

study. They show that subjects in a productive society mostly consent on payoff maximization under the constraint of income floors for the worst-off individuals as the preferred principle of distributive justice. Indeed, most Organization for Economic Co-operation and Development (OECD) countries provide minimum-income transfers, which differ in the extent they shape distributional outcomes, but can all be characterized as simple income floors (Immervoll 2012).

In this paper, we close the research gap on how the (non-)coverage of basic needs in different welfare regimes influences productive risk-taking, efficiency and sustainability within a society. Therefore, we base our theoretical model (Section 2) and our experimental design (Section 3) not only on the individualistic approach to social welfare pioneered by Friedman (1953) and Harsanyi (1955), but additionally include needs. For this purpose, we assume that people need a certain amount of income that allows for social participation. This need threshold is addressed by three different redistribution systems: a simple proportional tax, a progressive tax, and a means-tested minimum income. These regimes lead to different shapes of the income distribution in terms of efficiency, equality and need-coverage. In our experiment, we use a neutral framing in order to avoid the framing effects found by Fochmann and Hemmerich (2014), and let individual decision makers act as social planners for their preferred society's income distribution, which they determine via productive investments. We expect that inequality reduction and efficiency differences determine the amount of investments, and that the specific insurance of needs is the most suitable approach.

3 The Experiment

Our experiment models a simplified version of the welfare state that focuses on investment decisions under risk and a need constraint, and neglects other aspects of a welfare state, such as optimum taxation or incentives for labor effort.

We follow Friedman's (1953) and Harsanyi's (1955) individual-choice approach to social welfare and assume that in a welfare state, the decision-maker becomes a member of the respective society after having made her investment choice under the veil of ignorance. We follow Harsanyi's impartial observer theorem and assume that individual maximization of cardinal utility equals maximization of an utalitarian welfare function. Hence, the investors' preference for payoff (expected value) and risk (standard deviation) equal the society's efficiency and inequality preferences, respectively. This is the theoretical foundation of the experiment's main part, which we describe in Section 3.1. We also conducted two additional tasks to elicit risk and distributional preferences of subjects (Section 3.3).

3.1 The Investment Task

The payoff structure of the experiment closely follows the model of Sinn (1996), and is related to a design used by Traub and Krügel (2017).

At the beginning of each round, subjects receive an endowment of $Y_0 = 100$ points each, and are randomly assigned to groups of eight. Each group can be interpreted as a small stylized society in the sense of Friedman (1953) and Harsanyi (1955). Then, the participants act as involved social planners by simultaneously and anonymously choosing their preferred individual investment V_0, where $0 \leq V_0 \leq 100$. The investment can either result in a gain or a loss and determines the society's publicly known income distribution in each of the five treatments and three parametrizations. The subjects' payoff per round is determined by the outcome of the risky investment plus the residual amount of $Y_0 - V_0$, as long as the need threshold implemented in some treatments is reached, otherwise the payoff is set to zero. To maintain a subject's attention during the 15 rounds, the experiment is highly incentivized, with 100 points being converted into 10 €. Furthermore, to avoid wealth effects, only one of all eight group members' dictator's decisions is randomly chosen at the end of the experiment and implemented for all group members with a probability of $p = \frac{1}{120}$. This common fate also strengthens the group context of the decision (Kramer and Brewer 1986).

While subjects know the income distribution resulting from their investment, they do not know which of the available income positions will be theirs, as we assume that success after investments is determined randomly. With this approach, we follow the observation that individual income can be mainly or partly characterized stochastically, as emphasized by e.g. Jencks (1972), Lillard and Willis (1978), and Meghir and Pistaferri (2004). To model the random results of investments, the resulting income distribution is determined by a "super lottery" (Wagner 1958) with positive expectation. It consists of a sequence of 3 independent Bernoulli trials with success probability $p = 0.5$. This can be illustrated using a coin toss, where heads wins ("success") and tails loses ("failure"). The outcome of the tth lottery is denoted with $z_t = \{0\,(\text{failure}), 1\,(\text{success})\}$, and the total number of successful investments $x = \sum_{t=0}^{3} z_t$ is a random variable. After each lottery, investment V_0 yields an interest rate of r^+ in case of success, and r^- in case of failure, with $r^+ > 0 > r^-$. Accumulated return to investment ϕ is determined by the cases of success x after 3 lotteries, so that

$$\phi = (1 + r^+)^x (1 + r^-)^{3-x}. \tag{1}$$

V_0's interest rates r^+ and r^- are exogenously varied for each parametrization to test the influence of different risk levels and different expected values of the lottery. Table 1 displays the three different variations, which we call *Basic*, *High Inequality* and *High Efficiency*.

Table 1: Round-Variation of Parameter Values

	Basic	High Efficiency	High Inequality
r^+	0.6	0.7	0.9
r^-	-0.4	-0.4	-0.7

In the *Basic* parametrization, r^+ and r^- are given with 0.6 and -0.4 respectively. In *High Efficiency*, the value for r^+ increases from 0.6 in *Basic* to 0.7, while r^- remains at 0.4, which increases the mean profitability of the asset. The variation *High Inequality* has higher values of both r^+ and r^-, and thus gives a higher standard deviation of outcomes.

As the coin toss for r^+ or r^- is repeated three times, the investment generates $2^3 = 8$ possible outcomes that all have an individual probability of 1/8. The outcomes are referred to as positions $\{A, B, C, D, E, F, G, H\}$, respectively. Having submitted their investment V_0 for all rounds, one round and one dictator's decision is randomly chosen by the computer. Then, each group member is randomly assigned to one of the eight positions. Each position, as well as the corresponding payoff, is given out only within each group, based on the V_0 of the dictator and the parametrization of the chosen round.

The possible coin toss outcomes, along with the corresponding income positions and payoffs per point, are depicted in Table 2. It can be seen that the sequence of three coin tosses in combination with the higher interest rate of success leads to a positively skewed income distribution, which is typical for OECD countries and predicted by stochastic theories of income distribution.

Table 2: Coin Toss and Position

1^{st} coin toss	H				T			
2^{nd} coin toss	HH		HT		TH		TT	
3^{rd} coin toss	HHH	HHT	HTH	THH	HTT	THT	TTH	TTT
Position	A	B	C	D	E	F	G	H
Payoff per point $\phi = ((1+r^+)^x(1+r^-)^{3-x})$:								
ϕ Basic	4.096	1.536	1.536	1.536	0.576	0.576	0.576	0.216
ϕ High Efficiency	4.913	1.734	1.734	1.734	0.612	0.612	0.612	0.216
ϕ High Inequality	6.859	1.083	1.083	1.083	0.171	0.171	0.171	0.027

Notes: 'H'= heads (success) means a multiplication with $(1+r^+)$, with $1 > r^+ > 0$; 'T'= tails (failure) means a multiplication with $(1 + r^-)$, with $-1 < r^- < 0$. For specifications of r^+ and r^-, see Table 1.

This investment task with the three parametrizations is played in five different variations (= 15 rounds). We use a within-subjects-design. *No Tax* is our control treatment. Here, an influence-free income distribution is generated, determined only by investment V_0 and the random ϕ_i, which can be understood as the gross income after three coin flips and before taxes or need considerations, Y_3^G.

$$Y_3 = Y_3^G = 100 + (\phi_i - 1)V_0. \tag{2}$$

No Tax – Need is the baseline treatment, also without redistribution, but with the constraint of the need threshold β. Following the different approaches mentioned in Part 2, our model understands need β as either a fixed, absolute number of income needed for living, or a relative measure of poverty. Below this threshold, social participation is not possible, and no utility is gained for the affected society member. Therefore, need is modeled by setting all payoffs which fall short of the need threshold β to zero. We use this simple procedure instead of a more complex Stone-Geary utility function, which discounts all utility levels for need.

We also test two different need schemes "between-subjects" and model the need threshold β either as a relative or a fixed need threshold, depending on the session. Hence, only one of these definitions for β is used per session. The relative need threshold equals 60% of the influence-free *No Tax* treatment's mean income for each V_0.[4] The fixed need threshold is set at 80 points, since this leads to the same income distributions as the relative need specification for all-in investments ($V_0 = 100$).

This leads to the following income definition for the *No Tax – Need* treatment:

$$Y_3 = 100 + (\phi_i - 1)V_0, \text{ if } Y_3 \geq \beta, \text{ otherwise } Y_3 = 0. \tag{3}$$

Note that this interpretation of need also implies that there is no monotonic increasing relation between efficiency and inequality: when society members experience need and are excluded from social participation, the expected value of the lottery decreases sharply, while risk increases. This is depicted in more detail in Figures 1 and 2, see part 3.1.

To test the influence of different redistribution regimes on investment, we further conduct one influence-free control treatment and three redistribution treatments: a proportional *Tax* treatment, a *Lump Sum* treatment, and a *Means-Tested* minimum income scheme.

In the *Tax* treatment, gains and losses are reduced by τ, which is set at 0.4. The payoff of the *Tax* treatment is hence determined by

$$Y_3 = Y_3^G - (Y_3^G - Y_0)\tau, \text{ if } Y_3 \geq \beta, \text{ otherwise } Y_3 = 0, \tag{4}$$

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[4] This definition is based on the often used poverty definition of 60% of the median income. Nevertheless, for reasons of simplicity and since our income distributions are per definition free of outliers, we use the mean instead of the median.

with Y_3^G depicting the gross income after three coin flips, before taxes or need are considered. As the income distribution is positively skewed, more taxes are taken from the upper income positions than handed down to the lower income positions. This inefficiency reduces welfare in the *Tax* treatment, but is addressed in the *Lump Sum* treatment. Here, gains and losses are also taxed by τ, but additionally the resulting surplus is equally split between all subjects. Therefore, each position receives a lump-sum transfer γ, which is defined as:

$$\gamma = \tau V_0 \sum_{x=0}^{3} f_X(x)(\phi - 1), \tag{5}$$

with x being the number of coin tosses. Given the parameters $r^+ = 0.6$, $r^- = -0.4$ and $\tau = 0.4$, γ amounts to 13.2% of the chosen investment V_0. Hence, payoffs in the *Lump Sum* treatment result from the subjects' investment decision V_0, her lottery outcome ϕ_i, the added or subtracted tax τ and the lump sum payment γ:

$$Y_3 = Y_3^G - (Y_3^G - Y_0)\tau + \gamma, \text{ if } Y_3 \geq \beta, \text{ otherwise } Y_3 = 0 \tag{6}$$

In the *Means-Tested* treatment, a minimum income ensures that the need threshold β is reached. If the payoff resulting from the invested V_0 and the lottery outcome ϕ_i falls short of β, then the missing amount is transfered via a tax τ_{MT} from the rich income positions to the poor positions (either only H, or E, F, G and H) until β is reached.[5] Note that τ_{MT} is endogenously determined by the amount needed to lift all income positions to β and the amount of payoff above β:

$$\tau_{MT} = \frac{\sum(\beta - Y_3^G), \text{ for all } Y_3^G - \beta < 0}{\sum Y_3^G, \text{for all } Y_3^G - \beta \geq 0}, \tag{7}$$

The effective τ_{MT} hence varies with V_0, as the latter determines the total sum of income and the different positions. The payoff in the *Means-Tested* treatment is calculated as:

$$Y_3 = 100 + (\phi_i - 1)V_0(1 - \tau_{MT}), \text{ if } Y_3 \geq \beta, \text{ otherwise } Y_3 = \beta \tag{8}$$

Table 3 shows the calculation of payoffs in the different treatments.

This payoff calculation leads to different relations of expected value and risk to investment, as depicted in Figures 1 and 2 for the *High Efficiency* parametrization. While risk increases continuously with investment, the expected value decreases

Table 3: Payoff Function by Treatment

Treatment	Calculation of payoff	
NO TAX	$Y_3^G = Y_0 + (\phi_i - 1)V_0$	
NO TAX – NEED	$Y_3 = Y_0 + (\phi_i - 1)V_0,$	if $Y_3 \geq \beta$, otherwise $Y_3 = 0$
TAX	$Y_3 = Y_3^G - (Y_3^G - Y_0)\tau,$	if $Y_3 \geq \beta$, otherwise $Y_3 = 0$
LUMP SUM	$Y_3 = Y_3^G - (Y_3^G - Y_0)\tau + \gamma,$	if $Y_3 \geq \beta$, otherwise $Y_3 = 0$
MEANS-TESTED	$Y_3 = Y_0 + (\phi_i - 1)V_0(1 - \tau_{MT}),$	if $Y_3 \geq \beta$, otherwise $Y_3 = \beta$

Notes: $\tau = 0.4$. Values of ϕ_i vary by parametrization and can be found in Table 2. Parameters γ and τ_{MT} are defined in Equations 5 and 7.

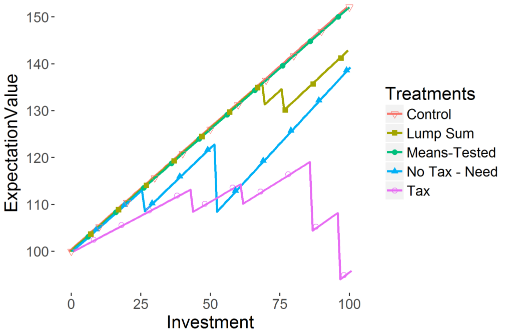

Figure 1: Expected Value per V_0, High Efficiency Parametrization

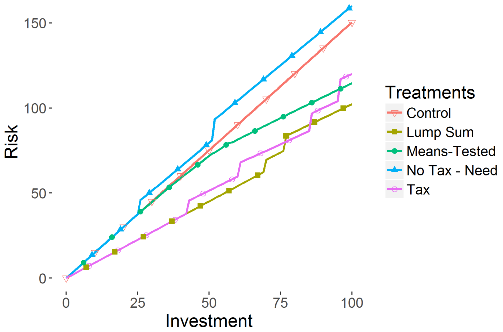

Figure 2: Risk per V_0, High Efficiency Parametrization

when subjects experience need, which in fact leads to a lower optimal investment for some *No Tax – Need* and *Tax* treatments.

All types of redistribution have in common that they transfer wealth from high income positions to low ones and thereby reduce the span of possible incomes and hence risk/ inequality. As we assume subjects to be risk averse, we expect them to prefer treatments offering higher accumulated payoffs for the same risk. Furthermore, the reduction of net wealth in case of an overall gain ($Y_3 > Y_0$) increases the marginal utility of wealth ($u'(\cdot)$). Analogously, the increase of net wealth in case of an overall loss ($Y_3 < Y_0$) decreases the marginal utility of wealth. This implies that investors increase their investments in a welfare state compared to a state without insurance function. This insurance effect is called the Domar-Musgrave effect (Domar and Musgrave 1944):

Hypothesis 1 (Domar-Musgrave Effect) *Investments are higher under all redistribution schemes than without redistribution.*

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[5] This calculation process sometimes causes a previously upper income position to fall below β. In these rare cases, the calculation process is repeated in the background, and the affected positions are also lifted to β.

In their investment decision, investors generally have to trade off higher efficiency of investment against increasing risk. But when a society member experiences need, risk increases while efficiency drops, as shown by Figures 1 and 2. This implies that all impartial observers may stop investing at the highest value of V_0 before the need constraint becomes binding. Therefore, we expect them to use the different values of β as a signal for their optimal investment.

Hypothesis 2 (Signaling Effect) *The maximum investment chosen in each treatment is the highest value of V_0, before the first subject's need constraint becomes binding.*

Furthermore, we are interested in the relative importance of need insurance and inequality reduction on investments. Therefore, the *Means-Tested* minimum income scheme does not efficiently reduce inequality, while the inequality reducing *Lump Sum* treatment fails to ensure needs. We expect that elimination of the risk to receive zero payoffs fosters investments the most.

Hypothesis 3.a (Need Effect) *Investments are highest in the treatments where no subject experiences need.*

Hypothesis 3.b (Inequality Effect) *Investments are highest in the treatment with the lowest variance.*

3.2 Procedure

As the payoff calculating process is rather complex, and to avoid framing effects, the experiment is framed as a neutral investment choice only. In the experiment's instructions, subjects are not informed on the equations displayed in Table 3 or the exact way outcomes are calculated. Instead, subjects can move a slider to simulate different investments. In the background, the program calculates the outcome with the respective V_0 and the treatment and round-specific parameter variation. Then, only the eight possible income positions which belong to the currently chosen investment amount are displayed. The instructions were handed out to the participants and read aloud by the experimenter at the beginning of each treatment. Starting the experiment, subjects first had to answer five control questions and were subsequently informed about the right answers. At the end of the experiment, subjects completed a questionnaire. In the instructions, subjects are simply told that, at the beginning of the task, they are randomly assigned to a group which consists of eight people and remain with this group for the whole investment task. Each group member receives an initial amount of 100 points and has to decide individually on her investment between 0 and 100 points, which leads to eight possible outcomes that have the same probability. The outcomes are referred to as positions A to H. Furthermore, they are informed that after all subjects submitted their 15 investment decisions, one of the group members' decisions is randomly chosen as payoff relevant. Then, every group member is randomly allocated to one of the positions, which are each assigned only once within a group, and receives the corresponding outcome. The complete instructions can be found in Appendix A.

3.3 Preference Elicitation Tasks

As social preferences and risk attitudes might differ across subjects, we supplement the main investment task with two preference elicitation tasks. We conduct Kerschbamer's (2015) equity equality test in part one of the experiment, and also elicit subjects' risk attitudes using the standard lottery selection design by Holt and Laury (2002) in the slightly modified version by Balafoutas et al. (2012) in part three.

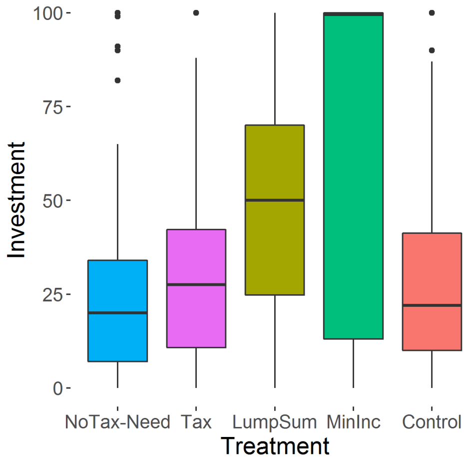
In the equity equality test, subjects face two blocks of five binary choices, where they have to decide on allocating points to themselves or a "passive person", when efficiency (number of points in total) is traded against advantageous inequality (first block) or disadvantageous (second block) inequality. At the end of the task, subjects' payoff consists of one of their ten choices as a decision maker and one choice where they acted as "passive person". It is not possible to be matched with the same person twice. A more detailed description can be found in the original description of the double price-list technique by Kerschbamer (2015) and our instructions for the task are provided in the Appendix A.

The two blocks with advantageous and disadvantageous inequality serve as a measure for inequality aversion and efficiency preferences, respectively. The advantageous inequality block shows the willingness-to-pay for advantageous inequality $WTP^a \in [-0.667, 0.667]$. It is calibrated to the allocation where a subject switches from the more-efficient-self-advantageous to the more equal allocation. A negative WTP^a indicates that the subject prefers to sacrifice equality for a more efficient allocation, while positive values reveal a preference for equality despite sacrificing efficiency. Analogously, the disadvantageous inequality block elicits the willingness-to-pay for disadvantageous inequality, $WTP^d \in [-0.667, 0.667]$. It is calibrated to the allocation where a subject switches from the more-efficient-self-disadvantageous to the more equal allocation. A negative WTP^d indicates that the subject prefers to sacrifice efficiency for a more equal allocation, while positive values reveal a preference for efficiency despite getting a lower payoff than the "passive person".

Risk attitudes are elicited with the lottery-selection task, where subject are assigned a score $R \in [0, 1]$, with $R = 0.5$ marking risk neutrality. Lower (higher) values indicate risk aversion (risk seeking). At the end of the task, one decision is randomly chosen for payoff. The instructions are provided in the Appendix A.

4 Results

The experiment was conducted in May 2017 at the experimental lab of the University of Hamburg, using 96 subjects, 34 (35.4%) male and 62 (64.5%) female. The experiment was implemented with z-Tree (Fischbacher 2007) and subjects were recruited using hroot (Bock et al. 2014). All subjects played all treatments and parametrizations of either the relative or the fixed need threshold scheme (48 subjects for each need definition) in a random order. One session lasted for approximately 60 minutes, and payoffs ranged from 9 € to 53 €, with an average payoff of 21 €. The descriptive pattern of investments by treatments, aggregated over both need specifications and all three parametrizations, can be seen in Figure 3.



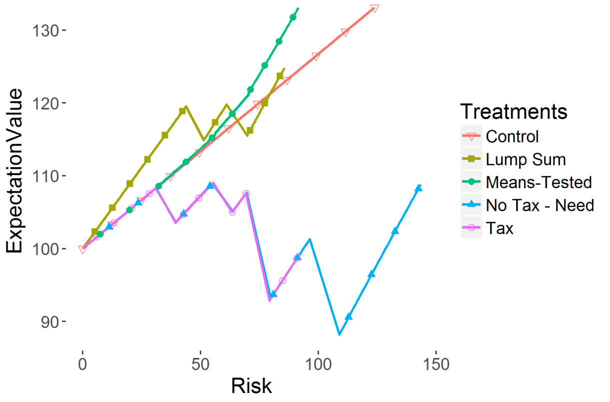


Figure 3: Investments by Treatment Figure 4: μ-σ-relation per "Basic" Treatment

It is easily seen that investment is lowest (mean= 24.99) in *No Tax – Need*, slightly higher (mean= 31.15) in *Tax*, reaches a mean of 49.53 for *Lump Sum* and is highest in *Means-Tested* (mean 61.94). The control treatment's mean of 30.11 is similar to *Tax*.

To statistically support these indications, we run a regression analysis using a random-effects panel Tobit estimation. We use investment in points, V_0, as the dependent variable and *No Tax – Need* as benchmark. Our regression model takes into account that our dependent variable is censored from below (0) and above (100), and that we have 15 observations per subject and fixed covariates (such as gender or need specification). Regression results are shown in Table 4. Model

I tests for the significance of the main treatment effects at the within subject-level, and controls for subjects' risk attitudes (R), efficiency preferences (WTP^d), inequality aversion (WTP^a) and gender (using "male" as benchmark). Model II includes the impact of parameter variations on subjects' investment behavior, while Model III controls for the difference of the relative need threshold $Need^{rel}$ compared to the fixed threshold as benchmark.

Table 4: Regression Results

V_0	Model I	Model II	Model III
Tax	7.161***	7.148***	7.147***
	(2.746)	(2.610)	(2.610)
Lump Sum	28.804***	28.936***	28.930***
	(2.746)	(2.611)	(2.610)
Means-Tested	49.114***	48.867***	48.865***
	(2.859)	(2.720)	(2.719)
No Tax	6.328**	6.291**	6.292**
	(2.759)	(2.624)	(2.623)
High Efficiency		-0.153	-0.152
		(2.038)	(2.038)
High Inequality		-19.998***	-19.996***
		(2.049)	(2.049)
$Need^{rel}$			6.658
			(4.448)
R	56.310***	56.446***	55.778***
	(18.350)	(18.330)	(18.079)
WTP^a	-12.416	-12.385	-13.736*
	(7.951)	(7.943)	(7.886)
WTP^d	2.263	2.192	2.761
	(8.782)	(8.772)	(8.660)
female	-14.010***	-14.026***	-13.653***
	(4.932)	(4.926)	(4.865)
σ_u cons	20.161***	20.311***	19.989***
	(1.798)	(1.781)	(1.764)
σ_e cons	32.109***	30.464***	30.461***
	(0.755)	(0.715)	(0.715)
Wald-χ^2	422.405 ***	570.865***	573.275***

Notes: Random effects Tobit model, n=1440. Dependent variable: investment in points, V_0.* $p \leq 0.1$, ** $p \leq 0.05$, *** $p \leq 0.01$.

Altogether, we have 1440 observations from 96 subjects in each regression. Subjects invest significantly more under all redistribution schemes and most under the *Means-Tested* minimum income scheme. Here, investments are about 20 points higher than in *Lump Sum*, which in turn shows higher (about 21 points) investments than *Tax* or *No Tax*. Mann-Whitney tests confirm that all these differences in treatments are highly significant, except for the difference between the *No Tax – Need* and the control treatment *No Tax* (p=0.155). These results confirm Hypothesis 1: all redistribution schemes, irrespective of the exact specification, significantly increase investment when compared to situations with no redistribution. This is also illustrated by Figure 5, which depicts the predicted investments per treatment variation (based on Model III). The two different specifications of our need threshold show no significant differences. Model II and III both show that a higher inequality of outcomes, implying higher risk in terms of standard deviation, significantly reduces investments by roughly 20 points. However, increasing efficiency by increasing overall returns in a group shows no effects on investment. This is shown by Figure 6, which depicts the predicted investments per parameter variation (based on Model III).

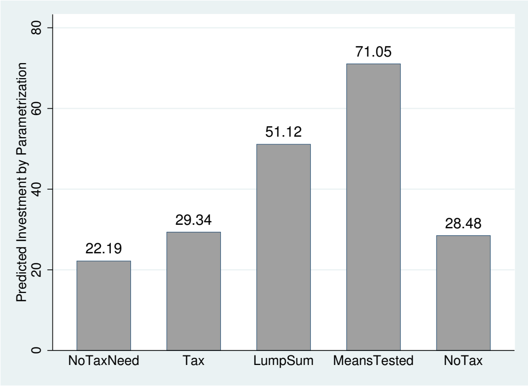


Figure 5: Predicted Investment by Treatment

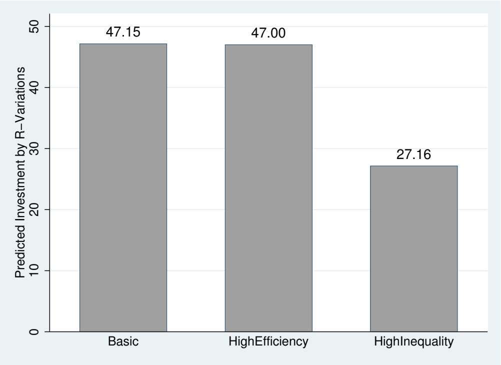


Figure 6: Predicted Investment for Variations of r^+ and r^-

These differences in investments across treatments cannot be driven by framing, as the instructions do not mention any differences between the treatments and the subjects decision is based on the payoff structure only. The controls for heterogeneity between subjects show that risk seeking behavior R significantly increases investments, implying that risk aversion significantly reduces V_0. Female subjects invest significantly less (-13.6 points) than male subjects. Efficiency preferences seem to have no effect on investment behavior, while inequality aversion shows a weakly significant negative effect on investments in Model III only.

To gain more insight into the differences between treatments, consider Figure 4, which depicts the ratio of risk and expected value. It shows that for a similar standard deviation, *Means-Tested* allows for a higher expected value than the other treatments. The investment pattern of the other treatments also mostly follows the σ-μ-ratio – with the exception of the influence-free control treatment (and, less clearly, *No Tax – Need*). Within the different welfare regimes, it can be seen

Table 5: μ and σ for Predicted Values

Treatment	Parametrization	Predicted V_0	μ	σ	$\frac{\sigma}{\mu}$	1. Need V_0
No Tax	Basic	35.2	111.65	43.57	0.39	/
	High Efficiency	35	118.23	52.62	0.45	/
	High Inequality	15.2	105.03	34.7	0.33	/
NoTax-Need	Basic	28.9	104.01	40.62	0.39	42
	High Efficiency	28.8	109.14	47.32	0.43	38
	High Inequality	8.9	89.77	75.05	0.84	36
Tax	Basic	36.1	106.95	25.99	0.24	69
	High Efficiency	35.9	110.63	30.67	0. 28	62
	High Inequality	16.1	102.98	20.55	0.2	62
Lump Sum	Basic	57.8	118.54	41.59	0.35	76
	High Efficiency	57.7	129.17	50.52	0.39	78
	High Inequality	37.8	111.92	49.31	0.44	63
Means-Tested	Basic	77.8	125.16	77.24	0.62	/
	High Efficiency	77.6	139.59	94.95	0.68	/
	High Inequality	57.8	118.54	102.99	0.87	/

that investments not only increase with increasing σ-μ-ratio (see Figure 4), but also that the absolute efficiency of the treatments explains the investment pattern better than absolute risk (see Figure 2). However, when keeping in mind that an overall increase of efficiency has no effect on investments, higher efficiency of treatments cannot be the only explanation for this pattern.

For more insight, Table 5 depicts expectation value, risk and their ratio for the predicted investment amount V_0 (based on Model III), as well as the investment amount where the need constraint becomes binding for the first time per treatment and parametrization. Looking at Table 5, it becomes apparent that Hypothesis 2 cannot be supported: investments do not reach the amount where the first subject falls short of β and experiences need, and the pattern of the significantly smaller investments might also be better explained by the high risk of the *High Inequality* parametrization.

Hypothesis 3.a is supported by the results, because we can see that within the redistribution treatments, *Means-Tested* leads to the highest investments for all parametrizations despite having the highest inequality levels of all treatments. This falls in line with the findings of Boulding (1962), who suggested that people will maximize expected utility and tolerate more risk if a social contract ensures an income floor. This idea is also strengthened by the observed pattern of all-in and zero investments. We have 138 left-censored (V_0=0) observations (39, 29, 9, 24 and 37 in *No Tax – Need*, *Tax*, *Lump Sum*, *Means-Tested*, and *No Tax*) and 220 right-censored (V_0=100) observations (14, 9, 29, 144 and 24). This shows us that *Means-Tested*, the only redistribution treatment without subjects experiencing need, results in significantly more all-in investments (also compare the descriptive investment depicted in Figure 3). Furthermore, it seems that the perceivable income floor actually makes more of a difference than simply having no subjects experiencing need and having reduced efficiency in the society, since the influence-free control treatment also shows significantly less investment than *Means-Tested*. In fact, the introduction of a certain income floor in *Means-Tested* might have a signaling effect on capped losses (up to -20 points in the worst case scenario with $V_0 = 100$ and position H) and might decrease risk perceptions of subjects even though the standard deviation in income is higher than e.g. in *Lump Sum*. This supports the findings by Traub et al. (2009), who show that risk in form of increasing inequality in a society is perceived differently than risk in form of losses. The notion that losses are more important for risk perception than the standard deviation is not new, and has actually inspired the literature on portfolio choice to develop approaches such as semivariance or semideviations (Ogryczak and Ruszczyński 1999), which only measure expected values below the mean.

Thus, while our results demonstrate the importance of inequality reduction for an increase in investments, they also suggest that the introduction of a means-tested minimum income that ensures needs is essential for a sustainable welfare state.

5 Conclusion

This study aimed to show the influence of different redistribution schemes on investment in a society with need. While need is a well-known concept, it is rarely included in models of the welfare state. This is an important gap in the literature because unsatisfied needs might prevent proper social participation of citizens and henceforth reduce efficiency of the state. This also implies that risk and expected value of a risky asset have no positive monotonic relation. Instead, if people fall below a certain income threshold and experience need, risk soars while the expected value of the investment decreases. We used a laboratory experiment to test the influence of a proportional tax regime, a progressive tax regime, and a means-tested minimum income on subjects' investments in such a welfare state. This strategic investment decision equaled a dictator's choice on the known income distribution for their group. We also used a design where the allocation of income positions was randomly chosen.

Our findings confirm that all welfare regimes increase productive risk-taking and efficiency in a society, while reducing inequality. A means-tested minimum income, financed by a proportional tax, leads to the highest efficiency. However, inequality in the society is still quite high. The expected value per standard deviation best explains this pattern. Furthermore, the introduction of the means-tested income floor leads to significantly more all-in investments and therefore significantly increases the welfare states efficiency. This suggests that risk perception cannot be assumed to be completely identical with standard deviation, as it seems that an income floor has a stronger effect on risk perception than the deviation of top incomes. Nevertheless, high inequality in incomes also significantly hampers productive investments.

Our simplified welfare state does not match real world welfare states, as it depends on many assumptions, such as the full deductability of losses, the completely random position in a society's income distribution and the level of need thresholds. Nevertheless, our results show that all varieties of a welfare state, despite having different results in terms of need ensurance, efficiency and inequality, induce people to take more risks, which leads to higher lifetime incomes and less income inequality. One might argue that this positive effect of the welfare states could be mitigated by moral hazard effects, which we chose not to include in our experiment. Still, we believe that the huge efficiency differences between different welfare state iterations found in this paper emphasize the importance of welfare states not being reduced to their general insurance function, but instead being designed to specifically ensure social participation and to reduce inequality.

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A Instructions

A.1 Preliminaries

Welcome to the experiment. In this experiment, you will earn money provided that you read these instructions carefully and follow the rules. The money will be paid out to you in cash immediately after the experiment. During the experiment, we will use the term ‘points’ instead of Euros. Points will be converted into Euros as follows: 100 points = 1 Euros.

During the experiment, you must not talk to other participants. If you have a question, please ask us. We will answer your questions individually. Compliance with these rules is important; otherwise, the results of the experiment will be of no scientific use.

For your participation, you receive 5 Euros as fixed payoff. The experiment consists of three parts. Each part will be explained separately. In each part, you can earn additional money. Your final payoff is the sum of all 3 parts’ payoffs plus the fixed payoff of 5 Euros. All together, the experiment will last for approximately 60 min.[6]

A.2 Part 1

In the 1st part, we will ask you to make 10 decisions. In each decision, you are assigned to a group with another participant, who is called ‘passive agent’. Your decision as an ‘active decision maker’ and the decision of the passive agent are made anonymously. In each of the 10 decisions, the passive agent is a different randomly chosen participant. In all decisions, you always have to choose between a left and a right option. The options are payoff distributions, meaning that both options are associated with a payoff for you and for the passive agent.

We ask you to decide for each of the 10 decisions between the left and right options. The 10 decisions will be presented in two blocks of 5 decisions each. Please compare row by row the left and right options and decide on your preferred distribution for each row. You can make your decision by clicking on the left or right button.

Example: The left option in the 2nd line is: You 32 points, “passive agent” 52 points. The right option in the 2nd line is: You 40 Punkte, “passive agent” 40 Punkte. If you select in line two e.g. the left option, and this situation is randomly selected as payoff-relevant, you receive a payoff of 32 points and the “passive agent” receives a payoff of 52 points.

Calculation of your payoff from Part 1: Your payoff from Part 1 results from two partial payoffs. The 1st partial payoff results from the situation in which

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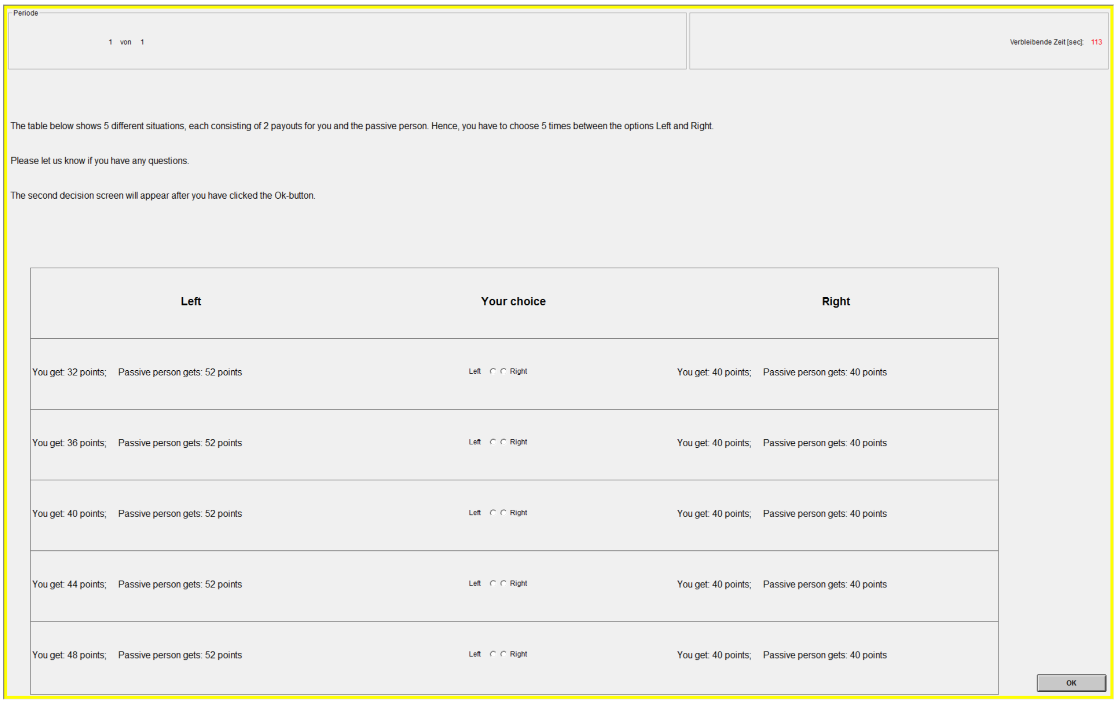
[6] The original instructions were in German.

Figure 7: Decision Screen of Risk-preference Elicitation Task



The table below shows 5 different situations, each consisting of 2 payouts for you and the passive person. Hence, you have to choose 5 times between the options Left and Right.

Please let us know if you have any questions.

The second decision screen will appear after you have clicked the Ok-button.

Left	Your choice	Right
You get: 32 points; Passive person gets: 52 points	Left ○ ○ Right	You get: 40 points; Passive person gets: 40 points
You get: 36 points; Passive person gets: 52 points	Left ○ ○ Right	You get: 40 points; Passive person gets: 40 points
You get: 40 points; Passive person gets: 52 points	Left ○ ○ Right	You get: 40 points; Passive person gets: 40 points
You get: 44 points; Passive person gets: 52 points	Left ○ ○ Right	You get: 40 points; Passive person gets: 40 points
You get: 48 points; Passive person gets: 52 points	Left ○ ○ Right	You get: 40 points; Passive person gets: 40 points

you were the active decision maker. At the end of the 1st Part, the program will randomly select 1 of the 10 decisions. For this decision situation, your decision between left and right will determine the payoff for yourself and the passive agent.

The 2nd partial payoff results from the situation in which you were the passive agent. Following the same procedure as mentioned above, another participant is randomly selected and determines with her chosen left-right-decision your payoff in the role of being the passive agent. We make sure that no two participants are in a reciprocal relation of being an active decision maker and a passive agent for the same person.

Your total payoff from the 1st part of the experiment is calculated by adding the payoffs from the situations in which you were the active decision maker and the passive agent.

If you have any questions, please raise your hand. One of the supervisors will come to you and answer your questions.

If you do not have further questions, please start and make your decisions between the left and right options.

A.3 Part 2

Now we start with the 2nd part of the experiment. The choices in the 2nd part have no consequences on the payoffs of part 1 and 3 of the experiment. This part is played for 15 rounds, i.e., the game is repeated 15 times in a row.

At the beginning of each round, you are randomly assigned to a group which consists of 8 people (group 1, group 2 or group 3). A randomly chosen decision by one group member is payoff relevant for the whole group. Each group member receives an initial amount of 100 points and has to decide on an investment. The invested amount can lie between 0 and 100 points.

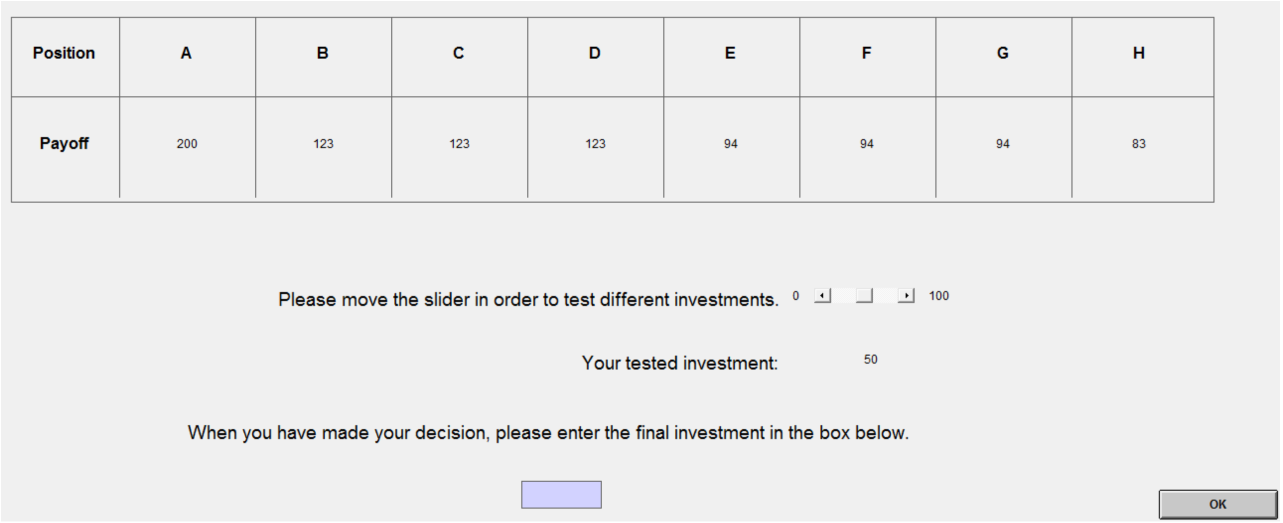
Your potential payoff is calculated as follows: there are 8 outcomes that have the same probability. The outcomes are referred to as position A, B, C, D, E, F, G, and H. The outcome may involve a loss – i.e. a decrease of your invested amount – or a gain – i.e. an increase of your invested amount. Potential gains and losses grow with increasing investment and vary in each of the 15 rounds.

On the decision screen in the experiment (see Figure 8), you can test the payoff for different investments for each position by moving a slider from left to right. Please use the provided possibility to inform yourself about the payoffs of different investments. Note that the size of gains and losses varies within each of the 15 rounds. Therefore, please inform yourself anew at the beginning of each round as the possible payoffs have changed compared to the previous round.

Calculation of Payoff in Part 2: After all participants chose an investment in each of the 15 rounds, the computer randomly selects a round, and the decision of one participant in this round, as payoff relevant. Then every participant is assigned to one of the eight positions, which are only given out once within each group. Your final payoff in part 2 therefore depends on: the round randomly chosen as payoff relevant, the decision of the participant in your group randomly chosen as payoff relevant, as well as your randomly assigned position.

Example (compare Figure 8): You can invest 100 points. Suppose, you decided to invest an amount of 50 points and the hypothetical payoff of Figure apply. Furthermore assume that your decision in this round was randomly chosen by the computer to be payoff relevant. If you are assigned to position A, your payoff in this round would equal 200 points (Figure 8, column 2). Hence, you would have made a gain of 100 points. In position B, C or D you would get a payoff of 123 points, in position E, F and G the payoff would equal 94 points and in position H 83 points. Your invested amount would have therefore increased in position B, C and D, but decreased in position E, F, G or H. Please be aware that each position is assigned with the same probability of 1/8 and that each position is only given out once.

Figure 8: Decision Screen in the Investment Task (Example: 50 Invested Points)



Position	A	B	C	D	E	F	G	H
Payoff	200	123	123	123	94	94	94	83

Please move the slider in order to test different investments.

Your tested investment: 50

When you have made your decision, please enter the final investment in the box below.

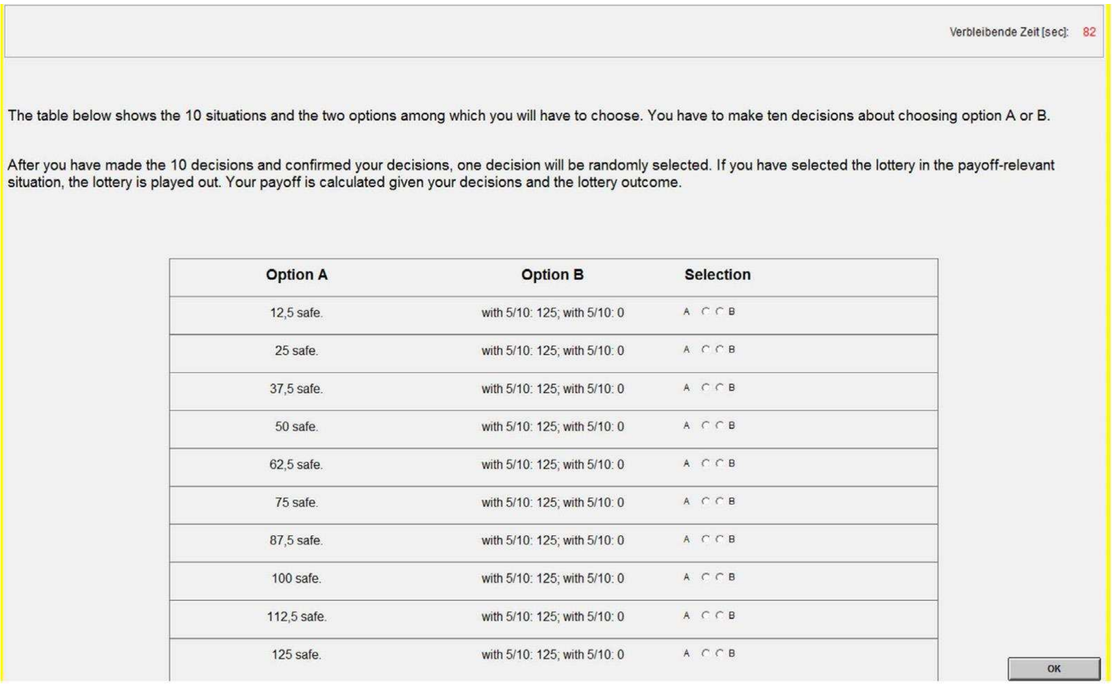
A.3.1 Part 3

Now we start with the 3rd part of the experiment. In this part, you can again earn some money. This part has no consequences for the payoff you obtained from the other parts of the experiment.

In this part of the experiment, you choose between two options A and B for 10 different situations, which means you choose 10 times between options A and B. Option A always involves a safe payoff of a certain amount of points. Option B always determines your payoff by exactly the same lottery.

The table below shows the 10 situations and the 2 options among which you will have to choose. Either you see the table shown in Figure 9 or you see it in just the reverse order. The presentation of the table to you is randomized.

Figure 9: Decision Screen of Risk-preference Elicitation Task



The table below shows the 10 situations and the two options among which you will have to choose. You have to make ten decisions about choosing option A or B.

After you have made the 10 decisions and confirmed your decisions, one decision will be randomly selected. If you have selected the lottery in the payoff-relevant situation, the lottery is played out. Your payoff is calculated given your decisions and the lottery outcome.

Option A	Option B	Selection
12,5 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
25 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
37,5 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
50 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
62,5 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
75 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
87,5 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
100 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
112,5 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B
125 safe.	with 5/10: 125; with 5/10: 0	A ○ ○ B

Example: Option A in the 9th line is 112.5 for sure. Option B in the 9th line is 5/10: 125 and 5/10: 0. If you select option A in the 9th line, you get a payoff of 112.5. If you select option B in the 9th line, you will get, in 5 out of 10 cases (50%), a payoff of 125, and in 5 out of 10 cases (50%), a payoff of 0 points.

We ask you to decide for each of these following 10 situations between options A and B. Please compare line by line options A and B and decide for each line by clicking A or B.

Calculation of payoff from Part 3: Your payoff from this part of the experiment is determined as follows: The computer randomly selects 1 of the 10 situations. Your decision in this situation is relevant for your payoff. For example you have decided for option B in the 2nd line and the computer randomly selects the situation in line 2 as relevant for the payoff. With a probability of 5 out of 10 cases (50%), you will get 125 points as payment, and in 5 of 10 cases (50%), you will get 0 points. You can imagine an urn filled with 5 white and 5 black balls for playing out the lottery. When a blindfolded person grabs into the box and draws a white ball, you will receive a payout of 125. If the drawn ball is black, you will get 0 points. The drawing of the balls is automated in the experiment and is performed by the computer.

If you have any questions, please raise your hand and wait quietly until someone comes to you. If you have no further questions, then you can make the selection of options A and B on the screen. After all participants have completed the 3rd part of the experiment, all participants see their individual payoffs of all three parts of the experiment, the total number of points, and thus, the total payment resulting from the addition of the three payments from the different parts of the experiment. This screen is followed by a short questionnaire. Finally, you will receive your payoff in cash and the experiment is finished.

Thank you for your participation.

DFG Research Group 2104
– Latest Contributions

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