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Preferences over Wealth: Experimental Evidence

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Abstract. Preferences over wealth can explain why households do not spend more when real interest rates fall, because they save more than optimal under a standard model. However, little is known about preferences over wealth empirically. We run an intentionally simple lab experiment on intertemporal spending and saving decisions with 180 students. Under a positive discount factor, zero interest and linear utility, maximizing behaviour would imply spending any funds instantaneously. While half of the participants behave optimally, we find a robust pattern where participants on average form and maintain a stock of wealth, consistent with wealth entering the utility function directly.

Keywords. consumption; saving motives; wealth; experiment
JEL classification. D12, E21, E62, H23

1 Introduction

A good understanding of consumption and saving behaviour is indispensable for conducting monetary and fiscal policy. Recent New Keynesian models (Michaillat and Saez 2018; Rannenberg 2018) presume households to have preferences over wealth in order to solve the so-called forward guidance puzzle. The latter raises the question of why households do not consume much more of their savings when interest rates are close to or below zero (and should stay there for a long time). Standard preferences would predict a strong increase in consumption, which is, however, at odds with the evidence

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after the financial crisis. Preferences over wealth could be a possible explanation for the sluggish reaction to low interest rates.[1]

However, while preferences over wealth are increasingly being presumed as a useful tool in macro models, little is known about them empirically. From a behavioural perspective preferences over wealth essentially cover several saving motivations beyond intertemporal optimization. From the list of Browning and Lusardi (1996), these include precaution, the enjoyment of independence and being avaricious.

This paper investigates the details of possible preferences over wealth via a lab experiment among 180 students of various disciplines. We construct an intentionally simple consumption-saving experiment, where agents have to make periodical saving and spending decisions.

Just as in a situation with negative real interest rates, the value of savings decreases in each period. The underlying payoff function is designed such that the optimal decision would be to spend any periodical income or initial wealth instantaneously. Keeping any savings would be suboptimal for a rational agent as it would lower the payoff. The payoff function does not promote any saving motives. Nevertheless, agents are free to deviate from optimizing behaviour and can practice excess saving at the cost of a lower payoff.

The participants solve this easy optimization task quite well. However, we find systematic deviations from the optimal behaviour. While about half of the participants are optimizers, there is a robust pattern where participants on average tend to form and maintain a stock of wealth. The full sample of participants on average sacrifices about 2% of their maximum payout in order to hold wealth in the experiment – with rather similar figures among different treatments. For the subgroup of non-optimizers alone, the sacrifice is about 4.5%. Referring to a benchmark where the participants would at

[1] The forward guidance puzzle is only one field of application of preferences over wealth. Carroll (1998) has formulated a "Capitalist Spirit" model where direct utility from wealth explains the saving behaviour of the very rich (see also Francis 2009). Kurz (1968) and Zou (1994) study the implications of preferences over wealth for the economic growth path. Bakshi and Chen (1996) and Gong and Zou (2002) examine its implications for asset pricing, while Saez and Stantcheva (2016) analyzes wealth taxes in a model featuring preferences over wealth.

least spend their remaining cash on hand in the final period, the sacrifice of suboptimal intertemporal allocation is 7% for the full sample and 16% for non-optimizers.

We interpret these findings as evidence for preferences over wealth with utility from both consumption and wealth.

One might argue that small deviations from optimal behaviour can simply be interpreted as near-rationality (Cochrane 1989). However, further patterns imply a meaningful structure of the participants' behaviour: first, subjects starting from very different initial wealth conditions tend to approach the same stock after a smooth trajectory phase; second, agents that face higher discount factors plausibly approach a smaller stock of wealth, pointing to optimizing behaviour at the margin, consistent with Hey and Dardanoni (1987); third, participants tend to run down their stock in the final period. Fourth, saving dynamics are such that holding savings is mean-reverting around a certain level and the marginal propensity to save increases with higher wealth. Both results are very much in line with implications from the buffer stock model of precautionary saving which is akin to a model featuring preferences over wealth (Carroll 1998). Finally, personal characteristics of participants provide plausible explanatory factors: people that characterize themselves as more impulsive are more likely non-optimizers. On the other hand, if the own patience is perceived to be high, people save more, obviously discounting the foregone payout more strongly, again in line with the buffer stock model.

The paper is structured as follows. Section 2 discusses some theoretical underpinnings of our model in use. Section 3 lays out our experimental design in detail. Section 4 presents the results and provides some explanations. The final section concludes.

2 Model

We start from a simple model of consumption choice featuring additive utility over a finite horizon T. The household i maximizes the utility function

$$u_i = E\{\sum_{t=1}^{T} \beta^{(t-1)} v(c_{it})\} \tag{1}$$

where u_i is lifetime utility; $0 \leq \beta < 1$ is a positive intertemporal discount factor and $v(c_{it})$ is the instantaneous (sub)utility function, assumed to be increasing in consumption in period t, c_{it}. The process is subject to the intertemporal budget constraint

$$w_{it} = (1+r)w_{i,t-1} + y_{it} - c_{it} = x_{it} - c_{it}, \qquad \sum_{t=1}^{T} w_{it} \geq 0 \tag{2}$$

where w is wealth at the end of the respective period t, r the interest rate, y is income, and x cash on hand at the beginning of period.

In order to enforce the intertemporal budget constraint in the experiment [in line with][](Carbone and Hey 2004), we include a borrowing constraint $w_{it} \geq 0, \quad \forall t = 1..T$ (Deaton 1991). Under an uncertain income process $y_{t..T}$, subject to i.i.d. shocks, this might trigger a precautionary saving motive to insure against bad future income draws.

Moreover, if we would assume $v(c_t)$ to be CRRA, such that the consumption Euler equation would equal $c_{i,t+1}/c_{it} = [\beta(1+r)]^{\sigma}$, the household would have a saving motive in smoothing consumption, which could lead to $w_{it} > 0$.

However, we do not want to trigger a certain saving motive, neither precaution nor intertemporal substitution. Moreover, we want to rule out systematic error, which could stem from the complicated calculation of the optimal consumption path in such a framework. Furthermore, the macroeconomic literature since Campbell and Mankiw (1989) has often referred to two groups of consumers: forward-looking optimizers and hand-to-mouth consumers, where the latter are assumed to be so impatient that they consume any cash on hand right away. Such behaviour would produce very similar patterns as credit constraints and precautionary saving motives.

For these reasons, we construct the optimal payoff utility function such that smoothing creates no rewards ($\sigma = 0$) while impatience dominates ($\beta < 1, r = 0$). Zero interest combined with a discount factor less than one is similar to a situation of negative real interest rates or even a situation with negative nominal interest rates. Under such conditions, the optimal rule boils down to consuming any cash on hand instantaneously: $c_{it} = x_{it}$. This should lead to $w_t = 0$ for all $t = 1...T$. Notice, that this result is independent of initial wealth w_0, expected income $Ey_{t..T}$ and β (as long as $\beta < 1$).

In the experiment, we endow half of the participants with a substantial initial stock of wealth. This gives us control over the impact of the borrowing constraint. Endowed households are *a priori* unconstrained by the borrowing limit if they would desire to smooth their consumption (even if smoothing would not maximize payout).

Observed saving should thus not be due to a desire to maximize payout or any enforced saving motive. Instead, saving is costly. Moreover, since the decision rule is rather simple, observed saving should not be driven by systematic miscalculation. As hand-to-mouth consumption and rational choice coincide in our case, deviations from optimality cannot simply be interpreted as mere signs of (partial) hand-to-mouth behaviour.

3 Experimental Design

The experiment took place at the “Essen Laboratory for Experimental Economics” (elfe) in November 2017. We used the software ORSEE (Greiner 2015) for participant recruitment and zTree (Fischbacher 2007) to conduct the experiment.

We processed nine sessions, with at least two different treatments in each session to avoid bias by date or time. The subjects are 180 students of various fields of interest, including both natural and social sciences. They are drawn from a pool of registered students at the University of Duisburg-Essen.

Participants perform the task independently at single PCs in the laboratory. They receive instructions (see Appendix C) and can ask questions, which are answered privately by the experimenter. Once all subjects indicated that they understood the instructions, they have to answer eight comprehension questions (see Appendix C). After all subjects have answered the questions correctly, the training part starts, which is identical to the main part, yet irrelevant for payoff. The main part follows. Participants then are cashed out according to their results.

The experimental design is kept as simple as possible in order to lower the risk of systematic mismatch between the intention of the experimenters and the understanding of the participants. Subjects have to make periodical spending and saving decisions under a well-known lifetime of 20 periods. They receive a periodical income y_{it} with known mean of 100 experimental currency units (ECU), subject to i.i.d. shocks. This gives them an expected stationary lifetime income of 2,000 ECU. Fluctuations of the periodical income can be observed by the participants, but the standard deviation (of 25.9 ECU) is not communicated. Periodical incomes and their fluctuations are identical for all participants.

Half of the participants start with an endowment of $w_{i0} = 1{,}000$ ECU and are instructed to represent "rich" households. The other half start with zero endowments and are instructed to represent "poor" households. Participants however do not get any further information about other participants' income, spending, wealth, etc.

In each round participants have to decide how much of their current cash on hand (x_{it}) they want to spend (c_{it}). The residual is saved as a risk-free, non-interest bearing and liquid asset (bank account), fully available for the next period. We assume people gain utility from consumption. This is constructed by rewarding participants' spending decisions with a cash-out after the experiment according to an underlying utility function, which is kept most simple: it is linearly increasing in consumption, there is no gain from smoothing and the linear transformation rate from consumption into payout after the

Table 1: Treatment Overview

	w0	w1000	
$\beta = .99$	30	29	59
$\beta = .95$	30	30	60
$\beta = .8$	30	31	61
	90	90	180

experiment is decreasing by a constant discount factor β_i:

$$U_i = \sum_{t=1}^{20} c_{it} \rho_i * \beta_i^{t-1} \tag{3}$$

where ρ_i is a transformation factor of consumption into utility U_i represented by money rewards after the experiment. The transformation factor is chosen relative to the β factor such that different β treatments still lead to comparable payout when participants behave optimally.

Due to the irrelevance of smoothing, zero interest and positive discounting, the optimal decision would be to spend any periodical income or initial wealth instantaneously. The utility function does not promote any saving. Nevertheless, participants are free to deviate from optimizing behaviour and can practice excess saving at the cost of a lower payoff.

We consider six different treatments: agents are randomly assigned the initial wealth stock $w_{i0} = [0; 1000]$; additionally, agents are randomly assigned one of three different discount factors $\beta_i = [99\%, 95\%, 80\%]$. The discount factors correspond to a situation with negative real interest rates. Assuming that the nominal interest rates would be zero and the intertemporal discount factor would be one, the chosen treatments would correspond to inflation rates of 1%, 5% and even 20%. See Table 1 for an overview of the different treatments and the number of (independent) participants.

We attempt to make sure that participants understand the task correctly by several means. The students are not confronted with equation (3) directly, but they receive a conversion Table of spending-payout pairs for all periods and can also consult a payout calculator implemented at their workplace. Participants have to answer comprehension questions and play a full trial run.

Our experiment is subject to the general critique of laboratory experiments regarding the relatively short time span and the poor context of the experiment as compared to real-life decisions of spending and saving. On the other hand, this has the advantage that we can abstract from a number of confounding factors that usually make it hard to identify behaviour from survey data and other more natural experiments.

Other simplifying attempts to intertemporal consumption choice experiments have been made by e.g. Carbone and Hey (2004), who also use a finite known lifetime, a simple expected income process (high when employed, low when unemployed), smoothing incentives and a no-borrowing constraint. They show excess sensitivity to current income changes. Another comparable avenue has been taken by Meissner (2016), whose experiment features a finite horizon, borrowing facilities, smoothing incentives, zero interest and zero discount rate, and treatments with an either increasing or decreasing stationary trend income path. He observes more optimal behaviour for the decreasing income trend and a reluctance to perform optimal early-period borrowing in the case of an upward-sloping income trend. Meissner interprets his findings as evidence for debt aversion. As a critical difference to our approach, both Carbone and Hey (2004) and Meissner (2016) impose an optimal consumption path that rewards smoothing and that is not straightforward, but has to be solved via mathematical software, which participants do not have at hand.

4 Results

4.1 Descriptive Statistics

Table 2 presents descriptive statistics, subdivided by treatments regarding initial wealth and discount factors. The parentheses contain the upper and lower limits of a 95% confidence interval determined by a simple bootstrap method with original sample size and 10.000 repetitions. On average, the participants are close to the optimizing rule. About 50% of participants (86/180) act completely in accordance with the payout-maximizing consumption path which would imply consuming any wealth and income instantaneously and thus saving nothing at all. The other half deviates from this by holding savings for at least some rounds. Of this latter group, another 16 subjects behave close to optimal with a savings rate (ratio between end-of-period wealth and beginning-of-period cash on hand $\varphi_{it} = (x_{it} - c_{it})/x_{it} = w_{it}/x_{it}$) that has a mean below 2%. That is, there are 78 non-optimizers with a relevant mean savings rate.

Panel A in Table 2 gives figures for the full sample of students, Panel B focuses on non-optimizers. We report (i) the number of students belonging in each group, (ii) the average of the end-of-period wealth $\overline{w_{it}}$ in ECU, (iii) the average savings rate $\overline{\varphi_{it}}$ in %, (iv) the mean loss of payout in Eurocents, (v) efficiency (eff_1) of payout in % measured in a range between zero (worst case) and maximum payout (p_{max}) and (vi) efficiency (eff_2) measured in a range between the payout that would emerge if agents would accumulate wealth until the very last round and then consume everything (second worst case) (p_{min}), and the maximum payout: $eff_1 = \frac{p}{p_{max}} > eff_2 = \frac{p-p_{min}}{p_{max}-p_{min}}$.[2]

[2]Since almost all participants (except for four cases) did not keep relevant savings after the very last round, eff_2 provides an intuitive reference point for the loss that agents may maximally incur due to suboptimal intertemporal allocation, while at least not foregoing any consumption possibilities over the experimental lifespan. Moreover, differences among the β treatments in the Table between eff_1 and eff_2 should be driven by the varying costs of saving alone, since postponing consumption is much more costly with e.g. $\beta = 80\%$ than with $\beta = 99\%$. In the latter case, postponing all consumption until the very last round would, in the case of $w_{i0} = 0$ ($w_{i0} = 1000$), still result in a payout of about 91% (88%) of the maximum, while it would give only 6% (3%) of the maximum when $\beta = 80\%$. The distinction can thus inform us about the way participants deviate from the optimal rule in terms of absolute or relative payout loss.

Table 2: Descriptive Statistics

Panel A: all

	all	w0	w1000	$\beta = .99$	$\beta = .95$	$\beta = .8$
obs	179	89	90	58	60	61
savings $\overline{w_{it}}$ (ECU)	47.67 (43.36; 52.15)	27.76 (23.89; 32)	67.35 (59.57; 75.28)	76.2 (66.49; 86.46)	52.82 (44.66; 61.44)	15.47 (12.82; 18.35)
sav. rate $\overline{\varphi_{it}}$ (%)	14.11 (10.97; 17.23)	11.81 (7.73; 16.2)	16.38 (11.68; 21.4)	19.59 (13.08; 26.5)	14.97 (9.46; 20.97)	8.03 (4.78; 11.71)
loss (Eurocents)	-40.45 (-56.76; -26.31)	-40.45 (-67.53; -18.76)	-40.44 (-59.78; -24)	-30.52 (-58.62; -10.52)	-40.17 (-64.5; -20)	-50.16 (-85.41; -23.61)
eff_1 (%)	98.07 (97.32; 98.73)	97.91 (96.64; 98.97)	98.23 (97.4; 98.94)	98.56 (97.21; 99.51)	97.97 (96.88; 98.92)	97.71 (96.11; 98.92)
eff_2 (%)	93.16 (88.48; 96.55)	90.9 (81.53; 97.35)	95.4 (93.65; 96.92)	86.03 (72; 95.76)	95.54 (93.2; 97.6)	97.6 (95.91; 98.87)

Panel B: non-optimizers

	all	w0	w1000	$\beta = .99$	$\beta = .95$	$\beta = .8$
obs	77	37	40	29	25	23
savings $\overline{w_{it}}$ (ECU)	110.65 (101.05; 120.3)	66.66 (58.04; 75.83)	151.34 (135.79; 167.28)	152.37 (135; 170.7)	126.54 (109.07; 145.45)	40.77 (34.07; 47.76)
sav. rate $\overline{\varphi_{it}}$ (%)	32.7 (27.66; 37.85)	28.3 (21.14; 35.91)	36.77 (30.26; 43.26)	39.17 (30.27; 47.94)	35.79 (27.08; 44.94)	21.2 (15.44; 27.41)
loss (Eurocents)	-93.51 (-127.53; -64.03)	-96.76 (-155.14; -49.46)	-90.5 (-128.25; -58.5)	-60.69 (-113.79; -23.45)	-96.4 (-144.8; -56)	-131.74 (-210.43; -72.61)
eff_1 (%)	95.54 (93.98; 96.91)	95 (92.25; 97.25)	96.05 (94.43; 97.43)	97.13 (94.58; 98.91)	95.13 (93.02; 96.98)	93.99 (90.41; 96.68)
eff_2 (%)	84.18 (73.81; 91.68)	78.26 (56.6; 93.13)	89.67 (86.85; 92.24)	72.22 (45.45; 90.7)	89.31 (84.87; 93.32)	93.7 (89.93; 96.53)

Students have been allocated to the different treatments by equal proportions. The calculations exclude one outlying participant (with treatments $w_{i0} = 0, \beta = 99\%$), who kept substantial savings after the final round and thus ended up with an extremely low payout of EUR 3.70 as compared to the optimum of about EUR 20. Excluding this agent does not alter the mean figures by much, but strongly deflates some confidence bounds.[3]

Non-optimizers (Panel B) are also rather equally distributed among the treatments, yet there is a higher probability of behaving optimal when discounting increases. Since optimizers would have zero-entries in each column and non-optimizers are distributed rather equally, the reported means in Panel B are scaled up versions of those in Panel A. The confidence bounds, on the other hand, are not inflated as much in Panel B even though the sample size is strongly reduced. This is because excluding optimizers eliminates between-group heterogeneity.

On average, participants hold a stock of savings of about 50 ECU over the periods, with an average saving rate of about 14%. In terms of payout this translates into a loss of about EUR 0.40 of the maximum average payout of about EUR 20. The general efficiency eff_1 is therefore rather high (98%). Relative to the benchmark where agents would at least spend everything over their lifetime and only intertemporal allocation is suboptimal, efficiency eff_2 equals 93%. When focussing on non-optimizers, average losses more than double to almost EUR 1. eff_2 is below 85% in this group.

Concerning the role of endowments, saving rates do not differ too much, but the average level of end-of-period savings is 2.5 times as large for agents with initial wealth compared to those without. The drivers of these deviations will be discussed below when looking at period-wise dynamics. There are no relevant differences in losses and efficiency, though.

[3]Note that our findings would be even reinforced when including the participant in the sample. Additionally, due to one absence at one day of the experiments that was compensated the other day, there are generally only 59 observations with $\beta = 99\%$, but 61 with $\beta = 80\%$. We are confident that this small deviation does not affect our results.

Zooming in to the treatments regarding discounting, there are significant differences in holding end-of-period savings between the groups. The treatment with very high costs of saving ($\beta = 80\%$) stands out also with a strongly significantly lower saving rate. These findings are plausible and show that participants rationally react to increasing costs of saving. From Panel B one can derive two distinct channels at play. First, with lower β there is a higher probability that participants behave optimally. Second, even within the group of non-optimizers, wealth holdings and saving rates are significantly reduced when saving is very costly. Most strikingly, both in Panel A and B, differences are small in terms of losses and eff_1. Irrespective of β, participants do accept rather similar absolute losses, while relative losses are significantly different (eff_2) and therefore do not seem to guide average behaviour.

Our interpretation of these first results is that participants do understand the rules and incentives of the game quite well. They react plausibly to higher discount rates and (with a few exceptions) eventually spend their entire lifetime income. Nevertheless, they readily sacrifice a constant portion of their payout of about 2% in order to hold wealth. When benchmarking with intertemporal (in-)efficiency (eff_2), the sacrifice rises to even 7%. Excluding optimizers, both figures are about double in size.

One might argue that small deviations from optimal behaviour can simply be interpreted as near-rationality (Cochrane 1989), stemming from small errors or due to weighing losses against costs of optimization. Since the optimal decision rule is quite simple, rational inattention is rather unlikely in our case. We try to make sense of the findings by looking at the data in more detail in the following sections.

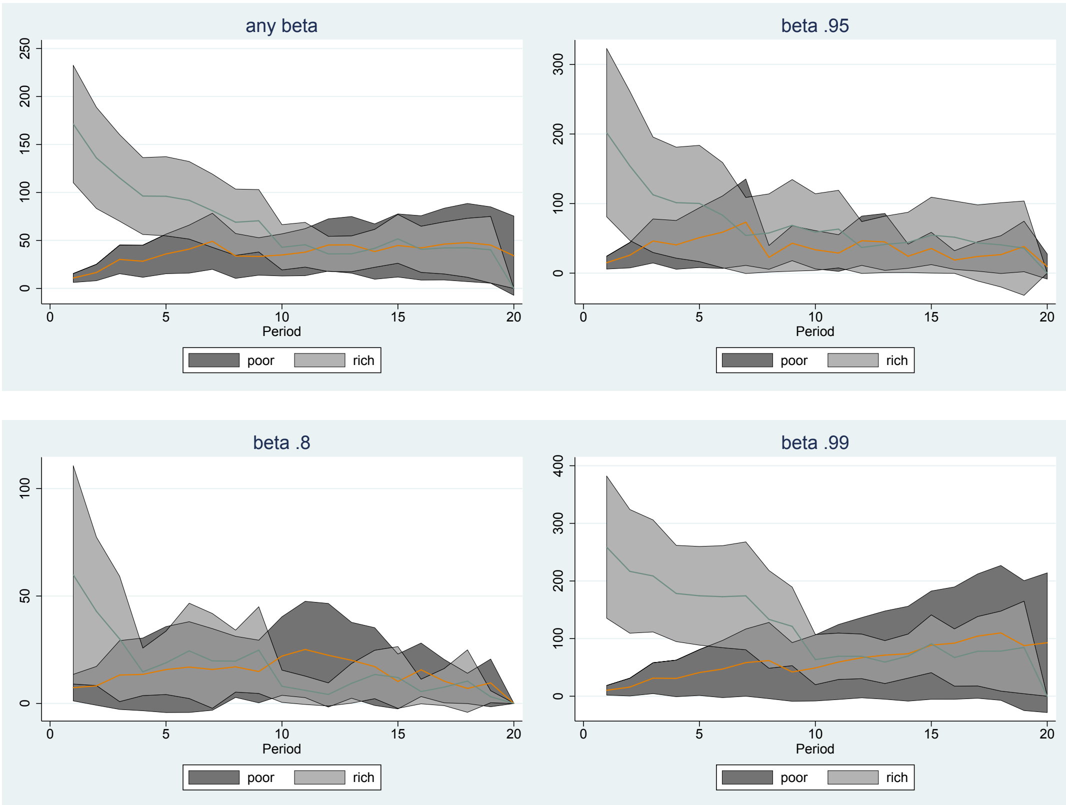
4.2 Dynamic Saving Behaviour

In order to understand the descriptive statistics in more detail, it is beneficial to see the development of the end-of-period wealth holdings over time. Figure 1 shows these patterns for the full sample and the single treatments. Several patterns stand out: “rich” agents in the early periods tend to smoothly run down their endowment to a positive stock of wealth that they maintain until the penultimate round. "Poor" agents in the early periods tend to build up a stock of wealth of similar size which they also maintain. For each discount factor, "rich" and "poor" agents desire a stock of very similar size. The higher the costs of saving, the lower the desired stock of wealth, in line with Table 2, and the steeper the "rich" agents' trajectory towards the desired stock. On average, participants tend to form and maintain a stock of wealth of about 40-50% of the mean of the uncertain periodical income (equal to 2 standard deviations or about 2.5% of the expected lifetime income). If we interpret our experimental time horizon as a lifetime, the figures are very close to estimates by Lusardi (1998) on precautionary savings based on Health and Retirement Study data for the US (1-4.5% of permanent income). They also coincide with guidelines for financial planning suggesting to holding emergency funds of 33-50% of annual earnings under income uncertainty and with outcomes of a plausible parameterized buffer-stock saving model, where financial wealth is on average about 40% of annual income for agents that are still far from retirement age (Carroll 1997), like our participants.

The smooth run-down of endowed wealth in the first periods can explain why "rich" agents have significantly higher average saving rates in Table 2. This behaviour is consistent with the theory of the endowment effect (Thaler 1980): initial wealth may be valued higher than a purely rational choice would imply. Nevertheless, agents are responsive to smaller β and the endowment effect becomes relatively less important. Eventually, the desire to hold a significant basic stock of savings dominates for all treatments.

How can these patterns be rationalized? Keynes (1936) developed a comprehensive list of saving motives that has been reconsidered and amended by Browning and Lusardi (1996): (1) the precautionary motive, (2) the life-cycle motive, (3) the intertemporal substitution motive, (4) the improvement motive, (5) the independence motive, (6) the enterprise motive, (7) the bequest motive, (8) the avarice motive, and (9) the down-

Figure 1: Mean wealth stock at end-of-period of "poor" vs. "rich" agents for varying costs of saving β



payment motive. Given the structure of our experiment and the observed patterns, we can exclude the life-cycle, improvement, enterprise, bequest and downpayment motive. There is also no extrinsic reward for smoothing consumption. However, the observed pattern is generally consistent with precautionary buffer stock saving, even if in our experiment there is no need, but only costs of precaution. However, people seem to behave *as if* there were a need for precaution. At the same time, the dynamic patterns are consistent with an independence and an avarice motive. Both avarice, independence and precautionary motives would be consistent with a general preference over wealth.

One can test further implications of these theoretical saving concepts by looking at behaviour of agents over time, in order to discriminate between them. We can exploit the fact that in our experiment incomes vary by an i.i.d. process with a known mean, so there is transitory income uncertainty.

There are two relevant differences between the precautionary, avarice and independence motives: first, how saving is expected to be influenced by changes in the wealth level; second, the prediction of the motives of the reaction of saving behaviour after an unexpected increment in income (i.e. the marginal propensity to save, MPS) depending on the level of wealth. Regarding the direct impact of the wealth level on saving, both the precautionary and independence motive would predict that there is a positive target wealth level. Existing wealth would therefore ceteris paribus lead to less saving. The opposite would occur if people were driven by avarice motives.

Regarding the MPS, both the precautionary and the avarice motives would predict the MPS to be increasing in the level of wealth for very different reasons: precautionary savers will save more than optimal on average and will target a buffer stock, but on the edge of precautionary fear they will consume a higher share of a positive income shock the lower their wealth holdings are (Jappelli and Pistaferri 2014; Carroll 1997). Likewise, agents with less wealth will cut down consumption more strongly after a negative income shock. Avarice would imply that in particular rich persons want to become even richer and therefore have a higher MPS. Independence would imply the opposite: the independence motive should be increasingly satisfied by rising wealth. Thus, given a certain wealth stock, additional income can be safely consumed completely.

Since the path of income y_{it} is stationary and has a known mean, but is subject to i.i.d. shocks, we can exploit the variation in income, consumption and cash on hand (normalized to its sample mean) in order to estimate the marginal propensity to save out of changes in income as compared to the previous round Δy_{it}:

$$\Delta s_{it} = \alpha_0 + \alpha_1 \Delta y_{it} + \varepsilon_{it} \tag{4}$$

where α_1 gives an estimate of the MPS. In order to investigate the impact of the level of wealth on saving directly and on the MPS, we append (4) by $w_{i,t-1}$, the wealth level at the end of the previous period, and by an interaction term $\Delta y_{it} * w_{i,t-1}$ to allow for a possible heterogeneity of the MPS:

$$\Delta s_{it} = \alpha_0 + \alpha_1 \Delta y_{it} + \alpha_2 w_{i,t-1} + \gamma \Delta y_{it} * w_{i,t-1} + \varepsilon_{it} \tag{5}$$

α_2 will signal the direct impact of the wealth level on saving behaviour, whereas γ indicates the impact of wealth on the MPS. Results (referring to the sample means of income and wealth) are shown in Table 3.

Column (1) gives a plain estimate assuming a homogeneous MPS, which turns out to be 16% on average (notably including all optimizers with a zero MPS). Agents in general do respond to an income increase by saving more, but the much larger part goes to additional consumption, which is plausible, given the incentives of the experiment. Column (2) then allows for heterogeneity with respect to wealth holdings. The baseline MPS of 20% is calculated at the mean level of wealth. The coefficient α_2 on $w_{i,t-1}$ itself shows that having a higher wealth level negatively affects saving (holding income constant). This reflects the general tendency to reducing wealth holdings when being

Table 3: Marginal Propensity to Save and the Level of Wealth

	Dep. Var. Δs_{it}				
	(1)	(2)	(3)	(4)	(5)
	plain	prime	FE	r9-19	nonopt
Δy_{it}	0.161***	0.204***	0.194***	0.185***	0.296***
	(0.0371)	(0.0357)	(0.0717)	(0.0375)	(0.0817)
$w_{i,t-1}$		-0.237***	-0.639***	-0.262***	-0.282***
		(0.0122)	(0.120)	(0.0176)	(0.0202)
$\Delta y_{it} * w_{i,t-1}$		0.00188***	0.00197**	0.00153***	0.00161***
		(0.000284)	(0.000842)	(0.000332)	(0.000472)
Const	-0.674	-6.455***	-16.47***	-8.179***	9.298**
	(1.713)	(1.640)	(2.987)	(1.992)	(3.782)
Obs	3,222	3,222	3,222	1,969	1,386
R^2	0.006	0.121	0.268	0.113	0.141

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

above the average and increasing wealth holdings when being below. This is in line with precautionary savings (or buffer stock behaviour as described by Carroll (1992)) and desired independence, but does not fit to avarice.

Regarding our second testable implication, the MPS increases in $w_{i,t-1}$, as shown by the interaction term γ. That is, a participant with 100 ECU more wealth than a reference participant will save about 19% more of a positive income shock. A poorer agent on the other hand, will consume a larger fraction of such shocks. This finding is consistent with precautionary saving motives and avarice. It does not support the independence motive that would project a lower MPS given an already high wealth level. Combining both tests, there is no evidence against precautionary saving, but the first test speaks against avarice and the second result does not square well with an independence motive.

The buffer-stock interpretation is reinforced when using a fixed-effects specification with clustering of standard errors at the participant level (column (3)) where we effectively discard level variation between agents' MPS. The mean reversion (reducing saving when wealth is above average and increasing saving when below) is even stronger. The magnitude of heterogeneity of the MPS is slightly increased.

Might these effects be driven by the trajectories observed over the first rounds or the special circumstances in the last round? Given the figures in column (4), when only looking at observations from round 9 to 19, heterogeneity of MPS is somewhat lower, but still strongly statistically and economically significant. Could the results be driven by the difference of optimizers vs. non-optimizers? Since optimizers would have an MPS of zero, between-group variation may have a strong influence. However, when focussing on non-optimizers in column (5) results hardly change. From this analysis, the preference to hold costly non-interest bearing wealth might be best explained by a buffer-stock precautionary motive.

4.3 Personal Characteristics and Learning

As an additional exercise, we relate the mean end-of-period wealth to the respective treatment categories and self-reported characteristics of agents that we collected from a questionnaire after to the experiment. Results are shown in Table 5 in Appendix B. In line with Table 2, increasing costs of saving (lower β) have a negative impact on average saving stocks while the endowment is positively related to average savings. These findings do not change much when keeping the sample constant but controlling for a couple of personal characteristics in column (2).

The impact of the endowment becomes less clear when focusing on non-optimizers and is plausibly much less relevant in later periods. When looking at the dynamic specification in columns (5) and (6), there is strong inertia with respect to x_{it} in line with Figure 1. Cash on hand at the beginning of the period strongly predicts wealth at the end of the period, in particular during the later periods where the average savings stock is kept quite stable. When controlling for such an autoregressive process, the endowment w_0 ceases to be a relevant explanatory factor since x_{it} can track the different trajectories of "rich" and "poor" savers quite well. The discount factor is always highly statistically significant, but less relevant in later periods and when looking at the dynamics instead of average levels. Regarding personal factors, male students tend to accumulate more savings on average, but this is only statistically significant and quantitatively more relevant when looking at the subgroup of non-optimizers. At the same time, the share of optimizers is larger among male participants.

The time it took participants to answer the comprehension questions is a significant watershed for optimal vs. non-optimal behaviour, since the coefficient is significant and positive for the full sample, but close to zero and insignificant when looking at non-optimizers or the late rounds (with lower average savings) only.

Self-perceptions do have some correlation with saving decisions as well: Higher patience is related to higher savings, which can be rationalized in that patient participants might have a lower intrinsic discount rate. In line with this interpretation, patience ceases to be a significant factor in later rounds when discounting becomes less important for the payout by design. Impulsiveness may be a good predictor for non-optimal behaviour as can be seen from the difference between column (2) and (3).[4] Likewise, impulsiveness can well explain some wealth level differences in later rounds (column (4)), but when controlling for level inertia in the dynamic specification via x_{it} (column (6)), it ceases to be significant. Perceptions of attitudes towards risk do not seem to be relevant for explaining saving behaviour in the experiment.

Table 6 in Appendix B shows similar regression output, when the participants' loss in Eurocents is considered as left-hand-side variable instead of average wealth holdings. Differences in losses are generally hard to explain – neither by experimental treatments nor by personal characteristics. In line with what has been found above, patience and impulsiveness do seem to have an impact, increasing the absolute value of losses.

Descriptive statistics from the training round (see Table 4 in Appendix A) show that there are much more (7) cases with a substantial loss (if there were a payout from

[4] A simple probit regression shows that a one-step increase on the scale of impulsiveness (0-10) makes it 10% less likely (and highly significantly so) to be an optimizer (results not shown).

the training round). There are much more non-optimizers (140 out of 173), which are again rather randomly distributed among the treatments. Furthermore, there are on average much higher savings, (theoretical) losses and lower efficiency. Therefore, there seems to be a substantial learning process towards the payout-relevant game or stronger compliance due to the payout incentive. We cannot discriminate one from the other.

Nevertheless, there is a strikingly similar dynamic of end-of-period wealth holdings over time (see Figure 2 in Appendix A). The average buffer is considerably higher and there are some level differences between agents with endowment and those without. However, the pattern of a smooth trajectory towards a preferred buffer stock that is maintained throughout the second half of the game seems quite robust. Likewise, higher costs of saving lead to a lower buffer stock and a steeper trajectory for endowed agents, very much in line with our central findings above.

5 Conclusions

We evaluate an intentionally simple lab experiment of intertemporal consumption-saving decisions. About half of the participants behave in line with the underlying optimal rule: they consume any cash on hand instantaneously. The behaviour of the other half, however, is consistent with general preferences over wealth. The dynamic patterns show that participants tend to smoothly form and maintain a buffer stock of wealth, quite consistent with a precautionary saving motive (as if there were a need for precaution), or some other form of wealth providing direct utility. In particular, participants seem ready to sacrifice a rather similar payout for these wealth holdings in the experiment. When costs of saving are higher, agents tend to hold less cash on hand. These findings can be rationalized by a simple model with a direct ingredient of wealth in the utility function where utility from consumption (the payout) is weighed against holding wealth in the experiment:

$$u_i = E\{\sum_{t=1}^{T} \beta^t v(c_{it}, w_{it})\}. \tag{6}$$

In the optimum, the marginal utilities from consumption and wealth should be equal:

$$\frac{\partial v}{\partial c_{it}} = \frac{\partial v}{\partial w_{it}}. \tag{7}$$

In the face of the budget constraint, participants would trade off impatient consumption against wealth holdings. Plausibly, the utility from wealth should fall to zero after the final round.

Personal characteristics of participants provide some plausible explanatory factors: There is some evidence that a higher financial literacy leads to payout-maximizing behaviour. People that characterize themselves as more impulsive are more likely non-optimizers. When participants see themselves as more patient, they are also inclined to hold higher savings, likely employing a lower intrinsic discounting of future consumption, in line with a buffer stock model (Carroll 1997). In any way ”[...]the implications for saving behaviour are [...] virtually indistinguishable from the idea that wealth enters the utility function directly” (Carroll 1998). Our experimental findings therefore may provide some micro-evidence for recent New-Keynesian models that use preferences over wealth as a channel to rationalize macroeconomic patterns (Michaillat and Saez 2018; Rannenberg 2018).

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References

Bakshi, G. S. and Z. Chen (1996). The spirit of capitalism and stock-market prices. *The American Economic Review 86*(1), 133–157.

Browning, M. and A. Lusardi (1996). Household Saving: Micro Theories and Micro Facts. *Journal of Economic Literature 34*(4), 1797–1855.

Campbell, J. Y. and N. G. Mankiw (1989). Consumption, Income, and Interest Rates: Reinterpreting the Time Series Evidence. *NBER Macroeconomics Annual 4*, 185–246.

Carbone, E. and J. D. Hey (2004). The effect of unemployment on consumption: an experimental analysis. *Economic Journal 114*(497), 660–683.

Carroll, C. (1992). The Buffer-Stock Theory of Saving: Some Macroeconomic Evidence. *Brookings Papers on Economic Activity 1992*(2), 61–156.

Carroll, C. (1997). Buffer Stock Saving and the Life Cycle/Permanent Income Hypothesis. *Quarterly Journal of Economics 112*(1), 1–55.

Carroll, C. (1998). Why do the rich save so much? NBER Working Papers 6549, National Bureau of Economic Research, Inc.

Cochrane, J. H. (1989). The Sensitivity of Tests of the Intertemporal Allocation of Consumption to Near-Rational Alternatives. *American Economic Review 79*(3), 319–337.

Deaton, A. (1991). Saving and Liquidity Constraints. *Econometrica 59*(5), 1221–1248.

Fischbacher, U. (2007). z-Tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics 10*(2), 171–178.

Francis, J. L. (2009). Wealth and the capitalist spirit. *Journal of Macroeconomics 31*(3), 394–408.

Gong, L. and H.-f. Zou (2002). Direct preferences for wealth, the risk premium puzzle, growth, and policy effectiveness. *Journal of Economic dynamics and control 26*(2), 247–270.

Greiner, B. (2015). Subject pool recruitment procedures: organizing experiments with ORSEE. *Journal of the Economic Science Association 1*(1), 114–125.

Hey, J. D. and V. Dardanoni (1987). Optimal consumption under uncertainty: an experimental investigation. *Economic Journal 98*(390), 105–116.

Jappelli, T. and L. Pistaferri (2014). Fiscal Policy and MPC Heterogeneity. *American Economic Journal: Macroeconomics 6*(4), 107–136.

Keynes, J. M. (1936). *The General Theory of Employment Interest and Money.* New York: Harcourt, Brace & Company.

Kurz, M. (1968). Optimal economic growth and wealth effects. *International Economic Review 9*(3), 348.

Lusardi, A. (1998). On the Importance of the Precautionary Saving Motive. *American Economic Review: Papers and Proceedings 88*(2), 449–453.

Meissner, T. (2016). Intertemporal consumption and debt aversion: an experimental study. *Experimental Economics 19*(2), 281–298.

Michaillat, P. and E. Saez (2018). A New Keynesian Model with Wealth in the Utility Function. NBER Working Papers 24971, National Bureau of Economic Research, Inc.

Rannenberg, A. (2018). Forward guidance with preferences over save assets. Working Paper Research 364, National Bank of Belgium.

Saez, E. and S. Stantcheva (2016). A simpler theory of optimal capital taxation. NBER Working Papers 22664, National Bureau of Economic Research, Inc.

Thaler, R. (1980). Toward a positive theory of consumer choice. *Journal of Economic Behavior & Organization 1*(1), 39–60.

Zou, H.-f. (1994). The spirit of capitalism and long-run growth. *European Journal of Political Economy 10*(2), 279–293.

Appendix A Statistics of the trial run

Table 4: Descriptive Statistics – Trial Run

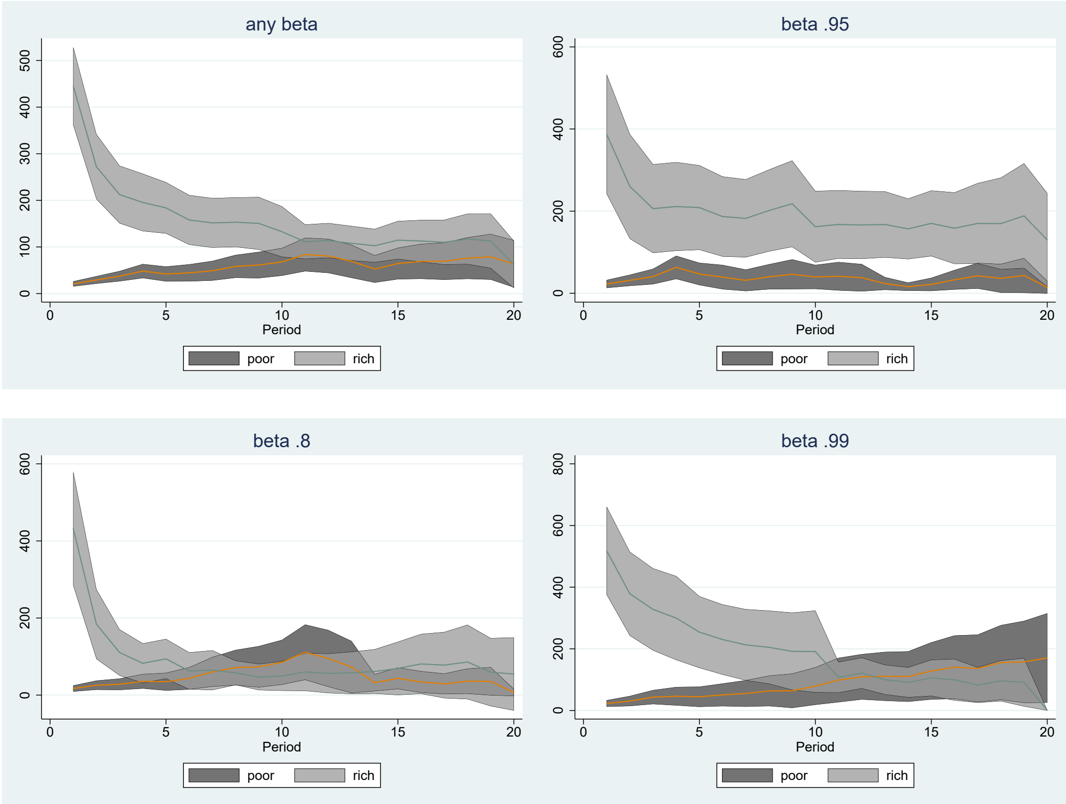
Panel A: all

	all	w0	w1000	$\beta = .99$	$\beta = .95$	$\beta = .8$
obs	179	89	90	58	60	61
savings	103.86	51.12	156.02	127.58	114.52	70.83
$\overline{w_{it}}$ (ECU)	(96.81; 111.07)	(45.31; 57.28)	(143.9; 168.6)	(113.34; 142.23)	(102.24; 127.72)	(61.15; 80.96)
sav. rate	24.82	19.27	30.31	27.56	26.36	20.7
$\overline{\varphi_{it}}$ (%)	(21.17; 28.48)	(14.82; 23.88)	(24.81; 35.96)	(20.67; 34.7)	(19.89; 33.05)	(15.55; 26.25)
loss	-140.34	-118.99	-161.44	-88.28	-113.17	-216.56
(Eurocents)	(-174.02; -109.11)	(-172.36; -73.48)	(-203.22; -121.67)	(-156.9; -34.31)	(-157.17; -73.33)	(-277.54; -162.3)
eff_1	93.52	94.18	92.87	95.79	94.87	90.03
(%)	(91.97; 94.95)	(91.67; 96.31)	(91; 94.64)	(92.49; 98.39)	(93.09; 96.52)	(87.23; 92.53)
eff_2	78.93	71.49	86.28	57.05	89.24	89.59
(%)	(66.89; 88.29)	(47.65; 89.67)	(83.63; 88.87)	(21.89; 84.97)	(85.68; 92.55)	(86.65; 92.2)

Panel B: non-optimizers

	all	w0	w1000	$\beta = .99$	$\beta = .95$	$\beta = .8$
obs	140	67	73	46	45	49
savings	132.48	67.83	191.83	160.65	152.06	88.07
$\overline{w_{it}}$ (ECU)	(123.5; 141.42)	(60.1; 75.92)	(177.15; 206.9)	(143.39; 178.6)	(136.36; 168.58)	(76.33; 100.28)
sav. rate	31.67	25.52	37.32	34.67	35.07	25.74
$\overline{\varphi_{it}}$ (%)	(27.72; 35.68)	(20.4; 30.98)	(31.67; 43.08)	(27.15; 42.46)	(28.08; 42.31)	(20.11; 31.7)
loss	-176.36	-154.78	-196.16	-108.7	-148.89	-265.1
(Eurocents)	(-217.5; -139)	(-222.99; -95.97)	(-245.48;-150)	(-195; -40.43)	(-203.78; -100.89)	(-330.61; -202.45)
eff_1	91.85	92.42	91.34	94.81	93.25	87.8
(%)	(89.97; 93.57)	(89.2; 95.16)	(89.14; 93.39)	(90.66; 98.1)	(91.05; 95.18)	(84.78; 90.69)
eff_2	73.58	62.78	83.5	47.04	85.82	87.25
(%)	(58.83; 85.28)	(31.91; 86.93)	(80.53; 86.36)	(2.87; 82.31)	(81.43; 89.7)	(84.08; 90.26)

Figure 2: Trial Run: Mean wealth stock at end-of-period of “poor” vs. “rich”



Appendix B Influence of personal characteristics

The characteristics are constant over the periods such that we can only exploit cross-sectional variation of the participants in this regard. When looking at the full sample in the final two columns, standard errors are clustered at the participant level. Column (1) is a plain specification featuring only the experimental treatments. Columns (2)-(4) look at the impact of personal characteristics for the full sample (2), a sample excluding optimizers (3) and a sample taking only the information from periods 9 to 19 into account (4). Columns (5) and (6) are rather similar to (2) and (4), but include the longitudinal dimension from single rounds and control for the impact of cash on hand x_{it} as a representation of an autoregressive process of savings. $1-\beta$ are the costs of

Table 5: Wealth Holdings and Personal Characteristics

	Dep. Var. w_{it}					
	(1)	(2)	(3)	(4)	(5)	(6)
	plain	full	noopt	r9-19	w_{it}	w_{it} r9-19
$(1-\beta)$	-3.014***	-2.654***	-4.484**	-2.189**	-1.561***	-0.465***
	(0.924)	(0.928)	(1.841)	(0.850)	(0.378)	(0.140)
$w_0 = 1000$	39.96***	31.42**	47.72	10.24	-2.714	0.315
	(15.17)	(14.91)	(29.79)	(13.65)	(6.598)	(2.544)
x_{it}					0.416***	0.785***
					(0.0489)	(0.0550)
male		24.81	67.80**	16.39	14.37*	2.395
		(16.00)	(31.20)	(14.65)	(8.005)	(2.598)
age		2.197	12.70**	3.639	1.308	0.961**
		(2.539)	(5.223)	(2.325)	(1.253)	(0.428)
natsci		-4.117	11.39	-4.651	-2.696	-2.068
		(15.72)	(29.34)	(14.39)	(9.577)	(3.393)
school		10.84	6.658	8.446	6.476	1.854
		(12.93)	(23.23)	(11.84)	(6.172)	(1.736)
tquest		0.150**	0.00500	0.0528	0.0878**	0.00459
		(0.0679)	(0.102)	(0.0622)	(0.0401)	(0.0154)
patience		6.991**	10.29*	4.259	4.096***	0.841*
		(2.953)	(5.794)	(2.703)	(1.356)	(0.438)
impulse		8.501**	10.19	6.355**	4.986***	1.026
		(3.332)	(6.932)	(3.051)	(1.780)	(0.699)
risk		0.167	-3.409	-0.0598	0.0362	-0.141
		(3.419)	(7.284)	(3.130)	(1.670)	(0.599)
conc_econ		-10.81	-22.18	-9.292	-6.209	-1.898
		(12.46)	(25.12)	(11.41)	(6.272)	(1.990)
conc_fin		-22.94*	-7.461	-21.98*	-13.67*	-3.031
		(12.72)	(27.03)	(11.64)	(7.173)	(2.414)
conc_health		17.84	43.47*	22.11**	10.67	4.493**
		(12.18)	(21.95)	(11.15)	(6.848)	(2.269)
inc_real		7.289	17.36	6.495	3.952	1.153
		(12.63)	(27.01)	(11.56)	(8.463)	(3.351)
sav_real		0.171	-10.24	1.951	0.237	0.859
		(5.213)	(10.31)	(4.773)	(2.763)	(0.906)
Const	54.14***	-122.9	-349.3**	-125.0*	-115.8***	-114.7***
	(13.46)	(76.68)	(158.9)	(70.21)	(41.43)	(14.79)
Obs	179	179	77	179	3,580	1,969
R^2	0.090	0.241	0.443	0.165	0.476	0.707

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

saving [1%, 5%, 20%]; $w_0 = 1000$ is 1, if the initial wealth is 1000, or 0, if the initial wealth is 0; x_{it} is cash-on-hand before the consumption decision; *natsci* is a dummy, which is 1, if the participant studies natural sciences or a technical subject, or 0 else; *male* is a dummy equal to one for male participants; *age* gives the age of the participant in years; *school* is the average high school exam grade (German "Abiturnote"); *tquest* measures the time in seconds until the participant has answered the comprehension questions; *patience* is the self reported patience (between 0 and 10, where 10 is largest); *impulse* is the self reported impulsiveness (same scale); *risk* is the self reported attitude towards risk taking (same scale); *conc_econ* is the answer to the question "Do you have concerns about the general economic development?" (between 1 and 3, where 3 means strong concerns); *conc_fin* is the answer to the question "Do you have concerns about your own financial situation?" (same scale); *concerns_health* is the answer to the question "Do you have concerns about your health?" (same scale); *inc_real* is the answer to the question "What is the amount of money, that you can use for spending per month on average?" categorized into seven classes; *sav_real* is the answer to the question "Are you able to save in a normal month? And if so, how much is that?" categorized into seven classes.

Table 6: Average Loss and Personal Characteristics

Dep. Var. Average Loss (negative sign)[5]			
	(1)	(2)	(3)
	plain	full	noopt
$(1-\beta)$	-0.929	-1.260	-4.436*
	(0.953)	(1.000)	(2.313)
$w_0 = 1000$	0.121	3.882	14.60
	(15.64)	(16.06)	(37.42)
male		-1.301	-23.43
		(17.24)	(39.19)
age		2.190	-2.871
		(2.736)	(6.561)
natsci		4.096	-10.45
		(16.94)	(36.86)
school		-26.10*	-24.60
		(13.94)	(29.18)
tquest		-0.0713	0.0133
		(0.0732)	(0.128)
patience		-6.312**	-8.817
		(3.181)	(7.279)
impulse		-8.391**	-12.78
		(3.590)	(8.708)
risk		2.928	10.69
		(3.684)	(9.149)
conc_econ		-0.781	-9.895
		(13.43)	(31.56)
conc_fin		10.01	6.133
		(13.70)	(33.95)
conc_health		-14.78	-47.51*
		(13.13)	(27.58)
inc_real		3.616	24.08
		(13.60)	(33.93)
sav_real		-1.400	7.250
		(5.616)	(12.95)
Const	-32.32**	63.46	181.6
	(13.88)	(82.62)	(199.6)
Obs	179	179	77
R^2	0.005	0.094	0.178

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix C Instructions

The original instructions are in German language (see below). Here you see a translated version. For brevity, we only present the instructions for one treatment (wealth=0 [wealth=1000], $\beta = 0.95$, $\rho = 1.1$). Note that in the other treatments only the content of the conversion table changes.

Welcome to the experiment!

You will take part in a study of decision-making behaviour within the framework of experimental economic research. During the investigation you will be asked to make decisions. You can earn money. How much money this will be depends on the course of the experiment. Detailed instructions are given below. All participants will be paid individually and in cash immediately after the experiment. Therefore, please remain seated at your seat after the experiment until your seat number is called. Before the actual experiment, there will be a trial run. During the trial run you will not be able to make any real money. The rehearsal is only for the sake of understanding. The decisions you make in the trial do not affect the main part of the experiment. If you have any questions before the start of the experiment, please contact one of the laboratory staff members by hand signal. They will then come to your place and help you. No more questions can be answered during the experiment. After the main part of the experiment, a questionnaire will open. Only after all participants have answered the questionnaire completely the payout begins. **Any communication with the other participants is not allowed during the experiment. Violation of this rule will result in immediate exclusion from the experiment.**

The trial run and the main part of the experiment consist of **20 rounds** each. In each of these rounds you will have to make a decision on how to split your available money between **saving** and **spending**. You can see which round you are in at the top of the screen. Your money will be displayed in the unit Experimental Currency (ECU).

Money available

Your available money consists of several parts: Your savings from the previous rounds and your current income. From the first round of the trial run as well as from the first round of the main part, you also have a starting capital at your disposal. The available money is expressed in ECU. Attention: You cannot transfer any savings from the trial round to the main part of the experiment. Available Money = Savings + Current Income

Current income

In each round you receive a current income. The amount of the current income is determined randomly and varies in each round. On average, the current income is approximately 100 ECU. The exact amount of current income in each round is shown at the beginning of each round.

Starting wealth

From the first round of the trial run and from the first round of the main part, you have a starting wealth at your disposal. Your starting wealth is part of your available money. So you can spend or save it just like the rest of your available money. Since you represent a poor [rich] household, your wealth is 0 [1000] ECU.

Information in each round

In each round, savings, current income and the resulting available money are displayed in a table. You can also see the values of the previous rounds in the table.

Your decision

Your decision as to how much of your available money you want to spend in the round (and thus indirectly how much you want to save) is entered in the "Your decision" field. The ECU amount you spend in each round is converted into Eurocents. The sum of the ECU amounts of the main part is paid to you at the end of the experiment.

Conversion table

You can use the conversion calculator on the screen to calculate on a trial basis how many Eurocents you will receive for a certain amount in Eurocents. The more ECU you spend, the more Eurocents you receive. The conversion of expenses into Eurocents is also influenced by the number of rounds. The higher the number of rounds, the less Eurocents you will receive for a certain amount of expenditure. Attention! The values in the conversion table are rounded to whole numbers for clarity. In the game, however, the values are not rounded. Only at the very end is the amount in Eurocents that you have earned rounded to the next higher multiple of 10 Eurocents. The conversion calculator displays the values exactly with four decimal places.

Conversion Table Round 1 to 10

	Round:									
	1	2	3	4	5	6	7	8	9	10
Expenditure in ECU:	Earnings in Eurocents									
0	0	0	0	0	0	0	0	0	0	0
20	21	20	19	18	17	16	15	15	14	13
40	42	40	38	36	34	32	31	29	28	26
60	63	60	57	54	51	49	46	44	42	40
80	84	79	75	72	68	65	61	58	55	53
100	105	99	94	90	85	81	77	73	69	66
120	125	119	113	108	102	97	92	88	83	79
140	146	139	132	125	119	113	108	102	97	92
160	167	159	151	143	136	129	123	117	111	105
180	188	179	170	161	153	146	138	131	125	119
200	209	199	189	179	170	162	154	146	139	132
220	230	218	207	197	187	178	169	161	153	145
240	251	238	226	215	204	194	184	175	166	158
260	272	258	245	233	221	210	200	190	180	171
280	293	278	264	251	238	226	215	204	194	184
300	314	298	283	269	255	243	230	219	208	198
320	334	318	302	287	272	259	246	234	222	211
340	355	338	321	305	289	275	261	248	236	224
360	376	357	340	323	306	291	277	263	250	237
380	397	377	358	340	323	307	292	277	263	250
400	418	397	377	358	340	323	307	292	277	263
420	439	417	396	376	357	340	323	307	291	277
440	460	437	415	394	375	356	338	321	305	290
460	481	457	434	412	392	372	353	336	319	303
480	502	477	453	430	409	388	369	350	333	316
500	522	496	472	448	426	404	384	365	347	329
1000	1045	993	943	896	851	809	768	730	693	659
1500	1568	1489	1415	1344	1277	1213	1152	1095	1040	988
2000	2090	1986	1886	1792	1702	1617	1536	1460	1387	1317
3000	3135	2978	2829	2688	2553	2426	2305	2189	2080	1976
...	...	...	...	...	...	...	...	...	...	...

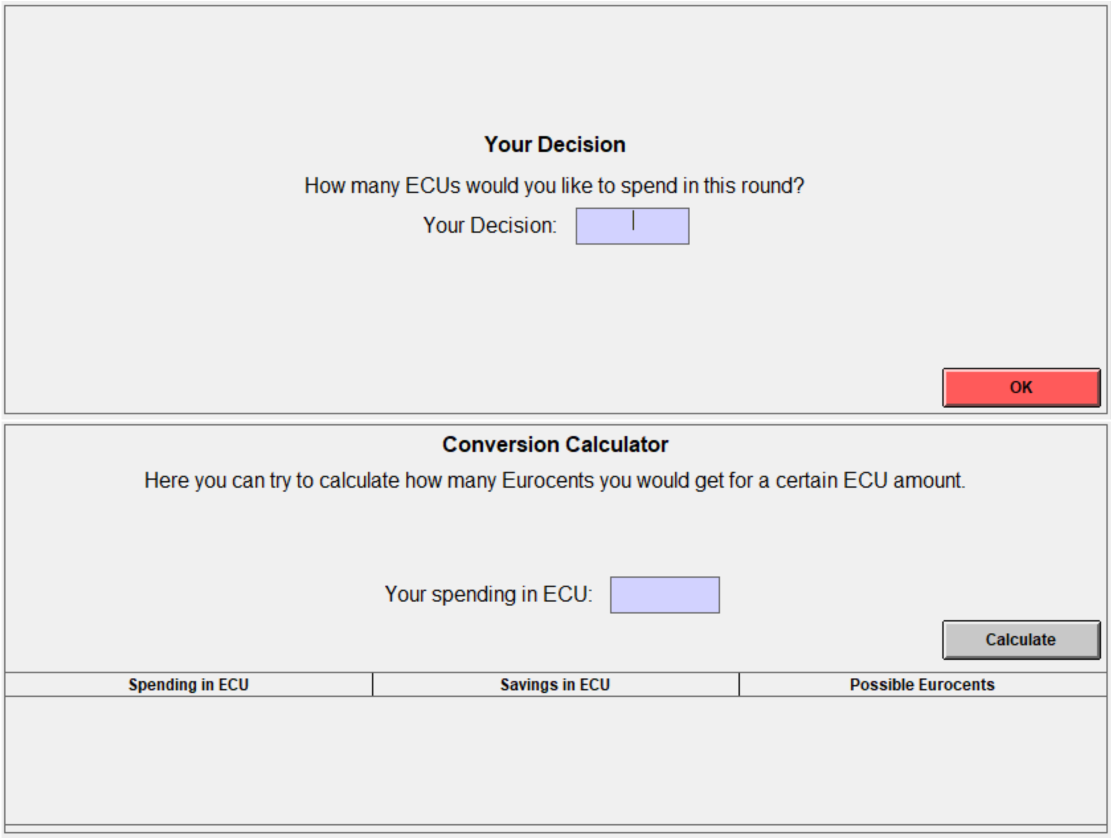
If, for example, you decide to spend 100 ECU in round 7, you will receive 77 Eurocents.

Conversion Table Round 11 to 20

	Round:									
	11	12	13	14	15	16	17	18	19	20
Expenditure in ECU:	Earnings in Eurocents:									
0	0	0	0	0	0	0	0	0	0	0
20	13	12	11	11	10	10	9	9	8	8
40	25	24	23	21	20	19	18	17	17	16
60	38	36	34	32	31	29	28	26	25	24
80	50	48	45	43	41	39	37	35	33	32
100	63	59	56	54	51	48	46	44	42	39
120	75	71	68	64	61	58	55	52	50	47
140	88	83	79	75	71	68	64	61	58	55
160	100	95	90	86	82	77	74	70	66	63
180	113	107	102	97	92	87	83	79	75	71
200	125	119	113	107	102	97	92	87	83	79
220	138	131	124	118	112	107	101	96	91	87
240	150	143	136	129	122	116	110	105	100	95
260	163	155	147	139	133	126	120	114	108	103
280	175	166	158	150	143	136	129	122	116	110
300	188	178	169	161	153	145	138	131	125	118
320	200	190	181	172	163	155	147	140	133	126
340	213	202	192	182	173	165	156	149	141	134
360	225	214	203	193	183	174	166	157	149	142
380	238	226	215	204	194	184	175	166	158	150
400	250	238	226	215	204	194	184	175	166	158
420	263	250	237	225	214	203	193	184	174	166
440	275	262	248	236	224	213	202	192	183	174
460	288	273	260	247	234	223	212	201	191	181
480	300	285	271	257	245	232	221	210	199	189
500	313	297	282	268	255	242	230	218	208	197
1000	626	594	565	536	510	484	460	437	415	394
1500	939	892	847	805	764	726	690	655	623	592
2000	1251	1189	1129	1073	1019	968	920	874	830	789
3000	1877	1783	1694	1609	1529	1452	1380	1311	1245	1183
...	...	...	...	...	...	...	...	...	...	...

If, for example, you decide to spend 320 ECU in round 18, you will receive 140 Eurocents.

Course of the rounds
As described above, in each of the 20 rounds you have to make a decision on how to spend and save your available money. Once you've decided to split and left the round, you can't change that decision. So you can't go back to past rounds. The following picture shows what your decision screen looks like in the experiment.



Your payment
The rounds of the trial round are not relevant for disbursement. Only the decisions in the main part of the experiment determine the payout. At the end of the 20 rounds of the main part, all Eurocents that you have collected through your expenses in the individual rounds of the main part are added. You will receive this sum in cash at the end of the experiment.

Comprehension questions
Before the trial run begins, you have to answer a series of on-screen comprehension questions. The experiment does not begin until you have answered all the questions correctly. These questions do not affect your payout. If you have any questions about the instructions, please contact us by hand signal. An employee will then come to you and answer your questions.

Comprehension Questions

- You are in round 1. How many Eurocents do you get if you spend 40 ECU?
- You are in round 2. How many Eurocents do you get if you spend 40 ECU?
- You are in round 3. How many Eurocents do you get if you spend 400 ECU?
- You are in round 16. How many Eurocents do you get if you spend 400 ECU?
- You spend 100 ECU. How many Eurocents do you get more by spending in round 2 instead of round 12?
- You spend 200 ECU. How much Eurocents do you get less if you spend in round 16 instead of round 3?
- In one round you will have a current income of 100 ECU plus savings from the preliminary rounds of 200 ECU. What is your disposable income in ECU in this round?
- In one round your disposable income is 250 ECU You spend 120 ECU. How high are your savings in the next round?

Original Instructions

In the following, you see the original instructions in German language. For brevity, we only present the instructions for one treatment (wealth=0, $\beta = 0.95$, $\rho = 1.1$).

Willkommen zum Experiment!

Sie nehmen an einer Untersuchung des Entscheidungsverhaltens im Rahmen der experimentellen Wirtschaftsforschung teil. Während der Untersuchung werden Sie gebeten, Entscheidungen zu treffen. Dabei können Sie Geld verdienen. Wie viel Geld das sein wird, hängt vom Experimentverlauf ab. Im Folgenden erhalten Sie hierzu detaillierte Instruktionen. Alle Teilnehmer werden direkt im Anschluss an das Experiment einzeln und in bar ausgezahlt. Bitte bleiben Sie daher nach dem Experiment so lange an Ihrem Platz sitzen, bis Ihre Platznummer aufgerufen wird. Vor dem eigentlichen Experiment findet ein Probedurchgang statt. In dem Probedurchgang können Sie kein echtes Geld verdienen. Der Probedurchgang dient lediglich dem Verständnis. Die Entscheidungen, die Sie in dem Probedurchgang treffen, haben keine Auswirkungen auf den Hauptteil des Experiments. Sollten Sie vor dem Start des Experiments Fragen haben, wenden Sie sich bitte per Handzeichen an einen Mitarbeiter des Labors. Er wird dann zu Ihnen an den Platz kommen und Ihnen weiterhelfen. Während des Experiments können keine Fragen mehr beantwortet werden. Nach dem Hauptdurchgang des Experiments, öffnet sich noch ein Fragebogen. Erst nachdem alle Teilnehmer den Fragebogen vollständig beantwortet haben, beginnt die Auszahlung. **Jegliche Kommunikation mit den anderen Teilnehmern ist während des Experiments nicht gestattet. Ein Verstoß gegen diese Regel führt zum sofortigen Ausschluss vom Experiment.**

Der Probedurchgang und der Hauptteil des Experiments bestehen aus je **20 Runden**. In jeder dieser Runden müssen Sie eine Entscheidung treffen, wie Sie Ihr verfügbares Geld zwischen **sparen** und **ausgeben** aufteilen wollen. In welcher Runde Sie sich befinden, sehen Sie am oberen Bildschirmrand. Ihr Geld wir dabei in der Einheit Experimentwährung (EW) angezeigt.

Verfügbares Geld

Ihr verfügbares Geld setzt sich aus mehreren Teilen zusammen: Ihr Erspartes aus den vorherigen Runden und Ihr aktuelles Einkommen. Ab der ersten Runde des Probedurchgangs sowie ab der ersten Runde des Hauptteils steht Ihnen zusätzlich ein Startvermögen zur Verfügung. Das verfügbare Geld wird in EW angegeben. Achtung: Sie können keine Ersparnisse aus dem Probedurchgang in den Hauptteil des Experiments übertragen. Verfügbares Geld = Erspartes + aktuelles Einkommen

Aktuelles Einkommen

In jeder Runde erhalten Sie ein aktuelles Einkommen. Die Höhe des aktuellen Einkommens ist zufällig bestimmt und variiert in jeder Runde. Im Durchschnitt beträgt das aktuelle Einkommen ungefähr 100 EW. Wie hoch das aktuelle Einkommen in jeder Runde genau ist, wird Ihnen zu Beginn jeder Runde angezeigt.

Vermögen

Ab der ersten Runde des Probedurchgangs sowie ab der ersten Runde des Hauptteils steht Ihnen ein Vermögen zur Verfügung. Ihr Vermögen ist Teil ihres verfügbaren Geldes. Sie können es also genau wie das restliche verfügbare Geld ausgeben oder sparen. Da Sie einen armen Haushalt repräsentieren, beträgt ihr Vermögen 0 EW.

Informationen in jeder Runde

In jeder Runde werden Erspartes, aktuelles Einkommen und das daraus resultierende verfügbare Geld in einer Tabelle angezeigt. Auch die Werte der vergangenen Runden sind in der Tabelle für Sie sichtbar.

Ihre Entscheidung

Ihre Entscheidung, wie viel Ihres verfügbaren Geldes Sie in der Runde ausgeben wollen (und damit indirekt auch wie viel Sie sparen wollen), tragen Sie im Feld "Ihre Entscheidung" ein. Der EW-Betrag, den Sie in jeder Runde ausgeben, wird in Eurocent umgerechnet. Die Summe der EW-Beträge des Hauptteils wird am Ende des Experiments an Sie ausgezahlt.

Umrechnungstabelle

Wie viel Eurocent Sie für einen bestimmten EW-Betrag bekommen, können Sie auf dem Bildschirm mit dem Umrechnungskalkulator probeweise berechnen. Dabei gilt, je mehr EW Sie ausgeben, desto mehr Eurocent erhalten Sie. Die Umrechnung der Ausgaben in Eurocent wird auch von der Rundenzahl beeinflusst. Je höher die Rundenzahl, desto weniger Eurocent bekommen Sie für einen bestimmten Ausgabenbetrag. Achtung! Die Werte in der Umrechnungstabelle sind zur Übersichtlichkeit auf ganze Zahlen gerundet. Im Spiel werden die Werte jedoch nicht gerundet. Erst ganz am Ende wird der Betrag in Eurocent, den Sie erspielt haben, auf das nächsthöhere Vielfache von 10 Eurocent gerundet. Der Umrechnungskalkulator zeigt die Werte mit vier Nachkommastellen genau an.

Umrechnungstabelle Runde 1 bis 10

	Runde:									
	1	2	3	4	5	6	7	8	9	10
Ausgaben in EW:	Verdienst in Eurocent:									
0	0	0	0	0	0	0	0	0	0	0
20	21	20	19	18	17	16	15	15	14	13
40	42	40	38	36	34	32	31	29	28	26
60	63	60	57	54	51	49	46	44	42	40
80	84	79	75	72	68	65	61	58	55	53
100	105	99	94	90	85	81	77	73	69	66
120	125	119	113	108	102	97	92	88	83	79
140	146	139	132	125	119	113	108	102	97	92
160	167	159	151	143	136	129	123	117	111	105
180	188	179	170	161	153	146	138	131	125	119
200	209	199	189	179	170	162	154	146	139	132
220	230	218	207	197	187	178	169	161	153	145
240	251	238	226	215	204	194	184	175	166	158
260	272	258	245	233	221	210	200	190	180	171
280	293	278	264	251	238	226	215	204	194	184
300	314	298	283	269	255	243	230	219	208	198
320	334	318	302	287	272	259	246	234	222	211
340	355	338	321	305	289	275	261	248	236	224
360	376	357	340	323	306	291	277	263	250	237
380	397	377	358	340	323	307	292	277	263	250
400	418	397	377	358	340	323	307	292	277	263
420	439	417	396	376	357	340	323	307	291	277
440	460	437	415	394	375	356	338	321	305	290
460	481	457	434	412	392	372	353	336	319	303
480	502	477	453	430	409	388	369	350	333	316
500	522	496	472	448	426	404	384	365	347	329
1000	1045	993	943	896	851	809	768	730	693	659
1500	1568	1489	1415	1344	1277	1213	1152	1095	1040	988
2000	2090	1986	1886	1792	1702	1617	1536	1460	1387	1317
3000	3135	2978	2829	2688	2553	2426	2305	2189	2080	1976
...	...	...	...	...	...	...	...	...	...	...

Entscheiden Sie sich also beispielsweise in Runde 7 für einen Ausgabenbetrag von 100 EW, erhalten Sie dafür 77 Eurocent.

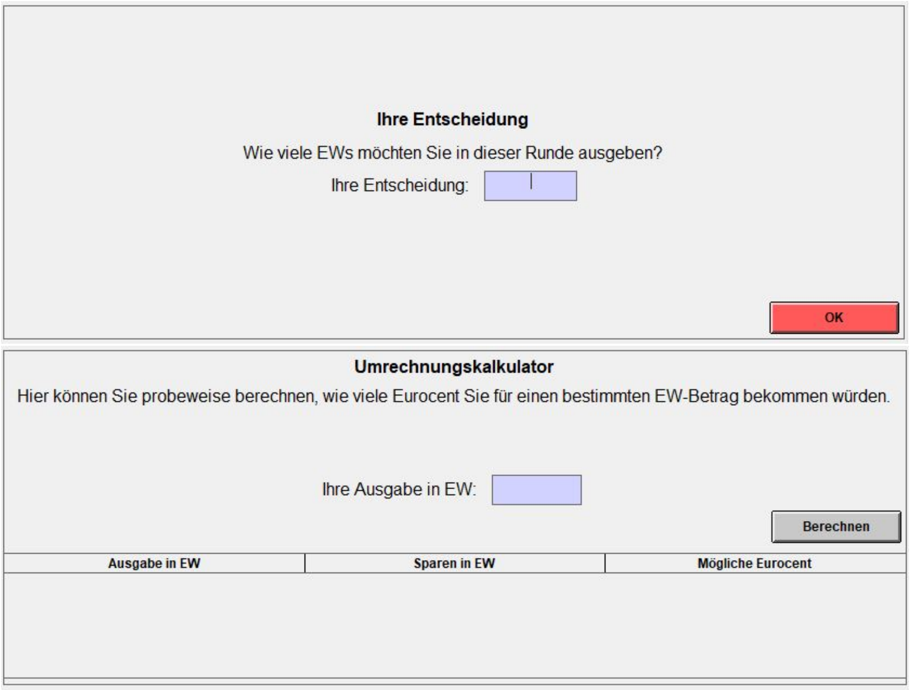
Umrechnungstabelle Runde 11 bis 20

	Runde:									
	11	12	13	14	15	16	17	18	19	20
Ausgaben in EW:	Verdienst in Eurocent:									
0	0	0	0	0	0	0	0	0	0	0
20	13	12	11	11	10	10	9	9	8	8
40	25	24	23	21	20	19	18	17	17	16
60	38	36	34	32	31	29	28	26	25	24
80	50	48	45	43	41	39	37	35	33	32
100	63	59	56	54	51	48	46	44	42	39
120	75	71	68	64	61	58	55	52	50	47
140	88	83	79	75	71	68	64	61	58	55
160	100	95	90	86	82	77	74	70	66	63
180	113	107	102	97	92	87	83	79	75	71
200	125	119	113	107	102	97	92	87	83	79
220	138	131	124	118	112	107	101	96	91	87
240	150	143	136	129	122	116	110	105	100	95
260	163	155	147	139	133	126	120	114	108	103
280	175	166	158	150	143	136	129	122	116	110
300	188	178	169	161	153	145	138	131	125	118
320	200	190	181	172	163	155	147	140	133	126
340	213	202	192	182	173	165	156	149	141	134
360	225	214	203	193	183	174	166	157	149	142
380	238	226	215	204	194	184	175	166	158	150
400	250	238	226	215	204	194	184	175	166	158
420	263	250	237	225	214	203	193	184	174	166
440	275	262	248	236	224	213	202	192	183	174
460	288	273	260	247	234	223	212	201	191	181
480	300	285	271	257	245	232	221	210	199	189
500	313	297	282	268	255	242	230	218	208	197
1000	626	594	565	536	510	484	460	437	415	394
1500	939	892	847	805	764	726	690	655	623	592
2000	1251	1189	1129	1073	1019	968	920	874	830	789
3000	1877	1783	1694	1609	1529	1452	1380	1311	1245	1183
...	...	...	...	...	...	...	...	...	...	...

Entscheiden Sie sich also beispielsweise in Runde 18 für einen Ausgabenbetrag von 320 EW, erhalten Sie dafür 140 Eurocent.

Ablauf der Runden

Wie schon beschrieben, müssen Sie in jeder der 20 Runden eine Entscheidung treffen, wie Sie Ihr verfügbares Geld zwischen ausgeben und sparen aufteilen. Sobald Sie sich einmal für eine Aufteilung entschieden haben und die Runde verlassen haben, können Sie diese Entscheidung nicht mehr ändern. Sie können also nicht mehr in vergangene Runden zurückkehren. Das folgende Bild zeigt, wie Ihr Entscheidungsbildschirm im Experiment aussieht.



Ihre Auszahlung

Die Runden des Probedurchgangs sind nicht auszahlungsrelevant. Erst die Entscheidungen im Hauptteil des Experiments bestimmen die Auszahlung. Nach Ablauf der 20 Runden des Hauptteils werden alle Eurocent, die Sie durch Ihre Ausgaben in den einzelnen Runden des Hauptteils gesammelt haben, addiert. Diese Summe bekommen Sie am Ende des Experiments bar ausgezahlt.

Verständnisfragen

Bevor der Probedurchgang beginnt, beantworten Sie eine Reihe von Verständnisfragen am Bildschirm. Das Experiment beginnt erst, wenn Sie alle Fragen korrekt beantwortet haben. Diese Fragen haben keinen Einfluss auf Ihre Auszahlung. Sollten Sie Fragen zu den Instruktionen haben, melden Sie sich bitte per Handzeichen. Ein Mitarbeiter kommt dann zu Ihnen und beantwortet Ihre Fragen.

[a]

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