Measuring Preferences Over the Temporal Resolution of Consumption Uncertainty*

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Abstract

We develop and test a novel experimental design that allows to directly elicit preferences over the temporal resolution of consumption uncertainty. To identify preferences over the temporal resolution of *consumption* uncertainty – as opposed to income uncertainty – we investigate choices over consumption (real effort). We find that on average subjects weakly prefer early resolution of consumption uncertainty: They are willing to forgo 4.52% of their total consumption in order to resolve all uncertainty immediately. However, this result is mainly driven by a minority with strong preferences for early resolution of consumption uncertainty. Most subjects are indifferent towards the temporal resolution of consumption uncertainty.

To test whether the theoretical link between preferences over the temporal resolution of consumption uncertainty and preferences over risk, time and intertemporal substitution holds as formulated in recursive utility models, we additionally elicit these preferences experimentally. Surprisingly, we find that recursive utility has no predictive power in explaining preferences over the temporal resolution of consumption uncertainty.

JEL classification: C91 · E24 · E44 · G12 · O40
Keywords: Recursive Utility · Timing of Resolution of Uncertainty · Preference Elicitation · Timing Premia

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1 Introduction

Imagine your life time consumption path was fully predetermined but unknown to you. Would you be willing to pay in order to learn about your life time consumption now? If so, how much?

This question is at the core of recursive utility (henceforth, RU) models as in Kreps and Porteus (1978) and Epstein and Zin (1989). RU models build on the idea that agents have intrinsic preferences towards the resolution of *consumption uncertainty* over time. In general, there are many reasons why people may prefer uncertainty to resolve early. For example, knowing your future income helps to optimally choose between consumption and saving. In RU models, however, an early resolution of uncertainty may be preferred even if it has no instrumental value. By assuming preferences towards the timing of the resolution of consumption uncertainty, RU decouples attitudes towards risk from the elasticity of intertemporal substitution, i.e. the willingness to shift consumption over time.[1] This additional flexibility has proven very useful in a host of studies.[2] A prime example from macro-finance is the seminal work of Bansal and Yaron (2004). Utilizing preferences for an early resolution of uncertainty, their long-run risk model offers a unified explanation of several long-standing asset pricing puzzles.[3]

Despite the recent success of RU, it remains unclear whether people actually exhibit a preference for the temporal resolution of consumption uncertainty. Recently, Epstein et al. (2014) argue that the macro-financial literature has ignored the full implications of assuming a preference for the temporal resolution of uncertainty. They show how common parameter specifications lead to implausibly high timing premia, i.e. the amount of consumption one would be willing to forgo in exchange for consumption uncertainty to be resolved immediately.[4] In the end, the question whether individuals exhibit such timing premia, and what magnitude they have, is an empirical one.

[1] In the expected utility framework, the coefficient for relative risk aversion is always the reciprocal of the elasticity of intertemporal substitution. Note the separation of these parameters under RU is only possible *via* the notion of timing of the resolution of uncertainty.

[2] RU is an essential part in studies covering asset pricing (the long run risks paradigm developed in Epstein and Zin 1989 and Bansal and Yaron 2004), international risk sharing (Obstfeld 1994), climate change risks (Ackerman et al. 2013 and Kent et al. 2016), and welfare costs of economic disasters (Barro 2009).

[3] See their conclusion (Bansal and Yaron, 2004, p. 1502): "The model is capable of justifying the observed magnitudes of the equity premium, the risk-free rate, and the volatility of the market return, dividend-yield, and the risk-free rate. Further, it captures the volatility feedback effect, that is, the negative correlation between return news and return volatility news. As in the data, dividend yields predict future returns and the volatility of returns is time-varying."

[4] In the same paper, the authors highlight the need for empirical studies, measuring potential timing premia and thus giving empirical guidance to theoretical studies. So far only results based on simulations or introspection are available. Agents in Bansal and Yaron (2004) would give up a debatable fraction of 31 percent of their life time consumption to have all uncertainty resolved early (Epstein et al. 2014). Petrosky-Nadeau et al. (2015) calculate timing premia arising in a theoretical economy with endogenous disasters via Monte Carlo simulations. They report a timing premium of 17 percent. However, there is no empirical counterpart available to evaluate these results.

In this paper, we aim to answer this question by running a laboratory experiment. To this end, we develop a novel experimental design that directly elicits the magnitudes of individual timing premia.

Importantly, RU involves preferences towards the temporal resolution of *consumption* uncertainty – as opposed to *income* uncertainty. Even under standard (non-recursive) preferences, early resolution of income uncertainty should be preferred because information about future income can be used to improve consumption decisions now. With respect to consumption uncertainty, no such planning advantage exists: At the time all uncertainty is resolved (that is future consumption is known for certain) future consumption cannot be changed. RU models imply that people nevertheless may be non-indifferent towards the timing of the resolution of *consumption* uncertainty.

Our experimental design reflects these considerations. To measure preferences over the temporal resolution of consumption uncertainty, subjects complete a list of incentivized lottery choices (also called multiple price list (MPL), see e.g. Coller and Williams 1999 and Holt and Laury 2002) that varies the timing of the resolution of consumption uncertainty. Instead of monetary payments these lotteries are defined over real consumption, represented by a real effort task and YouTube watching time. Subjects' choices in this MPL can be used to directly measure their timing premium in a model-free way. This novel approach improves upon the existing literature which typically identifies timing premia only indirectly using structural assumptions about the connection of risk aversion, time discounting and preferences over intertemporal substitution.

As a main result we find that subjects on average weakly prefer the early resolution of consumption uncertainty. On average, subjects are willing to forgo 4.52% of their consumption in order to expedite the resolution of consumption uncertainty by five weeks. However, we observe a substantial heterogeneity with respect to the preference for early resolution at the individual level. Most subjects are indifferent to the temporal resolution of uncertainty, while a significant minority of subjects has a strong preference for the early resolution of uncertainty. No subject has a strong preference for the late resolution of uncertainty.

RU models propose a structural relation between the timing premia and risk aversion, time discounting and preferences over intertemporal substitution. To test this link, we also elicit these preferences in three additional multiple price lists. We then use the information from these MPLs to calculate predicted timing premia under the RU model.

Notably, we find no significant correlation between the theoretically predicted timing premia and the timing premia elicited in our experiment. This result implies that while we do find some evidence for a preference over the temporal resolution of consumption uncertainty, recursive utility cannot explain the underlying mechanism. Our finding is robust to additional controls, such as gender, personality traits, cognitive reflection ability, and the efficacy of the experimental incentivization, among others.

1.1 Related Literature

A number of previous efforts exist on identifying preferences towards the temporal resolution of uncertainty.[5] Closest to our study are Von Gaudecker et al. (2011) and Brown and Kim (2013). Von Gaudecker et al. (2011) use MPLs to estimate preferences with respect to risk, loss aversion and timing of risk resolution. They find preferences for the resolution of uncertainty to be the least important factor in determining subjects choices. In another study based on MPLs, Brown and Kim (2013) find that most subjects prefer an early resolution of uncertainty. Miao and Zhong (2015) provide empirical support for the RU model using a convex time budget setup. Epstein et al. (2014) point out that these studies focus on identifying whether subjects prefer early or late resolution but not on assessing the strength of these preferences.

Moreover, these experimental studies elicit timing premia only *indirectly* by assessing preferences over risk, time and intertemporal substitution, and utilizing RU models to back out corresponding timing premia. In contrast, our experimental design allows to measure timing premia directly in a model-free way.

Another important novel feature of our experiment is the use of consumption instead of monetary rewards to incentivize subjects. In general, subjects should internalize time-dated monetary rewards as changes to their income stream. Experiments using monetary rewards to elicit preferences over the temporal resolution of uncertainty thus allow to test whether subjects anticipate the planning advantage associated with knowing income early, but not whether subjects have a preference over the temporal resolution of *consumption* uncertainty, as postulated in RU models. The distinction is important, as observing preferences for early resolution of uncertainty with respect to monetary rewards is not sufficient to infer whether subjects also prefer an early resolution of consumption uncertainty.

Additional confounds exist when using choices over monetary rewards instead of choices over consumption in order to identify time and risk preferences. Among these are subjective assessments of the experimenter's payment reliability as well as arbitrage options with the outside world (Augenblick et al., 2015).

2 Theoretical Framework

Our elicitation of timing premia does not rely on any specific model. However, since we will test the theoretical link between preference parameters and the timing premium, it will be helpful to introduce a formalization of recursive utility. A recursive utility function can be

[5] For experimental approaches, see also, e.g., Chew and Ho (1994), Ahlbrecht and Weber (1997), Erev and Haruvy (2010), Abdellaoui et al. (2011), Van Winden et al. (2011). Recent work by Croce et al. (2016) and Schlag et al. (2017) also uses financial market data to study preferences over the temporal resolution of uncertainty.

written as follows:

$$U_t(C) = W\Big[C_t, \mathcal{R}_t(U_{t+1}(C))\Big], \tag{1}$$

where U_t represents utility at time t. $W(\cdot,\cdot)$ is a time aggregator function that summarizes how consumption, C, is valued at different points in time. It is defined on current consumption and the conditional certainty equivalent of future utility, $\mathcal{R}_t$, which captures risk aversion.

For the remaining paper, we refer to RU with the popular specific functional form introduced by Epstein and Zin (1989) where

$$W(C, \mathcal{R}_t) = \left[C_t^\rho + \beta \mathcal{R}_t(U_{t+1}(C))^\rho\right]^{1/\rho}, \tag{2}$$

and

$$\mathcal{R}_t(U_{t+1}(C)) = \Big(\mathbb{E}_t\left[U_{t+1}^\alpha\right]\Big)^{1/\alpha}. \tag{3}$$

ρ determines the elasticity of intertemporal substitution, β is the time discount factor and α governs relative risk aversion. With this specification RU can be written as:

$$U_t(C) = \left[C_t^\rho + \beta\Big(\mathbb{E}_t\left[U_{t+1}^\alpha\right]\Big)^{\rho/\alpha}\right]^{1/\rho}. \tag{4}$$

Note that recursive utility nests expected utility as the special case of $\alpha = \rho$. Only under this constellation, agents are indifferent towards the timing of the resolution of uncertainty. For $\alpha < \rho$, agents prefer an early resolution of consumption uncertainty. For $\alpha > \rho$, agents prefer a late resolution of consumption uncertainty.

2.1 Preferences for the temporal resolution of uncertainty

Consider the following setup (for sake of exposition, we label the dates according to our experimental setup). An individual lives for three periods $t = \{1, 2, 3\}$ and faces consumption at date 2 and date 3, denoted C_2 and C_3, respectively. Both are i.i.d. random variables. There exist two options: early draw and late draw. With an early draw (ED), both C_2 and C_3 get drawn at date $t = 1$. With a late draw (LD), C_2 gets drawn at $t = 2$ and C_3 gets drawn at $t = 3$.

Appendix A shows that for an early draw the specification in (4) collapses to

$$U_1^{ED}(C) = \mathbb{E}_1\left[\Big(C_2^\rho + \beta C_3^\rho\Big)^{\alpha/\rho}\right]^{1/\alpha}. \tag{5}$$

In case of late draw, however, C_3 will only be drawn at date 3. The consumption path remains uncertain until date 3 and

$$U_1^{LD}(C) = \mathbb{E}_1 \left[\left(C_2^\rho + \beta \mathbb{E}_2 \left[C_3^\alpha \right]^{\rho/\alpha} \right)^{\alpha/\rho} \right]^{1/\alpha}. \tag{6}$$

Generally, unless in the special case of expected utility ($\alpha = \rho$), $U_1^{ED} \neq U_1^{LD}$. Under RU, the two consumption streams – which differ only in the temporal aspect of the resolution of uncertainty – are evaluated differently. At an axiomatic level, the timing of the resolution matters because RU abandons the reduction of compound lotteries axiom of expected utility theory. Intuitively, temporal compound lotteries can no longer be reduced to simpler structures and therefore the time dimension of uncertainty resolution matters. We refer for further discussion of the theoretical foundations to, e.g., Kreps and Porteus (1978), Chew and Epstein (1989), Epstein and Zin (1989) and Weil (1990).

3 Experimental Design

The experiment uses multiple price lists (MPLs) to elicit timing premia and individual preferences. It consists of 56 binary choices which specify magnitude, timing and risk of units of effort that have to be exerted. We induce a real time dimension by inviting subjects to the laboratory on up to three different points in time (labeled $t = 1$, 2 and 3, respectively). Figure 1 provides a time line of our experiment.

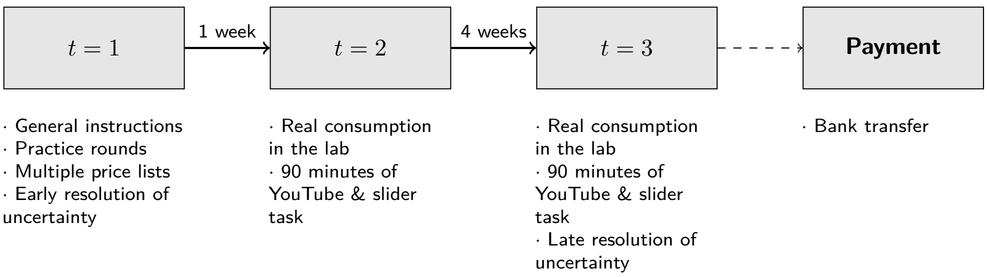

Figure 1: Time Line of Experimental Design

The first two dates were one week apart and the follow-up sessions were four weeks apart. Subjects made all actual choices made at $t = 1$. To control for present bias, all choices involved units of effort to be exerted in the future at $t = 2$ and/or $t = 3$. Lump-sum payments for participation took place after date 3.

3.1 Consumption

A key feature of this experiment is the use of consumption instead of monetary payments as incentives. Subjects consume in the lab by watching YouTube which is contrasted by a real effort task similar to Augenblick et al. (2015) and Pagel and Zeppenfeld (2013).[6] The real effort task is a modified version of the "slider task" in Gill and Prowse (2011).[7] We frame the task in work units (WU) each consisting of four "sliders" which subjects have to move to a certain value within 30 seconds. After 30 seconds all sliders are reset and subjects have to move them again.

We choose the task to be purposefully monotone and annoying. It contrasts the YouTube time and makes consumption a far more pleasurable activity. The dull task also ensures that participants take their choices seriously. A post-experimental questionnaire confirmed that subjects indeed perceived the task as boring, effortful and less pleasurable than watching YouTube.

Each WU lasts 30 seconds even if subjects finish the task earlier. Hence, work units as well as consumption can be measured in units of 30 seconds of time. All work effort and consumption took place during the follow-up sessions where all subjects spent 90 minutes in the lab. During this time a total of 180 of these 30 second units can be divided between work and consumption time: $180 = WU + C$, where C denotes 30 second units of consumption (time spent on YouTube).

All 56 binary choices that subjects make in the experiment are denoted in these work units. For their participation, subjects received a fixed monetary payment that does not depend on their experimental choices: a show up fee of €5 for each session they attended, and a completion bonus of €35 that was only paid in full if they completed all assigned real effort work tasks.[8]

3.2 Elicitation Strategy

Subjects completed a total of 56 binary choices, selected from four underlying MPLs with 14 choices each. The choices were displayed sequentially in a random order, each on a separate screen.[9] Each binary choice specifies magnitude, timing and risk of units of effort that have to

[6] Pagel and Zeppenfeld (2013) as well as Houser et al. (2016) proxy real consumption by internet surfing time vs. a boring monotone task such as clicking on pop-up windows. Surfing the internet or watching YouTube is particularly attractive because subjects are familiar with this activity (Bosch-Rosa et al. 2017). More importantly, we believe that restricting the subjects "leisure" in the lab to YouTube decouples choices in the lab from outside consumption. This separation is a prerequisite to study timing premia. Theoretically, if subjects were allowed to surf the internet freely, they could use this time to plan and engage in tasks relevant to choices outside of the lab. Choices would reflect an instrumental planning advantage independent of preferences towards the timing of the resolution of consumption uncertainty. Of course, one can never fully exclude the possibility that subjects may ascribe some instrumental value to knowing when and for how long they will watch YouTube. In this sense our findings on the timing premium may be seen as an upper bound of the timing premium with absolutely no instrumental value of the timing of uncertainty resolution.

[7] Appendix C contains a screenshot of the task.

[8] All subjects completed all required work units.

[9] In a previous pilot study, we employed a different MPL design where subjects were presented with 20 lottery pairs at once. This design choice does not affect our main results: The average timing premium was around 5 percent and we found a similar distribution pattern. However, some subjects used the center of the

	Option A (early resolution)						Option B (late resolution)						
	$t = 2$		$t = 3$				$t = 2$		$t = 3$				
			heads		*tails*				*heads*		*tails*		
row	WU	C	WU	C	WU	C	WU	C	WU	C	WU	C	*TP*
1	80	100	10	170	170	10	150	30	10	170	170	10	-36.8%
2	80	100	10	170	170	10	120	60	10	170	170	10	-21.0%
3	80	100	10	170	170	10	100	80	10	170	170	10	-10.5%
4	80	100	10	170	170	10	90	90	10	170	170	10	-5.3%
5	80	100	10	170	170	10	85	95	10	170	170	10	-2.6%
6	80	100	10	170	170	10	83	97	10	170	170	10	-1.6%
7	80	100	10	170	170	10	81	99	10	170	170	10	-0.5%
8	80	100	10	170	170	10	79	101	10	170	170	10	0.5%
9	80	100	10	170	170	10	77	103	10	170	170	10	1.6%
10	80	100	10	170	170	10	75	105	10	170	170	10	2.6%
11	80	100	10	170	170	10	70	110	10	170	170	10	5.3%
12	80	100	10	170	170	10	60	120	10	170	170	10	10.5%
13	80	100	10	170	170	10	40	140	10	170	170	10	21.0%
14	80	100	10	170	170	10	10	170	10	170	170	10	36.8%

Table 1: Price List for Uncertainty Resolution

Notes: Consumption and WU are measured in units of 30 seconds. *TP* shows implied timing premia if a subject switches from Option A to B in that row.

be exerted in two options, labeled neutrally A and B. Subjects indicate preference for Option A or B in each of the 56 choices. Although the choices from the four MPLs were presented randomly, we will refer to the four underlying MPLs for expository purposes throughout the paper.

Table 1 displays the first MPL that assesses timing premia – the amount of consumption subjects give up to resolve uncertainty early. Option A and B contain a safe amount of work to be completed at $t = 2$ and a lottery over units of work at $t = 3$. Importantly, the timing of resolution is different between Option A and B. In Option A subjects toss a coin at the end of $t = 1$ and learn their future consumption and WU early. In Option B the coin is only tossed at the start of $t = 3$. Accordingly, the uncertainty resolves just before the WU for this date have to be completed.

The only change between decision rows is the certain amount of WU in Option B at $t = 2$. In the first row the certain amount of work in Option B is 70 units larger than in Option A. Therefore, only subjects with a very strong preference for a late resolution of uncertainty would choose Option B. In the following rows the certain amount in Option B gradually decreases. Between rows 7 and 8, work units in both options are the same. In the last decision the amount of work in Option A is 70 units larger than in Option B and only a subject with a very strong preference for early resolution of uncertainty would still choose Option A. Except in such extreme cases, monotonicity implies a pattern where subjects start out choosing Option A, and then uniquely switch over to Option B before the last decision.

MPLs as a focal points which may bias estimated preferences. The pilot results are available upon request.

This switch point gives a corresponding timing premium for each subject.[10]

The remaining lists do not vary the timing of the resolution of consumption uncertainty, but are sufficient to jointly identify the three structural parameters α, β and ρ of the RU model.[11] The second MPL elicits risk preferences. In this MPL subjects choose between a varying safe amount of WU to be completed under Option A, and coin flip lottery that yields either 10 or 170 WU with equal probability under Option B. All WU in this MPL have to be solved at only one of the dates.[12] In the third and fourth MPL we vary safe amounts of WU at different points in time to elicit intertemporal substitution as well as time discounting. Note also that we do not enforce a single switch point in any of the MPLs.

3.3 Experimental Procedures

A total of 61 participants were recruited through ORSEE (Greiner 2015). Most of the subjects were undergraduate students from Berlin University of Technology. Most subjects (57%) study engineering or natural sciences. 22 (36%) were female. Sessions were run at the Experimental Economics Laboratory of Berlin University of Technology in 2017. The experimental software was programmed and implemented with Z-tree (Fischbacher, 2007). Upon arriving in the laboratory, subjects received a set of general instructions describing the course of the experiment.[13] They then solved 20 practice WU to understand the nature of the effort task, followed by a set of instructions explaining the binary choices in more detail. Upon completion of all 56 choices, subjects filled in an extensive questionnaire, which included socio-demographic information, cognitive reflection tests (original CRT (Frederick, 2005) and eCRT (Toplak et al., 2014)), a 10 item Big Five personality test (Rammstedt and John, 2007), and other controls, such as the (self-reported) reservation wage for solving WU and for watching YouTube.[14] Then one of the 56 choices was drawn randomly for each subject as the "decision that counts". This decision determined how many WU subjects had to complete and at what date. If the "decision that counts" involved risk, subjects flipped a coin to determine the final outcome. If subjects chose late resolution of uncertainty, this coin flip was deferred until $t = 3$.

To avoid systematic preferences for any of the dates, all sessions took place on the same day of the week and at the same time of day. All subjects completed all assigned WU. Subjects received on average €47.2 for their participation and were paid after the third date via bank transfer. Only three subjects missed some follow-up sessions.[15]

[10] See Section 4.1 for details on how timing premia are calculated.

[11] Appendix B provides all additional MPLs.

[12] Subjects were randomly assigned to choose over risky consumption at only $t = 2$ *or* $t = 3$. We use these treatments to check if there are differences regarding risk aversion, depending on whether the risky consumption takes place at date $t = 2$ or $t = 3$. We find no significant difference.

[13] Appendix C provides the instructions.

[14] Appendix D contains the full questionnaire.

[15] Excluding these subjects does not change any of the qualitative findings in the next section.

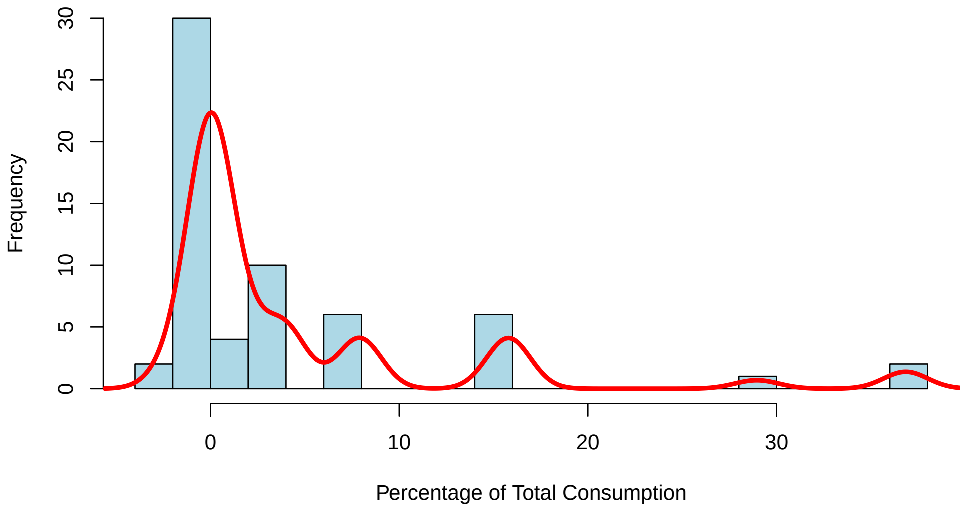

Figure 2: Elicited Timing Premia

Notes: The red solid line shows the marginal density. Figure 6 in Appendix B presents the corresponding switch points.

4 Results

In this section we first present our results regarding the directly elicited timing premia. We then report estimated preference parameters of the RU model. Finally, we study whether elicited timing premia can be explained by the RU model or individual time discounting and preferences over risk and intertemporal substitution.

4.1 Timing Premia

Our main contribution is to provide a direct empirical test of timing premia. We define the timing premium (TP) in our framework as the percentage of expected consumption a subject is maximally willing to forgo over the course of the experiment to have all uncertainty resolved immediately. For each row of Table 1 we can calculate the interval of potential timing premia that are consistent with choosing Option B for the first time in this row. We approximate the timing premium as the mean of this interval. For subjects who always choose Option A (B) this interval has no upper (lower) bound. Therefore, we approximate the timing premium with the lower (upper) bound of this interval. For subjects who do not always choose Option A or B, the timing premium can be written as:

$$TP_i = \frac{\overline{C}^B_{2,i} - C^A_2}{C^A_2 + E[C_3]}, \tag{7}$$

where $\overline{C}_2^B$ is the mean value of the two consumption levels specified for Option B at $t = 2$ in the rows in which subject i first switches to B and the row before. For instance, if a subject chooses Option A in rows one to ten in Table 1, and Option B in all remaining rows, then $\overline{C}_2^B = 115$. $C_2^A = 100$ is consumption at $t = 2$ for Option A and $E[C_3] = 90$ is expected consumption for Option A and B at $t = 3$.[16]

In this way we calculate the timing premium for all subjects who behave consistently, that is they have at most one switch point in the first MPL. Despite the relative difficulty of behaving consistently (due to the random and sequential presentation of choices), a total of 48 out of 61 subjects fall in this category. All remaining subjects almost behave consistently except for one or two choices. To calculate timing premia for these subjects, we "correct" their choice such that with the fewest possible changes their overall choice becomes consistent and exhibits a single switch point. For 10 subjects, one change was sufficient and for 3 subjects two changes were necessary.[17]

Figure 2 shows elicited timing premia. On aggregate subjects have moderate preferences for the early resolution of consumption uncertainty: the mean timing premium is 4.52%. This value is considerably lower than timing premia required in many representative agent models. For example, recent asset pricing models such as Bansal and Yaron (2004) commonly assume timing premia above 20 percent (Epstein et al. 2014).

However, we observe substantial heterogeneity in our sample: A majority of subjects (59.0%) is (approximately) indifferent towards the resolution of uncertainty and has a timing premium below 2 percent. 26.2% of our subjects exhibit small timing premia between 2% and 10%, and a minority (14.7%) has large timing premia exceeding 10%, including two subjects who are willing to give up more than a third of their consumption to have all uncertainty resolved early.[18] Notably, no subject has a strong preference for the late resolution of consumption uncertainty. Table 2 provides additional summary statistics.

Summing up, while subjects prefer an early resolution of uncertainty on average, individual level analysis reveals a substantial heterogeneity. A majority of subjects is indifferent towards the temporal resolution of uncertainty, and a minority has a strong or medium preference for early resolution of uncertainty.

[16] Subjects in the experiment made choices over work effort rather than consumption. However, for the estimation we make use of the identity $C = 180 - WU$.

[17] When there existed more than one way to correct behavior, we randomized which one to follow. Our findings are robust to the exclusion of these subjects, see Table 2.

[18] Three examples of a post-experimental questionnaire from a pilot study further exemplify the observed behavior. Subject B14 states "I don't care whether I know already today or at date 3. It is therefore irrelevant for my decision." Subject B17 shows a mild preference for early resolution of uncertainty: "Actually, I don't care to know how much I have to work at date 3. However, with only 3 work units difference, it is nice to know what I should expect." Finally, subject B16 explains: "I want to know already today how many [work units] I have to complete at date 3."

N	Mean	Median	Std. Dev.	Min	1st Quartile	3rd Quartile	Max
61	4.52%	0.00%	8.48%	-2.11%	0.00%	3.95%	36.84%
51	4.34%	0.00%	8.87%	-2.11%	0.00%	3.95%	36.84%
48	4.10%	0.00%	8.97%	-2.11%	0.00%	3.95%	36.84%

Table 2: Summary Statistics Timing Premia

Notes: The first row reports elicited timing premia for all subjects. The second (third) row excludes all subjects that do not behave consistently in one (two) choice(s).

4.2 Aggregate Parameter Estimates

While the first MPL directly elicits timing premia, we use the remaining three MPLs to jointly identify time discounting, as well as preferences over risk and intertemporal substitution, independently of preferences for the temporal resolution of uncertainty.[19] Our estimation strategy broadly follows the maximum likelihood specifications from Andersen et al. (2008) and Harrison and Rutström (2009). Let $C_{j,2}$ and $C_{k,3}$ denote each outcome in the lotteries at date 2 and 3, respectively. $j \in \{Heads, Tails\}$ and $k \in \{Heads, Tails\}$ specify all contingencies. The RU for each decision d is

$$RU_d = \sum_{j=H,T} \sum_{k=H,T} \left(p_{j,2} \times p_{k,3} \times \left(C_{j,2}^{\rho} + \beta C_{k,3}^{\rho} \right)^{\alpha/\rho} \right), \tag{8}$$

where $p_{j,2}$ and $p_{k,3}$ denote the probabilities associated with the consumption levels at date 2 and 3. For our estimation we introduce a stochastic element in the observed choices and assume that subjects state their true preferences disturbed by some noise.[20] The difference in utilities for each choice is the latent index

$$\nabla RU = \frac{RU_B - RU_A}{\exp(\mu)}, \tag{9}$$

where μ is a structural "tremble" parameter. For $\mu \to 0$, choices are utility maximizing. As μ goes up, choices become increasingly random. For $\mu \to \infty$, choice boils down to uniform randomization between Option A and B. We then link the latent index to observed choices using a standard Probit function $\Phi(\nabla RU)$.

The likelihood depends on choices of all subjects and the three parameters governing time discounting, risk aversion and intertemporal substitution. Conditional on the RU model being true, the log of the likelihood function is

$$\log L(\alpha, \beta, \rho, \mu; y) = \sum_d [\log (\Phi(-\nabla RU) | y_d = 1) + \log (\Phi(\nabla RU)) | y_d = 0)], \tag{10}$$

[19] Appendix E reports estimation results using all 56 choices.

[20] See for example Hey and Orme (1994). Decision-making errors may, for example, be caused by simple mistakes (trembles), a misunderstanding of experimental procedures or attention lapses etc.

Parameter	Point Estimate	Standard Error	95% Lower Bound CI	95% Upper Bound CI
α	0.708	0.035	0.638	0.777
β	1.115	0.018	1.079	1.151
ρ	0.708	0.018	0.673	0.744
μ	3.573	0.052	3.470	3.675
# of clusters:	61			
# of observations:	2562			
Log Likelihood:	-1105.07			

Table 3: Maximum Likelihood Estimates of Parameters

Notes: This table reports the maximum likelihood estimates using stochastic decision errors. Standard errors are clustered at the subject level.

where $y_d = 1(0)$ encodes the choice of Option B (A) in decision $d \in \{15, ..., 56\}$.

Table 3 summarizes our estimates of the model parameters that characterize choices by all subjects. Subjects are on average risk-averse with a point estimate for the risk aversion parameter $\alpha = 0.708$. We also identify a preference for intertemporal substitution with a point estimate of $\rho = 0.708$. Given that ρ and α are virtually identical, we cannot reject the hypothesis that $\alpha = \rho$. Recall from Section 2 that for $\alpha = \rho$, RU reduces to the special case of expected utility theory. Hence, the data cannot reject expected utility theory. Moreover, for these estimates, RU predicts indifference towards the temporal resolution of consumption uncertainty. The estimated time discount factor β is close to but slightly above one. Although this may seem surprising at first, it is reconcilable with mixed findings regarding the discounting of unpleasant experiences in the literature (Loewenstein and Thaler (1989), Harris (2012)): While some studies suggest equal discounting of gains and losses, others find that people prefer to realize unpleasant experiences sooner rather than later, implying discount factors above one.[21]

Note that under RU, the question whether people have a preference for early (or late) resolution, should not depend on the discount factor, but only on the relation of α and ρ. Hence, the prediction of indifference towards the temporal resolution of consumption uncertainty under RU, should not be affected by our estimate of the discount factor.

4.3 Individual Parameter Estimates

The previous section estimated preference parameters jointly for all subjects. However, there is considerable heterogeneity in our sample. To get a better understanding of the distribution of preferences, we estimate the utility function parameters individually using information from the last three MPLs. For this purpose, we apply two parallel strategies.

[21] The finding is also consistent with the well documented preference for improving sequences. Loewenstein and Prelec (1993), for instance, find that subjects like more distant payoffs less when choices are presented without a sequential context, but when the sequence context is highlighted, people tend to prefer improving sequences. Choices in our experiment were always presented as sequences.

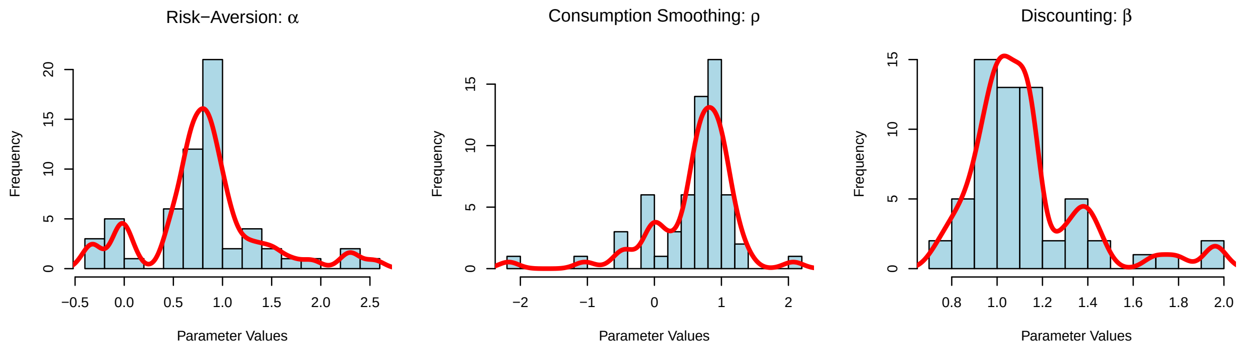

Figure 3: Individual Preference Parameters

Notes: Red solid lines show the marginal densities.

	N	Mean	Median	Standard Deviation	5% Pctile.	95% Pctile.
α	61	0.817	0.834	0.584	-0.030	1.908
β	61	1.123	1.078	0.254	0.827	1.696
ρ	61	0.601	0.738	0.628	-0.429	1.191

Table 4: Individual Preference Parameters

First, for subjects whose choices exhibit a single switch point in all of the last three MPLs, we calculate preference parameters analytically. We assume that respondents are indifferent at the mean values of the rows between which they switch. Subjects who never switch in one MPL, i.e. always choose A (B), are assumed to be indifferent at the last (first) row of this MPL. The switch points thus provide three equations that we solve for the three unknown preference parameters.

Second, for subjects who exhibit multiple switch points, we cannot calculate preference parameters in the same way. Instead, we estimate preference parameters individually with the maximum likelihood specification outlined in the previous section.[22] Note that for most cases, the two strategies yield virtually identical results. However, for some cases the analytical solution yields better results.[23]

Figure 3 illustrates the elicited individual preference parameters. Most subjects display moderate risk aversion and prefer to smooth consumption. As in the aggregate estimation discount rates are above one on average.

[22]In this case we estimate a simpler Probit model without the structural tremble parameter (i.e. assuming $\mu = 0$). We do this because because some individual choice profiles allow to only identify three structural parameters.

[23]For subjects that always choose A or B, the maximum likelihood estimation does not assume indifference in the last or first rows of the MPLs (as we do in the analytical solution). Thus, any parameter value beyond a certain threshold explains behavior equally well.

4.4 Elicited vs. Predicted Timing Premia

Using the individual parameter estimates from the previous subsection, we can now calculate timing premia predicted by the RU model. We can then compare the predicted timing premia to observed timing premia, as elicited with our first price list, to analyze whether the theoretical connection of preferences over time and risk and the timing premium holds as postulated by RU model. To derive individual predicted timing premia, we first numerically solve the equation

$$U^{ED}(\hat{\alpha}_i, \hat{\beta}_i, \hat{\rho}_i, C_2^A, C_{H,3}, C_{T,3}) = U^{LD}(\hat{\alpha}_i, \hat{\beta}_i, \hat{\rho}_i, \tilde{C}_{2,i}^B, C_{H,3}, C_{T,3}) \tag{11}$$

for $\tilde{C}_{2,i}^B$, where $C_2^A = 100$ is consumption in period $t = 2$ under Option A and $C_{H,3} = 170$ ($C_{T,3} = 10$) is consumption in $t = 3$ if the coin flip yields heads (tails). $\tilde{C}_{2,i}^B$ is the consumption amount that subject i would need to receive at date $t = 2$ in Option B, to make him/her indifferent between early and late resolution, given his/her parameter estimates $(\hat{\alpha}_i, \hat{\beta}_i, \hat{\rho}_i)$. Using this amount, we can calculate the predicted timing premium, analogously to Section 4.1 as

$$TP_i^{RU} = \frac{\tilde{C}_{2,i}^B - C_2^A}{C_2^A + E[C_3]}. \tag{12}$$

The left panel in Figure 4 shows the corresponding histogram. The difference to the elicited timing premium as shown in Figure 2 is striking. A Mann-Whitney U test rejects the hypothesis that the distributions of elicited and predicted TP are statistically identical ($p < 0.001$).

To analyze whether the elicited timing premia for each subject TP_i can be explained by the RU model, specification 1 estimates the regression equation:

$$TP_i = const. + \theta\, TP_i^{RU} + \varepsilon_i. \tag{13}$$

Table 5 and Figure 4 (right panel) summarize the results.

If choices follow RU perfectly (or deviate randomly), we would expect the estimated coefficient θ to equal one. This is clearly not the case. The coefficient is negative and significantly different from one ($p < 0.001$).

A weaker test of RU is whether there exists at least some correlation between predicted and elicited timing premia, i.e. whether the estimated coefficient θ is different from zero. Surprisingly, RU has no predictive power regarding our elicited timing premia: θ is not statistically different from zero ($p = 0.164$). Hence, the theoretical link between preferences over time and risk and the timing premium as formulated by RU models is resoundingly rejected by the data.[24]

[24]Note that this result is robust to the exclusion of subjects who have an estimated discount factor above

	(1)	(2)	(3)	(4)	(5)	(6)
Predicted TP^{RU}	-0.177	-0.153	-0.116			
	(0.126)	(0.129)	(0.132)			
Female		0.051^{**}	0.055^{*}		0.056^{**}	0.059^{*}
		(0.024)	(0.028)		(0.024)	(0.030)
Joint CRT		0.001	0.001		0.001	0.002
		(0.006)	(0.006)		(0.006)	(0.006)
Δw		-0.002^{*}	-0.002^{**}		-0.001	-0.002^{*}
		(0.001)	(0.001)		(0.001)	(0.001)
$\hat{\alpha}$				-0.012	-0.014	-0.019
				(0.020)	(0.020)	(0.021)
$\hat{\beta}$				0.038	0.068	0.047
				(0.047)	(0.048)	(0.056)
$\hat{\rho}$				-0.031	-0.019	-0.017
				(0.020)	(0.022)	(0.023)
Constant	0.039^{***}	0.054	0.008	0.031	0.004	-0.016
	(0.012)	(0.044)	(0.117)	(0.060)	(0.077)	(0.133)
Control field of study	No	Yes	Yes	No	Yes	Yes
Control German	No	Yes	Yes	No	Yes	Yes
Control Big 5	No	No	Yes	No	No	Yes
Observations	61	61	61	61	61	61
R^2	0.033	0.183	0.250	0.113	0.265	0.317
Adjusted R^2	0.016	0.075	0.062	0.067	0.135	0.109

Notes: Standard errors are reported in parentheses. *p<0.1; **p<0.05; ***p<0.01

Table 5: Regression Results: Elicited vs. Predicted Timing Premia

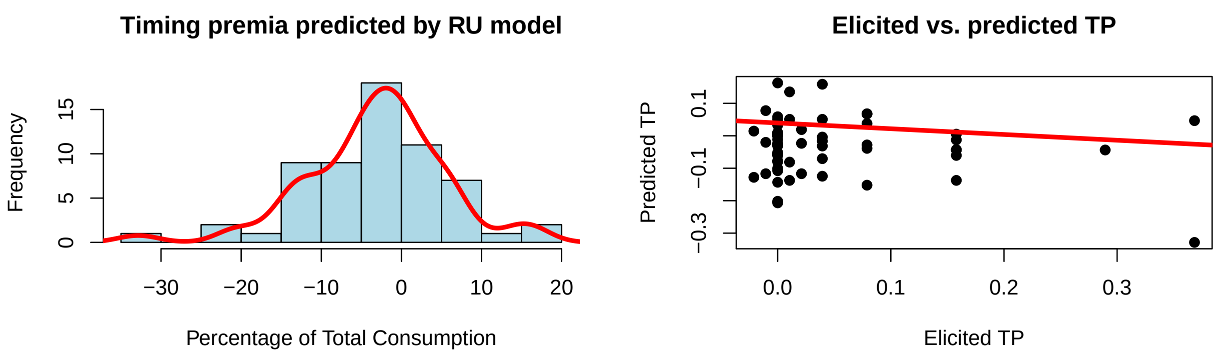

Figure 4: Predicted Timing Premia

Notes: Left panel: Histogram of predicted timing premia under RU. The red solid line shows the marginal density. Right panel: Scatterplot of of elicited and predicted timing premia. The red solid line shows the regression line from equation (13).

Specification 2 includes additional control variables. Interestingly, female subjects have significantly higher timing premia but the power weakens once we include Big Five personality traits in specification 3. Neither field of study nor CRT score (joint score of CRT and eCRT) have a significant impact on the timing premium. We also control for differences in perception of the work effort or relative pleasure of watching YouTube. For this purpose, we elicit (self-reported) hourly reservation wages for solving the slider task (w_{WU}) and watching YouTube (w_C). The difference of the two reservation wages ($\Delta w = w_{WU}$-w_C) measures how well our incentivizes work.[25] The estimated coefficient is economically small but statistically significant at the 5% level in specifications 2 and 3, implying that the higher the incentives, the lower the timing premium. To control for potential language problems, we also include a dummy variable indicating whether a subject's mother tongue is German, but find no significant impact.

To test whether individual risk aversion, time discounting or preferences for intertemporal substitution are linked to elicited timing premia in any other way than the one formulated by RU models, we additionally test specifications 4, 5, and 6 in which the parameter estimates $\hat{\alpha}, \hat{\beta}$, and $\hat{\rho}$ are dependent variables. The results are striking: neither attitudes towards risk nor time discounting or preferences for intertemporal substitution explain elicited timing premia. Hence, while some subjects have a preference for the early resolution of consumption uncertainty, this preference does not appear to depend on risk preferences, time discounting or preferences over intertemporal substitution.

5 Conclusion

This paper provides a direct test of whether people have preferences for the temporal resolution of consumption uncertainty as axiomatized in Kreps and Porteus (1978) and Epstein and Zin (1989).

Our main finding is that subjects on average weakly prefer early resolution of consumption uncertainty: they are willing to forgo on average 4.52% of their consumption to have all consumption uncertainty resolved immediately. However, we observe considerable heterogeneity. Most subjects are indifferent towards the temporal resolution to consumption uncertainty, while some subjects show a strong preference for early resolution. No subject has a strong preference for the late resolution of consumption uncertainty.

To test whether recursive utility can explain observed timing premia, we additionally elicit all structural parameters of recursive utility. We then use these parameters to calculate predicted timing premia under recursive utility. Interestingly, we find no correlation of predicted timing premia with the directly elicited timing premia. This result suggests that while people

one.

[25]The high average Δw of €7.9 per hour shows that subjects strongly prefer YouTube time.

do have a preference over the temporal resolution of consumption uncertainty, the structural relation of preferences over risk, time, intertemporal substitution and the timing premium as formulated in recursive utility models does not appear to hold. This finding underlines the importance of measuring timing premia directly instead of using structural assumptions to identify the timing premium indirectly.

Our results have implications for a wide range of studies utilizing RU models and offer interesting areas of future research. First, the timing premia we observe are considerably lower than commonly assumed in the theoretical asset pricing literature, where timing premia are often well above 20% (Epstein et al. 2014). However, more research is necessary to corroborate these findings in different contexts and for different subject pools. Second, the heterogeneity of timing premia in our sample may inspire theoretical work that incorporates heterogeneity in preferences for the temporal resolution of consumption uncertainty. Similarly, the lack of a connection between preferences over risk, time and intertemporal substitution and the timing premium calls for theories that do incorporate preference for the temporal resolution of consumption uncertainty while not requiring this structural link. Third, we believe that our setup provides valuable new methodological tools. Combining multiple price list preference elicitation and real consumption in the lab, may prove useful for testing preferences over time and uncertainty, particularly preferences over the temporal resolution of consumption uncertainty.

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Appendix

A Temporal Resolution of Uncertainty

This Appendix gives a simple example of two consumption lotteries with Epstein and Zin (1989) preferences. As our subjects in the experiment, the decision maker faces consumption at two future dates, labeled date 2 and date 3. We start with the standard formulation (as in 4):

$$U_t\left(C\right)=\left[C_t^{\rho}+\beta\Big(\mathbb{E}_t\left[U_{t+1}^{\alpha}\right]\Big)^{\rho/\alpha}\right]^{1/\rho}. \tag{A.1}$$

Raise both sides to the power of ρ and set $t=1$

$$U_1\left(C\right)^{\rho}=C_1^{\rho}+\beta\Bigg(\mathbb{E}_1\left[U_2^{\alpha}\right]\Bigg)^{\rho/\alpha}, \tag{A.2}$$

and iterating one step ahead in the recursion (use $U_2^{\alpha}=\Bigg(C_2^{\rho}+\beta\Big(\mathbb{E}_2\left[U_3^{\alpha}\right]\Big)^{\rho/\alpha}\Bigg)^{\alpha/\rho}$) yields:

$$U_1(C)^{\rho}=C_1^{\rho}+\beta\left(\mathbb{E}_1\left[\left(C_2^{\rho}+\beta\left(\mathbb{E}_2\left[U_3^{\alpha}\right]\right)^{\rho/\alpha}\right)^{\alpha/\rho}\right]\right)^{\rho/\alpha} \tag{A.3}$$

Note that date 3 is the last period, normalize $C_1=0$ to focus on future (uncertain) lotteries and get rid of the scaling with β :

$$U_1(C)=\left(\mathbb{E}_1\left[\left(C_2^{\rho}+\beta\left(\mathbb{E}_2\left[C_3^{\alpha}\right]\right)^{\rho/\alpha}\right)^{\alpha/\rho}\right]\right)^{1/\alpha} \tag{A.4}$$

C_2 and C_3 are some i.i.d. random variables. There exist two options: early draw and late draw. With an early draw (ED), both C_2 and C_3 get drawn at 2. With a late draw (LD), C_2 gets drawn at date 2 and C_3 gets drawn at date 3. With an early draw, consumption at date 3 is known at the end of date 1. From the perspective of the decision maker, we drop the expectations operator in $t=2$ and the problem simplifies to:

$$U_1^{ED}(C)=\mathbb{E}_1\left[\left(C_2^{\rho}+\beta C_3^{\rho}\right)^{\alpha/\rho}\right]^{1/\alpha} \tag{A.5}$$

With a late draw, the future consumption (at date 3) remains uncertain until date 3 and is summarized by the certainty equivalent. Therefore,

$$U_1^{LD}(C)=\mathbb{E}_1\left[\left(C_2^{\rho}+\beta\Big(\mathbb{E}_2\left[C_3^{\alpha}\right]\Big)^{\rho/\alpha}\right)^{\alpha/\rho}\right]^{1/\alpha}. \tag{A.6}$$

Equations (A.5) and (A.6) correspond to (5) and (6) in the main text.

B Multiple Price Lists

	Option A		Option B			
	Safe		*heads*		*tails*	
row	WU	C	WU	C	WU	C
15	59	121	10	170	170	10
16	64	116	10	170	170	10
17	69	111	10	170	170	10
18	74	106	10	170	170	10
19	79	101	10	170	170	10
20	84	96	10	170	170	10
21	89	91	10	170	170	10
22	91	89	10	170	170	10
23	95	85	10	170	170	10
24	100	80	10	170	170	10
25	110	70	10	170	170	10
26	120	60	10	170	170	10
27	130	50	10	170	170	10
28	150	30	10	170	170	10

Table 6: Price List for Risk Aversion

Consumption and WU are measured in units of 30 seconds.

	Option A				Option B			
	$t = 2$		$t = 3$		$t = 2$		$t = 3$	
row	WU	C	WU	C	WU	C	WU	C
29	30	150	140	40	130	50	130	50
30	30	150	140	40	115	65	115	65
31	30	150	140	40	100	80	100	80
32	30	150	140	40	95	85	95	85
33	30	150	140	40	90	90	90	90
34	30	150	140	40	88	92	88	92
35	30	150	140	40	86	94	86	94
36	30	150	140	40	84	96	84	96
37	30	150	140	40	82	98	82	98
38	30	150	140	40	80	100	80	100
39	30	150	140	40	75	105	75	105
40	30	150	140	40	70	110	70	110
41	30	150	140	40	60	120	60	120
42	30	150	140	40	50	130	50	130
43	160	20	20	160	150	30	150	30
44	160	20	20	160	130	50	130	50
45	160	20	20	160	115	65	115	65
46	160	20	20	160	105	75	105	75
47	160	20	20	160	100	80	100	80
48	160	20	20	160	95	85	95	85
49	160	20	20	160	92	88	92	88
50	160	20	20	160	88	92	88	92
51	160	20	20	160	86	94	86	94
52	160	20	20	160	84	96	84	96
53	160	20	20	160	82	98	82	98
54	160	20	20	160	80	100	80	100
55	160	20	20	160	75	105	75	105
56	160	20	20	160	70	110	70	110

Table 7: Price Lists for Time Discounting and Preference over Intertemporal Substitution Consumption and WU are measured in units of 30 seconds.

C Instructions and Screenshot

The instructions below are translated from the original German instructions. The instructions were distributed sequentially (first “General Instructions”, then “Decision Situations”). Subjects were given time to carefully read the instructions and ask questions.

Instructions

Welcome to our experiment!

General Rules

You are not allowed to talk and exchange information with other participants during the experiment. You are not allowed to use electronic devices or bring your own books etc. Please turn off your mobile phone now. Please use only the programs and functions of today's experiment. Do not talk to other participants. Please raise your hand if you have a question. An experimenter will then come to your place and answer your question. Please don't ask your questions out loud. If your question is relevant for other participants we will repeat it aloud.

Overview

This is a three-part experiment. As announced, you have to be able to come to the lab apart from today (date 1) also in exactly one week from now on **May 18th, at 10:00am** (date 2) and in exactly five weeks from now on **June 15th, at 10:00am** (date 3). Each of the following sessions will take 90 minutes. If you cannot participate at one of these dates, please raise your hand now.

Today's experiment is about economic decisions making. The situations are not difficult and no IQ tests. Therefore, there is no ``right'' answer. We are only interested in knowing how you decide in such decision situations.

Your task in the experiment is to select your preferred option (**A** or **B**) in **56 decision situations**. Option **A** and **B** each specify a number of so-called work units (WU), that you will have to carry out on date 2 and/or date 3. What exactly constitutes a work unit, will be explained subsequently.

How many work units you have to carry out on what date, depends partially on decisions today and partially on chance. At the end of today's session, one of the 56 decision situations will be randomly drawn. You will have to carry out the number of work units specified in Option A or B, depending on which Option you choose in this decision situation. Whatever decision is drawn you will always receive your preferred option A or B. It is therefore in your own interest, to carefully choose option A or B in each of the 56 situations. Each of the decision situations has the same probability to determine the amount of units you have to work.

At each date on which you have to carry out work units, you have to spend the full 90 minutes in the laboratory. After you completed your work units, you can surf on YouTube for the remaining time (in the following we call this “leisure”).

Your Payment

For your participation today, you receive a fixed amount of 5€. Moreover, you receive 5€ for participation at each of the following dates. On top of that you receive a completion bonus of 35€ after you have shown up on time on all your assigned dates and have completed all of your assigned work units. In case you do not complete all assigned units, we will deduct money from your completion bonus (see below). All the money you earn from this experiment will be wired to you two business days after date 3. To this end, we will ask you for your bank account details at the end of this experiment. Alternatively, you can collect your payment at the office of the chair of macroeconomics. If you are not willing to participate in the experiment under these conditions, please inform one of the experimenters.

Work units and ``leisure''

Each work unit consists of a couple of sliders that have to be moved from 0 to 50 on the computer screen.

You have 30 seconds to complete each of these units. This time should more than suffice to complete this task. Before you make the decisions that determine how many work units you have to complete at what date you will solve 10 of these units as practice, in order to get a feeling for the task. Should you have problems with operating the computer mouse or do not see yourself fit to solve these units for duration of maximally 90 minutes, please inform one of the experimenters.

After you have completed your work units on date 2 and 3, a browser opens automatically and you can surf the remaining time on YouTube. The less you have to work, the more you can surf freely on YouTube. Headphones are provided at your place. You are free in watching whatever you like on YouTube - however, you may only surf on YouTube and not on other websites (Gmail, Facebook, news, etc.).

> **Example:** Suppose you have to complete 80 work units at one date. Because each WU takes 30 seconds, 80 WU take 40 minutes. Because you spend 90 minutes in the lab, you can spend the remaining time freely on YouTube. This time is calculated as 90 - 40 = 50 minutes.

Your surf behavior is explicitly not part of this experiment. No data will be gathered, saved or processed in this part of the experiment. Also, no passwords will be saved. The internet connection will go through the network of the Technical University of Berlin.

Note: During the time you do not solve work units, you are not allowed to read your own books and the like. Moreover, you are not allowed to use own electronic devices.

What happens if you do not solve all assigned work units? Missing up to two work units will not decrease your payoff. All missed units beyond that reduce your completion bonus. Each work unit that has not been completed reduces your completion bonus by 1 EUR (maximally you can lose the whole completion bonus).

Selection of decision situations

At the end of today's experiment, one of the 56 decision situations will be randomly selected for each participant. The random draw is carried out with a Bingo machine with 56 numbered balls. This ensures that all decision situations are selected with the same probability. How much time you spend in the lab with work and how much you spend with leisure, is determined by your choice in the selected decision situation.

Let’s go

Please complete the 20 practice work units now. The password will be announced shortly.

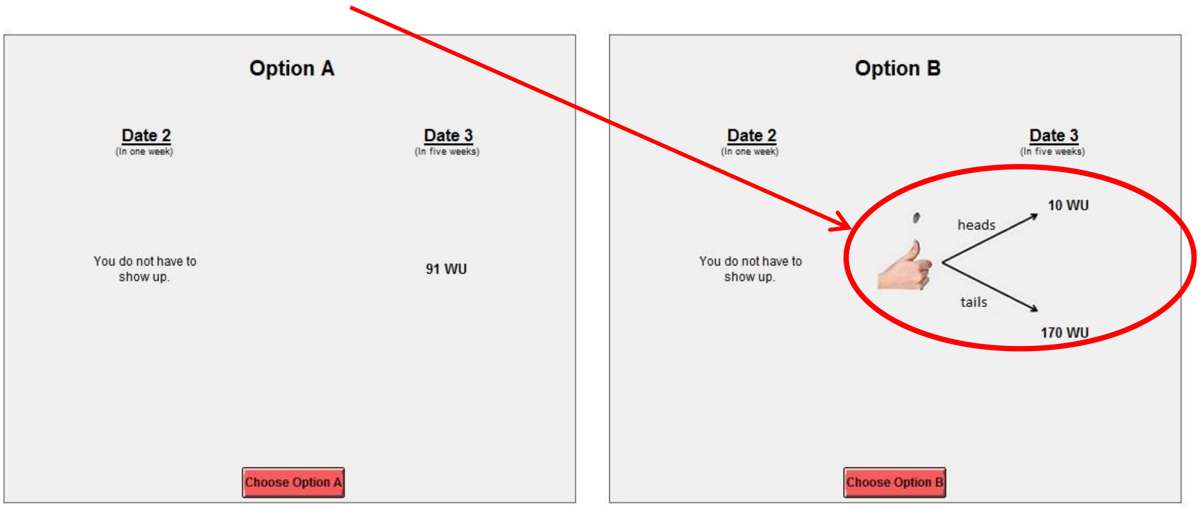
Decision Situations

Next we explain the decision situations that you will face in more detail. In each of the 56 decision situations you decide about the allocation of work units (henceforth: WU) that you have to complete at date 2 and/or 3. In each decision situation you have the choice between two options, labeled A and B.

For instance, a decision situation could look as follows:

If you choose **Option A** in this decision situation, you have to complete 160 WU at date 2 and 20 WU at date 3. If you choose instead **Option B**, you have to complete 70 WU at date 2 and 70 WU at date 3.

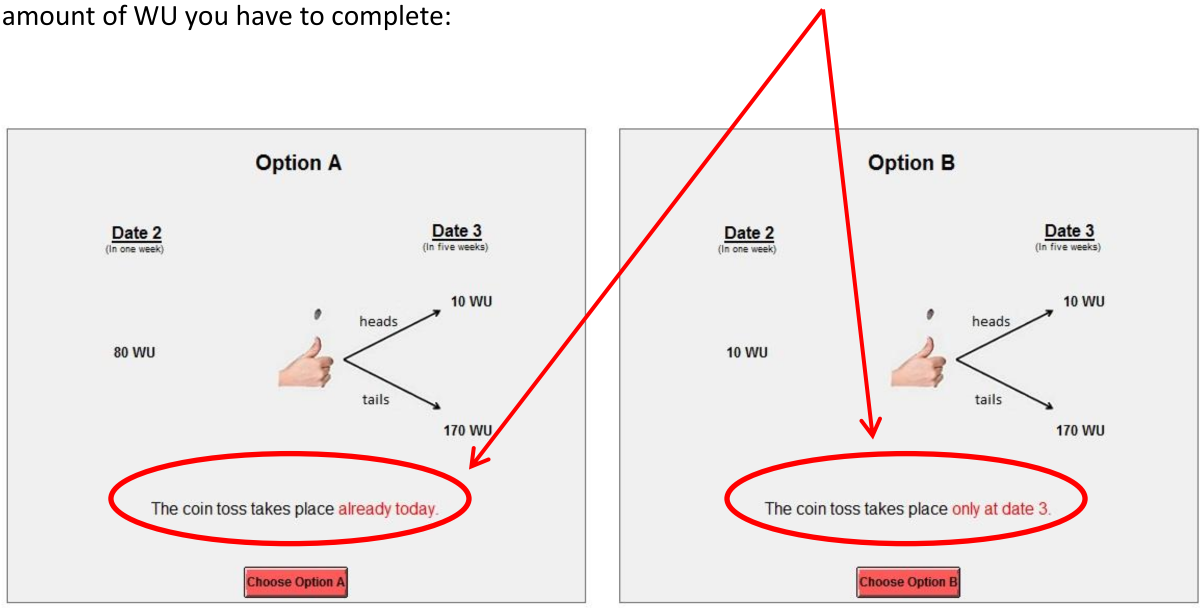
In some decision situations a coin flip determines the amount of WU. In these decision situations the coin flip is depicted as hand that tosses a coin. An example of such a decision situation is:



In this decision situation you do not have to show up at date 2 no matter which option you choose. If you choose **Option A** you have to complete 91 WU at date 3. If you choose **Option B** a coin flip (that you will carry out yourself) determines the amount of WU at date 3. If the coin flip yields heads you have to complete 10 WU, but in case of tails 170 WU.

Please turn over

In some decision situations you can decide, **when the coin flip takes place** that determines the amount of WU you have to complete:



If you choose **Option A** in this decision situation, you have to complete 80 WU at date 2. In addition, you toss a coin **today** and you learn already today, how many WU you have to complete at date 3 and how many minutes of "leisure" you have at date 3.

If you choose **Option B** in this decision situation, you have to complete 80 WU at date 2. In addition, you toss a coin only **at date 3.** This means you learn only at date 3, how many WU you have to complete at date 3 and how many minutes of "leisure" you have at date 3. If the coin flip yields heads you have to complete 10 WU at date 3. If the coin flip yields tails you have to complete 170 WU at date 3,

Important

If the timing of the coin flip is not mentioned explicitly, the coin flip will always take place **today** at the end of the experiment.

Reminder: One decision situation will be randomly selected at the end of the experiment to determine the amount of WU. You then have to complete the amount of WU specified in Option A or B, depending on your choice in the selected decision situation. It is therefore in your own interest to carefully consider in each of the 56 decision situation whether you prefer Option A or B.

You can ask questions at any point during the experiment by raising your hand.

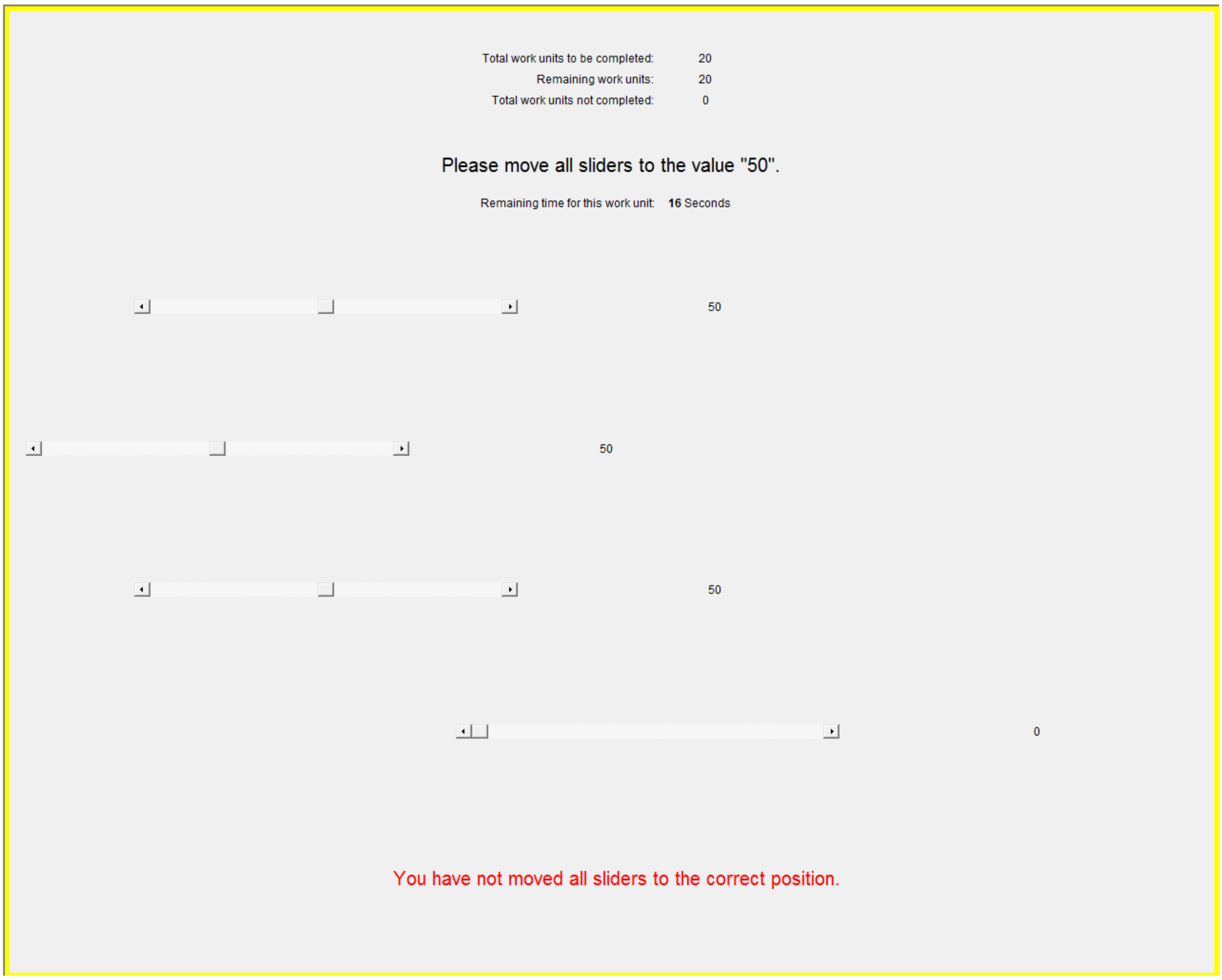


Figure 5: Screenshot of a work unit.

Subjects had 30 seconds to complete each work unit. The sliders appeared at random positions.

D Questionnaire

D.1 Reservation Wage

- Imagine we would offer you to stay in the laboratory for an additional hour, to solve 120 work units. What is the lowest wage that you would be willing to accept for this offer?
- Now imagine we would offer you to stay in the laboratory for an additional hour, to freely surf on YouTube. What is the lowest wage that you would be willing to accept for this offer?

D.2 Socio-demographics

- Age:
- Gender:
- Height:
- Faculty:
- Degree:
- Semester:
- Mother Tongue:
- In case your mother tongue is not German, since how many years do you speak German?
- Please state the number of of experiments in which you have participated so far:

D.3 CRT

CRT

1. A bat and a ball cost €1.10 in total. The bat costs €1.00 more than the ball. How much does the ball cost?
2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

eCRT

1. If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together?
2. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?
3. A man buys a pig for €60, sells it for €70, buys it back for €80, and sells it ïňĄnally for €90. How much has he made?
4. Simon decided to invest €8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has: a. broken even in the stock market, b. is ahead of where he began, c. has lost money.

D.4 Big Five

Instruction: How well do the following statements describe your personality?

I see myself as someone who...	Disagree strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
...is reserved	(1)	(2)	(3)	(4)	(5)
...is generally trusting	(1)	(2)	(3)	(4)	(5)
...tends to be lazy	(1)	(2)	(3)	(4)	(5)
...is outgoing, sociable	(1)	(2)	(3)	(4)	(5)
...is relaxed, handles stress well	(1)	(2)	(3)	(4)	(5)
...has few artistic interests	(1)	(2)	(3)	(4)	(5)
...tends to find fault with others	(1)	(2)	(3)	(4)	(5)
...does a thorough job	(1)	(2)	(3)	(4)	(5)
...gets nervous easily	(1)	(2)	(3)	(4)	(5)
...has an active imagination	(1)	(2)	(3)	(4)	(5)

E Additional Results

Figure 6 depicts individual switch points whenever subjects exhibit single switching.

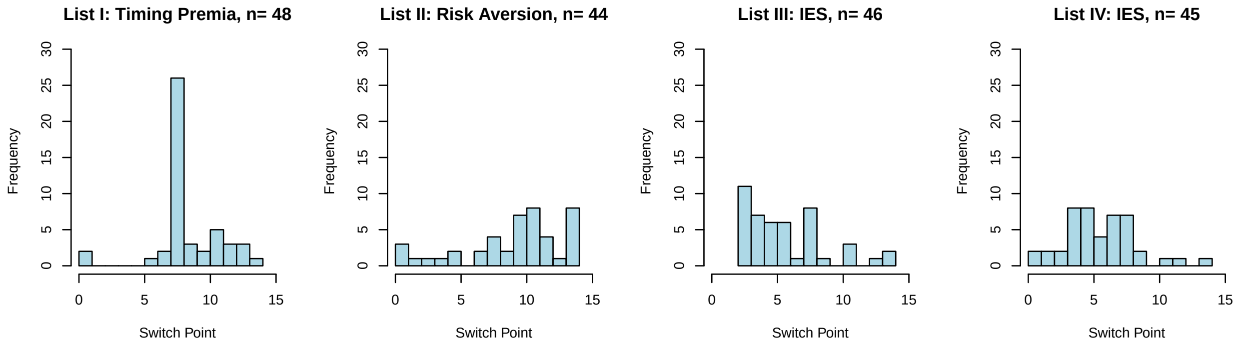


Figure 6: Switch Points

Notes: A switch point of 0 (15) indicates that subjects always choose Option A (B).

Table 8 shows results from a maximum likelihood estimation using information from all four MPLs. Conditional on the RU model (and in particular the structural link between timing premia and preferences over risk and time) being true, we can use the likelihood function specified in (10) which now uses all 56 choices, i.e. $d \in \{1, ..., 56\}$. The timing premium elicited in the first MPL now influences the link between intertemporal substitution and risk aversion as discussed in Section 2. Because our second MPL directly identifies α, this mainly affects the estimate for $\hat{\rho}$ for which we find a higher estimate. Moreover, the estimated discounting factor $\hat{\beta}$ is lower.

Parameter	Point Estimate	Standard Error	95% Lower Bound CI	95% Upper Bound CI
α	0.867	0.087	0.698	1.037
β	0.887	0.067	0.756	1.018
ρ	1.145	0.086	0.977	1.314
μ	2.033	0.314	1.418	2.648
# of clusters:	61			
# of observations:	3416			
Log Likelihood:	-1475.90			

Table 8: Maximum Likelihood Estimates of Parameters: Overidentification

Notes: This table reports the maximum likelihood estimates using stochastic decision errors. Standard errors are clustered at the subject level.