# Compensated Discount Functions: An Experiment on the Influence of Expected Income on Time Preferences*

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**Abstract**

This paper examines the empirical question of whether subjects' static choices among rewards received at different times are influenced by their expected income levels at those times. Moreover, we recover time preferences after compensating for possible income effects. Besides eliciting subjects' preference between standard delayed rewards, the experimental design also elicited their preferences over delayed rewards that are received only if the subject's income remains approximately constant. These preferences, along with elicited subjective probabilities of satisfying the condition, make the correction possible. We conducted the experiments in Iceland, where our prompt access to income tax records enabled us to condition delayed rewards on income realizations. We find that background income is associated with preferences over unconditional delayed rewards. While most people exhibited present bias when comparing unconditional delayed rewards, subjects with stable income did not. The results are similar for the entire sample once we correct subjects' discount functions for income effects. This suggests that income expectations have an effect on choices between future rewards, and that this may account for some of the present-bias observed in experiments.

**Keywords:** time preferences, hyperbolic discounting, income expectations, rewards conditional on income realization

**JEL Classification:** C93, D03, D11, D90

# 1 Introduction

In order to make inferences from their trade-offs between delayed monetary rewards, experimental studies exploring the nature of time preferences typically presume that a subject's marginal utility for money is constant across time. However, several theoretical papers note that subjects may integrate these rewards with their baseline consumption levels (Olson and Bailey 1981, Rubinstein 2002, Frederick et al. 2002, Noor 2009 and Gerber and Rohde 2010). In this case, anticipated changes in marginal utility for money would influence their trade-offs between delayed rewards.[1] This is also related to the recent experimental and theoretical literature that accounts for an unavoidably uncertain future as a contrast to a certain present.[2] On the other hand, there is the narrow bracketing view that subjects treat experimental rewards in isolation from their background expected financial situation. It may be that integration with background plans is too difficult for people to do,[3] or that small rewards are often viewed as windfalls under different mental accounting and enjoyed separately from base consumption. This important open empirical question of whether background expected financial conditions matter for intertemporal choices is the subject of this paper. Furthermore, we show how to compensate for possible background marginal utility effects when measuring discount functions.

We conducted a lab experiment in Reykjavík, Iceland, using a random sample of individuals from the census, conditional on them living in post codes not too far from the lab.[4] We obtained prompt individual tax information

[1] A strand of the literature focuses on timing a consumption stream, or primary rewards (McClure et al., 2007), acknowledging that the value of timed monetary rewards can change with liquidity constraints and other financial frictions, as well as *in vivo* transfers.

[2] See Weber and Chapman (2005), Fernandez-Villaverde and Mukhijit (2011), Baucells and Haukamp (2012), Andreoni and Sprenger (2012) and Halevy (2012).

[3] See some arguments along this line in pages 356-357 of Frederick et al. (2002).

[4] This feature of taking lab experiments to field subjects is similar to Andersen at al. (2008). Note that such subject pools very likely include more people with stable income than the canonical lab subjects of students. As consumptions of the latter are

from the Icelandic Revenue Service for two years following the experiment, as well as retrospective individual tax information for three years preceding the experiment.

In the first part of the experiment, we used a standard design of asking participants to choose between unconditional present rewards and unconditional rewards received one or two years later.[5] The elicitation was done through a series of binary choice questions, presented as a standard multiple price list. From this we derive the *uncompensated discount function*: for instance, if a subject is indifferent between \$100 in the current period and \$150 in t years, we obtain $D_u(t) = \frac{100}{150}$. This discount function is uncompensated in the sense that expected changes in marginal utility create a wedge between the indifference point and the subject's true underlying discount function.

In the second part of the design, we asked participants to choose between (a) unconditional present rewards and (b) rewards received one or two years later *conditional* on the subject's income staying "approximately" constant.[6] The idea is that approximately constant income corresponds to approximately constant marginal utility for money, and so the utility evaluation of the rewards is time-independent. Note that the evaluation of a conditional delayed reward depends on the utility from receiving the reward, the degree to which it is discounted due to temporal delay, and the subject's *beliefs* about the likelihood that the conditioning event will be satisfied. Eliciting the second element – the true discount function – is our

highly volatile (and steeply rising in a matter of years), any confound of income trends we document is likely to be even more powerful for subject pools biased towards students.

[5] We used a front-end delay of one week to put both options on an even footing with respect to transaction costs, immediacy, or trust in the experimenters. What we label here as present rewards were specified to be paid a week after the experiment. Similarly, rewards labeled one and two years later were paid one year plus one week, and two years plus one week later.

[6] More precisely, we required that the after-tax inflation-adjusted income of the participant stayed within 4% of base income, for both the month and the year preceding the moment in question. See our online appendix for the translation of our actual questionnaire.

objective. By assuming that the rewards are small relative to background consumption, we assume approximate linearity of utility from the rewards. We elicit beliefs in an incentivized fashion as follows. First, we sought a good whose utility to the subject is plausibly independent of the marginal utility of money – we consider charity payments made on behalf of the subject to possess this property. Next, we ask subjects to compare (a') a payment $h$ made to a charity of the subject's choice at time $t$ with probability $\alpha$ and (b') a payment $h$ to the same charity at time $t$ conditional on the subject's income staying roughly the same. By observing preferences for various $\alpha$, we uncover the desired subjective belief. With this in hand, we can then derive the underlying discount function (see Section 2 for details), which we label as the *compensated discount function*, to contrast it with the original uncompensated discount functions that do not take marginal utility expectations into account.

The analysis assumes that subjects face frictions (these could be external borrowing and lending constraints or internal cognitive constraints) that induce them to consume small rewards at the time when they are received. This assumption is made (either explicitly or implicitly) in most experimental investigations of time preferences. Indeed, if subjects could freely transfer monetary amounts across time periods then they would only care about the discounted present value of their earnings, and appear to the experimenter as exponential discounters with the interest rate as the discount rate. The extensive evidence for non-exponential discounting in the literature therefore shows that subjects don't smooth the consumption of rewards is over time.

We also assume that the money amounts we offer subjects are "small" relative to their background consumption, in which case money adds to the agent's background utility approximately linearly. The rewards we offered subjects were equivalent to approximately $165 (in 2010), which is small relative to our subjects annual incomes.

Our first set of results only uses the traditional experimental questions that use unconditional future rewards. Consistent with most existing studies, we find that in the full sample the estimated discount factor between one and two years from the experiment is significantly higher than the estimated discount factor between the time of the experiment and one year later.[7] In the quasi-hyperbolic "$\beta$-$\delta$" framework, the estimated present-bias parameter $\beta$ is 0.89 and significantly different from 1, while the estimated long-run discount factor $\delta$ is 0.92. We get a very different picture though when we look at subjects with stable incomes. In particular, when we restrict attention to subjects whose real annual income remained within a 10% range of current income in both of the two years following the experiment (31 of the 116 subjects), the discount factor between the first and second year after the experiment is almost identical to the discount factor between the present and one year after the experiment, and the estimated $\beta$ is 0.97 and not significantly different from 1 (while the estimated $\delta$ for this group is almost exactly the same as for the whole subject population). This means that those subjects whose real income remained stable after the experiment made choices consistent with exponential discounting, while other subjects on average made choices that revealed significant present bias.

We get similar results when, instead of realized income, we use subjects' expectations, elicited in a not incentivized survey, at the time of the experiment to identify those who expect stable income in the two years following the experiment. For example, for those subjects who expect to stay in their current job with more than 80% probability for the two years following the

[7] Many experiments describe discount functions as hyperbolic, implying a present bias. See Frederick et al. (2002) for a review, and more recent evidence by Benhabib et al. (2012). Pender (1996) finds similar results in a field experiment using rice instead of money for rewards. Other papers find no evidence for hyperbolic discounting: see for example Harrison et al. (2002), Andersen et al. (2008) and Andreoni and Sprenger (2012). The experimental finding of present bias generated much theoretical work such as Laibson (1997), O'Donoghue and Rabin (1999), Gul and Pesendorfer (2001) and Fudenberg and Levine (2006), and led to much applied work.

experiment, the estimated discount factor between one and two years from the experiment is not significantly different than the discount factor between the time of the experiment and one year later, and the estimated $\beta$ is 0.94.

We also investigate subjects whose income increases significantly in the year following the experiment, but stays relatively stable afterwards.[8] Given that the expected marginal utility of extra income for these subjects (as long as they could foresee the said income pattern) is lower in both future years than at the time of the experiment, but about the same magnitude in the two future years, we expect a more significant present bias in these cases. In line with the theoretical predictions, the estimated $\beta$ decreases to 0.79.[9]

To further examine the relationship between income stability and exponential discounting, in the second half of the analysis we investigated subjects' choices regarding conditional rewards, and derived their compensated discount functions. We had two concerns that needed to be addressed for our data analysis. First, our derivation of the compensated discount functions assumed that subjects followed the discounted expected utility model, and to the extent that this misspecifies some of the subjects' model, we may not get meaningful compensated discount functions for all subjects. Second, the conditional questions are cognitively more demanding than the simpler traditional unconditional questions, and therefore we had to expect that some subjects' responses may not be meaningful (for this purpose we put in much effort to streamline the experimental questionnaire and provide a detailed instruction session). Consequently, we conducted our analysis based not just on the whole sample, but also on a restricted subsample of subjects whose answers conveyed "sensible" compensated discount factors. Without imposing arbitrary restrictions on the data based either on the results or

[8] In the standard model, a one-shot future reduction (resp. increase) in marginal utility of money predicts present (resp. future) bias in unconditional choices, confounding the true curvature of the utility function with uncertainty and trends in consumption.

[9] There were few subjects with a substantial reduction in income to allow a test of the corresponding prediction of higher estimated $\beta$.

some covariates, we fit a finite mixture of bivariate normal distributions on the one-period discount factors and the ones between years 1 and 2 maximizing the Bayesian Information Criterion, with discrete classification into clusters. The number of mixtures fitted was chosen by the same algorithm and the same criterion, also allowing for classification of observations as outliers (noise). Out of the resulting three clusters, two show compensated discount rates in a reasonable range, consisting of 68.1% of the sample (79 observations overall). The likelihood of falling into either of these two clusters is positively correlated with the subject's education level.

We ran multiple tests of the compensated discount rates being equal to the uncompensated ones (using their difference), or either being 1 (the benchmark of treating future and present equivalently). For $\beta$ corresponding to present-bias in the quasi-hyperbolic discounting framework, we also tested for differences between the compensated and the uncompensated cases (using their difference), as well as either measure being different from 1. For all these, we employed two-sided $t$-tests using standard errors robust to heteroskedasticity, and also non-parametric Wilcoxon signed rank tests.

Our first finding is that compensated discount factors are higher than uncompensated ones, for the entire two-year time period covered in our experiment. This suggests that experiments that do not take into account expectations regarding future income overestimate subjects' true impatience. Second, we find that compensated discount functions are significantly less present biased than uncompensated ones ($p = 0.24$ for the arithmetic difference being 0, but $p = 0.033$ with the signed rank test). The estimated $\beta$ parameter, when using compensated discount factors, is higher than when using uncompensated discount factors, and not significantly different from 1, while it is significantly less than one when using uncompensated discount factors.

To summarize, our two strands of analysis point in the same direction.

Both suggest that people integrate promised experimental rewards with their underlying (expected) income, and that their inherent impatience is less than what traditional experiments eliciting time preferences tend to find. When differences in expected future incomes are compensated for, the implied discount function becomes less hyperbolic, and closer to exponential.

The rest of the paper is structured as follows. Section 2 presents the theory of rewards integrated with other income, including our formula for recovering primitives from elicited choices and subjective probabilities. Section 3 details the experimental design, section 4 the conduct. Section 5 gives the empirical results, while Section 6 concludes.

# 2 Theoretical background

Here we provide theoretical foundations for the experiments investigating conditional discount factors.

## 2.1 *Overview*

Suppose that subjects evaluate consumption using an expected discounted utility model with (uncertain) background consumption $b_t$. As we compute below, these subjects will evaluate an unconditional reward $m$ received at time $t$ by $D(t) \cdot E[u(b_t + m) - u(b_t)]$, that is, the discounted increase in expected utility due to the reward. Moreover, assuming that $m$ is small relative to $b_t$, we can exploit the approximation that $u(b_t + m) - u(b_t) = u'(b_t) \cdot m$. Therefore, the utility of an unconditional reward is

$$D(t) \cdot E(u'(b_t)) \cdot m.$$

Denote current income by $b^*$, which is of course not uncertain.

Traditional experiments elicit the present amount $X_t^u$ which is just as good as a future unconditional reward, yielding the equality

$$u'(b^*) \cdot X_t^u = D(t) \cdot E(u'(b_t)) \cdot m.$$

Define the *uncompensated discount function* by

$$D_u(t) = \frac{X_t^u}{m}. \tag{1}$$

Seeing that $D_u(t) = D(t) \cdot \frac{E(u'(b_t))}{u'(b^*)}$, it is clear that the uncompensated discount function correctly estimates the true discount function $D(t)$ if and only if $\frac{E(u'(b_t))}{u'(b^*)} = 1$ for all $t$, which will not hold generically, and is the reason for the usual assumption of constant marginal utility $u'(b_t)$ across time in experiments that use $D_u(t)$ as an estimate for $D(t)$.

To compensate for income effects (ie, non-constant marginal utility across time), consider payments that are paid only in the "constant income" event that $b_\tau = b^*$ for all $\tau \leq t$. Denote this event by $s^t$. Then such conditional rewards are evaluated by the discounted increase in expected utility:

$$D(t) \cdot p(s^t) \cdot u'(b^*) \cdot m.$$

So, if an agent states that $X_t^c$ received today is as good as $m$ received at $t$ under the condition $s^t$, we obtain the equality $u'(b^*) \cdot X_t^c = D(t) \cdot p(s^t) \cdot u'(b^*) \cdot m$, and thus,

$$\frac{X_t^c}{m} = D(t) \cdot p(s^t). \tag{2}$$

Since $\frac{X_t^c}{m}$ is observable, we need only elicit $p(s^t)$ to compute the true discount function $D$. A means of deriving such beliefs is to assume the existence of a commodity $h$ whose utility $v(h)$ is independent of base consumption $b_t$ and additively separable from the utility for money. A possible example of such a commodity could be an anonymous charitable contribution to the charity of the agent's choice. Then a charity payment of $h$ at time $t$ under the condition $s^t$ is evaluated by[10]

$$D(t) \cdot p(s^t) \cdot v(h).$$

[10]There is no reason that $v(h)$ must be discounted by $D$, but this is without loss of generality for our purpose.

If the subjects exhibits indifference between such a charity payment $h$ at time $t$ under the condition $s^t$ and an unconditional charity payment $h$ made at the same time $t$ but with objective probability $\alpha^t$, then it is clear from the implied equality $D(t) \cdot p(s^t) \cdot v(h) = D(t) \cdot \alpha^t \cdot v(h)$ that

$$\alpha^t = p(s^t).$$

Now the *compensated discount function* can be defined by

$$D_c(t) = \frac{X_t^c}{m} \cdot \frac{1}{\alpha^t}, \tag{3}$$

and indeed $D_c(t) = D(t)$.

In what follows we describe the model more precisely.

### 2.2 *Model*

Time is discrete and with finite horizon, $\mathcal{T} = \{0, 1, \ldots, T\}$. The set of possible (inflation-adjusted) future base-consumption levels at time $t > 0$ is given by the finite set $B_t \subset \mathbb{R}_+$ with generic element $b_t$. This corresponds to assuming the the set of possible income levels are bounded and measurable in the unit of monetary exchange. Because base-consumption will be uncertain, the set $B_t$ is the period $t$ state space. Period 0 base-consumption is given by $b^*$ and $b^* \in B_t$ for all $t \leq T$, that is, period 0 base consumption is known and is a possible consumption level in the future. The $t$-horizon state space is $\mathcal{S}(t) = \Pi_{i=1}^t B_i$, with generic element $s^t = (b_0, \ldots, b_t)$. The full state space is $\mathcal{S} = \cup_{t \in \mathcal{T}} \mathcal{S}(t)$.

The set of (inflation-adjusted) monetary prizes is an interval $\mathcal{M} = [0, M]$. Writing $B_t = \{b_t^0, \ldots, b_t^{N_t}\}$ with $b_t^0 \leq \ldots \leq b_t^{N_t}$, we let $M$ be larger than the grid size for base consumption, $M > \max\{\left|b_t^i - b_t^{i+1}\right| : t \leq T,\, i < N_t\}$. In what follows, we will require that $M$ be small, thereby also requiring a fine state space.

A state-contingent reward is a function $x : \mathcal{S} \to \mathcal{M}$ that delivers a prize $x(s^t) \in \mathcal{M}$ at date $t$ conditional on the realization of $s^t = (b_0, \ldots, b_t)$. The set of all state-contingent rewards is denoted $X$. The primitive of our analysis is a preference $\succsim$ on $X$. We assume the following.

*Basic assumptions* – The subject is assumed to evaluate future consumption according to a discounted utility model where uncertainty is evaluated according to (state-dependent) subjective expected utility theory. Instantaneous utility is given by an unbounded, strictly increasing and differentiable function $u : \mathbb{R}_+ \to \mathbb{R}$ with a differentiable inverse. The discount function is $D(t) > 0$ and satisfies $D(0) = 1$ but is not necessarily strictly monotone or restricted to take values less than 1. The subject's prior (over future base consumption) is a probability measure $p$ on $\mathcal{S}(T)$.

*Integration assumptions* – Assume that the subject integrates state-contingent rewards with her anticipated base consumption and completely consumes any prize in the period and state that it is received. The presumption here is that the rewards in $\mathcal{M}$ are small enough for this to be an acceptable assumption. It follows that the discounted expected utility due to a state-contingent reward $x$ given beliefs $p$ is

$$U(x) = u(b^*) + \sum_{(b_1,\ldots,b_T)\in\mathcal{S}(T)} \left[\sum_{t=0}^{T} D(t)u(b_t + x(b_0, \ldots, b_t))\right] p(b_0, \ldots, b_T). \tag{4}$$

*Full support assumption* – We assume that $p(s^T) > 0$ for all $s^T$, that is, unconditional beliefs on each $B_t$ have full support, and positive probability is assigned to future base consumption staying the same as current consumption $b^*$. Given the strict monotonicity of $u$, this is equivalent to assuming behaviorally that for any $s_T$, there exists some prize $m > 0$ such that the state contingent reward $x_{m,s^T}$ that pays $m$ at $T$ in state $s^T$ and 0 otherwise satisfies

$$x_{m,s^T} \succ \omega,$$

where $\omega$ denotes the state-contingent rewards that yields 0 at all $t$ and $s^t$.

### 2.3 *Deriving $D$ from $\succsim$*

The primitive preference $\succsim$ on $X$ has the representation (4) where the utility of a reward $x(s^t)$ received at time $t$ conditional on $s^t$ is *state-dependent*. That is, a dollar received in a given period depends on base consumption $b$ in that period, so that the instantaneous utility in that period is $u(b+1)$, and thus dependent on $b$. This might lead one to suspect that the representation (4) lacks desirable uniqueness properties, and in particular the key component of interest, the discount function $D$, may not be unique. This would be problematic since it would imply that $D$ is not pinned down by preferences $\succsim$, and in particular, there is no meaningful sense in which it can be extracted from $\succsim$ in any experiment.[11] Therefore, we must establish that any discounted expected utility representation for $\succsim$ must have a unique $D$. This is the content of the proposition below, the proof of which is relegated to the Appendix.

**Proposition 1** *The prior $p$ and the discount function $D$ are uniquely determined by $\succsim$.*

Having established the possibility of eliciting $p$ and $D$ from $\succsim$ we now outline a procedure for doing so.

[11] For instance, in state-dependent subjective expected utility, a function $f$ that takes states into prizes is evaluated by $\sum_s u(f(s),s)p(s)$. In this representation, the prior is not unique and thus has no behavioral meaning. We could take any $\alpha_s > 0$ for each $s$, take a monotone transformation of $u(\cdot,s)$ given by $v(\cdot,s) = \frac{1}{\alpha_s}u(\cdot,s)$ for all $s$, and adopt a different prior given by $q(s) = \frac{\alpha_s}{\sum_s \alpha_s p(s)}p(s)$ for all $s$. Then it is easy to see that the utility function $f \longmapsto \sum_s v(f(s),s)q(s)$ represents precisely the same preference as before. In contrast, when $u$ is state-independent (as in Savage's subjective expected utility theory), *every* subjective expected utility representation for the preference must share the same prior $p$, and thus $p$ is uniquely pinned down by preferences. It can be elicited by asking the agent to choose between bets.

Let $x_{m,s^t}$ be the reward that yields prize $m$ at time $t$ conditional on constant base consumption $s^t = (b^*, \ldots, b^*)$. Denote by $\psi(x_{m,s^t})$ the reward that yields a prize immediately such that $\psi(x_{m,s^t}) \sim x_{m,s^t}$.[12] Identify the immediate prize with $\psi(x_{m,s^t})$. The representation (4) implies that

$$u(b^* + \psi(x_{m,s^t})) - u(b^*) = D(t)p_t(s^t)[u(b^* + m) - u(b^*)].$$

Note that since $u$ is a strictly increasing diffeomorphism, $\psi(x_{m,s^t})$ is a strictly increasing differentiable function of $m$ that takes the value 0 when $m = 0$. Taking a derivative of the above expression with respect to $m$ yields

$$u'(b^* + \psi(x_{m,s^t}))\frac{\partial \psi(x_{m,s^t})}{\partial m} = D(t)p_t(s^t)u'(b^* + m).$$

Evaluating at $m = 0$ gives $\frac{\partial \psi(x_{m,s^t})}{\partial m}|_{m=0} = D(t)p_t(s^t)\frac{u'(b^*)}{u'(b^*)}$ and so

$$\frac{\partial \psi(x_{m,s^t})}{\partial m}|_{m=0} = D(t)p_t(s^t).$$

In practice we can rely on an approximation via the observation that for small $m$,

$$\frac{\partial \psi(x_{m',s^t})}{\partial m}|_{m'=0} \approx \frac{\psi(x_{m,s^t}) - \psi(x_{0,s^t})}{m - 0} = \frac{\psi(x_{m,s^t})}{m}.$$

Hence

$$\psi(x_{m,s^t}) \approx D(t)p_t(s^t)m$$

Note that $\psi(x_{m,s^t})$ and $m$ are observable, so if we can identify $p_t(s^t)$ (for instance, as described earlier) then we can find $D(t)$.

### 2.4 *Discussion of Assumptions*

Our key assumptions can be spelled out as follows.

1. An agent's preferences over rewards are not independent of their background consumption and income (in contrast with "narrow bracketing").

[12] The existence of such a reward is implied by the unboundedness and continuity of $u$. Its uniqueness is implied by the strict monotonicity of $u$.

2. Rewards are consumed totally in the period of receipt.

3. The marginal utility of rewards is linear for the range of rewards that we consider.

In our subsequent empirical analysis, because background consumption is difficult to observe, we will need a further assumption:

4. Income changes act as a proxy for consumption changes.

The first assumption is an empirical assertion, and in this paper we validate it. It corresponds to the idea that an individual's current and expected financial situation bears some influence on her attitude towards money in any setting, whether for more fundamental decisions or for ones with smaller stakes. The natural benchmark here is that, as in our model, the marginal utility at base consumption determines the marginal utility for rewards.

The second assumption can be motivated multiple ways. There may be cognitive costs of integrating rewards with lifetime income and subsequently revising lifetime consumption, and thus it may be utility maximizing for small windfalls to simply be used to increase consumption in the period received. Moreover, there may exist a temptation for a splurge that one's financial situation does not justify, and an optimal response to this may well be to fully consume small windfalls (for instance see Fudenberg and Levine (2006)). Indeed, for such reasons the agent can be sophisticated enough to smooth background consumption and yet fully consume small windfalls. Finally, there can just simply be transaction costs associated with saving, which might make smoothing relatively small rewards suboptimal.

In our experiment a period is *one year*, and thus the rewards we consider (approximately $165 in 2010) are very small compared with annual consumption. This speaks to the second assumption but also motivates our third assumption that the utility over the range of rewards exhibits approximately constant marginal utility.

As noted, the fourth assumption is necessitated by the fact that consumption is difficult to observe directly. Income changes would be a poor proxy for consumption changes in the standard life cycle consumption model with perfect smoothing. However, perfect smoothing is a poor descriptive assumption: whether or not there is narrow bracketing, perfect smoothing implies that all rewards should be ranked according to its present value and elicited discount functions must be exponential (with a discount rate equal to the market rate of interest), but the evidence against exponential discounting abounds in the experimental literature. Additionally, empirical studies show that consumption tracks income over the life cycle (Browning and Crossley (2001)), pointing both to possible frictions in consumption smoothing and to possibly boundedly rational behavior. Several boundedly rational explanations considered in the literature take the form of rule-of-thumb or heuristic saving rules (see Winter et al (2012) and its references), such as the rule to save a fixed fraction of income (Deaton 1992, Browning and Crossley 2001), and these would bring consumption movements closer in line with income movements.[13]

We should clarify however that, since we elicit preferences over rewards conditional on unchanging income, for the purposes of this paper we need only a weaker claim to hold, namely that *equal incomes in two periods implies equal consumption in those periods.*

# 3 Experimental Design

The experiment used a questionnaire with three sections, all three translated fully in the online appendix. In the first one we asked subjects to choose between rewards received at different times. Some of the future rewards involved payments that were conditional, i.e. only received if the subject's real

[13]We note that our derivation of underlying discount functions holds if we assume that subjects fully integrate rewards with income and then consume a constant fraction of this income.

income remains "approximately constant" (defined shortly) up to the time of payment. The second part provided subjects binary choice questions involving a payment to the subject's charity of choice either with an exogenously given probability or under the condition the subject's real income remains "approximately constant". Finally, the third part featured a not incentivized questionnaire eliciting demographic and financial information about subjects, as well as subjective beliefs about future income. All in all, this amounted to six sets of decisions that all included a range of binary choices before they turned to a survey – the small number of questions helps keeps the cognitive burden low on the subjects. During instructions at the beginning of the experiment, we explained to the subjects how a dice roll would determine which one of those six choice categories will be used to generate payoffs, and for that choice one random line from the range of binary choices, according to their expressed preferences.[14]

The first section started with questions involving only unconditional payments. A generic question asks for the subject's preference between[15]

(i) a "later" payment of 20,000 Icelandic Kronur (ISK), paid to the subject at $t$ years plus 1 week later,

(ii) a "present" payment in the amount of $x$ paid 1 week later,

where $t$=1 or 2 years, and $x$ ranges from ISK 200 to ISK 22,000 in steps of ISK 200. This series of binary choice questions is presented as a standard multiple price list, that is, in the form of a table.[16] Although subjects could indicate their preference in each cell of the table, for their convenience they

[14]It is a dominant strategy to make the binary choices truthfully, with the caveat that if a subject is exactly indifferent between the two options then the choice can be either of them.

[15]In 2010, 20,000 ISK was worth approximately $165.

[16]This is equivalent to a Becker-DeGroot-Marschak (BDM) procedure. Like most of the related literature, we opted for the list of binary questions because we believe the original BDM procedure (in particular, understanding why truth-telling is weakly dominant) to be cognitively more demanding for the subjects. This is also in accordance with our experience from several pilots conducted before the experiment.

were allowed a shortcut where they could indicate two consecutive cells on the table where preferences switch from favoring the present reward to preferring the later reward. Consequently, the subject's indifference point was captured within an ISK 200 interval.

In order to elicit compensated discount functions (and specifically to bring equation (2) into play), we next asked analogous binary choice questions where some payments are paid on the condition that the subject's income remains "approximately constant". We formally defined this condition to consist of two requirements:

(a) the price-indexed disposable annual income of the subject during the year following the experiment (in case of a 2-year delayed reward, in both years) is within 4% of the annual income in the 12 months preceding the experiment;

(b) the price-indexed disposable monthly income of the subject in the last month before payment occurs is within 4% of the monthly income in the month preceding the experiment. In the case of payments two years from the experiment, this has to hold true both one year after the experiment and two years after the experiment.

The idea behind part (a) is that the general income level of the subject remains the same, relative to the time of the experiment, while the motivation for part (b) is to make sure that the subject's overall financial situation is similar to the time of the experiment. We refer to both conditions holding together as the subject's income situation remaining constant.

Given this definition, the next set of binary choice questions asked subjects to indicate their preference between:

(i') a "conditional later" payment of 20,000 Icelandic Kronur (ISK) paid to the subject, after $t$ years plus 1 week, *if* income remains approximately constant.

(ii') a "present" payment in the amount of $x$ paid 1 week later,

where as before, $t$=1 or 2 years, and $x$ ranges from ISK 200 to ISK 22,000 in steps of ISK 200.

Section II obtained the data that allows us to exploit equation (3). The section started with the subject choosing a charity from a list of well known and established charities with different objectives that were briefly described to the subjects. Subjects were told that the forthcoming questions involve rewards in the form of payments to their charity of choice. They were then asked to indicate their preference between:

(i") a "conditional charity payment" of ISK 20,000 to the subject's charity of choice, after time $t$ years plus 1 week, *if* income remains "approximately constant",

(ii") a "random charity payment" of ISK 20,000 to the subject's charity of choice, after time $t$ years plus 1 week, with exogenous probability $p$,

where $t$=1 or 2 years, and $p$ ranges from 0.01 to 1 in steps of 0.01. This series of questions was presented in the form of a table as in Section I.

In Section III, subjects were asked to fill out a survey, which asked them, among other things, for their bank information in order to transfer their payments. Using the one week delay in payments, as opposed to exactly at the time of the experiment, as well as one and two years later, allowed us to use the exact same procedures and payment methods, regardless of whether the rewards were delayed or not. This section also included questions on the subjects' social and economic background, as well as expectations on their future economic situation. It also included a direct but not incentivized question on how likely they think their yearly income remains approximately the same one and two years following the experiment. We also elicited subjects' probability assessments of entering a new job by one and two year's time after the experiment, and their probability assessments on losing their current jobs.

# 4 Experimental Procedures and Background

## 4.1 Experimental Sessions

The experiment took place on June 9th and 10th of 2010. Recruitment was conducted by phone from a random sample of Icelanders between the ages of 20 and 45 living in western or central Reykjavík, specifically post codes 101, 105 and 107. The sample was collected from the census by Skýrr, an Icelandic IT company and frequent government contractor. Subsequently, the subjects' phone numbers were collected manually through ja.is, the online Icelandic Telephone Directory. The experiment was conducted in groups simultaneously in one location, specifically a lecture hall at the University of Iceland. The hall had a podium and an overhead projector used in the presentation of instructions, which was carried out by one of the researchers (photos of the location are available upon request). Before starting, the subjects were asked to read and sign a consent form. They were also asked not to talk to each other and informed that if they had questions they should raise their hand, rather than speak up, and they would be assisted individually by a researcher or an assistant. Each session consisted of approximately 15 subjects and took a little bit over one hour. Outside the classroom we set up four dice rolling stations at which assistants reported the randomized outcome of the subjects' dice roll and computerized randomization process.

Before the experimental session in 2010, we conducted several small (10-25 subjects) informal pilots in 2007-2009. These pilots featured similar questions as the experiment, but subjects only received a fixed compensation for participating, independent of their answers. These pilots were mainly used to fine-tune how to effectively explain the questions in the experiment.[17]

[17] We also conducted two small post-experiment pilots, one in 2011 and one in 2012, with slightly altered questionnaires and instructions as the ones used in the experimental session in 2010, to investigate whether these design changes lead subjects to a better understanding of the questions involving conditional rewards. As we did not find any evidence for this, these post-experimental pilots did not lead to a subsequent incentivized

### 4.2 Payment Process

As online banking is widespread in Iceland, subjects were paid by bank transfer. In all instances, both for pilots and the experiment itself, subjects received their payments. This happened in the vast majority of instances at the scheduled time. In a few instances with illegible account numbers, payments made with a few days' delay after quick follow-up e-mails or phone calls. Payments were initiated by the finance division at the University of Iceland. In 2010, 48 subjects in the experiment received payments, on average ISK 14,823. In 2011, 17 payments were made, in the amount of ISK 20,673. 12 of those went directly to participants, but five went to charities of their choice. In 2012, 13 individuals received a payment of ISK 21,891 each[18].

### 4.3 Income Verification

We chose Iceland for the experiment because of our access to prompt and comprehensive income-tax information due to a pay-as-you-earn system where the income tax is continuously withheld at source. That is, the lion's share of income-tax revenue in Iceland is collected monthly, and the Directorate of Internal Revenue (DIR) receives fairly accurate accounts of each individual's income in a timely fashion. For this reason, we signed a contract with the DIR on February 12th 2010, in accordance with the Icelandic Data Protection Act 77/2000 and a notification to the Icelandic Data Protection Authority (S4052). According to this DIR contract and the subjects' informed consent, we did not obtain direct information on subjects' incomes. Instead, income *changes* were calculated by the DIR staff, and they sent us the percentage changes in subjects' monthly as well as yearly incomes, for the specific months and twelve month periods. This was done using the

experimental session.

[18]These delayed payments were inflation-adjusted equivalents of ISK 20,000 at the time of the experiment.

latest information available in the DIR systems, which is generally fairly complete by the 18th of the following month, with only minor adjustments after that.

According to our contract, DIR calculated and delivered the income changes at three points in time. During the week after the experiment took place, as well as one and two years later. [19] Income changes were adjusted for changes in the Consumer Price Index (CPI) which is published by Statistics Iceland by the second to last day of the reference month.

### 4.4 Economic Situation Around the Time of the Experiment

The seemingly flourishing economy of Iceland suffered a major meltdown less than two years before our main experimental session, when the country's three largest banks collapsed and were nationalized. In a widely-viewed televised address, Prime Minister Geir Haarde announced to the country: "(T)here is a very real danger, fellow citizens, that the Icelandic economy, in the worst case, could be sucked with the banks into the whirlpool and the result could be national bankruptcy" (Prime Minister's Office, 2008). Although a sovereign default did not follow, this is indicative of the volatility and uncertainty of the situation. During the following months, hundreds of firms in the country declared bankruptcy. The announcement of the crisis triggered international consequences, including a decision by the United Kingdom to freeze the assets of one of the three large banks (Landsbanki), emergency funding from the International Monetary Fund, protests and a subsequent fall of the government in February 2009.

This was a dramatic macroeconomic shock that affected the entire population of this small open economy with its own currency and for which exchange rates and prices changed suddenly and dramatically. Although the experiment and the post-experimental payments took place after the

[19] We alerted DIR of each deadline with two week's advance notice, and delivery and payments went through with no delay.

collapse, and our design in principle remains valid no matter what expectations subjects have regarding future income, the crisis should be noted as many subjects may have felt considerable uncertainty as to how the economy would adjust in the coming years. Iceland is one of the world's smallest currency areas, making the Icelandic krona very vulnerable, which affects the price level and real wages. From the time of the experiment and to the payment dates one and two years later, the price level rose by 4.2% and 9.9% respectively and the real wage rate increased by 2.7% and 4.1% respectively. All in all, it can thus be said that most subjects in our sample faced considerable uncertainty at the time of the experiment regarding their future income.

Our means of deriving compensated discount functions is immune to the economic turbulence as long as subjects use discounted expected utility with respect to some beliefs about the future. To the extent that the ambiguity about the future led subjects to assess the future uncertainty and beliefs in an inconsistent way, it would be revealed to us through unreasonable compensated discount functions.

# 5 Computation of Discount Factors and Statistical Analyses

Recall our notation $X_t^u$ and $X_t^c$ in Section 2 for the present payments that are indifferent to a later conditional and unconditional payment at $t$ respectively. For simplicity, we estimate these as the lowest payment that the subject indicates as superior to the later payment. For the questions involving only unconditional rewards, if the later payment was paid $t$ years after the experiment, this gives us an uncompensated discount function $D_u(t)$ as defined in equation (1). It will be convenient to define uncompensated

discount factors between $t$ and $t+1$:

$$D_u(t, t+1) = \frac{D_u(t+1)}{D_u(t)}.$$

Note that $D_u(0) = 1$ so $D_u(0,1) = D_u(1)$. When interpreting these parameters in the standard $\beta - \delta$ framework, we set $\delta_u = D_u(1,2)$, and

$$\beta_u = \frac{(D_u(1))^2}{D_u(2)} = \frac{D_u(1)}{D_u(1,2)}.$$

To compute compensated discount functions $D_c(t)$, defined by equation (3), we first define $p_t$ as the probability that a subject expects her income $t$ years after the experiment to be approximately the same as at the time of the experiment (as defined in Section 2 and in the experimental instructions). Specifically, this is coded as the lowest reported probability with which a probabilistic contribution to her charity of choice $t$ years after the experiment is indicated as superior to a contribution of the same amount at the same time to the same charity, conditional on her income staying approximately the same. The probabilities computed this way, from incentivized experimental questions, strongly correlate with subjects' reported probabilities of stable income in Section III of the experimental questionnaire, although the latter, not incentivized measures are noisier. Linear regressions of the not incentivized responses on the incentivized ones yield slopes 0.602 and 0.442 with an $R^2$ of 0.3368 and 0.2154, for the two time horizons respectively.

Given $p_t$, and $X_t^c$, which denotes the amount of present payment that makes the subject indifferent to a conditional payment of ISK 20,000 $t$ years after the experiment, the estimated compensated discount function is $D_c(t) = \frac{X_t^c}{p_t \cdot 20{,}000}$. As with uncompensated discount functions, we define the discount factor $D_c(t, t+1) = \frac{D_c(t+1)}{D_c(t)}$, $\delta_c = D_c(1,2)$, and $\beta_c = \frac{(D_c(1))^2}{D_c(2)}$.

For the possible reasons outlined in the introduction – namely the possibility of model misspecification and the possibility of imperfect responses by subjects to the more involved conditional questions – the compensated

discount functions computed for a subset of our subjects were not plausible. For example, while it is plausible that a subject may exhibit negative discount rates (that is, $D_c(t) > 1$), it is implausible that discount functions may be steeply upward sloped, as we observed in some cases. Indeed, several instances of implausible discount functions were typically the result of hard-to-rationalize choices such as preferring a reward $m$ at time $t$ with probability $\alpha < 1$ to a reward $m$ at $t$ for sure.

In light of this, we proceed by following two separate strategies to analyze our predictions for uncompensated and compensated answers. First, for the simpler, uncompensated choices, we report discount functions by strata of income changes, with different predictions under our assumptions that baseline income levels matter for time preferences over monetary rewards. Besides the full sample, those subsamples are (a) people who experienced relatively stable income for two years after the experiment and would thus be expected to show less present bias under the proposed theory, (b) those who have stable income for two years before and after the experiment and are thus assumed to be individuals with even greater stability of income and thus even less confound in the conventional measures of present bias, (c) those who, at the time of the experiment, assess their probability of having a new job to be small and should thus show a smaller present bias than the full sample, and finally (d) those individuals whose realized income rises in the first year after the experiment took place but plateaus after that, who should, according to theory show greater present bias than the full sample or any of the subsamples described above.

Second, for the compensated questions, we identify groups with plausible conditional discount functions, and repeat our analysis restricted to these subsamples. Not to force any arbitrary judgment (and thus results) on the data, we employ the tools of statistical cluster analysis to identify (latent) classes of subjects in the data and focus on groups with a "reasonable" range

of discount factors. We choose to define clustering in terms of the discount factors $D_c(0,1)$ and $D_c(1,2)$ (the latter only implied by $D_c(1)$ and $D_c(2)$).

For the purposes of clustering, we assume jointly normally distributed discount factors, within an unobserved $k$ class of subjects. Allowing for noise (outliers), the likelihood function that is numerically maximized is

$$\prod_{i=1}^{n}\left[\frac{\tau_0}{V}+\sum_{k=1}^{G}\tau_k\phi_k(\mathbf{x}_i|\theta_k)\right], \tag{5}$$

where $V$ denotes the hypervolume of the data region, data can come from different distributions or simply be noise, which have respective probabilities $\tau_k$ (and thus of course $\tau_k \geq 0$ and $\sum_k \tau_k = 1$). The algorithm initializes with noise estimates coming from a nearest-neighbor method and hierarchical clustering applied to the rest of the data (with a simple maximization using the EM algorithm), and the EM algorithm alternating Bayesian updating conditional on the parameter estimates (Expectation step) and maximizing in the parameters conditional on the classification probabilities (Maximization step).

In equation 5 the likelihood contribution for an observation comes from assuming that the densities of the discounts factors follow a bivariate normal distribution. This procedure is conditional on the number of clusters, $G$. This we let be chosen to maximize the Bayesian Information Criterion (BIC),

$$BIC = 2 \cdot \log L(\mathbf{x}, \theta^{\star}) - (\#\text{parameters}) \log n. \tag{6}$$

*Formal hypotheses* We conduct a family of tests over two important variants of two measures, using a parametric and a nonparametric test, both two-sided and also one-sided about the economically interesting differences.

Our first set of tests compare first-year and second-year discount factors. The tests are done for both compensated and uncompensated, so we drop the superscript on $D$ below to simplify exposition.

- $H_0 : D(1,2) = D(0,1)$, corresponding to subjects being exponential discounters.

- $H_1 : D(1,2) > D(0,1)$, corresponding to subjects exhibiting present bias in their time preferences.

We also report test results of no present bias without taking the stance on which way a deviation could occur. This amounts to a two-sided test against the alternative hypothesis of inequality.

Our preferred parametric test is a paired $t$-test, testing the null hypothesis that $H_0 : E[D(1,2)] = E[D(0,1)]$ against the alternative $H_1 : E[D(1,2)] > E[D(0,1)]$ or $H_1 : E[D(1,2)] \neq E[D(0,1)]$. The test makes the usual assumption that the discount factors are normally distributed in small samples, or the samples are large enough that the asymptotic approximation is good enough. The nonparametric test of our choice is a sign test, testing the medians without assuming the two variables have the same distribution: comparing the null hypothesis that $H_0 : med[D(1,2)] = med[D(0,1)]$ against the alternative $H_1 : med[D(1,2)] > med[D(0,1)]$ or $H_1 : med[D(1,2)] \neq med[D(0,1)]$.

We conduct the tests both for the uncompensated and the compensated discount factors.

Finally, we repeat the exact same test procedures for another parametrization of present bias, namely the transformation of the discount factors into the common $\beta = \frac{D(0,1)}{D(1,2)}$ parameter being larger or less than one.[20] Thus for the $t$-tests the null is $H_0 : E[\beta] = 1$ (no present bias on average) against the alternatives of $H_1 : E[\beta] < 1$ or $H_1 : E[\beta] \neq 1$, while for the sign tests, the analogues with medians. Again, we conduct the tests separately for uncompensated or compensated measures.

[20] Of course, for the parametric test the transformation can matter because of the approximation being better or worse in our finite samples. The nonparametric test is indifferent to such a transformation.

# 6 Experimental Results

## 6.1 Uncompensated Discount Factors

The bottom pane of Table 1 shows the difference of first and second year uncompensated discount factors ($D_u(1,2) - D_u(0,1)$), as well as the implied $\beta$ and $\delta$ parameters, with the strata by income stability around the time of the experiment and times of payment in separate columns. There are 31 subjects in column 2, whose realized annual real income in both years after the experiment stayed within 10% of real income at the time of the experiment. Not surprisingly, these are slightly older subjects, more likely to be employed, but also better educated and with more females than in full sample (The top pane of Table 1 shows summary statistics using our survey in Section III). Reassuringly, these subjects were much less likely to expect job changes after the experiment. [21] Column 3 focuses on subjects whose real income was stable both before and after the experiment. Because most of our subjects experienced turbulent income in the years before the experiment, due to the financial crisis and the subsequent recession, we define this category as the subjects whose real income in both years before the experiment was within 20% of real income at the time of the experiment, and whose real income in both of the two years after the experiment was within 10% of real income at the time of the experiment. Even this more permissive criterion for the two years before the experiment results in only a small number of subjects (10, with 9 females) being in this category. They are also better educated and slightly older.

We assume that those whose realized income was stable for two years

[21] For those in Column 2 whose realized income stayed stable for two years after the experiment, the assessment (at the time of the experiment) of being in a new job one year (two years) after the experiment is 20.0 (25.6) percentage points less likely than those not having such stable income, and this difference has a $p$-value of 0.003 (0.00). For those in column 3 who we categorized as having stable income both before and after the experiment, these differences from the rest of the sample are 26.8 and 27.1 in the same direction (with both $p$-values of 0.00).

after the experiment expected more stable income in these years than the rest of the subjects. This is consistent with subjects' reported beliefs in Section III of the questionnaire, and the highly correlated incentivized reposes in Section II. Yet if we define stable income subjects directly based on their reported expectations in the questionnaire, instead of their realized income that we directly observe, we get results similar to what follows, but noisier (Column 4 focuses on the 32 people who estimated the risk of have a new job in two years to be less than 20%). This suggests that at least some subjects have trouble reporting their expectations in terms of probabilities.

As shown in the bottom pane of Table 1, the difference between the second and first year discount factors is large and highly statistically significant for the entire sample of 115 (we lose one observation with an invalid second-period discount factor). The overall sample shows considerable present-bias (average $\beta$ is 0.895), and a reasonable amount of impatience (on average $\delta$ being 0.922). In contrast to this, for those 31 people whose incomes were stable for two years after the experiment, the difference in discount factors is statistically insignificant, with a point estimate close to 0, and the implied $\beta$ is only insignificantly below 1, with a point estimate of 0.972. On the other hand, the estimated $\delta$ (0.924) is essentially the same as for the whole subject pool. We see the same pattern for those subjects whose income was stable both before and after the experiment.

This difference of mean present-bias parameter $\beta$ between those with stable income after the experiment and the rest of the subjects is statistically significant at the 5% level ($p = 0.031$), and robust to controlling for other differences between this group and others. Applying the tests in a regression framework, the mean difference in $\beta$ declines only slightly, from 0.108 to .1, when demographic controls from Table 1 are included, to control for selection on observables.[22] However, this exercise is informative only if any

[22]For this we also include those 8 observations who have BMI, employment or number or children data missing. These observations enter with value zero for the respective variable,

remaining selection on unobservables has an effect comparable to that of the observables. In the framework of Oster (2014) for linear regressions, we can calculate that the improvement of the model fit $R^2$ by 5% when controlling with observables implies that the group with stable income has the larger $\beta$ unless (similarly confounding) unobservables could improve $R^2$ by 50% or more. Such a huge increase in explanatory power is not very plausible, thus even this more cautious perspective leads us to the conclusion that incomes stable after the experiment are associated with less present bias. [23]

We can contrast these results with the 11 subjects who experienced a relatively large real income rise (more than 10%) in the first year after the experiment, but then saw their incomes stabilized (remained within 10% of the income in the first year after the experiment). If these subjects foresaw this income path,[24] their expected marginal utilities for monetary rewards in both of the two years following the experiment are lower than at the time of the experiment. This should imply more present bias than for the rest of the subject pool (without compensating for the confound of the income process, of course). We find some evidence for this, as the estimated $D_u(1,2) - D_u(0,1)$ difference rises to 0.223, and the estimated $\beta$ decreases to 0.792 for this subsample, although we have no power in this small sample to establish these changes as statistically significant.

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but also with an extra indicator in the regression to take out their group-specific mean separately. An alternative model without these controls have less explanatory power but yield a stable-unstable difference only larger than the unconditional point estimate.

[23] All analogous calculations are collected in Appendix Table 1. This table contrasts measures of time-preference for these groups in univariate and multivariate regressions to show how robust these differences are. With explanatory power taken into account, the table also reports the other extreme bound on the contrast from Oster (2014), as well as the minimal explanatory power a model with unobservables would need to have to call the sign of the unconditional point estimate confounded. These calculations assume that unobservables correlate with the group indicator "in exactly the same direction"as observables ($\delta = 1$ in that framework, not to be confused with the time-preference parameter). The bounds on the contrast come from assuming that the all-inclusive models could achieve the theoretical maximum $R^2 = 1$.

[24] This is reasonable in many instances, e.g. for those finishing school or for some other reason expecting to get into a higher-paying job.

## 6.2 Compensated Discount Factors

### 6.2.1 Clustering outcomes

The noise and clusters resulting from the procedure in Section 5 are summarized in the top pane of Table 2. The best-fitting distribution is one with no correlations between the two discount rates in any cluster, and three clusters with different means and variances for the normal distributions, and some outliers (noise).[25] Descriptive statistics for clusters are shown in the middle pane of Table 2. The first two clusters, containing 79 of the 116 subjects, have compensated discount factors mostly in a plausible range. Since Cluster 1 still contains some individuals with high compensated discount factors for some period of time, we also focus on cluster 2 separately, although this group only contains 16% of our sample. The "reasonable" clusters are slightly better educated, on average (see Table 2), which is consistent with the hypothesis that these subjects understood the questions involving conditional rewards better, but the overlap between all clusters is apparent for any covariate.

### 6.2.2 Main results

Comparisons of uncompensated and compensated discount factors are reported in the bottom pane of Table 2, with standard errors in parentheses. The p-values of our tests outlined above are reported in Table 3. As with the average discount factors before, some statistics for the whole dataset are quantitatively implausible, although they imply the same qualitative conclusions as we obtain when restricting attention to subjects in the two reasonable clusters. We find the same clear patterns no matter whether we include all subjects, only those in Clusters 1 and 2, or only those in Cluster 2.

[25] The conclusions are robust to different initializations of the clustering. Though the number of clusters might be higher with a different initialization (e.g. initializing the expected outliers differently), the clusters with "reasonable" discount factors largely overlap, as do the vector of noise-indicators.

Compensated discount factors, on all horizons are significantly higher than uncompensated ones: $D_c(0,1) > D_u(0,1)$ and $D_c(1,2) > D_u(1,2)$. This suggests that standard elicitations of time preferences, which do not take into account future income expectations of subjects, on average overestimate the amount of impatience of individuals. One explanation for this is that most subjects expect a rising income path, decreasing the marginal utility of small monetary rewards in the future, relative to the present.

Second, the left pane of Table 3 shows that our tests reject exponential discounting without compensation for income changes in the entire sample, but not for the groups with stable income, restating the conclusions of our previous analysis reported in Table 1. More interestingly, the new results on compensated discount factors in the right pane of Table 3 show no evidence of present bias once we control for the potential confounds of income changes. This suggests that once one compensates for income expectations, there is insufficient evidence that the average subject has a present bias.

# 7 Conclusion

We find that in a setting where most people reveal present bias, people with stable incomes are standard exponential discounters. Our results show that subjects' choices over delayed rewards depend on their income expectations, revealing their importance for intertemporal choice experiments. The experimental design shows how choices on rewards conditional on no income changes, alongside incentivized elicitations of subjective income expectations, can help researchers compensate for this confound. Our results cast doubt on the maintained hypothesis of many other studies that mental accounting implies that subjects evaluate monetary rewards without integrating them to other income.

It is important for future research to obtain a richer empirical picture on how time preferences over monetary payments depend on different charac-

teristics of future income expectations such as trends in expected income, trends in volatility of income, or the amount of autocorrelation of income in future periods. Any conclusion on saving behavior or policy would be overly speculative at this point, but for fundamental work in choice theory, this is an important step towards more conclusive lab experiments and empirical studies.

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Table 1: Description of the Sample

| | Full sample | Stable income after 2010[ɣ] | Stable income before and after 2010[ɣɣ] | New job less likely than 20%[ɣɣɣ] | Income rises, then plateaus[ɣɣɣɣ] |
|---|---|---|---|---|---|
| | | | Summary Statistics (with SDs) | | |
| Female | 0.59<br>(0.49) | 0.68<br>(0.48) | 0.90<br>(0.32) | 0.59<br>(0.50) | 0.64<br>(0.50) |
| Age | 33.19<br>(6.90) | 36.68<br>(6.37) | 37.20<br>(5.35) | 35.66<br>(6.99) | 32.18<br>(7.36) |
| Higher education | 0.43<br>(0.50) | 0.55<br>(0.51) | 0.70<br>(0.48) | 0.44<br>(0.50) | 0.45<br>(0.52) |
| Smoker | 0.20<br>(0.40) | 0.23<br>(0.43) | 0.20<br>(0.42) | 0.13<br>(0.34) | 0.27<br>(0.47) |
| BMI | 25.43<br>(4.52) | 24.55<br>(3.48) | 23.93<br>(2.77) | 25.34<br>(4.27) | 25.35<br>(4.27) |
| Emloyed | 0.88<br>(0.33) | 0.94<br>(0.25) | 0.90<br>(0.32) | 0.88<br>(0.34) | 1.00<br>(0.00) |
| Single | 0.60<br>(0.49) | 0.74<br>(0.44) | 0.80<br>(0.42) | 0.72<br>(0.46) | 0.45<br>(0.52) |
| Number of children | 1.22<br>(1.36) | 1.35<br>(1.36) | 1.30<br>(1.42) | 1.78<br>(1.48) | 1.45<br>(1.57) |
| Expect job change in t=1 | 35.44<br>(35.46) | 20.73<br>(28.74) | 11.00<br>(15.78) | 2.78<br>(3.96) | 20.09<br>(24.72) |
| Exect job change in t=2 | 47.76<br>(36.64) | 28.93<br>(30.55) | 23.00<br>(26.37) | 4.91<br>(5.40) | 42.73<br>(36.36) |
| | | | Time Preference Variables (with SEs) | | |
| $D_u(1,2)-D_u(0,1)$* | 0.13<br>(0.03) | 0.04<br>(0.04) | 0.03<br>(0.06) | 0.08<br>(0.04) | 0.22<br>(0.10) |
| $ß_u$ ** | 0.89<br>(0.03) | 0.97<br>(0.04) | 0.98<br>(0.06) | 0.94<br>(0.04) | 0.79<br>(0.10) |
| $\delta_u$ *** | 0.92<br>(0.02) | 0.92<br>(0.02) | 0.92<br>(0.03) | 0.90<br>(0.03) | 0.89<br>(0.06) |
| N | 116 | 31 | 10 | 32 | 11 |

Note: The table reports means and standard deviations (in parentheses) for basic descriptive variables for various subsamples in the top pane, means and standard errors (in parentheses) for time preference variables in the bottom pane. * Reports the average difference between each subject's revealed uncompensated discount factor over the second year and the one over the first year. ** Reports the average ratio of discount factors over the second year and over the first year. *** Reports the average ratio of the two-year discount factor and the one-year discount factor. [ɣ] Only including those whose realized annual income remained within 10% of their 2010 income both in 2011 and 2012. [ɣɣ] Only including those whose annual incomes in 2008 and 2009 as well. [ɣɣɣ] Includes those whose self-report the probability of getting a new job in either year after the experiment to be less than 20%. [ɣɣɣɣ] Includes those whose realized annual income rose more than 10% in 2011 but less than 10% on top of that in 2012.

Table 2: Parameters by Clusters

| | Full sample | Cluster 1 | Cluster 2 | Clusters 1&2 | Cluster 3 | Noise |
|---|---|---|---|---|---|---|
| **Estimated Parameters of Clustering** | | | | | | |
| Probability* | | 0.497 | 0.159 | | 0.198 | 0.147 |
| $E[D_c(0,1)]$** | | 1.374 | 1.008 | | 1.692 | |
| $V[D_c(0,1)]$*** | | 0.670 | 0.001 | | 2.702 | |
| $E[D_c(1,2)]$** | | 1.150 | 0.971 | | 4.107 | |
| $V[D_c(1,2)]$*** | | 0.183 | 0.005 | | 9.123 | |
| **Summary Means (SDs)** | | | | | | |
| Female | 0.59 | 0.63 | 0.53 | 0.61 | 0.52 | 0.56 |
| | (0.49) | (0.49) | (0.51) | (0.49) | (0.51) | (0.51) |
| Age | 33.19 | 33.48 | 31.84 | 33.09 | 32.62 | 34.44 |
| | (6.90) | (7.29) | (6.27) | (7.05) | (7.02) | (6.23) |
| Higher education | 0.43 | 0.47 | 0.53 | 0.48 | 0.43 | 0.19 |
| | (0.50) | (0.50) | (0.51) | (0.50) | (0.51) | (0.40) |
| Smoker | 0.20 | 0.23 | 0.16 | 0.22 | 0.14 | 0.19 |
| | (0.40) | (0.43) | (0.37) | (0.41) | (0.36) | (0.40) |
| BMI | 25.43 | 25.22 | 25.32 | 25.24 | 25.20 | 26.67 |
| | (4.52) | (4.55) | (5.85) | (4.87) | (2.98) | (4.59) |
| Emloyed | 0.88 | 0.88 | 0.84 | 0.87 | 0.81 | 1.00 |
| | (0.33) | (0.33) | (0.37) | (0.34) | (0.40) | (0.00) |
| Single | 0.60 | 0.62 | 0.74 | 0.65 | 0.52 | 0.50 |
| | (0.49) | (0.49) | (0.45) | (0.48) | (0.51) | (0.52) |
| Number of children | 1.22 | 1.25 | 1.11 | 1.22 | 1.00 | 1.50 |
| | (1.36) | (1.36) | (1.15) | (1.31) | (1.34) | (1.63) |
| Expect job change in t=1 | 35.44 | 27.52 | 33.68 | 29.04 | 50.62 | 46.31 |
| | (35.46) | (30.31) | (38.87) | (32.47) | (38.19) | (39.10) |
| Exect job change in t=2 | 47.76 | 39.76 | 43.42 | 40.66 | 65.24 | 59.00 |
| | (36.64) | (34.63) | (44.07) | (36.90) | (30.39) | (34.09) |
| **Sample Estimates (SEs)** | | | | | | |
| $D_c(0,1)$ | 5.963 | 1.399 | 1.005 | 1.305 | 1.767 | 34.471 |
| | (1.666) | (0.108) | (0.007) | (0.084) | (0.408) | (9.539) |
| $D_c(1,2)$ | 2.832 | 1.145 | 0.975 | 1.104 | 4.510 | 9.161 |
| | (0.530) | (0.056) | (0.016) | (0.043) | (0.682) | (3.296) |
| $D_c(0,1)$-$D_u(0,1)$ | 5.171 | 0.578 | 0.226 | 0.493 | 1.037 | 33.692 |
| | (1.664) | (0.103) | (0.046) | (0.081) | (0.396) | (9.519) |
| $D_c(1,2)$-$D_u(1,2)$ | 1.926 | 0.237 | 0.092 | 0.202 | 3.541 | 8.212 |
| | (0.536) | (0.056) | (0.037) | (0.044) | (0.672) | (3.323) |
| $D_c(1,2)$-$D_c(0,1)$ | -3.131 | -0.254 | -0.030 | -0.200 | 2.743 | -25.310 |
| | (1.803) | (0.123) | (0.018) | (0.094) | (0.992) | (11.838) |
| $D_u(1,2)$-$D_u(0,1)$ | 0.130 | 0.088 | 0.104 | 0.092 | 0.240 | 0.171 |
| | (0.027) | (0.031) | (0.053) | (0.027) | (0.084) | (0.080) |
| $ß_u$ | 0.895 | 0.929 | 0.899 | 0.922 | 0.791 | 0.898 |
| | (0.026) | (0.031) | (0.056) | (0.027) | (0.079) | (0.082) |
| $ß_c$ | 16.075 | 1.487 | 1.037 | 1.379 | 1.634 | 107.595 |
| | (8.997) | (0.175) | (0.020) | (0.135) | (0.714) | (62.053) |
| N | 116 | 60 | 19 | 79 | 21 | 16 |

Note: The table collects the parameters corresponding to the clusters as well as means and standard errors (in parentheses) for key constructs. *Estimated probabilities of the cluster in the mixture model. **Estimated mean of the compensated discount factors. *** Estimated variance fo the discount factors.

Table 3: P-values from Hypothesis Tests

| Uncompensated Discount Factors | | | | | |
|---|---|---|---|---|---|
| Null hypothesis | Test | Full sample | Stable income after 2010[ɣ] | Stable income before and after 2010[ɣɣ] | Income rises, then plateaus[ɣɣɣ] |
| $D_u(1,2) \leq D_u(0,1)$ | Student's t | 0.000 | 0.161 | 0.318 | 0.023 |
| | sign test | 0.032 | 0.828 | 0.945 | 0.113 |
| $ß_u \geq 1$ | Student's t | 0.000 | 0.242 | 0.368 | 0.034 |
| | sign test | 0.032 | 0.828 | 0.945 | 0.113 |
| $D_u(1,2)-D_u(0,1)=0$ | Student's t | 0.000 | 0.322 | 0.637 | 0.046 |
| | sign test | 0.064 | 0.572 | 0.344 | 0.227 |
| $ß_u=1$ | Student's t | 0.000 | 0.483 | 0.736 | 0.067 |
| | sign test | 0.064 | 0.572 | 0.344 | 0.227 |
| N | | 115 | 31 | 10 | 11 |
| Compensated Discount Factors | | | | | |
| | | Full sample | Cluster 1 | Cluster 2 | Clusters 1&2 |
| $D_u(1,2) \leq D_u(0,1)$ | Student's t | 0.957 | 0.979 | 0.948 | 0.982 |
| | sign test | 0.719 | 0.817 | 0.945 | 0.906 |
| $ß_u \geq 1$ | Student's t | 0.952 | 0.996 | 0.958 | 0.997 |
| | sign test | 0.719 | 0.817 | 0.945 | 0.906 |
| $D_u(1,2)-D_u(0,1)=0$ | Student's t | 0.085 | 0.043 | 0.105 | 0.036 |
| | sign test | 0.699 | 0.519 | 0.344 | 0.282 |
| $ß_u=1$ | Student's t | 0.097 | 0.007 | 0.083 | 0.006 |
| | sign test | 0.699 | 0.519 | 0.344 | 0.282 |
| N | | 115 | 60 | 19 | 79 |

Note: The table collects p-values for tests with the null hypothesis corresponding to present bias. Low p-values thus indicate hyperbolicity or simply "non-exponentiality". [ɣ] Only including those whose realized annual income remained within 10% of their 2010 income both in 2011 and 2012. [ɣɣ] Only including those whose annual incomes in 2008 and 2009 as well. [ɣɣɣ] Includes those whose realized annual income rose more than 10% in 2011 but less than 10% on top of that in 2012.

Appendix Table 1: Robustness to Selection on Observables and Unobservables

| | Full sample | Stable income after 2010[y] | Stable income before and after 2010[yy] | New job less likely than 20%[yyy] | Income rises, then plateaus[yyyy] |
|---|---|---|---|---|---|
| W/o controls | Difference in Time Preference Variables (with robust SEs) | | | | |
| $D_u(1,2)$-$D_u(0,1)$* | | -0.13 | -0.11 | -0.07 | 0.10 |
| | | (0.05) | (0.07) | (0.05) | (0.10) |
| $ß_u$ ** | | 0.11 | 0.09 | 0.06 | -0.11 |
| | | (0.05) | (0.07) | (0.05) | (0.10) |
| $\delta_u$ *** | | 0.00 | 0.00 | -0.03 | -0.03 |
| | | (0.03) | (0.04) | (0.03) | (0.06) |
| W/ controls | Difference in Time Preference Variables (with robust SEs) | | | | |
| $D_u(1,2)$-$D_u(0,1)$* | | -0.12 | -0.09 | -0.08 | 0.12 |
| | | (0.05) | (0.07) | (0.06) | (0.09) |
| $ß_u$ ** | | 0.10 | 0.07 | 0.07 | -0.12 |
| | | (0.05) | (0.07) | (0.06) | (0.10) |
| $\delta_u$ *** | | 0.00 | 0.00 | -0.04 | -0.04 |
| | | (0.03) | (0.04) | (0.03) | (0.06) |
| Bound and R^2max | Oster (2014) Bounds (and Maximal R2s) | | | | |
| $D_u(1,2)$-$D_u(0,1)$* | | 0.03 | 0.24 | -0.23 | 0.38 |
| | | (0.80) | (0.32) | (0.44) | (0.36) |
| $ß_u$ ** | | -0.09 | -0.34 | 0.24 | -0.25 |
| | | (0.55) | (0.22) | (0.32) | (0.82) |
| $\delta_u$ *** | | 0.04 | 0.14 | -0.35 | -0.27 |
| | | (0.08) | (0.02) | (0.08) | (0.13) |
| N | 116 | 31 | 10 | 32 | 11 |

Note: The table reports contrasts of time-preference variables between subsamples and their complements. These are implemented as OLS regressions of the respective measure on the group identifier, with White-Huber robust standard robust errors in parentheses. Uncontrolled, univariate regressions in the top pane can be compared with how the coefficient of interest changes in models with controls for the demograhpic variables listed in Table 1 in the middle pane. The bottom pane reports the bound on the contrast from Oster (2014), with the minimal R2 with unobservables necessary to make the true contrast zero (but the naive contrast confounded by selection on unobservables). See the main text for more explanation (also for why Oster calls this Rmax, not a minimum). The controls include the covariates with missing values replaced with zeros, but add a separate indicators for each covariate's originally missing observations. * Reports the average difference between each subject's revealed uncompensated discount factor over the second year and the one over the first year. ** Reports the average ratio of discount factors over the second year and over the first year. *** Reports the average ratio of the two-year discount factor and the one-year discount factor. [y] Only including those whose realized annual income remained within 10% of their 2010 income both in 2011 and 2012. [yy] Only including those whose annual incomes in 2008 and 2009 as well. [yyy] Includes those whose self-report the probability of getting a new job in either year after the experiment to be less than 20%. [yyyy] Includes those whose realized annual income rose more than 10% in 2011 but less than 10% on top of that in 2012.

# A Appendix A: Proof of Proposition

**Proof.** Denote by $p_t$ the probability measure over $\mathcal{S}(t)$ induced by $p$. We first show that $p_t$ is pinned down by $\succsim$. Write $B_t = \{b^0, \ldots, b^N\}$ such that $b^0 \leq \ldots \leq b^N$ (the $t$ subscripts are dropped to ease notation). For any $i \leq N$, let $x_{m,s^t}$ be the reward that yields prize $m$ at time $t$ conditional on $s^t = (s_1, \ldots, s_{t-1}, b^i)$. Denote by $\psi(x_{m,s^t})$ the reward that yields a prize immediately such that $\psi(x_{m,s^t}) \sim x_{m,s^t}$.[26] Identify the immediate prize with $\psi(x_{m,s^t})$. The representation implies that

$$u(b^* + \psi(x_{m,s^t})) - u(b^*) = D(t)p_t(s_1, \ldots, s_{t-1}, b^i)[u(b^i + m) - u(b^i)].$$

Note that since $u$ is a strictly increasing diffeomorphism, $\psi(x_{m,s^t})$ is a strictly increasing differentiable function of $m$ that takes the value 0 when $m = 0$. Taking a derivative of the above expression wrt $m$ yields

$$u'(b^* + \psi(x_{m,s^t}))\frac{\partial \psi(x_{m,s^t})}{\partial m} = D(t)p_t(s_1, \ldots, s_{t-1}, b^i)u'(b^i + m).$$

Evaluating at $m = 0$ gives

$$\frac{\partial \psi(x_{m,s^t})}{\partial m}|_{m=0} = D(t)p_t(s_1, \ldots, s_{t-1}, b^i)\frac{u'(b^i)}{u'(b^*)}. \tag{7}$$

Consider the contingent reward $x_{m,s^t}^{b_1 - b_0}$ that gives $b^1 - b^0$ at time $t$ unconditionally and in addition gives $m$ at time $t$ conditional on $s^t = (s_1, \ldots, s_{t-1}, b^0)$. Denote by $\psi(x_{m,s^t}^{b^1-b^0})$ the contingent prize that pays $b^1 - b^0$ at time $t$ unconditionally and also an immediate prize (which, abusing notation, is also denoted by $\psi(x_{m,s^t}^{b^1-b^0})$) satisfies $\psi(x_{m,s^t}^{b^1-b^0}) \sim x_{m,s^t}^{b^1-b^0}$. Then by the representation,

$$\begin{aligned} u(b^* + \psi(x_{m,s^t}^{b^1-b^0})) - u(b^*) &= D(t)p_t(s_1, \ldots, s_{t-1}, b^0)[u(b^0 + b^1 - b^0 + m) - u(b^0 + b^1 - b^0)] \\ &= D(t)p_t(s_1, \ldots, s_{t-1}, b^0)[u(b^1 + m) - u(b^1)]. \end{aligned}$$

[26] The existence of such a reward is implied by the unboundedness and continuity of $u$. Its uniqueness is implied by the strict monotonicity of $u$.

Moreover,

$$\frac{\partial\psi(x^{b^1-b^0}_{m,s^t})}{\partial m}|_{m=0} = D(t)p_t(s_1,\ldots,s_{t-1},b^0)\frac{u'(b^1)}{u'(b^*)}.$$

Similiarly, for each $0 < i \leq N$,

$$\frac{\partial\psi(x^{b^i-b^{i-1}}_{m,s^t})}{\partial m}|_{m=0} = D(t)p_t(s_1,\ldots,s_{t-1},b^{i-1})\frac{u'(b^i)}{u'(b^*)}. \tag{8}$$

By assumption, $p_t(s^t) \neq 0$ for all $s^t$ (that is, $\frac{\partial\psi(x_{m,s^t})}{\partial m}|_{m=0} \neq 0$ for all $s^t$). Using (7) and (8), we get

$$\frac{\frac{\partial\psi(x^{b^i-b^{i-1}}_{m,s^t})}{\partial m}|_{m=0}}{\frac{\partial\psi(x^{b^1-b^0}_{m,s^t})}{\partial m}|_{m=0}} = \frac{p_t(s_1,\ldots,s_{t-1},b^{i-1})}{p_t(s_1,\ldots,s_{t-1},b^i)}$$

for all $i$. That is, the noted relative probabilities are determined uniquely by preferences. Conclude that $p_t(s^t)$ is uniquely determined for each $s^t$. In particular, $p$ is uniquely determined.

To see that $D$ is uniquely pinned down by preferences, note that by (7), for $b^i = b^*$ (that is, $s^t = (s_1,\ldots,s_{t-1},b^0)$),

$$\frac{\partial\psi(x_{m,s^t})}{\partial m}|_{m=0} = D(t)p_t(s^t). \tag{9}$$

Thus, the uniqueness of $p_t(s^t)$ implies that of $D(t)$. ■

# Supplementary Appendix to Compensated Discount Functions: An Experiment on the Influence of Expected Income on Time Preferences (Not for Publication)

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August 2014

**Abstract**

This Supplementary Appendix contains the English translations of the experimental questionnaire, survey questions, and instructions that were used in our experimental sessions on June 9th and 10th of 2010. For the original Icelandic language documents, please contact the authors.

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# Questionnaire

Name: _____

SSN: _____

Please turn to the relevant pages only when instructed to do so

SECTION I

Section I

**Choice 1:**

Consider the following payment:

"Later Payment":

| Amount | Recipient | When | Condition |
|---|---|---|---|
| 20,000 kr. | You | In 1 year | none |

Which of the following amounts, received now, do you prefer over receiving the "Later Payment"? Please enter "-" if this amount now is worse for you than the "Later Payment", or "+" if you prefer to receive this amount now rather than the "Later Payment".

(See next page)

“Earlier Payment”:

| Amount now, without conditions | Choice |
|---|---|
| 200 | |
| 400 | |
| 600 | |
| 800 | |
| 1.000 | |
| 1.200 | |
| 1.400 | |
| 1.600 | |
| 1.800 | |
| 2.000 | |
| 2.200 | |
| 2.400 | |
| 2.600 | |
| 2.800 | |
| 3.000 | |
| 3.200 | |
| 3.400 | |
| 3.600 | |
| 3.800 | |
| 4.000 | |
| 4.200 | |
| 4.400 | |
| 4.600 | |
| 4.800 | |
| 5.000 | |
| 5.200 | |
| 5.400 | |
| 5.600 | |
| 5.800 | |
| 6.000 | |
| 6.200 | |
| 6.400 | |
| 6.600 | |
| 6.800 | |
| 7.000 | |
| 7.200 | |
| 7.400 | |

| Amount now, without conditions | Choice |
|---|---|
| 7.600 | |
| 7.800 | |
| 8.000 | |
| 8.200 | |
| 8.400 | |
| 8.600 | |
| 8.800 | |
| 9.000 | |
| 9.200 | |
| 9.400 | |
| 9.600 | |
| 9.800 | |
| 10.000 | |
| 10.200 | |
| 10.400 | |
| 10.600 | |
| 10.800 | |
| 11.000 | |
| 11.200 | |
| 11.400 | |
| 11.600 | |
| 11.800 | |
| 12.000 | |
| 12.200 | |
| 12.400 | |
| 12.600 | |
| 12.800 | |
| 13.000 | |
| 13.200 | |
| 13.400 | |
| 13.600 | |
| 13.800 | |
| 14.000 | |
| 14.200 | |
| 14.400 | |
| 14.600 | |
| 14.800 | |

| Amount now, without conditions | Choice |
|---|---|
| 15.000 | |
| 15.200 | |
| 15.400 | |
| 15.600 | |
| 15.800 | |
| 16.000 | |
| 16.200 | |
| 16.400 | |
| 16.600 | |
| 16.800 | |
| 17.000 | |
| 17.200 | |
| 17.400 | |
| 17.600 | |
| 17.800 | |
| 18.000 | |
| 18.200 | |
| 18.400 | |
| 18.600 | |
| 18.800 | |
| 19.000 | |
| 19.200 | |
| 19.400 | |
| 19.600 | |
| 19.800 | |
| 20.000 | |
| 20.200 | |
| 20.400 | |
| 20.600 | |
| 20.800 | |
| 21.000 | |
| 21.200 | |
| 21.400 | |
| 21.600 | |
| 21.800 | |
| 22.000 | |
| | |

**Choice 2:**

Consider the following payment:

”Later Payment”:

| Amount | Recipient | When | Condition |
|---|---|---|---|
| 20,000 kr. | You | In 2 years | none |

Which of the following amounts, received now, do you prefer over receiving the “Later Payment”? Please enter “-“ if this amount now is worse for you than the “Later Payment”, or “+” if you prefer to receive this amount now rather than the “Later Payment”.

(See next page)

”Earlier Payment”:

| Amount now, without conditions | Choice |
|---|---|
| 200 | |
| 400 | |
| 600 | |
| 800 | |
| 1.000 | |
| 1.200 | |
| 1.400 | |
| 1.600 | |
| 1.800 | |
| 2.000 | |
| 2.200 | |
| 2.400 | |
| 2.600 | |
| 2.800 | |
| 3.000 | |
| 3.200 | |
| 3.400 | |
| 3.600 | |
| 3.800 | |
| 4.000 | |
| 4.200 | |
| 4.400 | |
| 4.600 | |
| 4.800 | |
| 5.000 | |
| 5.200 | |
| 5.400 | |
| 5.600 | |
| 5.800 | |
| 6.000 | |
| 6.200 | |
| 6.400 | |
| 6.600 | |
| 6.800 | |
| 7.000 | |
| 7.200 | |
| 7.400 | |

| Amount now, without conditions | Choice |
|---|---|
| 7.600 | |
| 7.800 | |
| 8.000 | |
| 8.200 | |
| 8.400 | |
| 8.600 | |
| 8.800 | |
| 9.000 | |
| 9.200 | |
| 9.400 | |
| 9.600 | |
| 9.800 | |
| 10.000 | |
| 10.200 | |
| 10.400 | |
| 10.600 | |
| 10.800 | |
| 11.000 | |
| 11.200 | |
| 11.400 | |
| 11.600 | |
| 11.800 | |
| 12.000 | |
| 12.200 | |
| 12.400 | |
| 12.600 | |
| 12.800 | |
| 13.000 | |
| 13.200 | |
| 13.400 | |
| 13.600 | |
| 13.800 | |
| 14.000 | |
| 14.200 | |
| 14.400 | |
| 14.600 | |
| 14.800 | |

| Amount now, without conditions | Choice |
|---|---|
| 15.000 | |
| 15.200 | |
| 15.400 | |
| 15.600 | |
| 15.800 | |
| 16.000 | |
| 16.200 | |
| 16.400 | |
| 16.600 | |
| 16.800 | |
| 17.000 | |
| 17.200 | |
| 17.400 | |
| 17.600 | |
| 17.800 | |
| 18.000 | |
| 18.200 | |
| 18.400 | |
| 18.600 | |
| 18.800 | |
| 19.000 | |
| 19.200 | |
| 19.400 | |
| 19.600 | |
| 19.800 | |
| 20.000 | |
| 20.200 | |
| 20.400 | |
| 20.600 | |
| 20.800 | |
| 21.000 | |
| 21.200 | |
| 21.400 | |
| 21.600 | |
| 21.800 | |
| 22.000 | |
| | |

**Choice 3:**

Consider the following payment:

"Later Payment"

| Amount | Recipient | When | Conditions |
|---|---|---|---|
| 20,000 kr. | You | In 1 year | Your income next year will be approximately the same as your current income |

Which of the following amounts, received now, do you prefer over receiving the "Later Payment"? Please enter "-" if this amount now is worse for you than the "Later Payment", or "+" if you prefer to receive this amount now rather than the "Later Payment".

(See next page)

"Earlier Payment"

| Amount now, without conditions | Choice |
|---|---|
| 200 | |
| 400 | |
| 600 | |
| 800 | |
| 1.000 | |
| 1.200 | |
| 1.400 | |
| 1.600 | |
| 1.800 | |
| 2.000 | |
| 2.200 | |
| 2.400 | |
| 2.600 | |
| 2.800 | |
| 3.000 | |
| 3.200 | |
| 3.400 | |
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| 6.200 | |
| 6.400 | |
| 6.600 | |
| 6.800 | |
| 7.000 | |
| 7.200 | |
| 7.400 | |

| Amount now, without conditions | Choice |
|---|---|
| 7.600 | |
| 7.800 | |
| 8.000 | |
| 8.200 | |
| 8.400 | |
| 8.600 | |
| 8.800 | |
| 9.000 | |
| 9.200 | |
| 9.400 | |
| 9.600 | |
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| 13.600 | |
| 13.800 | |
| 14.000 | |
| 14.200 | |
| 14.400 | |
| 14.600 | |
| 14.800 | |

| Amount now, without conditions | Choice |
|---|---|
| 15.000 | |
| 15.200 | |
| 15.400 | |
| 15.600 | |
| 15.800 | |
| 16.000 | |
| 16.200 | |
| 16.400 | |
| 16.600 | |
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| 19.400 | |
| 19.600 | |
| 19.800 | |
| 20.000 | |
| 20.200 | |
| 20.400 | |
| 20.600 | |
| 20.800 | |
| 21.000 | |
| 21.200 | |
| 21.400 | |
| 21.600 | |
| 21.800 | |
| 22.000 | |
| | |

**Choice 4:**

Consider the following payment:

"Later Payment"

| Amount | Recipient | When | Conditions |
|---|---|---|---|
| 20,000 kr. | You | In 2 years | Your income in both of the next 2 years will be approximately the same as your current income |

Which of the following amounts, received now, do you prefer over receiving the "Later Payment"? Please enter "-" if this amount now is worse for you than the "Later Payment", or "+" if you prefer to receive this amount now rather than the "Later Payment".

(See next page)

"Earlier Payment"

| Amount now, without conditions | Choice |
|---|---|
| 200 | |
| 400 | |
| 600 | |
| 800 | |
| 1.000 | |
| 1.200 | |
| 1.400 | |
| 1.600 | |
| 1.800 | |
| 2.000 | |
| 2.200 | |
| 2.400 | |
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| 6.000 | |
| 6.200 | |
| 6.400 | |
| 6.600 | |
| 6.800 | |
| 7.000 | |
| 7.200 | |
| 7.400 | |

| Amount now, without conditions | Choice |
|---|---|
| 7.600 | |
| 7.800 | |
| 8.000 | |
| 8.200 | |
| 8.400 | |
| 8.600 | |
| 8.800 | |
| 9.000 | |
| 9.200 | |
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| 13.400 | |
| 13.600 | |
| 13.800 | |
| 14.000 | |
| 14.200 | |
| 14.400 | |
| 14.600 | |
| 14.800 | |

| Amount now, without conditions | Choice |
|---|---|
| 15.000 | |
| 15.200 | |
| 15.400 | |
| 15.600 | |
| 15.800 | |
| 16.000 | |
| 16.200 | |
| 16.400 | |
| 16.600 | |
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| 19.600 | |
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| 20.000 | |
| 20.200 | |
| 20.400 | |
| 20.600 | |
| 20.800 | |
| 21.000 | |
| 21.200 | |
| 21.400 | |
| 21.600 | |
| 21.800 | |
| 22.000 | |
| | |

Section II

From the following list of six charities, please specify now the charity to which you want us to pay the money, in case your prize will be based on the next two questions, by marking the charity's name with an "x".

_____ **The Ring:** The Ring is a charity that collects money for ill children in Iceland. The charity's main goal has been the strengthening of a children's hospital.

_____ **ICE-SAR:** ICE-SAR is a national association of prevention and rescue teams. The operations of the charity aim to prevent accidents and save lives and valuables.

_____**The Red Cross of Iceland:** The Icelandic Section of the International Committee of the Red Cross (ICRC), which is an impartial, neutral and independent organization whose exclusively humanitarian mission is to protect the lives and dignity of victims of war and internal violence and to provide them with assistance.

_____**UNICEF**: UNICEF is a sub-committee of the United Nations that emphasizes improving the lives of children throughout the world. UNICEF achieves its goal by offering free health clinics, basic education and care.

_____**Mæðrastyrksnefnd Reykjavíkur:** Mæðrastyrksnefnd gives food and clothes to those in financial distress, especially single parents, senior citizens and the disabled.

_____**Krabbameinsfélagið:** The aim of the charity is to support and further in every way the fight against cancer, especially by supporting knowledge and research about cancer and cancer prevention.

Your choice will be referred to as *your chosen charity*. Please indicate now whether in the past you personally contributed to your chosen charity:

☐ Yes ☐ No

**Choice 5:**

Consider the following payment:

”Conditional Payment”:

| Amount | Recipient | When | Condition |
|---|---|---|---|
| 20,000 kr | Your chosen charity | In 1 year | Your income next year will be approximately the same as your current income |

Which of the following payments, which come with no conditions, but imply us making a charity contribution 1 year from now with a fixed probability, do you prefer over receiving the “Conditional Payment”? Please enter “-“ if the “Probabilistic Payment” with the given probability is worse for you than the “Conditional Payment”, or “+” if you prefer the “Probabilistic Payment” with the given probability to the “Conditional Payment”.

(See next page)

”Probabilistic Payment”:

| Probability that we make a 20,000 ISK contribution 1 year from now to your chosen charity, with no conditions | Choice |
|---|---|
| 1% | |
| 2% | |
| 3% | |
| 4% | |
| 5% | |
| 6% | |
| 7% | |
| 8% | |
| 9% | |
| 10% | |
| 11% | |
| 12% | |
| 13% | |
| 14% | |
| 15% | |
| 16% | |
| 17% | |
| 18% | |
| 19% | |
| 20% | |
| 21% | |
| 22% | |
| 23% | |
| 24% | |
| 25% | |

| Probability that we make a 20,000 ISK contribution 1 year from now to your chosen charity, with no conditions | Choice |
|---|---|
| 26% | |
| 27% | |
| 28% | |
| 29% | |
| 30% | |
| 31% | |
| 32% | |
| 33% | |
| 34% | |
| 35% | |
| 36% | |
| 37% | |
| 38% | |
| 39% | |
| 40% | |
| 41% | |
| 42% | |
| 43% | |
| 44% | |
| 45% | |
| 46% | |
| 47% | |
| 48% | |
| 49% | |
| 50% | |

| Probability that we make a 20,000 ISK contribution 1 year from now to your chosen charity, with no conditions | Choice |
|---|---|
| 51% | |
| 52% | |
| 53% | |
| 54% | |
| 55% | |
| 56% | |
| 57% | |
| 58% | |
| 59% | |
| 60% | |
| 61% | |
| 62% | |
| 63% | |
| 64% | |
| 65% | |
| 66% | |
| 67% | |
| 68% | |
| 69% | |
| 70% | |
| 71% | |
| 72% | |
| 73% | |
| 74% | |
| 75% | |

| Probability that we make a 20,000 ISK contribution 1 year from now to your chosen charity, with no conditions | Choice |
|---|---|
| 76% | |
| 77% | |
| 78% | |
| 79% | |
| 80% | |
| 81% | |
| 82% | |
| 83% | |
| 84% | |
| 85% | |
| 86% | |
| 87% | |
| 88% | |
| 89% | |
| 90% | |
| 91% | |
| 92% | |
| 93% | |
| 94% | |
| 95% | |
| 96% | |
| 97% | |
| 98% | |
| 99% | |
| 100% | |

**Choice 6:**

Consider the following payment:

"Conditional Payment":

| Amount | Recipient | When | Condition |
|---|---|---|---|
| 20,000 kr | Your chosen charity | In 2 years | Your income in both of the next 2 years will be approximately the same as your current income |

Which of the following payments, which come with no conditions, but imply us making a charity contribution 2 years from now with a fixed probability, do you prefer over receiving the "Conditional Payment"? Please enter "-" if the "Probabilistic Payment" with the given probability is worse for you than the "Conditional Payment", or "+" if you prefer the "Probabilistic Payment" with the given probability to the "Conditional Payment".

(See next page)

”Probabilistic Payment”:

| Probability that we make a 20,000 ISK contribution 2 years from now to your chosen charity, with no conditions | Choice |
|---|---|
| 1% | |
| 2% | |
| 3% | |
| 4% | |
| 5% | |
| 6% | |
| 7% | |
| 8% | |
| 9% | |
| 10% | |
| 11% | |
| 12% | |
| 13% | |
| 14% | |
| 15% | |
| 16% | |
| 17% | |
| 18% | |
| 19% | |
| 20% | |
| 21% | |
| 22% | |
| 23% | |
| 24% | |
| 25% | |

| Probability that we make a 20,000 ISK contribution 2 years from now to your chosen charity, with no conditions | Choice |
|---|---|
| 26% | |
| 27% | |
| 28% | |
| 29% | |
| 30% | |
| 31% | |
| 32% | |
| 33% | |
| 34% | |
| 35% | |
| 36% | |
| 37% | |
| 38% | |
| 39% | |
| 40% | |
| 41% | |
| 42% | |
| 43% | |
| 44% | |
| 45% | |
| 46% | |
| 47% | |
| 48% | |
| 49% | |
| 50% | |

| Probability that we make a 20,000 ISK contribution 2 years from now to your chosen charity, with no conditions | Choice |
|---|---|
| 51% | |
| 52% | |
| 53% | |
| 54% | |
| 55% | |
| 56% | |
| 57% | |
| 58% | |
| 59% | |
| 60% | |
| 61% | |
| 62% | |
| 63% | |
| 64% | |
| 65% | |
| 66% | |
| 67% | |
| 68% | |
| 69% | |
| 70% | |
| 71% | |
| 72% | |
| 73% | |
| 74% | |
| 75% | |

| Probability that we make a 20,000 ISK contribution 2 years from now to your chosen charity, with no conditions | Choice |
|---|---|
| 76% | |
| 77% | |
| 78% | |
| 79% | |
| 80% | |
| 81% | |
| 82% | |
| 83% | |
| 84% | |
| 85% | |
| 86% | |
| 87% | |
| 88% | |
| 89% | |
| 90% | |
| 91% | |
| 92% | |
| 93% | |
| 94% | |
| 95% | |
| 96% | |
| 97% | |
| 98% | |
| 99% | |
| 100% | |

Section III:
DEMOGRAPHICS AND FINANCIAL SITUATION

The purpose of the following questions is to give the researchers information regarding the social and economic background of the participants in this research.

Information needed for sending the prizes

Name: _____

Bank account number: _____

Social Security Number: _____

Email addresses where we can reach you: _____

_____

_____

Phone numbers where we can reach you: _____

_____

_____

We need your social security number for verifying the changes in your disposable income, in case the prize is conditional on income remaining roughly the same as before.

We need your email addresses and phone numbers in order to verify the bank account information, at the appropriate time. The information will be used for no other purpose.

We will destroy the above information once we sent the prize.

**Demographic information**

Gender: ☐ Male ☐ Female

Type of residence:

☐ Owned ☐ Rented ☐ Other (please specify):_____

Primary occupation in the last 12 months:_____

Do you currently get paid for your work? ☐ Yes ☐ No

Highest level of education:

☐ Primary school

☐ Secondary school ☐ Other secondary-school education

☐ Vocational education

☐ Started college ☐ Finished a bachelor's degree

☐ Started schooling beyond a bachelor's degree

☐ Finished schooling beyond a bachelor's degree

Marital status:

☐ Single ☐ Married ☐ Divorced ☐ Widowed

Co-habitation with spouse or significant other:

☐ Yes ☐ No

Number of children: _____

Age of all children: _____

Number of children living in the household: _____

Number of employed household members: _____

Spouse's occupation (if applicable):_____

Do you smoke? ☐ Yes ☐ No

If yes, how many cigarettes do you smoke a day: _____

Height: _____ Weight: _____

**Expectations on future economic situation**

In the questions below by "income" we mean price indexed after-tax income.

What do you think is the probability, in percent, of the events below? Note that the each of the probabilities that you specify has to lie between 0% and 100%.

(a) Your income 1 year from now will be approximately the same (within 4%) as your current income:

_____(indicate probability between 0% - 100%)

(b) Your income 1 year from now is more likely to

☐ increase ☐ decrease

relative to your current income.

(c) Your income 2 years from now will be approximately the same (within 4%) as your current income:

_____(indicate probability between 0% - 100%)

(d) Your income 2 years from now is more likely to

☐ increase ☐ decrease

relative to your current income.

(e) You lose your current job within the next year:

_____(indicate probability between 0% - 100%)

(f) You lose your current job within the next 2 years:

_____(indicate probability between 0% - 100%)

(g) You will enter a new job within the next year:

_____(indicate probability between 0% - 100%)

(h) You will enter a new job within the next 2 years:

_____(indicate probability between 0% - 100%)

**Economic background**

How high is the maximum overdraft allowed on your checking account(s) (if applicable; otherwise indicate N/A):

_____

How high is the current overdraft on your checking account(s) (if applicable; otherwise indicate N/A):

_____

Number of credit cards: _____

Did you have any unusually large expenses in the last 12 months (e.g. uninsured damage, wedding): ☐ Yes ☐ No

If yes, please describe these expenses (amount and reason):_____

_____

Do you anticipate any unusually large expenses in the next 12 months? ☐ Yes ☐ No
If yes, please describe these expenses (amount and reason):_____

_____

_____

Do you anticipate significant changes in your co-habitant's income in the next 12 months (if applicable)?

☐ Yes ☐ No

Do you anticipate other significant changes in your financial situation in the next 12 months?

☐ Yes ☐ No

If yes, please explain:_____

_____

# Instructions

*[Distribute the consent forms upon entry to the room, the instructions and questionnaire later. At the beginning of the experiment, show the opening slide on the screen, with our names and affiliations.*

*During the experiment, the following activities will not be forbidden, if participants start them: reading, drinking. The following will be forbidden by quietly talking to the participants individually: eating, calculator, use of any other electronic items.]*

Welcome to this experiment! We will now collect the consent forms and distribute instructions.

*[Collect the consent forms, distribute instructions and questionnaire containing Sections I and II.]*

These instructions are only for your information. We also read them aloud to you. During the entire experiment, please do not communicate with anyone and do not look at other people's material. Also, please avoid loud talking of any kind. If you have any questions during the experiment, please raise your hand and a researcher will help you at your desk.

This experiment is part of a collaborative research that is funded and conducted by several universities and research agencies situated in different countries: University of Iceland, Boston University, Harvard University, University College London, German Institute for Economic Research and National Science Foundation (USA). We will ask you a series of questions on a printed questionnaire. Please read the questions carefully, think about your answers and consider all possible relevant factors before filling in your answer.

Please switch off your mobile phones for the duration of the experiment. If you need a pen to answer the questions, please raise your hand now.

*[Give out pens if demanded.]*

If you follow the instructions you could receive a money payment within a week's time, after 1 year or after 2 years. Alternatively, you will generate a payment to a charity of your choice. The payments can be worth up to ISK 33,000.

## About the choices that you will make

Together with these instructions, you have received a questionnaire. The questions in Section I of the questionnaire ask you to make comparisons between monetary amounts that will be paid either now or in 1 year, or between monetary amounts that will be paid either now or in 2 years. The questions in Section II of the Questionnaire ask you to compare different payments from us to a charity of your choice, either 1 or 2 years from now. There are 6 such comparisons in total, and a real payment will be carried out based on 1 of these 6 choices. After making the 6 comparisons, we ask you a few further questions.

We will make the selection of the choice that is paid out for real by having you throw a 6-sided dice at the end of the experiment. Once all participants have finished the experiment, you will come to our desk individually, and will throw the dice. That is, for each participant in the room there is a separate throw of the dice. The number shown by the dice indicates the choice on which your payment is based.

Money received by you "now" means that we transfer money to your bank account within one week of the experiment. Money received by you "in 1 year" means that we transfer money to your bank account during the week that starts 1 year from now. Likewise, money received by you "in 2 years" means that we transfer money to your bank account during the week that starts 2 years from now.

Note that all payments in 1 or 2 years will be "price indexed". This means that they are adjusted for inflation, using the official consumer price index data published by Statistics Iceland, so that you do not have to consider the possible effect of inflation when making your decisions.

Some of the questions will involve payments not to you, but to a charity. For these payments, too, we will use money transfers, to be made during the corresponding time periods.

For all payments that we promise, you can be certain that the money will actually be paid. The funds for this come from a grant from the National Science Foundation (USA), with grant number SES-0822927. The details of the payment procedure are specified in a contract between the involved research institutions and the Icelandic tax authority, IRS. We will make sure that every promised payment reaches its recipient, even if the recipient's address or bank information changes in the meantime.

We also guarantee you that all information that you give us will be used in a 100% confidential manner. No personally identifiable information of the participants will be connected to their answers to other questions, except to make sure that they will receive their payment, if eligible. All personally identifiable information will be deleted as soon as the appropriate money transfer has been made. Your other answers will only be used for scientific research, in an anonymous way.

This research has all appropriate approvals and will be carried out according to Legal Article #77/2000 – Data Protection and Handling of Identifiable Information. (Notification Number S4052/2008 to the Icelandic Data Protection Authority, and Approval #F15269-101 by Harvard University's Human Subjects Committee.)

If you have any question that comes up at any time in the future, feel free to email us at <ta@hi.is>.

Next we will provide instructions for each of the 6 choices in Sections I and II, one question at a time. Please do not start answering a question before you finished reading the instructions for the question.

**Description of choice 1**

For choice 1, please consider the following payment of IKS20,000 in 1 year:

*[Show table on the screen. Leave 10-20 seconds to look at it. (Also for subsequent tables). Also read aloud the contents of the table: "Later Payment. Amount: IKS20,000. Recipient: You. When: In 1 year. Condition: None". For later tables of the "Earlier Payment", only read the column headings.]*

"Later Payment":

| Amount | Recipient | When | Condition |
|---|---|---|---|
| ISK 20,000 | You | In 1 year | None |

In choice 1 you indicate your willingness to wait for this payment. You can either receive the "Later Payment" (ISK 20,000 in one year) or receive a different payment now. We will show you a list of possible amounts, and for each amount on this list you are asked to indicate with a "+" if you would rather receive this amount now than receiving IKS20,000 in one year, or with "-" if you would rather receive IKS20,000 in one year than the given amount now.

If your throw of the 6-sided dice shows a 1 at the end of the experiment, then question 1 is paid out for real. In this case, one of the amounts on the list will be chosen randomly by a computer, and your indicated choice between this amount (received now) and the "Later Payment" (IKS30,00 in one year) will be paid out for real. This procedure makes sure that it is in your best interest to think carefully for each amount whether you prefer to receive it now, or whether you prefer receiving IKS20,000 in 1 year.

As a shortcut for your answer, you do not need to make entries in all rows. If you prefer, you can fill in only part of the table. You would then have to fill in only the four consecutive boxes where you change your decision from the "Later Payment" to the amount now, that is two "–" signs and two "+" signs. We would then interpret your answers as saying that for any lower amount you answered "–" (meaning you prefer the "Later Payment" to all lower amounts) and for any higher amount you answered "+" (meaning you prefer all higher amounts to the "Later Payment").

For example, to indicate that you would rather get the "Later Payment" than any amount lower than ISK15,000 now, and that you would rather get any amount equal to or larger than ISK15,000 now, than the "Later Payment", you would fill out the table in the following way:

*[Show table on the screen. Values to be filled for translated version. Two more lines to be added, so that the maximum is at 33000]*

"Earlier Payment" :

| Amount now | Choice | Amount now | Choice | Amount now | Choice |
|---|---|---|---|---|---|
| 300 | | | | | |

| | |
|---|---|
| 200 | |
| 400 | |
| … | |
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| … | |
| 9400 | |
| 9600 | - |
| 9800 | - |
| 10000 | + |
| 10200 | + |
| 10400 | |
| 10600 | |
| 10800 | |
| … | |
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| | |
| … | |
| 22000 | |

Please note that this example is just an arbitrary example serving as an illustration, not meant to indicate how anyone might make their decisions in this experiment. There are no “right” or “wrong” answers in this experiment.

If you use the above shortcut, instead of filling all boxes of the table, make sure that you indicate it to us clearly where your preferences switch from preferring the “Later payment” to preferring the “Earlier Payment”. In particular, please do not leave unfilled boxes in between the “-“s and “+”s, as in the following example.

If you do leave empty cells between the “-“ and “+” sings, or if you otherwise fail to provide a clear choice for the amount that is selected to be paid out for real, then we will simply flip a coin to determine your payment. With such a incomplete answer, you would therefore run the risk to receive a payment that you like less than another available payment.

| Amount now | Choice |
|---|---|
| 200 | |
| 400 | |
| … | |
| | |
| | |
| | |

| Amount now | Choice |
|---|---|
| | |
| | |
| … | |
| 9400 | |
| 9600 | - |
| 9800 | - |

| Amount now | Choice |
|---|---|
| | |
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|---|---|
| 10000 | |
| 10200 | |
| 10400 | |
| 10600 | + |
| 10800 | + |
| … | |
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| | |
| … | |
| 22000 | + |

Remember that one of the amounts on the list will be selected by the computer if this choice is paid out for real – i.e. if the 6-sided dice shows a 1. Each amount in the table is equally likely to be drawn by the computer, and you will observe the random choice that the computer makes for you, immediately after your roll of the dice. If for this choice your answer is "-", you receive the "Later Payment", while if for this choice your answer is "+", you receive the amount featured in the choice now. In short, you will get the payment that you indicated you would prefer.

Do you have any questions on how to fill in these kinds of answers? If so, please raise your hand and we will come to your desk.

*[Give the participants a brief pause (15 secs if no-one answers) to consider the tables again. If participants have questions, make sure that they ask them not aloud, but go to their table and talk to them quietly.]*

If there are no further questions, the please make decision 1 in the questionnaire. Please make your choices carefully.

*[Do not read aloud the description on the next page. Leave the participants 2-3 minutes to make their entries. When about two thirds of them are ready, say "If you need more time, please raise your hand." If one or more raise their hand, say "Take your time." Repeat the procedure after one minute.]*

**Description of choice 2**

For Choice 2, please consider the following payment of IKS20,000 in 2 years:

*[Show table on screen.]*

”Later Payment”:

| Amount | Recipient | When | Condition |
|---|---|---|---|
| ISK20,000 | You | In 2 years | None |

You can either receive this payment, a payment of IKS20,000 in 2 years, or an amount of money now. Once again, you would indicate your choices on the same list of amounts that you saw earlier. For each amount on this list you are asked to indicate with a “+” if you would rather receive this amount now than receiving the “Later Payment”, or with “-“ if you would rather receive the “Later Payment” than the given amount now.

Again, If you prefer, you can fill in only part of the table. You would then have to fill in only the four consecutive boxes where you change your decision from the “Later Payment” to the amount now, that is two “–“ signs and two “+“ signs. Please make sure not to leave any empty cells between the two “–“ signs and the two “+“ signs.

As before, this choice may be relevant for your actual payment, depending on your throw of the 6-sided dice. If the throw of the dice shows a 2, then choice 2 is paid out for real. In this case, the computer would randomly select a number from the relevant list of amounts, and we would carry out your payment according to your choice. Again, each amount in the table is equally likely to be drawn by the computer, and you will observe the random selection that the computer makes for you, immediately after your roll of the dice. If for this choice your answer is “-“, you receive the “Later Payment”, while if for this choice your answer is “+”, you receive the amount featured in the choice now. In short, you will get the payment that you indicated you would prefer.

Are there questions about choice 2 at this point? If so, please raise your hand.

*[Brief pause.]*

If there are no further questions, then please make choice 2 in the questionnaire. As always, please make your choices carefully.

**Description of choice 3**

Choice 3 is like choice 1, asking how willing you are to wait for a payment of IKS20,000 in 1 year. But an important difference is that the payment in 1 year will not be made for sure. It will be made only if your income stays roughly the same – otherwise you will get no payment.

In choice 3, we will ask you to consider the following payment:

*[Show table on the screen.]*

”Later Payment”:

| Amount | Recipient | When | Condition |
|---|---|---|---|
| ISK20,000 | You | In 1 year | Your income next year remains approximately the same as your current income |

You will be asked to consider amounts to be received now, with no conditions, and compare them to the “Later Payment”.

We now explain in detail the condition that the amount in the “Later Payment” of this question (ISK 20,000) is to be paid only if “your income next year remains approximately the same as your current income“. This condition means that both your annual income and your monthly income have to be within 4% of their current level. More precisely, the condition is satisfies if

(a) your price indexed disposable (after-tax) annual income in the12 months of May 2010-April 2011 is within 4% of your disposable income in the preceding 12-months period, May 2009-April 2010, and

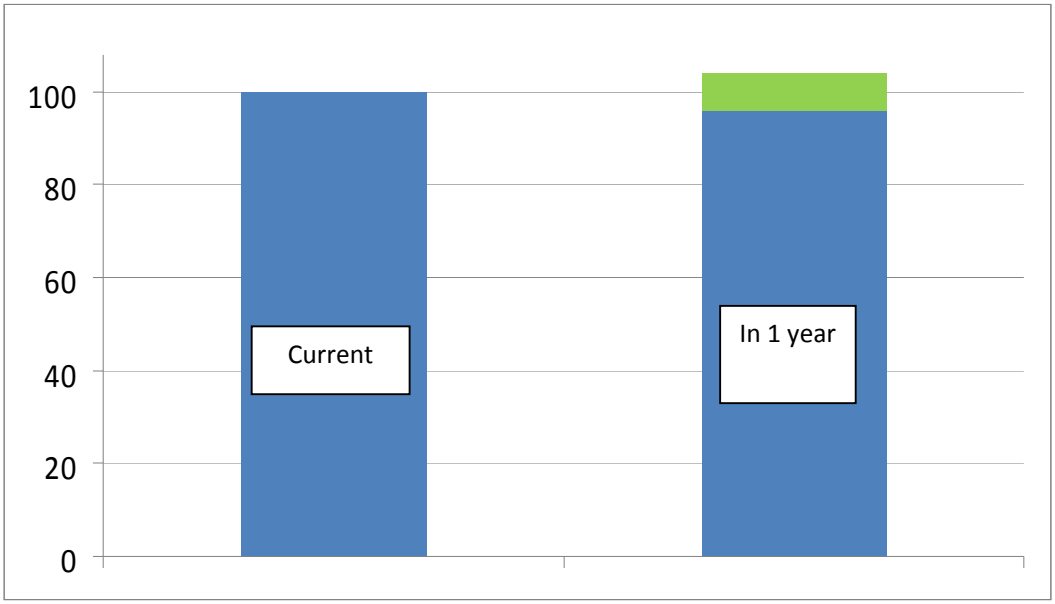
(b) your price indexed disposable (after-tax) monthly income in April 2011 is within 4% of your disposable monthly income in April 2010.

We will obtain the information about whether or not your income satisfies this condition from the IRS, as follows. An automated system of the tax authorities will provide us with the percentage changes in your income, according to your income taxes. We will not be given access to information regarding your actual income, only to information regarding percentage changes in your income. Again, you can be assured that this information is used in a 100% confidential way.

“Price indexed” means that we will adjust for inflation, using official data on the consumer price index published by the Statistics Iceland, so that the differences in income cannot arise because they only follow the movement in consumer prices.

The graph shown on the next page illustrates the condition about income. The graph is also shown on the screen.

*[Show graph with two columns on the screen, where the range of admissible income changes is indicated green. The two columns should not specify whether it relates to monthly or annual income. ]*




For a given current income, the graph shows that the income one year from now can be slightly higher or lower than the current income, in order to satisfy the condition. But it can only be higher by up to 4% of the current income, or lower by up to 4% of the current income.

Note that the income condition of the “Later Payment” has two important implications. The first is that you know in advance that if you receive the amount one year from now, then your income situation will be roughly the same as now. The second is that you only receive the amount if your income next year satisfies the condition. If you choose the “Later Payment” and the condition is not satisfied, you will not receive any money. This is different from the “Later Payment” in choice 1, where you receive the same amount of money for sure. With the added condition, you are therefore less likely to receive the payment.

In choice 3, you will compare this future payment of IKS20,000 (under the above condition) to a list of payments that you would receive now, with no condition. That is, if you decide that you prefer the “Earlier Payment”, then you will get the amount for sure. For each amount on this list you are asked to indicate with a “+” if you would rather receive this amount now than receiving the “Later Payment”, or with “-“ if you would rather receive the “Later Payment” than the given amount now.

If you prefer, you can again fill in only part of the table. You would then have to fill in only the four consecutive boxes where you change your decision from the “Later Payment” to the amount now, that is two “–“ signs and two “+“ signs.

As before, this choice may be relevant for your actual payment, depending on your throw of the 6-sided dice. If the throw of the dice shows a 3, then choice 3 is paid out for real. In this case, the computer would randomly choose a number from the relevant list of amounts, and we would carry out your payment in accordance with your preferences. If your answer is “-“, you receive the “Later

Payment", while if for this choice your answer is "+", you receive the amount featured in the choice now. As always, you will get the payment that you indicated you prefer.

Do you have questions about choice 3?

*[Brief pause.]*

If there are no further questions, please make decision 3 in the Questionnaire. As always, please make your choices carefully.

**Description of question 4**

Choice 4 is like choice 2, asking how willing you are to wait for 2 years. But here, again, the "Later Payment" is conditional on your income staying approximately the same until the payment is scheduled.

You will consider the following payment:

*[Show table on the screen.]*

"Later Payment":

| Amount | Recipient | When | Condition |
|---|---|---|---|
| ISK20,000 | You | In 2 years | Your income in both of the next 2 years will be approximately the same as your current income |

You will be asked to consider amounts to be received now, with no conditions, and compare them to the "Later Payment".

Notice that the amount in the "Later Payment" of this question (ISK 20,000) is to be paid only if "your income in both of the next 2 years will be approximately the same as your current income ". This condition means that both your annual income and your monthly income have to be within 4% of their current level, both 1 year from now and 2 years from now. More precisely, the condition is satisfied if

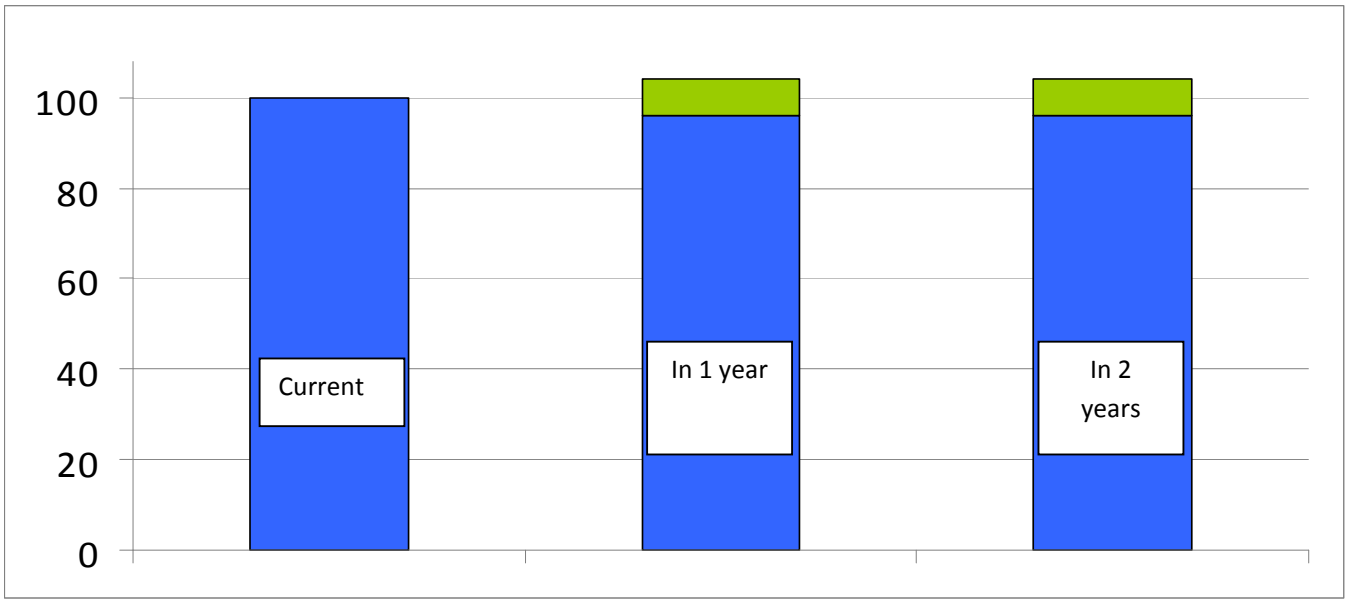
(a) your price indexed disposable (after-tax) annual income in the 12 months of May 2010-April 2011 is within 4% of your disposable income in the preceding 12-months period, May 2009-April 2010, and your price indexed disposable (after-tax) annual income in the 12 months of May 2011-April 2012 is also within 4% of your disposable income in the preceding 12-months period, May 2009-April 2010;

and

(b) your price indexed disposable (after-tax) monthly income in April 2011 is within 4% of your disposable monthly income in April 2010, and your price indexed disposable (after-tax) monthly income in April 2012 is also within 4% of your disposable monthly income in April.

This is illustrated in the following graph.

*[Show graph]*




The condition is fully analogous to the condition described above, in choice 3. The only difference is that here, your income in *both* of the next 2 years has to be within 4% of your current income, not only your income in the next year. Just as above, this has to be true for you annual income as well as your monthly income. Notice that the condition here is a stronger condition than the condition that your income stays approximately the same only for 1 year. That is, it is less likely that the condition given in choice 4 will be satisfied.

In choice 4, you will compare this future payment of IKS20,000 (under the above condition) to a list of payments that you would receive now, with no condition. For each amount on this list you are asked to indicate with a "+" if you would rather receive this amount now than receiving the "Later Payment", or with "-" if you would rather receive the "Later Payment" than the given amount now. As in the earlier choices, if you prefer, you can fill in only part of the table by only indicating two "-" signs and two "+" signs.

As before, this choice may be relevant for your actual payment, depending on your throw of the 6-sided dice. If the throw of the dice shows a 4, then choice 4 is paid out for real. In this case, the computer would randomly choose a number from the relevant list of amounts, and we would carry out your payment according to your choice 4.

Do you have any questions about this kind of decision problem? If so, please raise your hand.

*[Give a brief pause.]*

If there are no further questions, please make choice 4 in the questionnaire. As always, please make your choices carefully.

Section II

In Choice 5 and choice 6 you to compare payments that specify that under some conditions we give IKS20,000 to a charity of your choice. These choices are paid out for real if your throw of the dice shows a 5 or a 6, respectively.

First we ask you to choose a charity from a list, which you want us to contribute to, in case your throw of the dice is 5 or 6. Please also indicate whether in the past you contributed to the charity you chose from the list. Please make your choice at the beginning of Section II in the Questionnaire.

*[Give a pause, during which the subjects read through the description of the charities, and make their choice. Do not read the charity description to them. When most are ready, as "If you need more time..." etc.]*

**Description of choice 5**

In choice 5, we ask you to consider a payment that specifies that we pay IKS20,000 to your chosen charity in 1 year, under the above-described condition that your income stays approximately the same for the next year.

*[Show table on the screen.]*

"Conditional Payment":

| Amount | Recipient | When | Condition |
|---|---|---|---|
| 20,000kr. | Your chosen charity | In 1 year | Your income next year remains approximately the same as your current income |

Please note that if you choose the "Conditional Payment" and if your income does not stay approximately constant in the next year, then the charity will not receive a payment.

You will indicate to us whether or not you prefer certain payments to your chosen charity rather than the "Conditional Payment". But here, the different possible scenarios specify different *probabilities* with which the charity will receive the IKS20,000. That is, you will indicate whether you prefer that we pay the charity with a certain probability or whether you prefer that we rather pay out the "Conditional Payment", i.e. pay the charity if your income stays approximately the same for 1 year.

The different probabilistic payments will be as follows, with different probabilities entered in the last box.

*[Show table on the screen.]*

"Probabilistic Payment"

| Amount | Recipient | When | Condition | Probability |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 20,000kr | Your chosen charity | In 1 year | None | _____% |

In choice 5, you will compare the "Conditional Payment" above to a list of "Probabilistic Payments" with different probabilities. For each probability on the list you are asked to indicate with a "+" if you would rather receive this "Probabilistic Payment" than the "Conditional Payment", or with "-" if you would rather receive the "Conditional Payment" than this "Probabilistic Payment".

Notice that under the "Probabilistic Payment" the condition that your income remains constant does not apply. If you choose the "Probabilistic Payment", the payment will therefore be made irrespective of whether the income condition is satisfied. Instead, the payment is made only with a certain probability. This means that we will have a separate random draw done by a computer, and whether or not the charity will get the payment will be determined by this random draw. The random draw will be made in 1 year, on the basis of the correct probabilities, as indicated in the list.

Remember that we ask you to compare the "Probabilistic Payment" to the "Conditional Payment". This question can be interpreted as a rather simple question: what do you think is the probability that the condition about your income is satisfied? It is natural to argue that at this probability, you should be just indifferent between the two payments. That is, a good way to make this choice is to ask yourself how likely it is that your income will remain constant over the next year, and simply indicate a "+" for this probability and all higher probabilities on the list. This way of answering would maximize the chances of the charity receiving the payment of IKS20,000.

You will make a comparison for every possible whole-numbered probability between 1% and 100%. Again, if you prefer, you can fill in only part of the table. You would then have to fill in only the four consecutive boxes where you change your decision from the "Conditional Payment" to the "Probabilistic Payment", that is two "–" signs and two "+" signs. We would then interpret your answers as saying that for any lower probability you answered "–" (meaning you prefer the "Conditional Payment") and for any higher probability you answered "+" (meaning you prefer the "Probabilistic Payment"). If you use the above shortcut, please make sure, as always, to not leave empty cells between the "-" signs and the "+" signs.

As before, this choice may be relevant for your actual payment, depending on your throw of the 6-sided dice. If the throw of the dice shows a 5, then choice 5 is paid out for real. In this case, the computer would randomly choose a number from the relevant list of probabilities, and we would carry out your payment according to choice 5. Each probability in the table is equally likely to be drawn by the computer. If for this choice your answer is "-", you receive the "Conditional Payment", while if for this choice your answer is "+", you receive the "Probabilistic Payment".

Do you have any questions about choice 5? If so, please raise your hand.

*[Give a brief pause.]*

If there are no further questions, then please make choice 5 in the questionnaire. As always, please make your choices carefully.

**Description of choice 6**

Choice 6 is like choice 5 and involves payments to your chosen charity, but the payments are scheduled to take place in 2 years, rather than in 1 year.

You will consider the following "Conditional Payment":

"Conditional Payment":

| Amount | Recipient | When | Condition |
|---|---|---|---|
| 20,000 kr | Your chosen charity | In 2 years | Your income in both of the next 2 years will be approximately the same as your current income |

Note that the difference to the "Conditional Payment" in choice 5 is not only that it is made at a later point in time (in 2 years rather than 1 year) but also that the payment takes place only under the condition that your income stays approximately constant in *both* of the next two years. This is the same condition that you already saw in choice 4, and it is a stronger condition than the condition that your income stays approximately the same only for 1 year. That is, it is less likely that this condition will be satisfied than the condition in the "Conditional Payment" of choice 5.

As before, you will compare this "Conditional Payment" to a "Probabilistic Payment". The latter specifies that we make the payment of IKS20,000 without the condition on your income, but with a certain probability, to be specified in the last box:

"Probabilistic Payment"

| Amount | Recipient | When | Condition | Probability |
|---|---|---|---|---|
| 20,000kr | Your chosen charity | In 2 years | None | _____% |

You will make a comparison for every possible whole-numbered probability between 1% and 100%. Again, if you prefer, you can fill in only part of the table, using two "–" signs and two "+" signs.

As before, this question may be relevant for your actual payment, depending on your throw of the 6-sided dice. If the throw of the dice shows a 6, then choice 6 is paid out for real. In this case, the computer would randomly select a number from the relevant list of probabilities, and we would carry out your choice 6. If your answer is "-", you receive the "Conditional Payment", and if your answer is "+", you receive the "Probabilistic Payment".

Do you have any questions about choice 6? If so, please raise your hand.

*[Give a brief pause.]*

If there are no further questions, then please make choice 6 in the questionnaire.

As soon as all participants are done with making their choices, we will distribute a further questionnaire, entitled “Section III”. There, we will ask you to provide information that we need to verify your income changes and to be able to send you your payment. As explained earlier, this information will not be used for any other purpose. The questionnaire also contains questions about your social and economic background. The answers to these questions will be used anonymously for research purposes.

Until we distribute the additional questionnaire, you may want to go over your answers to choices 1-6 again, just in case you want to modify them. Take your time.