Preregistration for "Noise and Bias"

Carlos Alós-Ferrer, Johannes Buckenmaier, and Michele Garagnani.

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This pre-registration describes a laboratory experiment to be conducted at the University of Zurich to study the present bias phenomenon in inter-temporal decision making.

1 Experimental Setup

Subjects complete 160 inter-temporal, binary choices. Of them 128 are used for investigating the present bias phenomenon and 32 are designed with the specific purpose of estimating individual discount factors based on optimal design theory (Silvey, 1980) in the context of non linear (binary) models (Ford et al., 1992; Atkinson, 1996). Each choice involves two options, one yields a sooner, smaller monetary reward whereas the other yields a larger, later reward.[1] The 128 choices used for the study of the present bias phenomenon are organized in double pairs. In particular, 64 pairs involve choices between immediate monetary rewards and larger future rewards (*Present Pairs*), while the other 64 involve choices between future rewards only (*Neutral Pairs*). The pairs are constructed as follows. For *Present Pairs*, the immediate reward is drawn from a normal distribution $x \in Normal(27, 10)$ (truncated below at 10 and above at 60) and rounded to the nearest integer. The later reward y is calculated as a function of the sooner reward x by setting $y = (1 + r)x$ with r drawn uniformly from the interval $[0.01, 0.41]$, and then rounding y to the nearest integer. The delay of this future reward is drawn uniformly from the set $\{14, 30, 60, 90\}$. For each Present Pair the corresponding *Normal Pair* is constructed by shifting all dates toward the future by either 21 or 45 days (each with equal probability). All subjects will face the same experiment but

[1] 7 of the 32 estimation pairs allow estimating discount factors larger than 1. They involve larger, sooner rewards and smaller, later rewards.

stimuli will be presented in four different pseudo-random sequences (randomly assigned to subjects).

Participants are paid for one randomly-picked decision situation out of the 160. The participant's choice in that decision situation determines the reward to be paid and the date of the payment, which is implemented truthfully.

2 Hypotheses

We expect inconsistencies in behavior in line with the present bias phenomenon.

H1 Inconsistent choices that involve choosing the smaller, sooner reward in the *Present Pair* and the larger, later reward in the corresponding *Neutral Pair* are more frequent than the reverse inconsistency.

For each decision maker, we assume that the present value of a reward x at time $t \geq 0$ is given by $D(x,t) = x\delta^t$ where δ is a discount factor. Individual discount factors are estimated out-of-sample from the participant's choices in the 32 estimation pairs. For each choice pair ω, we define Δ_ω as the difference between the present value of the sooner, smaller reward minus the present value of the later, larger reward. A choice is *correct* if the (estimated) present value of the chosen option is larger or equal than the present value of the other option. We have the following hypotheses for the proportion of correct choices, which are illustrated graphically in Figure 1.

H2a If $\Delta_\omega > 0$, then the probability of a correct answer is increasing in Δ_ω.

H2b If $\Delta_\omega < 0$, then the probability of a correct answer is decreasing in Δ_ω.

H2c For *Present Pairs*, there is a discontinuity at $\Delta_\omega = 0$ with more correct answers for $\Delta_\omega > 0$ than for $\Delta_\omega < 0$.

H2d For *Neutral Pairs*, there is no discontinuity at $\Delta_\omega = 0$ with the probability of a correct answer being one half.

For response times, we have the following hypotheses, which are illustrated graphically in Figures 2 and 3

H3a For *Present Pairs*, response times of errors are slower than those of correct choices if $\Delta_\omega > 0$ and response times of errors are shorter than those of correct choices if $\Delta_\omega < 0$.

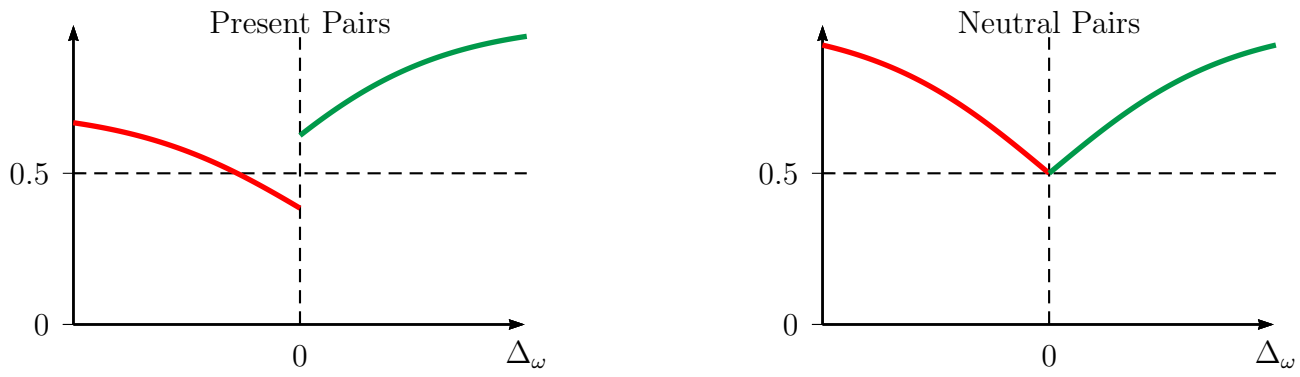

Figure 1: Probability of a correct answer as a function of Δ_ω.

H3b For *Neutral Pairs*, there is no systematic differences between the response times of correct choices and errors between pairs with $\Delta_\omega > 0$ and pairs with $\Delta_\omega < 0$.

H4a For *Present Pairs*, correct answers for pairs with $\Delta_\omega > 0$ are faster than correct answers for comparable pairs with $\Delta_{\omega'} < 0$ (comparable meaning that $|\Delta_\omega| \approx |\Delta_{\omega'}|$).

H4b For *Neutral Pairs*, there is no systematic difference in response times between pairs with $\Delta_\omega > 0$ and comparable pairs with $\Delta_{\omega'} < 0$.

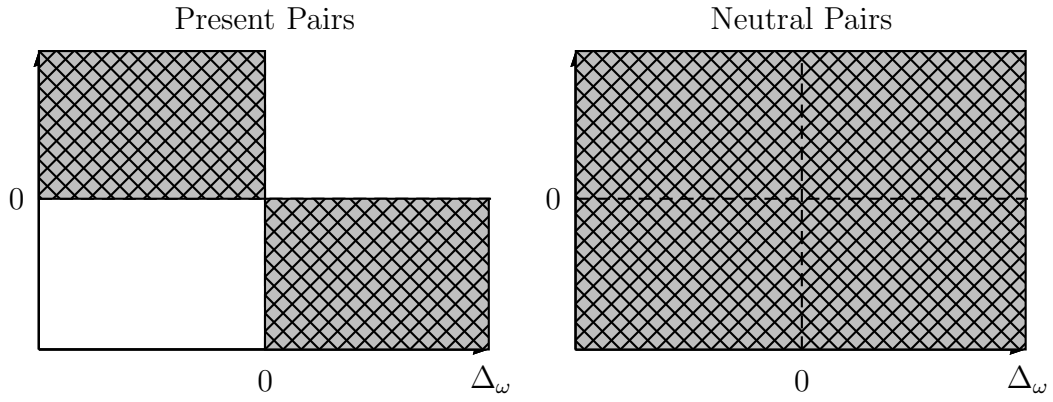

Figure 2: Response times as a function of Δ_ω, correct choices are those observation for which $\Delta_\omega > 0$ and errors those with $\Delta_\omega < 0$.

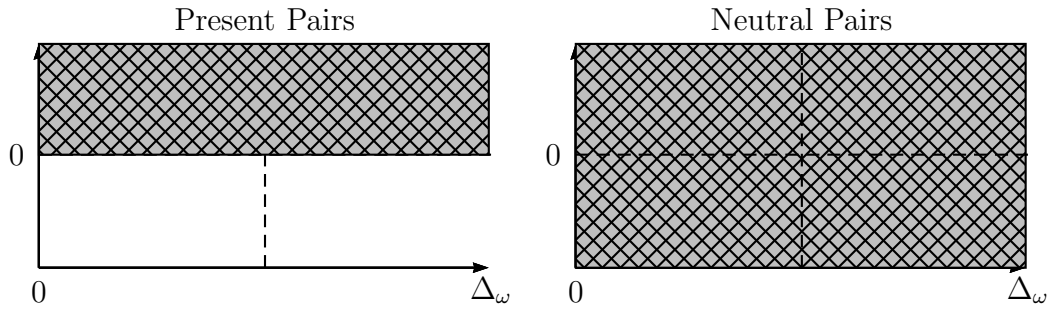

Figure 3: Difference in the response times for correct choices between $\Delta_\omega > 0$ and $\Delta_\omega < 0$ as a function of Δ_ω.

3 Exclusion Criteria

We will implement three control questions after subjects have read the experimental instructions. The questions address subjects' understanding of the delayed payment (what receiving X money in Y days entails) and of the Random Incentive Mechanism used for payment. Subjects that fail to answer one or more control questions will be excluded from the analysis and are not counted towards the total number of subjects.

4 Sample

We will run sessions with 36 invited subjects each until we have 128 or more (non-excluded) subjects.

5 Analysis Plan

H1 Wilcoxon signed-rank test investigating significant differences in the proportion of inconsistent choices that involve choosing the smaller, sooner reward in the *Present Pair* and the larger, later reward in the corresponding *Neutral Pair* against the reverse inconsistency.

H2 We test and quantify the jump at $\Delta_\omega = 0$ using a Local Polynomial Regression Discontinuity Estimation with Robust Bias-Corrected Confidence Intervals as detailed in Calonico et al. (2014). We further run a Random effects Probit regression on the probability of a correct answer including as independent variables Δ_ω, a dummy identifying

its sign $\Delta_\omega > 0$, and their interaction $\Delta_\omega \times (\Delta_\omega > 0)$. We perform separate tests and regressions for *Present Pairs* (H2c) and *Neutral Pair* (H2d).

H3 and H4 Random effect regression analysis on log-transformed response times with the following independent variables: an *Error* dummy indicating whether the choice was an error, a dummy $\Delta > 0$ identifying the sign of Δ_ω, and their interaction $(Error \times (\Delta_\omega > 0))$. The linear combination test of the interaction $Error \times (\Delta_\omega > 0)$ and *Error* tests H3, while the dummy $\Delta_\omega > 0$ tests H4. We run separate regressions for *Present Pairs* (H3a, H4a) and *Neutral Pairs* (H3b, H4b).