



**Loss Aversion for time: An experimental
investigation of time preferences**

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FEMM Working Paper No. 27, September 2008

F E M M

Faculty of Economics and Management Magdeburg

Working Paper Series

Loss Aversion for time: An experimental investigation of time preferences

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September 29, 2008

Abstract

This paper investigates decisions about inter-temporal tradeoffs. The objective of the study is to explore the valuation of time itself without tradeoffs between time and consequences. In an experimental study subjects made decisions about waiting time, where the time was subject to risk. We find that subjects are risk-seeking for decisions about time, which leads to the conclusion that waiting time is experienced as a loss. Subjects in this experiment show similar choice patterns as can be seen in studies about money when losses are involved.

1 Introduction

In economic and business settings agents are often required to make decisions about future actions in projects with delayed payoffs. Economic research focuses on modeling decisions with delayed streams of payoffs. In order to model preferences of economic agents, utility functions are derived that are characterized by three dimensions, which are good (e.g. money), time, and uncertainty (Andersen *et al.*, 2008). Early work on modeling decisions with delayed payoffs suggests that the preferences over time and payoffs are separable (Samuelson, 1937). That means the utility of delayed payoffs can be described as a utility function of money combined with a value function of time which can be described as $U(x,t) = u(x) \cdot v(t)$, with $u(x)$ being preferences for money and $v(t)$ being a value function for time.

While there is a lot of work done on preferences over money with and without uncertainty, the research on time preferences have been studied using decisions about inter-temporal tradeoffs. After providing a short overview of the research findings about decisions on delayed payoffs, the focus of this paper will be the analysis of preferences over time itself. There is an ongoing

discussion about which functional form can best explain experimental findings of decisions about delayed payoffs. Besides the classical approach using exponential discounting the hyperbolic discounting utility function was introduced (Phleps & Pollak, 1968) and its implications discussed (Laibson, 1997) with respect to inconsistencies in inter-temporal tradeoffs (Strotz, 1955).

Empirical work clearly supports hyperbolic discounting in favor of exponential discounting (Benzion *et al.*, 1989; Thaler, 1981). However, inconsistencies as differences in discount rates between short- and long-run (Harris & Laibson, 2001), as well as for different values of rewards (Benzion *et al.*, 1989; Kirby, 1997; Thaler, 1981) are still not explained by theory. Therefore, the focus of research needs to be finding new models to explain decisions about inter-temporal tradeoffs (Rubinstein, 2003; Rubinstein, 1988). Furthermore, recent work has shown the importance of eliciting both, risk and time preferences to explain behavior as reported in experiments (Andersen *et al.*, 2008). So far, economic research focuses on deriving a function for $U(x, t)$. This paper, however, presents results that help to separate time preferences $v(t)$ from the joint function for time and money preferences. Additionally, there seems to be a connection between risk preferences and discounting behavior (Anderhub *et al.*, 2001). In order to gain a more conclusive view of decisions about delayed payoffs, the experiment reported in this paper provides information about decisions about time, without the link to payoffs as used in the work reported so far.

Furthermore, research has shown that the elicitation of discount rates does not explain behavior in laboratories as well as more general measures of time preferences as self-control and impulsivity (Khwaja *et al.*, 2007). Furthermore, the dual-self model of impulse-control explains decisions reported in economic studies (Fudenberg & Levine, 2006). Additionally, recent research brought up the importance of a model to accommodate different levels of impatience (Bleichrodt *et al.*, 2008). These models provide insight into psychological processes underlying decisions where timing is involved. In order to turn these findings into an economic model for decisions about inter-temporal tradeoffs, the preference for time independent of possible consequences needs further investigation.

From experimental investigation economists have developed understanding about the utility of money and preferences of risky choices. For money, people tend to be risk-averse for gains and risk-seeking for losses (Tversky, 1972). Additionally, an index of loss-aversion needs to be added to explain phenomena gained in experiments about risky choices (Köbberling & Wakker, 2005). On the other hand, preferences have been studied where inter-temporal tradeoffs are involved. From empirical investigation it is known that people tend to choose trains with risky arrival time when there

is a possibility of gaining time (Weber & Milliman, 1997). Therefore, it is to be expected that people view waiting time as a loss. In addition to this knowledge about preferences over money and preferences for inter-temporal tradeoffs, this paper sets out to discover preferences over time without a link to consequences. That is not the tradeoffs between time and the utility of the consequences is analyzed, rather is it the valuation of time itself. By eliciting the preference structure over time, this paper helps to separate the value function over time from the utility of money.

2 Experiment

The group of participants consisted of 25 students from the Otto-von-Guericke-University Magdeburg from different fields of study. The experiment was conducted in a laboratory environment.

To elicit time preferences of subjects, participants were asked to choose between two lotteries, where payoffs were determined as waiting time. The choice of the options is within the random lottery payoff mechanism (Grether & Plott, 1979). In our experiment participants were paid a show-up fee of 6 Euros at the beginning of the experiment and told that their decisions were determining a waiting time in the laboratory. This waiting time started after all decisions were made and the chosen lotteries were played out. The participants spent this time in an experimental cabin without any communication devices or books.

The options were chosen in a form that is in line with (Holt & Laury, 2002), where Option A offered less risk, but a higher sure waiting time (with a waiting time of either 30 or 40 minutes) and Option B offered a higher risk, but the chance of a much smaller waiting time (with a waiting time of either 5 or 60 minutes). The probabilities of the favorable outcome stayed the same for both options, but varied between .1 and 1.0 as shown in table 1. Therefore, risk preferences for waiting time could be elicited for each participant by the row in which option B was chosen for the first time. If that point was in row 4 or earlier the choice pattern indicates risk-seeking behavior, if it was in row 6 or later the choice pattern indicates risk-averse behavior. The risk attitude for subjects switching to option B in row 5 cannot be identified since they can either be slightly risk-averse, risk-neutral or slightly risk-seeking. After the choices were made, the experimenter drew a ball from a bingo cage with balls labeled from 1 to 10, determining which choice was selected. Then, the lottery the participant chose for that row was realized and the waiting time started.

No.	Option A	Option B	Expected value difference
1	{.1, 30, .9, 40}	{.1, 5, .9, 60}	-15.5
2	{.2, 30, .8, 40}	{.2, 5, .8, 60}	-11
3	{.3, 30, .7, 40}	{.3, 5, .7, 60}	-6.5
4	{.4, 30, .6, 40}	{.4, 5, .6, 60}	-2
5	{.5, 30, .5, 40}	{.5, 5, .5, 60}	2.5
6	{.6, 30, .4, 40}	{.6, 5, .4, 60}	7
7	{.7, 30, .3, 40}	{.7, 5, .3, 60}	11.5
8	{.8, 30, .2, 40}	{.8, 5, .2, 60}	16
9	{.9, 30, .1, 40}	{.9, 5, .1, 60}	20.5
10	{1.0, 30, 0.0, 40}	{1.0, 5, 0.0, 60}	25

Table 1: Lottery choices determining waiting time

3 Results

As described in the experimental setting subjects can be sorted as risk-seeking and risk-averse for risky choices on waiting time by looking at the first row in which option B is chosen. In Table 1 it can be seen from the differences in expected values, that risk-seeking individuals would choose option B for the first time in row 4 or earlier, while the switching point from option A to option B would be in row 5 or later for risk-averse subjects. The frequencies for rows in which subjects switched to option B are reported in table 2. That means, a subject that chooses option A in rows 1 through 3 and chooses option B in rows 4 through 10 is noted in Table 2 in the column 4, while a subject choosing option A in rows 1 through 4 and then switches to option B is noted in column 5. From the expected value differences in Table 1 it can be seen that subjects listed in columns 1 through 4 are risk-seeking and subjects listed in columns 6 through 10 are risk-averse. Subjects that are listed in column 5 cannot be clearly identified as indicated in the section above.

One subject was excluded from analysis, because of switching from option A to B and back to A for a number of times. Assuming a standard utility function this behavior cannot be explained by such a functional form. Furthermore, since it is only one subject showing this behavior it can be assumed as error.

The data set shows 27 subjects showing risk-seeking behavior while 9 subjects made choices showing risk-averse behavior. Therefore we conclude that people show risk-seeking behavior when making decisions about time, where the outcome is subject to risk (1%-level, Binomial-Test).

Row of first choosing option B	1	2	3	4	5	6	7	8-10	Σ
Frequency	1	1	6	19	4	2	2	1	36

Table 2: Frequencies of first choosing option B

4 Conclusion

The subjects show risk-seeking behavior in our experiment. Results reported in this paper are similar as what is known from Prospect Theory (Kahneman & Tversky, 1979) for choices about money gambles involving losses. Therefore, we conclude that subjects perceived the time spent waiting as losses.

The experiment reported here give an insight into how people value time and how a utility function of time $v(t)$ can be constructed. Further research is necessary to explore how preferences over time can help explain inconsistencies of existing models on inter-temporal choice. Additionally it needs to be looked at, how time preferences are affected by context. That means if additional time can also be experiences as something positive. While the experiment of this paper gives first hints on what a utility function of time can look like, further research is needed to model decisions over time.

5 References

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