Environmental Choices and Hyperbolic Discounting: An Experimental Analysis

Timothy J. Richards and Gareth Green

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Timothy J. Richards* and Gareth Green**

* Morrison School of Agribusiness and Resource Management, Arizona State University **Dept. of Economics, Albers School of Business, Seattle University

Background & Motivation

Environmental policy necessarily involves long-term impacts. Assumptions made regarding the rate at which future costs and benefits are discounted to the present, therefore, can have dramatic impacts on which decision is taken, if any at all. Typically, future costs and benefits are discounted at a constant, exponential rate. Evidence from the lab, however, suggests that discount rates are rather hyperbolic, or more specifically, quasi-hyperbolic (Benhabib, Bisin and Schotter 2007; Andersen et al 2008). Quasi-hyperbolic rates of time preference are problematic from a policy perspective because they imply that decisions will be time-inconsistent (Cropper and Laibson 1999; Karp 2005). There is little empirical evidence as to whether discount rates for environmental goods reflect the same hyperbolic pattern for purely monetary rewards. In this study, we provide evidence regarding the nature of environmental discount rates, and whether they can be explained by personal behaviors that reveal systematic present bias in decision making.

Objectives

Our objectives are: (1) to estimate the structure of discount rates for environmental amenities using experimental data, (2) to compare discount rates obtained using multiple price list (MPL), matrix multiple price list (MMPL) and choice-based conjoint (CBC) methods, and (3) to test whether personal behaviors that reveal present bias are associated with discount rates for environmental goods.

Experimental Design

Two experimental designs have emerged in the recent literature: (1) MPL (Andersen et al. 2008) and (2) CBC (Viscusi, Huber and Bell 2005). Subjects in an MPL experiment are presented a series of binary choices that differ only in their future reward (price). By varying the reward incrementally as the subject moves through the series of choices, the MPL method identifies clear points of indifference. However, it only elicits interval responses, can be subject to framing effects and only allows the researcher to vary one attribute. CBC questions allow for more than one attribute for each choice, but only a limited number of levels. We synthesize the MPL and CBC approaches by developing a matrix multiple price list (MMPL) approach in which we present subjects with several price lists simultaneously. Each list differs by one attribute (cost). In this way, the MMPL method retains the flexibility of the CBC approach and the efficiency of the MPL method.

We select one choice (row) of the matrix at random to be binding on the subjects and offer to either pay the chosen amount of financial reward or donate the cost of the environmental good after the delay associated with the choice. The MMPL method is thus incentive compatible for both financial and environmental goods.

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Environmental Goods

Subjects are allocated randomly among the three elicitation methods (MPL, MMPL, CBC). All subjects complete the experiment with respect to financial assets, but are allocated randomly among four types of long-lived environmental goods:

1. Short-horizon, personal-benefit (SHP, greenspace)
2. Long-horizon, public-benefit (LHB, GHG)
3. Short-horizon, public-benefit (SHB, storm water)

These choices allow us to test how discount rates vary by the nature of the choice.

Modeling Discount Rates

We estimate all discount rates using the random parameter model described in Richards (2012).

Results

Table 1 Hyperbolic and Exponential Models: CRRA Form

	Hyperbolic		Exponential	
Fixed Parameter Estimate				
r	0.953*	294.634	0.956*	279.121
Random Parameter Estimates				
δ	0.418*	2.622	0.395*	2.202
Standard Deviation of Random Parameter				
σ_δ	0.742*	34.089	0.760*	34.300
Random Parameter Function				
Smoke?	-0.448*	-6.719	-0.482*	-6.600
Drink Number	0.022*	10.075	0.023*	11.783
BMI	0.013*	3.086	0.014*	2.990
Standard Deviation of Model				
σ	0.447*	333.044	0.474*	340.456
LLF	-1,257.327		-1,380.392	

Notes: *r* represents the coefficient of relative risk aversion, δ represents the annualized discount rate. LLF is the log-likelihood function. Estimation is by simulated maximum likelihood (Train, 2003). A single asterisk indicates significance at a 5% level.

Discussion

Our results imply that discounting for environmental goods differs from financial discounting in a number of important ways:

1. Environmental discount rates are near to zero
2. Present bias is often confounded for free-riding
3. Individuals with a pattern of present-bias have a greater tendency toward quasi-hyperbolic discounting
4. Quasi-hyperbolic discounting is associated with drinking, obesity and the failure to recycle, but is negatively associated with smoking.

We find that the MMPL approach is an efficient means of deriving time-value data and contains little bias relative to MPL or CBC elicitation methods.

Discount rates tend to be higher for goods with little immediate, personal benefit.

Conclusions

1. Subjects discount environmental benefits according to quasi-hyperbolic discount schedules.
2. Quasi-hyperbolic discounting is associated with other behaviors that show present bias: drinking, overeating and a failure to recycle.
3. A MMPL time-value elicitation method is a flexible and efficient means of gathering discount-rate data.