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Discounting future payments in stated preference choice experiments☆

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ABSTRACT

When costs are presented as a series of recurring payments in stated preference choice experiment (CE) questions, how respondents discount future payments is important in explaining choices and in the measurement of the present value of willingness to pay. In this paper, alternative discounting approaches are compared to examine their effect on measuring preferences and values using data from a survey examining public preferences for the protection of an endangered species. Exponential and hyperbolic discounting assumptions lead to very similar results in terms of both model fit and welfare. All estimated models suggest future payments are discounted at a very high rate. Several factors likely influencing the magnitude of these estimated discount rates are discussed, and then an argument is made for using payment vehicles in stated preference studies that employ a single lump sum payment rather than a series of future payments.

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1. Introduction

Discrete choice experiments, or stated preference choice experiments (CE), have become a common tool in economics for understanding consumer preferences for a range of market and non-market goods, particularly in the environmental, transportation, marketing, and health economics fields (e.g., Johnston et al., 2017; Hanley et al., 1998; Louviere and Lancsar, 2009; Louviere, 1988). In many CE applications of non-market goods, intertemporal decision making plays a prominent role. Respondents to the CE questions are typically asked to value future benefits (e.g., environmental improvements) through payment vehicles (e.g., taxes or fees) that involve multiple payments over time. In the analysis of these decisions, accounting for time preferences through discounting future benefits and costs is critical for the proper measurement of underlying preferences and values.

In economics, it has been common to assume individuals have a constant discount rate over time implied by the discounted utility model (Frederick et al., 2002), commonly referred to as exponential discounting. Under exponential discounting, the present value of a cost (or benefit) in time period t, C_t, is $\mathrm{PV}(C_t) = C_t \cdot (1 + r)^{-t}$, where r is the discount rate. This has been

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a common assumption in the stated preference (SP) literature, with several contingent valuation (CV) studies estimating implicit discount rates under the assumption of exponential discounting (e.g., Kovacs and Larson, 2008; Bond et al., 2009; Egan et al., 2015; Myers et al., 2017). However, a large literature exists that shows people's behavior is often inconsistent with exponential discounting (e.g., Soman et al., 2005; Loewenstein and Prelec, 1992). For instance, experimental research (e.g., Zauberman et al., 2009; Grijalva et al., 2014; Gintis, 2000) has revealed that people often display a "present bias"–where the discount rate decreases over time–when making intertemporal choices. This phenomenon has led some to advocate for modeling intertemporal choices using a type of discounting where the discount rate declines over time, called hyperbolic discounting. Two common (and tractable) specifications of hyperbolic discounting were introduced by Harvey (1986) and Mazur (1987).[1] In the Harvey hyperbolic model, the present value of a cost (or benefit) in time period t is $PV(C_t) = C_t \cdot (1 + t)^{-\mu}$, and under the Mazur model, $PV(C_t) = C_t \cdot (1 + \omega \cdot t)^{-1}$. Under both specifications, later time periods are valued less than more immediate ones (assuming positive discount parameters μ and ω in the respective models). To date, few empirical SP studies have allowed for hyperbolic discounting behavior, with Meyer (2013a, b) and Viscusi et al. (2008) being the exceptions in the environmental economics literature.

The focus in this paper is on assessing how respondents to CE questions discount future payments using data from a CE survey examining public preferences for the protection of an endangered species. The only other study to empirically estimate discounting behavior jointly with choices using CE data was a study by Meyer (2013a, b), which used variation in the timing of future benefits (i.e., the benefits horizon) to identify implicit discount rates with mixed logit (MXL) models (Train, 2003). Similarly here, MXL models embodying alternative assumptions about discounting behavior are estimated that allow for the joint estimation of implicit discount rates and choice behavior from variation in the payment horizon. Future payments are found to be discounted at a very high rate, regardless of whether exponential or hyperbolic discounting is assumed. In fact, the results suggest there is little difference between the discounting models in terms of welfare estimates or model fit. Furthermore, welfare estimates are shown to not just be statistically similar across exponential and hyperbolic discounting models, but also in comparison to those from a model that assumes respondents ignore future payments. Additional models show these results are robust to specifications that allow for attribute non-attendance (Scarpa et al., 2013; Hole, 2011). In light of these findings, factors likely influencing the magnitude of the estimated discount rates are discussed and an argument is made for the use of lump sum payment vehicles in stated preference surveys rather than annual future payments that have been argued for in the recent literature (Egan et al., 2015).

2. Literature review

There have been numerous empirical attempts to estimate implicit discount rates with stated preference data. There are two general approaches for measuring discount rates with SP data: exogenous and endogenous discounting approaches (Wang and Daziano, 2015). In general, exogenous, or external, discounting approaches estimate a rate used for the calculation of the present value of future costs or benefits that is determined outside of the valuation model, while endogenous, or internal, discounting approaches estimate the discount rate within the valuation model.

Among exogenous approaches, many studies employ a two-step indirect approach to estimate an implied discount rate (e.g., Crocker and Shogren, 1993; Stevens et al., 1997; Viscusi et al., 2008; Kim and Haab, 2009; Myers et al., 2017). In the first step, willingness to pay (WTP) is estimated for two different time periods or payment horizons. The second step involves solving for the discount rate parameter (r in the case of exponential discounting) in the discounting formula that equates the two values. This approach was used by Crocker and Shogren (1993) to infer discount rates from values for waiting times at ski lifts, Stevens et al. (1997) in a study of salmon restoration values, and Kim and Haab (2009) in a study of oyster reef restoration. More recently, Myers et al. (2017) calculated the implicit discount rate by comparing the present value of WTP associated with a one-time payment and the present value of WTP for a series of ongoing annual payments for a conservation program to protect a migratory species of shorebird along the east coast of the U.S. In contrast to these studies, which employed CV data and assumed exponential discounting, Viscusi et al. (2008) employed a CE approach that explicitly includes timing of future water quality benefits as an attribute and estimated discount rates under both exponential and hyperbolic discounting assumptions using the two-step approach. In an earlier CE study using a two-step approach, Layton and Brown (2000) estimated implied discount rates assuming exponential discounting behavior from WTP estimates using data from two survey versions administered to separate samples that differed in the time horizon for when forest losses would occur under mitigation programs.

Another exogenous estimation approach uses information from supplemental questions to infer individual-level discount rates, which are then applied to analyze choices. For example, Newell and Siikamäki (2014) asked a series of discount rate elicitation questions common in the experimental economics literature for exploring intertemporal decision making (e.g., Coller and Williams, 1999) in the same survey instrument as a series of CE questions. Responses to these elicitation questions were used to estimate a discount rate for each individual, which was then applied in the analysis of the CE data to reveal households' preferences for energy efficient appliances and compared against CE model results assuming commonly-used discount rates in government regulatory analysis (e.g., 3 and 7%). Egan et al. (2015) use a similar approach in a CV survey of wetland restoration in Ohio, but the discount rate elicitation questions were presented as a reward lottery experiment with

[1] Another empirical form that is commonly employed since it captures features of hyperbolic discounting is the quasi-hyperbolic form of Laibson (1997).