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Measuring time preferences: A comparison of experimental methods☆

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ABSTRACT

Eliciting time preferences has become an important component of both laboratory and field experiments, yet there is no consensus as how to best measure discounting. We examine the predictive validity of two recent, simple, easily administered, and individually successful elicitation tools: convex time budgets (CTB) and double multiple price lists (DMPL). Using similar methods, the CTB and DMPL are compared using within- and out-of-sample predictions. While each perform equally well within sample, the CTB significantly outperforms the DMPL on out-of-sample measures.

1. Introduction

Time preferences are fundamental to theoretical and applied studies of decision-making, and are a critical element of much of economic analysis. At both the aggregate and individual level, accurate measures of discounting parameters can provide helpful guidance on the potential impacts of policy and provide useful diagnostics for effective policy targeting.

Though efforts have been made to identify time preferences from naturally occurring field data,[1] the majority of research has relied on laboratory samples using variation in monetary payments.[2] Despite many attempts, however, the experimental

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[1] These methods investigate time preferences by examining durable goods purchases, consumption profiles or annuity choices (Hausman, 1979; Lawrance, 1991; Warner and Pleeter, 2001; Gourinchas and Parker, 2002; Cagetti, 2003; Laibson et al., 2003, 2007). While there is clear value to these methods they may not be practical for field settings with limited data sources or where subjects make few comparable choices.

[2] Chabris et al. (2008b) identify several important issues related to this research agenda, calling into question the mapping from experimental choice to corresponding model parameters in monetary discounting experiments. Paramount among these issues are clear arbitrage arguments such that responses in monetary experiments should reveal only the interval of borrowing and lending rates, and thus limited heterogeneity in behavior if subjects face similar

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community lacks a clear consensus on how best to measure time preferences; a point made clear by Frederick et al. (2002). One natural challenge which has gained recent attention is the confounding effect of utility function curvature. Typically, linear utility is assumed for identification, invoking expected utility's necessity of risk neutrality for small stakes decisions (Rabin, 2000). However, in an important contribution, Andersen et al. (2008) show that if utility is assumed to be linear in experimental payoffs (risk neutrality) when it is truly concave (risk aversion), estimated discount rates will be biased upwards.[3] This observation has reset the investigation of new elicitation tools.

Andersen et al. (2008) (henceforth AHLR) use of measures of risk taking to incorporate utility function curvature, which we refer to as a double multiple price list (DMPL: one multiple price list for time and one for risk). Andreoni and Sprenger (2012a) (henceforth AS) used variation in linear budget constraints over early and later income to identify convexity of preferences, a device they call a convex time budget (CTB). This technique is motivated by early developments in risk preference elicitation such as Gneezy and Potters (1997) and is already being used in field settings (e.g. Giné et al., 2012). The objective of this study is to work toward a consensus by comparing these two methods.

Our comparison criteria are both experimental and empirical. The key experimental criterion is simplicity. In particular, researchers eliciting preferences put a premium on devices that are simple for subjects, easy to administer, transportable to the field, and can be easily folded into a larger research design. Both methods seem to succeed equally well on this dimension.

More central to our analysis, we propose empirical predictive validity as the second and most relevant criterion. In particular, parameter estimates generated from a specific data set should yield good in-sample fit, have out-of-sample predictive power, and predict relevant, genuine economic activity.[4]

We document two main findings when examining predictive validity. First, we reproduce the broad conclusions of both AHLR and AS: there are clear confounding effects of utility function curvature that need to be controlled for in estimating discounting. Second, when taking these estimates out-of-sample we find that the CTB-based estimates markedly outperform the DMPL-based estimates when predicting intertemporal choice.

Determining why the CTB outperforms the DMPL is not the main focus of this paper. However, we suggest that there are three important theoretical distinctions that can guide the design of future preference elicitation techniques:

- using only domain-specific data to identify preferences,
- designing the elicitation to permit preferred estimation strategies,
- increasing the preference-identifying informational content of each choice.

In the context of our comparison exercise, the CTB lets the researcher avoid the worry that the time and risk domain may not be perfectly related, use demand theory rather than a probabilistic choice model for identification[5] and represent each choice as defining an equality rather than an inequality constraint.[6] Section 2 discusses each of these issues in more detail.

The issue of informational content is closely related to a criticism of the CTB: that the high frequency of observed corner choices is a shortcoming of the technique (Harrison et al., 2013). In fact, the frequency of corner solutions in the CTB is precisely its feature that generates the empirical improvements in predictive validity. This is because a corner solution from a CTB carries more information about preferences than the exact same choice from a DMPL. Specifically, it implies that preferences over time-dated experimental payments may be close to linear. In contrast, curvature in DMPL-elicited preferences is informed primarily from risky choices, not from choices over time. Hence, CTB and DMPL estimates differ largely in their identified degree of utility function curvature. Indeed, it is the near linearity in CTB estimated preferences that generate the improved predictive performance when compared to DMPL estimates.

Section 2 describes our preference elicitation techniques and experimental protocol. Section 3 presents estimation results and evaluates the success of the CTB and DMPL at predicting choice both in- and out-of-sample. Section 4 concludes.

credit markets (Cubitt and Read, 2007; Andreoni and Sprenger, 2012a,b). This last concern may be beyond the reach of most experimental samples. Evidence from Coller and Williams (1999) suggests that even when the entire arbitrage argument is explained to subjects, heterogeneity remains and responses do not collapse to reasonable intervals of borrowing and lending rates. Following most of the literature, the experiments we conduct will focus on monetary choices, taking the laboratory offered rates as the relevant ones for choice. Importantly, the methods we describe are easily portable to other domains with less prominent fungibility problems. One recent example using the convex time budget described below with choices over effort is Augenblick et al. (2013).

[3] Frederick et al. (2002) also provide discussion of this confound and present three strategies for disentangling utility function curvature from time discounting: (1) eliciting utility judgments such as attractiveness ratings at two points in time; (2) eliciting preferences over temporally separated probabilistic prospects to exploit the linearity-in-probability property of expected utility; and (3) "separately elicit the utility function for the good in question, and then use that function transform outcome amounts to utility amounts, from which utility discount rates could be computed" (p. 382). The third of these techniques is close in spirit to the double multiple price list implemented by Andersen et al. (2008) described below.

[4] Though this seems a natural objective, there are relatively few examples of research linking laboratory measures of time preference to other behaviors or characteristics (Ashraf et al., 2006; Dohmen et al., 2010; Meier and Sprenger, 2010, 2012; Mischel et al., 1989). These exercises at times demonstrate the lack of explanatory power for prior time preference estimates (Chabris et al., 2008a).

[5] In this sense, the CTB elicitation and estimation techniques are not separate advances: they go hand in hand.

[6] Or, depending on econometric approach, multiple inequality constraints simultaneously rather than a single inequality constraint.