Intertemporal Choice: A Laboratory Investigation of Choice Behavior under Additive and Compound Wealth Growth

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Introduction

Economic theory has traditionally treated time discounting, or the devaluation in one's mind of future payoffs compared to present ones, as part of a decision maker's preferences. A new literature, sometimes referred to as "Ergodicity Economics," focuses on alternate decision-making models under which time discounting is dependent on environmental factors rather than individual preferences. In this study, we investigate a new model of intertemporal choice that predicts decision makers will choose so as to maximize their rate of growth of wealth.

We consider the choice between two payment plans, or wealth generation processes. Option A is a plan of small but frequent payments, while Option B is a plan of larger payments over longer intervals, with both options ending after a fixed number of days. We consider this type of choice for both an environment without interest rates and an environment with interest rates. The first environment is founded in additive wealth dynamics, while the second is founded in compound wealth dynamics. In the second environment there are interest earnings on the current balance of each account. The terms "compound" and "multiplicative" are used interchangeably.

Background

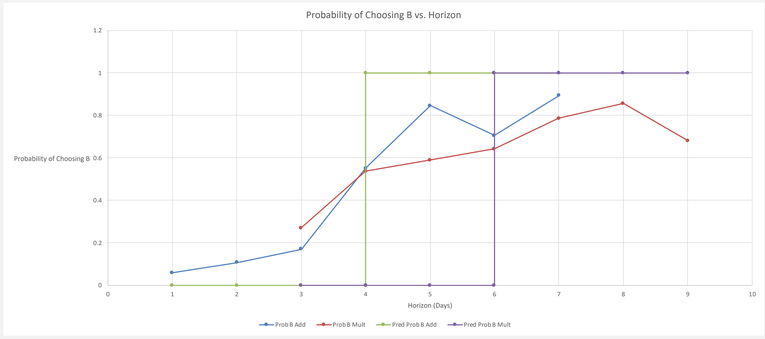
Experimental studies of intertemporal choice have focused mainly on very simple wealth generation processes in which choices between a smaller, earlier amount of money and a larger, later amount of money are offered. Most studies focus on imputing implicit discount rates implied by choices, with focus on violations of stationarity, most typically interpreted as "present bias." We focus instead on wealth generation processes in which either a smaller sum is received at regular, shorter intervals or in which a larger sum is received at regular, longer intervals. Our theory makes point predictions about the behavior of all participants, rather than relying on weaker consistency requirements as in the earlier studies. By focusing on the objective features of the environment, the theory is a "physical theory."

Objectives

Our main objective is to compare the choices made when wealth generation is additive versus when it is multiplicative. For both, as the interval between payments is increased for the more and less frequent payment processes, there is a point at which the larger, less frequent payment (B) is preferred to the smaller, more frequent payment plan (A). The main prediction concerns the "Horizon" and the "Delay" in the wealth generation processes. The Horizon is the time between payments in Option A, and the Delay is the additional time between payments in Option B. For a given Delay, as the Horizon increases, there is a predicted switch from A to B. The switch point is at a longer interval for the multiplicative process than for the additive one.

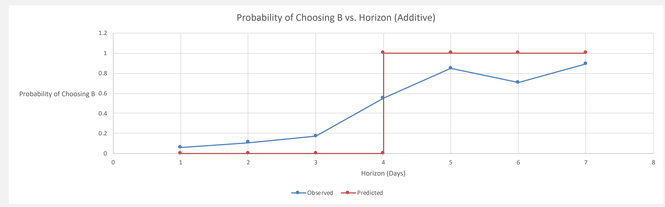
Methods and Materials

Participants were invited into a laboratory where they answered a 21-question survey. Each question let the participants selected their preference or indifference between Options A and B, as demarcated in the theory. These questions were selected such that participants should be indifferent when the Horizon (H) was equal to 4 for the additive processes and 6 for the compound processes. Each group was randomly selected to participate in either the additive or the compound surveys. The Horizon was varied in days from 1 to 7 for the additive survey and 3 to 9 for the compound survey. Also, the total length of time varied from 30 to 70 days in both surveys. Decision makers were also given the option of receiving their payment in 10 days by participating in a lottery that could lower their total earnings. The smaller the total they were willing to accept, the more likely that they'd receive that total early. Below is a graph combining the results of the additive and multiplicative processes.

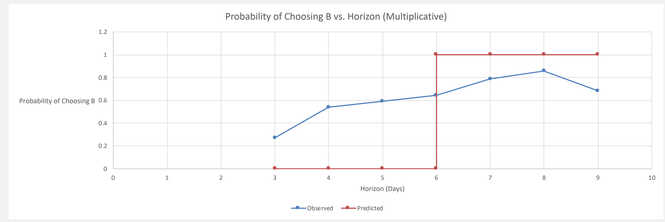


Results and Conclusions

The main results are summarized in the two figures showing both the theoretical predictions and empirical results for the additive and compound processes. For both the additive and the compound surveys, the frequency with which Option B is chosen is lower for the values of the Horizon below the switch over point and higher for values above the switch point. The empirical switch over is less sharp than the step function implied by the theory (and demonstrated in the theoretical predictions), but there is a clear jump at the switch over point for the additive survey.



The empirically-estimated probability of choosing Option B is less consistent with the theoretical prediction for the compound theory, though it is still in the right direction. We suspect that forecasting compound interest earnings, which were not provided to participants, is a major factor in the weaker consistency between the results and predictions for the compound surveys.



Future Steps and Acknowledgments

Our primary focus for the future is to introduce uncertainty about alternative stochastic wealth generation processes. Our theory based on ergodic properties of the wealth generation process makes similarly sharp predictions for this environment as for the deterministic environment studied here.

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