**Intertemporal Choice: A Laboratory Investigation of Choice Behavior under**

**Additive and Compound Wealth Growth**

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Abstract: Economic theory has traditionally treated time discounting as an aspect of a decision maker’s preference structure, just as expected utility theory treats risk preference as an aspect of a decision maker’s preference structure. A new literature, sometimes referred to as “Ergodicity Economics,” focuses on the nature of the alternative wealth generation processes that a decision maker is able to choose in his or her environment, and proposes that choosing the wealth generation process that maximizes the rate of growth of wealth is optimal for all decision makers. In this framework, changes from one process to another as parameters of the situation change can be interpreted in a manner analogous to time discounting, but the phenomenon is seen to be a function of the environment, and not of the decision maker’s preferences. Similarly, introducing uncertainty into the wealth generation processes that a decision maker is able to choose leads to behavior that appears either risk-loving or risk-averse, depending upon the details of the situation. In this study we begin an investigation of this newer approach by studying choice behavior over alternative future certain income payments that decision makers can choose among. Investigation of uncertainty in this environment will be the subject of a subsequent study.

When wealth generating processes are additive, meaning that a certain fixed payment is added to one’s account at a regular interval, then two alternative processes can be compared on the basis of the rates of growth implicit in the processes. For example, if option A offers $10 every 4 weeks, while option B offers $15 every 6 weeks, then the processes are equivalent, in terms of the total wealth they will generate, provided the number of dollars received per period, as a rate, are the same for each option. Since 10/4 = 15/6 =$2.5 dollars per week, the two options are equivalent, as long as one intends to allow the money to accumulate for some extended period of time. But if the frequency of the $10 payment in option A increases to once every 3 weeks, and the frequency of the $15 payment in option B also increases by the same amount, i.e., to once every 5 weeks, then option A should be strictly preferred, since 10/3=3.33 > 15/5 =3. Similarly, if the frequency of payments decreases, to 5 weeks and 7 weeks, respectively, then option B should be chosen, since 10/5=2 < 15/7 = 2.14.

When wealth generating processes also include compound interest growth, matters become a little more complicated, but the same principle of comparing growth rates can be applied. In general, compared to the purely additive process, at a positive rate of interest the frequency of payments can be decreased more before it makes sense to switch over to the option with a larger, less frequent payment scheme. The intuition for this is that the compound interest from the more frequent payment scheme increases the balance for option A during the delay until option B provides a payment.

We conducted an experiment investigating both the additive and the compound interest versions of this situation. Subjects answered a series of questions, each of which provided a choice between two options of the sort mentioned above. Questions varied in terms of how long the process would go on (30 days, 50 days or 70 days), and parameters were varied substantially so that sometimes Option A (smaller more frequent payments) was optimal, while at other times Option B (larger less frequent payments) was optimal. Questions were calibrated so that the sum of accumulated payments from the different options ranged from about $15 to about $25. At the end of the experiment, one of the questions answered by each participant was randomly selected to determine their earnings in the experiment. Participants receive a $10 payment up front for participation, and have to return the number of days later specified in their question that determines their earnings in order to collect their final payment.

The results for the Additive processes are very consistent with the predictions outlined above. Specifically, there is a big jump in the frequency with which option B is chosen as soon as the frequency of payments decreases past the point where the growth rate implied for option B is greater than for option A. The results for the Compound process are less sharply consistent with the predictions above, although they are broadly consistent in the sense that the frequency with which option B is chosen does tend to increase, greater the (theoretical) advantage that option provides. The difficulty in intuiting what the magnitude of compound interest growth will be in the absence of any calculating tool is surely a factor here. The participants were randomly assigned to either the additive or the compound interest treatment, so they are not statistically different.

We also elicited willingness to accept a smaller payment in order to receive an earlier payment (in 10 days, rather than the number of days specified in the question chosen to determine a participant’s earnings). Subjects indicated either 100%, 99%, 95%, 90% or 50% of each of the three lengths of accumulation (30, 50 or 70 days) in an incentive compatible manner. These data have not yet been analyzed in details. We note that this sort of questioning is more typical of other experimental studies of time discounting behavior, where preferences over earlier and later payments that one might receive are elicited. Many people choose 100% for all three cases, while others indicate a willingness to accept something less, though infrequently less than 90%. We believe that these data are more likely to be a reflection of other factors relating to the uncertainty that one will be able to return to collect a later payment, or that one will even remember when to collect a payment, rather than an indication of some sort of pure time preference.