MEASURING Time PREFERENCE AND THE ELASTICITY OF INTERTEMPORAL WITH WEB SURVEYS

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PRELIMINARY

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ABSTRACT

Preferences that affect intertemporal consumption decisions, in particular, sensitivity to changes in the interest rate, are fundamental to economics, but are seldom directly measured. This paper introduces a series of hypothetical choices in the American Life Panel that employ web graphics to elicit an individual’s elasticity of intertemporal substitution (EIS) and rate of time preference. The Internet design features do appear to encourage more active decision-making on these cognitively difficult questions than a paper version in the 1999 Health and Retirement Study Mailout. Preliminary analysis of the Internet survey responses yields an EIS estimate of 0.10 (standard error of 0.03) and desired consumption growth of -0.4% (standard error of 0.2%) at a zero interest rate. This paper also discusses the issues with data collection and analysis that arise in the Internet survey.
1. INTRODUCTION

Individual preferences are central to economic theories of behavior, yet there are few attempts to directly measure and study preferences. This paper describes hypothetical scenarios with Internet graphics designed to measure the preference parameters that inform intertemporal consumption decisions. The desired path of consumption over time and the sensitivity of consumption to changes in the interest rate have important implications for both individual welfare and public policy. Nonetheless there is little consensus in the economics literature on the plausible range or average value of these preference parameters.

To infer individual preferences from consumption choices, we use the following economic model of consumption growth:

\[ \Delta \log c_{it} = s_i (r_{it} - \rho) \]  

(1)

where \( r \) is the real interest rate, \( s \) is the elasticity of intertemporal substitution and \( \rho \) is the subjective discount rate. With this model and a non-negative intertemporal substitution, an interest rate that exceeds the individual’s subjective discount rate leads to an upward sloping consumption path. How much the individual reacts to changes in the interest rate depends on the intertemporal substitution parameter. This specific form of the Euler equation corresponds to the optimal consumption path when utility exhibits constant relative risk aversion and there is no uncertainty in the interest rate. Similar models have been previously used to study consumption with individual and aggregate data; see Browning and Lusardi (1996) for a survey.

Our research strategy has three steps: first vary the interest rate an individual faces, then observe the subsequent consumption choice, and finally use this data to estimate the preference parameters. This report describes how we use the web survey to obtain data on intertemporal consumption and also provides preliminary estimates of preference parameters. The web-based questions on the American Life Panel (ALP) extend the earlier measures on the 1992 Health and Retirement Study and the 1999 HRS Mailout. Barsky et al. (1997) developed the basic format for the intertemporal consumption questions and analyzed the responses on the 1992 HRS. The graphics capability of the Internet has greatly expanded our ability to present changes in the interest rate and elicit consumption choices.
The plan of the report is as follows. Section 2 presents the hypothetical consumption questions asked on the mail survey of the HRS and the web survey of the ALP. Then Section 3 summarizes the responses and presents estimates of time preference and the elasticity of intertemporal substitution across the different versions. Section 4 discusses the unique challenges of collecting and analyzing data from web surveys. The section also discusses the ongoing analysis of the consumption questions on the web survey.

2. INTERTEMPORAL CONSUMPTION QUESTIONS

This section presents the survey questions on intertemporal consumption choice that have been asked on the Health and Retirement Study and the American Life Panel. The HRS, a biennial panel study of American over age 50, began in 1992 with a sample of over 12,600 individuals in 7,600 households. New respondents entered the panel in the 1998 and 2004 waves of the HRS. In the year between the main surveys, the HRS also conducts a short mail survey with a sub-sample of respondents. In its various forms, the HRS collects detailed information on the demographics, employment, and financial resources of respondents. In addition, the survey has pioneered several measures of individual preferences and expectations. Over the past five years with a grant from the NIA, the HRS has begun to explore Internet interviewing. The HRS has fielded two web surveys in 2003 and 2006 with HRS respondents who have Internet access. The American Life Panel was also initiated through the grant with a separate sample of individuals to further experiment with this new survey mode.

The American Life Panel consists of individuals over age 40 who participated in the University of Michigan’s Surveys of Consumers and agreed to participate in further surveys online. The first wave of the web-based ALP began in the fall of 2003 and there are currently twelve waves.

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1 Detailed information on the HRS and the public-access data sets are available online at: http://hrsonline.isr.umich.edu/
2 A further description of the American Life Panel is online at: http://www.rand.org/labor/roybalfd/american_life.html. The Survey of Consumers is a monthly survey conducted by the University of Michigan Institute for Social Research that tracks a leading business-cycle indicator, the Index of Consumer Expectations, and other topics. The survey interviews a representative sample of 500 individuals in the U.S. adult population each month. Each individual is in two monthly survey waves that are six months apart. More information is online at: http://www.sca.isr.umich.edu/main.php
of the survey. As individuals enter the ALP from the Survey of Consumers, they progress through all of the existing waves. The Internet survey is nearing its ultimate sample size of 1,500 individuals. The ALP has also started to provide Web TV to individuals who do not otherwise have Internet access. The ALP provides a novel framework for testing questions, including the intertemporal consumption questions that could inform future Internet interviewing on the HRS and other large-scale surveys. The rest of this section presents the intertemporal consumption questions in two self-administered interview modes – a mail survey and a web survey.

2.1 Mail Survey

The long version of the 1999 HRS Mailout survey contained four questions on hypothetical pre-retirement and post-retirement consumption choices. In this report, we focus on the version mailed to 476 individuals under age 65, since it is directly comparable to the web version on the ALP. Figure 1 contains the three pages at the end of the mail questionnaire on intertemporal consumption choice. The first page presents the hypothetical setting for the next four consumption questions. In an attempt to make choices across individuals comparable and to remove uncertainty, the respondents are asked to imagine that they (and their spouse) are currently age 50 and will retire at age 65. In this hypothetical setting, any future health care and nursing are fully insured and there is no inflation. From now until death at age 80, they have a guaranteed after-tax income of $3,000 per month. The following chart offers five patterns for monthly spending in pre-retirement (age 50-65) and post-retirement (age 65-80). The introduction to the question sequence also explains that individuals can borrow to raise their pre-retirement spending or save to raise their post-retirement spending.

On the next page, individuals are asked to choose their first and second choice patterns on the top chart with five consumption paths. Each pre-retirement and post-retirement pattern in the choice set implicitly imposes the following intertemporal trade-off: a $100 increase in monthly consumption before retirement requires a $100 decrease in monthly consumption after retirement or a real interest rate of 0%. The chart presents consumption paths visually and there is no direct

3 An annotated version of the mail questionnaire is online at http://hrsonline.isr.umich.edu/meta/1999/qnaire/01HR99MA.PDF. An experimental module on the 1992 HRS also asked similar consumption questions; see Barsky et al (1997) for a description and analysis of those questions.
mention of the interest rate. The responses to this question reveal an individual’s desired time path of consumption at a zero interest rate and are related to his subjective discount rate.

In the second chart on the same page of the questionnaire, respondents are asked to choose a consumption pattern under a higher implicit interest rate. They are told that spending $300 more per month before retirement would reduce their spending after retirement by $600 per month, that is, an annualized real interest rate of 4.6%. On the next page, the introduction to the third chart states that “the amount you save has an even bigger effect on how much you can spend later on.” The interest rate in this chart set is 9.2%, and in the final chart at the bottom of the page the interest rate increases again to 13.9%. Over the sequence of questions, the variation in the interest rate is graphically presented via its impact on the consumption choice set. As the interest rate – or the cost of current consumption – increases, economic theory predicts that an individual should choose a steeper consumption path. The elasticity of intertemporal substitution captures the degree to which an individual alters his consumption growth to take advantage of changes in the interest rate. These questions on the mail survey demonstrate how graphics and hypothetical scenarios can be used to measure the preferences that inform intertemporal consumption choices.

Nonetheless the flexibility of a mail survey is limited. All of the respondents face the same sequence of interest rates and the same choice sets, so we cannot explore the effect of question presentation on the responses. And numerous studies in survey methodology show that question effects can be substantial in such cognitively difficult choice tasks; see Sudman et al. (1996) for a survey and references. The discrete choice set also limits what we can learn about individual preferences. For example, an individual who chooses the steepest consumption path of Pattern E at each interest rate reveals nothing about his willingness to substitute intertemporally. More generally, the responses provide a range for, not a point estimate of, the desired consumption growth rate at a particular interest rate.

2.2 Web Survey

4 There is also a positive income effect from a higher interest rate, but this should affect the consumption levels, not the growth in consumption across the two periods.
A web survey offers enhanced graphics and more design flexibility, which makes it an ideal mode to measure intertemporal consumption choice. The second and sixth waves of the American Life Panel ask a sequence of intertemporal consumption choices. One of three versions is comparable to the discrete choice of the mail survey, but the other two versions use the graphics of the Internet. The second wave of the ALP entered the field in November 2004 and the sixth wave began in August 2006. The questions on both waves are identical.\footnote{The data was downloaded from the ALP on August 13-16, 2007 and includes all responses prior to that date.}

The hypothetical scenario and the substance of the consumption questions on the web survey are comparable to the mail survey. But the web survey randomizes the presentation of choice sets, uses two forms of implicit variation in the interest rate, and explores two methods of eliciting choice. This leads to three different versions of the sequence, as well as some variation in each version. Each respondent is randomly assigned to one of the three versions and then answers four or five questions in the sequence. About half of the respondents are given the first version of the questions, which is comparable to the mail survey, and the other half is split evenly between the new two versions of the questions.

*Web Version 1: Discrete Choice*

The first version of the consumption questions closely resembles the mail survey. The top panel of Figure 2 shows the screen that introduces the question sequence. The hypothetical scenario is identical to the mail survey. The introduction also explains that on the following screens that respondents will choose from five possible patterns of spending before and after retirement. The middle panel of Figure 2 shows the introduction to the chart with a 0% interest rate. Prior to each of the four questions with different interest rates, the respondent is given the dollar trade-off between pre-retirement and post-retirement consumption. The next screen in the bottom of Figure 2 presents the chart and asks individuals to select their first and second choice patterns. The presentation of the choices is nearly identical to the mail survey, except that respondents are instructed to click on the boxes or use the “Choose” button. Once a pattern is selected its rank appears (“1” or “2”) and it turns gray. In the complete sequence, the faces a 0%, 4.6%, 9.2%, and 13.9% implicit interest rate. The first version of the consumption questions on the web survey
has the same substance as the questions on the mail survey, but randomization in the presentation is used to isolate question effects and encourage active decision-making.

There are three new design features in the web version: 1) randomize the order of the interest rates, 2) provide more options to individuals who select extreme patterns of A or E, and 3) randomize the discrete choice set that an individual faces. Altogether, web respondents are randomly assigned to one of 6 interest rate sequences and to one of 18 chart presentation groups. They also have up to 11 consumption patterns per question from which to choose. This degree of variation in the instrument was simply not feasible on the mail survey.

Randomization of the interest rate sequence is the most straight-forward of the new features. Roughly 25% of the respondents are asked a sequence of questions with increasing interest rates (as in the mail survey) and another 25% face a sequence with decreasing interest rates. For the rest of the respondents, the interest rate increases between some questions and decreases between others. Unlike the mail survey, each consumption chart is preceded by a screen that explicitly states the trade-off between the monthly consumption in the two periods. There is still no explicit mention of the interest rate.

The web questions also offer individuals more consumption patterns from which to choose. As on the mail survey, the initial chart for a particular interest rate is a discrete choice among five patterns. However, if an individual selects an extreme pattern (A or E) as his first choice, then the next screen offers an expanded set of patterns. The top panel of Figure 3 shows an individual who selects the highest consumption growth rate or Pattern E as his first choice pattern at a 0% interest rate. The next screen provides this individual with three more patterns with growth rates higher than E from which to choose. Likewise if an individual chooses the lowest growth rate in the initial screen or Pattern A, then the next screen provides three patterns with lower growth rates. Individuals who select the intermediate patterns of B, C, or D as their first choice do not view an expansion screen and they move on to the next question with a different interest rate. The expansion screens allow the web survey to offer more choice to individuals (up to eleven patterns versus five patterns on the mail survey) without making the discrete choice on the initial screen overwhelming.
The presentation of the choice sets is the most important departure of the web survey from the mail survey. The consumption questions are cognitively difficult, so respondents may rely on cues from the choice set, rather than their true preferences, to determine their answers. On the mail survey, all of the respondents received the same four charts in the same order, thus we cannot isolate the effects of the presentation. In contrast, the web survey varies the choice sets that individuals face in three ways and thus we can begin to separate question effects from individual preferences.

The web survey varies the consumption growth rate of Pattern C across respondents, since the middle option may anchor responses. When the implicit interest rate is zero, a respondent views a Pattern C that offers either a positive 2.2%, a 0%, or a negative 2.2% annualized growth rate of consumption between the periods before and after retirement. Figure 4 illustrates the differences in the question charts. The set of choices in the top chart is identical to the choice set on the mail survey (Figure 1b). Respondents are randomly assigned with equal probability to one of the three Pattern C groups.

The left-to-right trend of the consumption growth rates in the choice set may also affect the responses. On the mail survey at each interest rate, the consumption growth rate ranged from a negative 2.2% at Pattern A to a positive 7.0% at Pattern E. The web survey splits respondents into two groups: growth rates increase from left-to-right or decrease from left-to-right. Figure 5 displays two possible charts in which the choice sets are the mirror image of each other. The top chart offers the same choice set as on the mail survey (Figure 1b).

The web survey also varies the choice set of consumption growth rates across the different interest rate questions for some respondents. On the mail survey, the choice set offers rates of -2.2% at A, 0.0% at B, 2.2% at C, 4.6% at D, and 7.0% at E in all four questions. As the interest rate changes across the questions only the levels of monthly consumption in the two periods adjust. The web survey also experiments with changing the choice set of the growth rates. Respondents are randomly assigned to one of three groups: 1) no change in the choice set across the interest rate questions, 2) growth rates in the choice set are positively related to the interest
rate, and 3) growth rates in the choice set are negatively related to the interest rate. Figure 6 illustrates this design feature with three different versions of the 9.2% interest rate question. An individual who receives Chart 1 version in the left column would view only one of the Chart 3 versions in the right column. The choice set of growth rates at a 0% interest rate is identical (up to rounding errors) to the choice set at a 9.2% interest rate for the middle Chart 3. This pair of charts also corresponds to the questions on the mail survey. An individual who, instead, receives the top version of Chart 3 will be offered smaller growth rates in the initial screen as the interest rate increases. However, he can use the expansion screens to find three higher growth rates. The reverse pattern holds for individuals assigned to the bottom version of Chart 3. On the mail survey, several respondents choose the same pattern, for example Choice B, in all four questions. This behavior could reveal either a low willingness to substitute consumption intertemporally or simply reflect a survey response strategy similar to guessing the same answer on a multiple choice test. Random variation in the choice set of growth rates across questions begins to separate these two response sources and encourages active decision-making on each question in the sequence.

All three randomizations in the choice set presentation are done independently, so individuals are separated in 18 presentation groups. The sequence of the interest rates also varies within each of these groups. The first version of the consumption questions on the web survey demonstrates how much the flexibility of the web survey can extend the scope of the questions.

Web Version 2: Moveable Bars

The second version of the consumption pushes the Java-enabled graphics of the Internet even further. As the top two screens in Figure 7 show, the respondents face the same hypothetical scenario and differences in the tradeoff between consumption before and after retirement are again used to implicitly vary the interest rate. The elicitation of the desired consumption pattern is the new feature. Instead of a discrete set of choices, respondent in this version move the spending bars to make their consumption choice. They can either use the “+$100” and “-$100” buttons or they can use their mouse to drag the bars into place. The consumption pattern is always affordable given their total expected income and the interest rate in that question. As the
respondents manipulate the spending bars, the trade-off between consumption before and after retirement is illustrated for them in real-time. Their final answer is recorded when they click “Next,” but the instrument also records their interim answers. Other than the method of recording their consumption choice, the second version of the web survey is identical to the mail survey.

*Web Version 3: Wide Bars*

The third version of the web survey uses a different method to implicitly vary the interest rate. As the top screen in Figure 8 describes, there is always a one-to-one trade-off between consumption in the first period and second periods. But the length of the two periods varies across the five questions. The 30 year period from age 50 to 80 is split in different 5-year increments which implicitly alters the interest rate. The middle screen shows the introduction to the question with a 5 year early period and a 25 year later period. As in the second version, respondents move the bars to select their consumption path. The width of a bar is proportional to the period length, which illustrates how the period lengths affect the division of consumption.

### 3. PRELIMINARY RESULTS

This section presents the results from intertemporal consumption questions in the ALP Internet survey and the HRS Mailout. Table 1 compares the demographics of respondents in the Internet and mail surveys. The Internet respondents are somewhat younger with an average age of 49 versus an average age of 55 in the mail survey. A higher fraction of the Internet respondents are male relative to the mail respondents – 45% versus 39%. Educational attainment reveals an important difference between the two samples. While 46% of the Internet respondents have a college degree, only 28% of the mail respondents have a college degree. However, level of education is 44% for the mail survey respondents who regularly use the Internet. The over-representation of individuals with higher education in the Internet survey may limit our ability to

6 In this table and the subsequent analysis, we pool the responses from two waves of the ALP together. There were no qualitative differences in the results from each wave.
generalize the results from these cognitively difficult survey questions and affect the comparison of results across the two survey modes.

Table 2 describes the response rates on the different versions and survey modes. The first row provides the number of individuals assigned to the question version. In these tabulations an individual could be “assigned” to more than one version. The moveable and wide bars versions both required a respondent to have a Java-enabled browser. If this requirement was not met or if respondents had other technical difficulties answering this version, they were re-assigned to the discrete choice question. This led to a larger number of respondents to the discrete choice version which had considerably fewer technical difficulties. The moveable bar version had an error in the instrument which reduced the number of valid responses. The rounding function associated with the right buttons of “+$100” and “-$100” did not function as expected and did not maintain the correct trade-off in consumption. Individuals who used these buttons at any point in their sequence of responses are excluded from the analysis.

The bottom panel of Table 2 examines the active responses of individuals with a valid survey instrument (with no technical difficulties). On the moveable bars and wide bars version, a respondent passively accepts the initial consumption path that is randomly generated by the survey instrument by clicking “Next” and moving on to the next question. The Internet survey does prompt individuals who have not changed the instrument and asks them to reconsider their skipping of the question. All mouse clicks and dragging of the bars are recorded in the output, so an active decision to choose the initial value (after experimenting with other values) can be distinguished from a passive acceptance. A final value that differs from the initial value is also considered an active response. In the discrete choice versions, an active response is the selection of a first choice consumption pair. In the Internet survey few individuals (between 0% and 3%) provide no active responses, but almost 17% of the respondents in the mail survey provide no responses to the consumption questions. In all of the versions and modes the vast majority of individuals provide active responses on all of the questions except one. A complete set of active responses is less common, especially on the wide bars which ask 5 questions (on more than the other versions).
Figure 9 characterizes the slope of the desired consumption path over pre- and post-retirement when the interest rate is 0%. Each panel contains a different version or interview mode. The consumption paths that individuals choose are summarized with three broad groups: downward-sloping, flat, and upward sloping. With both the moveable bars and wide bars, a downward sloping consumption path is chosen most often and the flat path is the least popular. With the discrete choice in the Internet survey, the flat consumption path is somewhat more popular and the remaining respondents split between upward sloping and downward sloping. The mail survey reveals a starkly different pattern with the vast majority of respondents choosing the upward sloping path.

Figure 10 shows how the desired growth rate of consumption changes as the annualized interest rate increase from 0% to 13.9%. The higher interest rate implies that the opportunity cost of current consumption has increased relative to that of future consumption. Individuals who have a positive elasticity of intertemporal substitution should be willing to shift pre-retirement consumption to post-retirement, that is, the growth rate of consumption should be higher when the interest rate is 13.9% than when the interest rate is 0%. A low or zero elasticity would yield little change in the desired consumption growth rate. With the moveable bars almost 60% of the respondents increase their desired consumption growth rate as the interest rate rises. But almost 30% move in “wrong” direction and choose a lower growth rate. A similar pattern emerges with the wide bars and discrete choice in the Internet survey, but these versions yield fewer increases in consumption growth rates. The final panel underscores the degree of anchoring in the mail survey. Over 45% of the respondents do not change their desired consumption path as the interest rises. Slightly more increase their consumption growth rates than decrease them, but the difference is much smaller than in the Internet versions.

The lower degree of anchoring in the Internet survey does come at a cost of fewer consistent responses. Assuming that individuals have weakly positive elasticities of intertemporal substitution, consumption growth rates must change in the same direct as the change in the

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7 The remaining analysis of the moveable bars and wide bars includes individuals who provided all but one active response. The analysis of the discrete choice includes individuals with four active responses (since there is no passive response).
8 The level of consumption in pre-retirement need not decrease, since there is a wealth effect for savers from the higher interest rate; however, the consumption growth rate should increase as the interest rate increases.
interest rates or not change at all to be “consistent.” The Internet versions randomize the order of the interest rate sequence and provide individuals with more flexibility in their responses than the discrete choice questions in the mail survey. Table 3 shows that the overall consistency of responses in the Internet survey is lower than in the mail survey. We compare three pairs of annualized interest rate changes: 1) from 0% to 4.6% 2) from 4.6% to 9.2% and 3) from 9.2% to 13.9%. Very few individuals provide inconsistent responses across all three pairs of questions. In the Internet survey, the majority of respondents (66% to 80%) provide consist responses to all questions except one, but relatively few provide all consist responses (between 27% to 37%). The mail survey has notably higher consistency rates, but the anchored responses would appear consistent.

Table 4 uses the responses to the intertemporal consumption questions to estimate the average elasticity of intertemporal substitution \( s \) and the growth rate of consumption at a zero interest rate \(-s\rho\). Each column uses the responses from a different version of the question. A pair of responses from an individual is used to form an estimate of the elasticity \( s \):

\[
s_{jk} = \frac{\log(C_{2k} / C_{1k}) - \log(C_{2j} / C_{1j})}{\log R_k - \log R_j} = \frac{(g_k - g_j)/(r_k - r_j)}
\]

Each individual answers four questions with \( R = \{1, 2, 4, 8\} \), so we form three estimates of \( s \) for each individual. Table 4 provides the average value of the parameter across different changes in the interest rate. Each row provides the estimates from a regression of the individual estimates on a constant. The standard errors in parentheses are clustered to account for multiple observations from one person. The fourth row pools the estimates of \( s \) using all three interest rate changes for a given version. The estimates from the two versions of the Internet survey are generally small positive values. In some cases the point estimates is statistically different from zero at the 5% level, but it is always statistically different from one – the parameter value associated with the common log utility specification. With the moveable bar version the average elasticity of intertemporal substitution is 0.10 with a standard error of 0.03. None of the elasticities estimated from the mail survey are statistically different from zero. The average elasticity of 0.01 from the mail survey is roughly an order of magnitude smaller than the average elasticity from the Internet survey.
As Figure 9 previewed, there is considerable difference in the desired growth rate at zero interest rate. In the internet survey, on average respondents choose a flat consumption path when the interest rate is zero. In contrast, the mail survey respondents prefer an upward-sloping consumption path favoring consumption in the later period.

Table 5 examines the effect of response behavior on the estimated parameter values. As in Table 4 each row (and column) represents a separate regression. In the first row, the average elasticity is calculated with individual who always gave consistent responses. The second row repeats the calculation with individuals who gave at least one inconsistent response. Unsurprisingly, the estimated elasticity is considerably higher for consistent respondents. For example, with the moveable bars the average elasticity of always consistent respondents is 0.32 (standard error of 0.07) versus 0.03 (standard error of 0.03) for inconsistent respondents. The difference is larger in the two Internet versions than in the mail survey. The third and fourth row of Table 5 shows that the average elasticity in the moveable bars version does not differ much if the calculations use active versus passive responses. And the bottom panel reveals little difference in the average consumption growth rate at a zero interest rate relate to consistent or active responses in the Internet survey. In the mail survey, consistent respondents do tend to choose a flatter consumption path at a zero interest rate than inconsistent respondents.

Table 6 uses a multivariate regression to examine whether demographic characteristics can account for the heterogeneity in the individual parameter estimates. The dependent variable in the top panel is the individual elasticity estimate $s$ and in the bottom panel is the growth rate $-\rho$. Both regressions pool the individuals’ estimates from the three interest rate changes. Neither age, gender, nor a college degree has little discernible effect on the elasticity of intertemporal substitution or the desired growth rate at a zero interest rate.

The questions were included on two waves of the Internet study, so we could use repeat observations from some individuals to separate survey response error from true preferences. Maximum-likelihood estimation techniques are needed to implement such a statistical model. The preliminary results in the current draft suggest that these are important extensions to pursue.
4. CONCLUSION

The graphics and flexibility of the web survey have expanded our ability to measure individuals’ subjective discount rate and elasticity of intertemporal substitution, as well as encourage active decision-making in a series of cognitively difficult questions. Nonetheless this first use of the web to study intertemporal consumption has required considerable attention to the data. First the graphical content of the survey instrument requires substantial programming and software capability. The programming of the web survey makes the instrument less transparent to the analyst than a standard mail survey. This impedes both the testing of the instrument and the analysis of the data. In addition, only respondents with Java-enable browsers could view the questions with moveable bars. There are also issues with the data summary and delivery unique to the web survey. In particular, the web tracks respondents’ intermediate choices (at the frequency of clicks) as well as their final choices. This wealth of data means that the analyst and programmer must work closely to develop a useful format for the output. The integration of the data from the choice process in the analysis represents a further challenge. This paper has introduced the intertemporal consumption questions on the web-based American Life Panel and provided initial estimate of fundamental parameters in economics.
WORK CITED


APPENDIX: COMMENT DATA FROM THE WEB SURVEY

The following is a selection of the comments from respondents at the end of the web survey.

Question Confusion:

I found the questions regarding how much we’d spend before and after retirement very difficult to answer.

The questions were interesting but I did not understand what you were getting at with the series about expenses before and after retirement--made no sense to me.

… And it will be obvious that the graphs with the questions about retirement spending made no sense to me. Maybe I was still distracted by the thought of a guaranteed income of $3000 a month that I’ve certainly never seen in my working life. I’m afraid I don’t see the point of most of the questions.

the graph portion of the interview was a bit tough to grasp. I’m not sure if I didn’t completely understand the concept or it was the wording associated with the graphs. The graphs themselves were very helpful, however.

chart questions were meaningless to me

some of your questions are too intense....I hate graphs

The questions relating to the graphs were somewhat confusing and vague.

The questions related to the charts/graphs were confusing. The structure of the survey minimized my ability to do an effective job on the survey. Questions should be designed/written to cater to the least educated person the may take the survey. I recommend designing surveys that someone in sixth grad could answer.

Some of the questions are repetitive, to the point you want to get out of this interview.

I clicked right through the graph questions ... so I have no idea what may have registered. I’ve always had trouble with graphs, maps, 3-dimensional "how-many-cubes-are in this design?" problems.

On the retirement spending questions, you should state what trend you are looking for-I gave rather arbitrary answers.

Questions with graphs of spending, were confusing and I gave an answer, then it seemed you wanted me to second guess my answer. Annoying.

questions on spending before and after retirement not very useful for me since I am right on the edge. think the age breakdown should be different.

Those numbers graphs were confusing to me, a non-mathy person
**Technical Issues:**

The graphs were not illustrated proportionately to show the proper comparisons between amounts to be had before/post retirement. That is, the amounts written on top of the bars did not match up with the left axis numbers.

I had one problem with one chart (the first one) the “next” and “back” buttons were below my screen and I could not use them.

Some of the questions would have benefited from split screen presentation so that answers to one question can be viewed when answering the next question. A clearer correlation of accurate answers would be provided.

I had some difficulty with the charts, initially. I had to exit and reload the survey. I was very pleased that it took me to the exact spot where I needed to reply next.

Have had several problems completing this e-mail interview. On one previous attempt, I could not access a "next" box that was below a couple of bar graphs.

I would have liked to have seen the graphs the did not come up because, apparently, my e-mail was not processing “java” scripts. At the start of the next survey, perhaps you can tell us how to enable “java” scripts so I can see these next time.

**Reaction to Question**

The choices of spending before and after retirement brought on feelings of fear. I don’t like to have fear about retirement and I have a lot of plans for a great retirement, but now I’ll be more cautious spending until I do! Thank you

These questions were certainly thought provoking! Well worded and arranged. Thank you!

Thought provoking questions that forced me to consider my health, finances, retirement income, and possible lifespan. Such a questionnaire tells the individual taking it as much if not more than the group giving it.

Questions really make you use your brain.
Figure 1a: Sequence Introduction on 1999 HRS Mailout

Q49. Now we have a few questions about your preferences for spending and saving over time. To make the questions comparable for all respondents in the survey, let’s suppose that you are now 50 years old, that you [and your (husband/wife)] will retire when you are 65, and that you [and your (husband/wife)] will live until you are 80. Further suppose that

- future health care and nursing home costs are fully covered by insurance,
- there will be no inflation, and
- your income after taxes is guaranteed to be $3000 each month from age 50 to age 80.

Chart 1 on the next page shows five possible patterns of monthly spending before retirement (the light bars) and after retirement (the dark bars). You could borrow and spend more than your monthly income before retirement, spending less than your monthly income and repaying the loan after retirement, as in choice A. Or you could just spend your income each month, as in choice B. Or by saving part of your income before retirement, you could have more to spend after retirement, as in choices C, D and E. Choices D and E represent saving more than choice C.

Note: The intertemporal consumption questions are asked at the end of the mail survey. This page of the survey provides the setup for the next four questions.
Figure 1b: First Two Consumption Questions on Mail Survey

Recall that you can afford any of the spending patterns shown in Chart 1 below. Which pattern of spending do you like most among A, B, C, D, and E in Chart 1? Please put a "1" in the white box of your first choice pattern and a "2" in the white box of your second choice pattern.

Chart 1

Q50. Chart 2 below shows different possible spending patterns over time. As before, by saving part of your income before retirement, you can have more to spend after retirement. Chart 2 is different because the amount you save has twice as big an effect on how much you can spend later on. For example, in choice A, spending $300 more per month for the next 15 years before retirement reduces the spending you can do for the 15 years after retirement by $600 per month. Please put a "1" in the white box of your first choice pattern and a "2" in the white box of your second choice pattern.

Chart 2

Note: This is the second page of the consumption questions.
We want to ask you about two more scenarios in which the amount you save has an even bigger effect on how much you can spend later on. As before, each scenario has a chart showing the set of choices you can afford in that scenario.

Q51. Which pattern of spending do you like most among A, B, C, D, and E in Chart 3 below? Again, please put a "1" in the white box of your first choice pattern and a "2" in the white box of your second choice pattern.

Q52. Chart 4 below shows the final set of choices. Which pattern of spending do you like most among A, B, C, D and E in Chart 4? Please put a "1" in the white box of your first choice pattern and a "2" in the white box of your second choice pattern.

Note: This is the third and final page of the consumption questions. The rest of the mail survey asks respondents to rate the questionnaire and provide comments.
Figure 2a: Sequence Introduction to Web Version 1

Now we have a few questions about your preferences for spending and saving over time. To make the questions comparable for all respondents in the survey, let’s suppose that you are now 50 years old, that you will retire when you are 65, and that you will live until you are 80. Further suppose that:

- future health care and nursing home costs are fully covered by insurance,
- there will be no inflation, and
- your income after taxes is guaranteed to be $3000 each month from age 50 to age 80.

In the following screens, we will ask you to choose from five possible patterns of spending before retirement (the blue bars) and spending after retirement (the gold bars) in a number of different situations.

Choose "Next" to continue.

---

Figure 2b: Introduction to 0% Interest Rate Question

The next screen shows five possible patterns of monthly spending. In the first situation, increasing spending before retirement by $100 reduces spending after retirement by $100. Increasing spending after retirement by $100 reduces spending before retirement by $100.

Choose "Next" to continue or "Back" to go back.

---

Figure 2c: Consumption Choice with 0% Interest Rate

Chart 1
Recall that you can afford any of the spending patterns shown in Chart 1 below. Which pattern of spending do you like most among A, B, C, D, and E in Chart 1?
Please click first in the white box of your first choice pattern and then in the box of your second choice pattern or use the 'choose' buttons.

Choose "Next" to continue or "Back" to go back.
Figure 3a: Extreme Choice in First Chart Screen

Note: This is an initial chart for the 0% interest rate question, in which the individual selects Pattern E with the highest consumption growth rate as the first choice pattern.

Figure 3b: Next Screen Offers More Patterns

Note: This screen appears after Figure 3a. The respondent may choose E again but also has three new patterns with growth rates higher than E to choose from. Likewise the expansion screen for an individual who chooses A in Figure 3a offers three growth rates lower than A. There is no expansion screen for individuals who select B, C, or D as their first choice.
Figure 4: Randomize Consumption Pattern at C

Note: A respondent would only view one of these three charts for a 0% interest rate. The presentation of a positive, zero, or negative consumption growth rate at the middle pattern is varied randomly.
Figure 5: Randomize Left-to-Right Trend in Patterns

Chart 1
Recall that you can afford any of the spending patterns shown in Chart 1 below. Which pattern of spending do you like most among A, B, C, D and E in Chart 1?
Please click first in the white box of your first choice pattern and then in the box of your second choice pattern or use the 'choose' buttons.

Note: A respondent would only view one of these two charts. The presentation of a left-to-right increase or a left-to-right decrease in the consumption growth rates is varied randomly. All four of the questions in the sequence will have the same orientation for a particular respondent.
Figure 6: Randomize Consumption Growth Rates in Choice Set

Note: A respondent would views Chart 1 above would only view one of three version of Chart 3. The consumption growth rates for Patterns A to E in Chart 1 are the same (except for rounding) as in the middle Chart 3. For a particular respondent across the four questions, the consumption growth rates in the choice set will either vary positively, not change or vary negatively with the interest rate.
Figure 7a: Sequence Introduction to Web Version 2

Now we have a few questions about your preferences for spending and saving over time. To make the questions comparable for all respondents in the survey, let’s suppose that you are now 50 years old, that you will retire when you are 65, and that you will live until you are 80. Further suppose that:

- future health care and nursing home costs are fully covered by insurance,
- there will be no inflation, and
- your income after taxes is guaranteed to be $3000 each month from age 50 to age 80.

With the bars on the next screens you can choose your spending before and after retirement either by moving the bars up and down with the mouse or clicking the buttons below the bars. We will ask you to make these choices in four different situations.

Choose “Next” to continue or “Back” to go back.

Figure 7b: Introduction to 0% Interest Rate Question

In the first situation shown on the next screen, increasing spending before retirement by $100 reduces spending after retirement by $100. Increasing spending after retirement by $100 reduces spending before retirement by $100.

Choose “Next” to continue or “Back” to go back.

Figure 7c: Consumption Choice with 0% Interest Rate

Please move the bars up and down until you are satisfied with your choice of spending before and after retirement. Then choose “Next.”

Choose “Next” to continue or “Back” to go back.

Note: The only difference between this version on the web and the first version is the way in which individuals make their consumption choices. Here they click on the “+$100” and “-$100” buttons or drag the bars with their mouse. The final answer is when they click “Next.” Interim answers are also tracked.
Figure 8a: Sequence Introduction to Web Version 3

Now we have a few questions about your preferences for spending and saving over time. To make the questions comparable for all respondents in the survey, let's suppose that you are now 50 years old and that you will live until you are 80. Further suppose that:

- future health care and nursing home costs are fully covered by insurance,
- there will be no inflation, and
- your income after taxes is guaranteed to be 3000 each month from age 50 to age 80.

The 30 years you have left to live are divided into an early period and a later period— which may be of different lengths of time. In each of the following situations, spending $100 per month more in one period leaves $100 per month less to spend in the other period.

With the bars on the next screens you can choose your spending before and after retirement either by moving the bars up and down with the mouse or clicking the buttons below the bars. We will ask you to make these choices in five different situations.

Choose "Next" to continue or "Back" to go back.

Figure 8b: Introduction to 5 Year/25 Year Question

In the first situation shown on the next screen, the early period is 5 years long, from age 60 to age 55. The later period is 25 years long, from age 55 to age 80.

Increasing spending from age 50 to 55 by $100 reduces spending from age 55 to 80 by $100. Increasing spending from age 55 to 80 by $100 reduces spending from age 50 to 55 by $100.

Choose "Next" to continue or "Back" to go back.

Figure 8c: Consumption Choice with to 5 Year/25 Year

You can move the amounts of your monthly spending in the early period and the later period up and down with your mouse.

Note: This version varies the length of the two time periods and holds constant the dollar tradeoff in consumption between the two periods. The response method is similar to the second version.
NOTE: The desired paths of consumption in pre- and post-retirement are separated in three broad groups 1) downward sloping or “down” 2) same consumption in both periods or “flat” and 3) upward sloping or “up.” Each panel depicts the results from a version of the questions. The tabulations include respondents to moveable bars with at least 3 of 4 active responses, to discrete choice with 4 responses, and to wide bars with at least 4 of 5 active responses. The responses in wave 2 and wave 6 of the ALP are pooled together to calculate the percent in each growth profile.
Figure 10: Change in Slope of Consumption Path as Interest Rate Increases

NOTE: For the moveable bar and discrete choice versions, the annualized interest rate increases from 0% to 13.9%. The wide bar question, the first length of the first period falls from 15 years to 5 years (out of 30 years total). The change in the desired consumption growth rate for each individual is assigned to one of three broad groups 1) increasing 2) same and 3) decreasing. Since the interest rate – the cost of pre-retirement spending – increases, an economically consistent response is to choose a higher (or unchanged) consumption growth rate. Sample includes respondents to moveable bars with at least 3 of 4 active responses, to discrete choice with 4 responses, and to wide bars with at least 4 of 5 active responses. The responses in wave 2 and wave 6 are pooled together to calculate the percent in each growth profile.
Table 1: Demographics of Respondents

<table>
<thead>
<tr>
<th></th>
<th>ALP Internet</th>
<th>HRS Mailout</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Age</td>
<td>49.4</td>
<td>56.0</td>
<td>55.1</td>
</tr>
<tr>
<td>(Std. Dev.)</td>
<td>(16.9)</td>
<td>(5.5)</td>
<td>(5.5)</td>
</tr>
<tr>
<td>College Degree</td>
<td>46%</td>
<td>28%</td>
<td>44%</td>
</tr>
<tr>
<td>Male</td>
<td>45%</td>
<td>39%</td>
<td>37%</td>
</tr>
<tr>
<td>Respondents</td>
<td>893</td>
<td>397</td>
<td>207</td>
</tr>
</tbody>
</table>

NOTE: Tabulations include individuals with at least one active response to a valid survey instrument.
Table 2: Response Rates to Intertemporal Consumption Questions

<table>
<thead>
<tr>
<th></th>
<th>ALP Internet Survey</th>
<th>HRS Mailout</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moveable Bars</td>
<td>Discrete Choice</td>
</tr>
<tr>
<td>Total Assigned to Questions</td>
<td>431</td>
<td>928</td>
</tr>
<tr>
<td>% Technical Difficulties</td>
<td>49%</td>
<td>6%</td>
</tr>
<tr>
<td>Total Valid Survey Instrument</td>
<td>220</td>
<td>876</td>
</tr>
<tr>
<td>% No Active Responses</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>% All Active Except One</td>
<td>93%</td>
<td>93%</td>
</tr>
<tr>
<td>% All Active Responses</td>
<td>71%</td>
<td>86%</td>
</tr>
</tbody>
</table>

NOTE: The tabulations pool the responses in wave 2 and 6 of the ALP. The first two Internet versions ask 4 questions and the third asks 5 questions. The mail survey asks 4 questions.
Table 3: Consistent Responses across Questions

<table>
<thead>
<tr>
<th>Responses Consistent</th>
<th>ALP Internet Survey</th>
<th>HRS Mailout</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moveable Bars</td>
<td>Discrete Choice</td>
</tr>
<tr>
<td>None</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>All Except One</td>
<td>71%</td>
<td>80%</td>
</tr>
<tr>
<td>All</td>
<td>27%</td>
<td>37%</td>
</tr>
<tr>
<td>Respondents</td>
<td>204</td>
<td>753</td>
</tr>
</tbody>
</table>

NOTE: Tabulations include individuals with at most one passive response on the bars and with four active choices on the discrete choice. The responses in a pair of questions are consistent if the desired growth rate of consumption changes in the same direction as the interest rate. There are 3 pairs for the versions with 4 questions and 4 pairs for the version with 5 questions.
### Table 4: Average Parameter Estimates

<table>
<thead>
<tr>
<th></th>
<th>ALP Web Survey</th>
<th>HRS Mailout</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moveable Bars</td>
<td>Discrete Choice</td>
</tr>
<tr>
<td>Elasticity of Intertemporal Substitution: $s$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest Rate Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0% to 4.6%</td>
<td>0.08</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>4.6% to 9.2%</td>
<td>0.12</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>9.2% to 13.9%</td>
<td>0.11</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>All Changes Pooled</td>
<td>0.10</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Consumption Growth Rate at 0% Interest Rate: -$s\rho$</td>
<td>-0.004</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
</tbody>
</table>

Respondents: 198, 617, 355

**NOTE:** The average parameter value in each row is from a regression of individual’s calculated parameter on a constant. The responses from the two waves of the ALP are pooled together. The standard errors clustered to account for within-person variance correlations.
Table 5: Average Parameter Estimates by Response Behavior

<table>
<thead>
<tr>
<th></th>
<th>ALP Web Survey</th>
<th>HRS Mailout</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moveable</td>
<td>Discrete</td>
<td>Discrete</td>
</tr>
<tr>
<td></td>
<td>Bars</td>
<td>Choice</td>
<td>Choice</td>
</tr>
<tr>
<td><strong>Elasticity of Intertemporal Substitution: s</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always Consistent</td>
<td>0.32</td>
<td>0.27</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.02)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Some Inconsistent</td>
<td>0.03</td>
<td>-0.02</td>
<td>-0.13</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Active Responses</td>
<td>0.11</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive Responses</td>
<td>0.09</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Consumption Growth at 0% Interest Rate: -s ρ</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always Consistent</td>
<td>-0.005</td>
<td>-0.0005</td>
<td>0.011</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Some Inconsistent</td>
<td>-0.004</td>
<td>0.002</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Active Responses</td>
<td>-0.003</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive Responses</td>
<td>-0.009</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: The average parameter value in each row is from a regression of individuals calculated parameter on a constant. An individual who always changes her desired consumption growth in the same direction as the interest rate is an “always consistent” respondent. If the responses used to calculate the dependent variables (the parameter estimate) are the result of the respondent moving the bars then the response is “active.” Responses from the two waves of the ALP are pooled together. The standard errors clustered to account for within-person variance correlations.
Table 6: Average Parameter Estimates with Demographics

<table>
<thead>
<tr>
<th></th>
<th>ALP Web Survey</th>
<th>HRS Mailout</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moveable Bars</td>
<td>Discrete Choice</td>
</tr>
<tr>
<td><strong>Multivariate Regression</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Elasticity of Intertemporal Substitution: s</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age / 10</td>
<td>0.02</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Male</td>
<td>-0.04</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>College</td>
<td>-0.01</td>
<td>-0.02</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.01</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(0.08)</td>
</tr>
<tr>
<td><strong>Consumption Growth Rate at 0% Interest Rate: -sρ</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age / 10</td>
<td>-0.005</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Male</td>
<td>-0.002</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>College</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.003)</td>
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<tr>
<td>Constant</td>
<td>0.021</td>
<td>-0.012</td>
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<tr>
<td></td>
<td>(0.013)</td>
<td>(0.008)</td>
</tr>
</tbody>
</table>

NOTE: The top panel reports the coefficient estimates from the regression of the calculated elasticity on a small set of demographic controls. The bottom panel repeats the multivariate regression for consumption growth at a zero interest rate. The responses from the two waves of the ALP are pooled together. The standard errors clustered to account for within-person variance correlations.