What Is an Adequate Standard of Living During Retirement?*

PRELIMINARY

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Abstract

The question of what is an adequate level of retirement spending is key for the discussion about whether people adequately prepare for their old age. However, surprisingly little is known about what represents an adequate expenditure level during retirement given the overall lifetime budget constraint. In this paper we address this issue by conducting a survey with the American Life Panel at RAND, and with the Dutch CentER and LISS panel. We go to great length to ask survey questions that are meaningful to respondents and to reduce cognitive load as much as possible. Our findings suggest that adequate "expenditure replacement rates" exceed 70 percent. Minimum acceptable replacement rates decrease with income. The latter gradient effect is particularly pronounced for the US.

Key words: Retirement preparation, retirement income, replacement rates, risk aversion, pension reform.

JEL classification: D91, H55.

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1 Introduction

A large number of countries considers reducing their pay-as-you-go pension component and relying on more funded "privatized" systems. A key issue that arises is how much freedom of choice should be given to individuals in the context of more privatized systems. Whether more freedom of choice should be promoted is, to a major extent, a question of whether it is believed that individuals would prepare adequately for their old age when left with greater own responsibility.

The debate on adequate old-age provision raises the question of what we actually mean by "adequate." One possibility would be to pretend knowledge of individuals' true preferences. One may then calibrate old-age provision choices that are optimal under such preferences and deem old-age provision choices adequate if they come close to these calibrated choices. This is the route taken by an ambitious study by Scholz et al. (2006). Within the realm of neo-classical economics this approach is a very natural one if not the only correct one. However, evidence ranging from the stock-market participation puzzle to the equity premium puzzle calls into question whether economists have already discovered individuals' "true" preferences.[1] In turn, this suggests that one should be cautious when interpreting adequate old-age provision in terms of calibrated optimal old-age provision choices under, say, constant-relative-risk-aversion preferences.

An alternative route is taken by Banks et al. (2005). These authors make an attempt to capture adequacy by means of ad-hoc threshold values of so-called replacement rates.[2] Such replacement rates are meaningful even under complete ignorance of individuals' preferences. However, they are not well defined if old-age income is uncertain, which may result from uncertain stock returns or from uncertainty about the price at which a house can be sold. Would a

[1] See, for instance, Binswanger (2006, 2007) and Campbell (2006).

[2] Here, the term replacement rate refers to the ratio of annual disposable income during retirement to annual disposable income during the last years of working life. Below, we will often use this term more generally, referring to the ratio of the (average) value of an annual flow variable during retirement to the (average) value of the same variable during (part of) working life. We will be more clear on this in what follows, such that there should be no danger of misunderstanding.

target value thus refer to the expected replacement rate? Or to its 10th percentile?

This paper makes an attempt to provide direct quantitative measures of adequate old-age provision that (1) respect the concept of individual preferences, (2) do not require previous knowledge of those preferences and are not based on particular functional forms of those preferences, and (3) are meaningful in the presence of uncertainty. We infer such measures be means of a survey. In particular, we field a specifically designed survey module with the CentER Panel, a Dutch Internet Panel which is representative for the Dutch population.[3]

A first set of questions in our survey investigates the preferred ratio of expenditures during retirement to expenditures during working life in the absence of any uncertainty. This yields preference-based benchmark replacement rates for what one may interpret as a "normal" or "expected" scenario. The next set of questions is concerned with developing several measures of adequacy that are meaningful in the presence of risk. We do so in three ways. First, we ask about a minimum level of expenditures during retirement that respondents would not want to be undercut "at all costs." Second, we ask respondents to rate several risky retirement-income prospects that reflect different levels of equity investments, according to a stylized calculation. Third, we also elicit the parameter of relative risk aversion using a multiple-price-list format.

Our questionnaire is characterized by a number of features that stand out. Several questions involve hypothetical choices among several options or the rating of such options. All numbers that specify these options are calculated from previously available information on a respondent's income, as well as on other information that is specific to a respondent. This makes the options much more meaningful to respondents and reduces the cognitive load of the questions. We believe that this feature is important for improving the quality of responses.[4] Second, all questions are explicitly framed in terms of old-age provision. In particular, to our knowledge, our study is the first eliciting the parameter of relative risk aversion in such a context. Third, we include feedback questions that allow us to investigate to what degree individuals feel confident

[3]We plan to repeat our questionnaire with the American Life Panel (ALP) at RAND in the US.

[4]Kapteyn and Teppa (2003) is the only existing study that we are aware of which ties the options appearing in the questionnaire to the respondents' incomes.

with a particular question. Fourth, we include a number of randomization treatments in order to investigate to what degree individual answers are robust with respect to order and framing effects.

We would like to stress that it would be very difficult to obtain information on adequate old-age provision other than by means of a survey. In particular, such information cannot easily be inferred from available data on actual old-age provision choices. One reason is that such choices are constrained by the institutional design of a country's pension system, e.g. by mandatory contributions to a pay-as-you-go system. Second, individuals' actual choices do not allow for inference of their "true" preferences whenever individuals suffer from lack of appropriate financial knowledge or misunderstanding of compound returns etc.[5] In contrast, none of the questions in our survey require proper understanding of compound returns nor any specific financial knowledge.[6]

This does not mean to deny that surveys have problems of their own. In particular, the framing of questions may influence responses. Respondents may give different answers depending on the number of options that they are confronted with. Also, people may simply have no interest in answering certain questions and, as a result, always tick the first or last option. Many of these problems, however, can substantially be mitigated by a careful design such as a careful selection of the options presented, by means of randomization treatments, and by means of feedback questions.[7]

The main findings from our survey are the following. Neglecting risk, people aim for a profile where expenditures during retirement amount to between 70 and 100 percent of working-life expenditures. Using our question on minimally desired old-age expenditures we are in a position to calibrate minimally acceptable replacement rates (say, in terms of the ratio of these expenditures to annual income in the last years of working life). Based on our preferred

[5]Field experiments may potentially be confronted with the same problems. Furthermore, it is rather obvious that incentivized laboratory experiments would not qualify as promising either.

[6]See van Rooij et al. (2007) for the fact that financial illiteracy is very widespread.

[7]For instance, the (alleged) tendency to choose always the first (or last) option can be neutralized by randomizing the order of the response options.

estimation these rates amount to 77, 82, 69, 68, and 65 percent for the five income quintiles, respectively.

Concerning risk aversion we do not obtain a very clear-cut picture. Individuals seem to like a safe old-age income while, at the same time, they also like benefiting from upside potentials of more risky retirement prospects. To our surprise we find that respondents are satisfied with a large array of scenarios that, according to a stylized calculation, range from a situation with very low equity investments to a situation with a rather high amount of equity investments. Concerning the parameter of relative risk aversion we find a huge amount of heterogeneity. We also find that measured values of relative risk aversion are significant predictors of how individual rate risky prospects. On the other hand, we also find that constant-relative-risk-aversion preferences are not fully consistent with how respondents rate risky retirement-income prospects.

Existing studies that have explored intertemporal and risk preferences by means of surveys are Barsky et al. (1997), Donkers et al. (2001), Kapteyn and Teppa (2003), and Kimball et al. (2006). The aim of these studies is to identify preference parameters, most notably the elasticity of intertemporal substitution or the coefficient of relative risk aversion. Barsky et al. (1997) and Kimball et al. (2006) present questions that are related to old-age provision. However, a specific investigation of preferences over old-age provision choices is not the main concern of their studies. Our questionnaire differs from previous surveys as many of our questions do not refer to specific preference models but are somehow of a more "non-parametric" nature. Using the CentER Panel, van Rooij et al. (2006) investigate preferences over defined-benefit versus defined-contribution pensions. They are less concerned with providing measures of adequate old-age provision.

The rest of this paper is organized as follows. Section 2 discusses our questionnaire. Section 3 presents the results, and Section 4 concludes.

2 The Questionnaire

2.1 Our Sample

We field our questionnaire with the Dutch CentER Panel. This panel is representative for the Dutch population and consists of about 2000 members. These members regularly fill out questionnaires, typically on weekends. Our questionnaire was fielded on the weekend of March 24/25, 2007, and was again presented one weekend later to those who did not respond on the previous weekend. We presented the survey to respondents that are older than 25 and who represent either the main breadwinner of the household or his or her spouse. Based on these selection criteria, our questionnaire was presented to a total number of 835 panel members. The actual number of responses per question varies between about 550 and 800. The response rate is thus very high.

Members of the CentER Panel are regularly interviewed on matters such as general household characteristics, income, wealth, job situation, as well as on a host of further issues such as psychological disposition, savings motives etc. Therefore, we have at our disposal a great amount of information on respondents' characteristics that we are able to use in our questionnaire. In particular, many of our questions are tied to respondents' income.

In the following we outline the principal questions of our survey that deserve a more detailed explanation. Our questionnaire contains a number of further questions that we will discuss within the appropriate context.

2.2 Questions on Old-Age Provision in the Absence of Risk

A first set of questions aims at investigating the optimal expenditure path over the life-cycle. To provide for concise and clear-cut questions, we do so in a stylized way, i.e. we do not consider any variation of expenditures within working-life or within retirement. Rather, we are interested in how *average* expenditures during retirement compare to *average* expenditures during working life.

Specifically, we present to each respondent i a total number of six options of working-life and retirement consumption $\left(c^k_{w,i}, c^k_{r,i}\right)$, $k = 1, \ldots, 6$. These options are characterized by an identical present value of life-time consumption. For each respondent i we have information on total net household income (i.e. disposable income after taxes). Using information on respondents' income, household and employment status, we infer the total working-life income Y_i for each respondent's household. Obviously, this equals reported total net household income if both the respondent and his or her partner are not yet retired. If the respondent and his or her partner are retired we set Y_i to reported total net household income divided by .85. The latter number is the typical effective *net* replacement rate in the Netherlands. (The typical gross replacement rate amounts to 70 percent.) If the respondent has a partner and either only the respondent or only the partner is retired, we set Y_i to reported total net household income if the respondent is the main breadwinner, and to total net household income divided by .85 otherwise.

For each respondent we calculate a *hypothetical* present value of life-time income (PVY_i) according to

$$PVY_i = \sum_{t=W}^{R-1} \left(\frac{1}{1+r}\right)^{t-W} Y_i + \sum_{t=R}^{D-1} \left(\frac{1}{1+r}\right)^{t-W} \rho^* Y_i$$

where W denotes the age of (hypothetical) entrance in the labor market, R the age of retirement, and D the age of death (where death occurs at the beginning of age D). The variable r denotes the real (risk-free) interest rate. Finally $\rho^* := \min_k \frac{c^k_{r,i}}{c^k_{w,i}}$, i.e. the lowest "consumption replacement-rate" among the options k that are presented to respondents. The profiles $\left(c^k_{w,i}, c^k_{r,i}\right)$ are determined by

$$\sum_{t=W}^{R-1} \left(\frac{1}{1+r}\right)^{t-W} c^k_{w,i} + \sum_{t=R}^{D-1} \left(\frac{1}{1+r}\right)^{t-W} c^k_{r,i} = PVY_i.$$

Note that respondents' hypothetical life-time income is determined such that if they aim for a consumption replacement-rate ρ^* then they would not have to engage in any saving at all. Intuitively, this corresponds to a situation where the respondent gets a fraction ρ^* of his current net total household income guaranteed from the pension system. We choose this design in order

to assure that none of the values of $c^k_{w,i}$, not even the highest one (which leads to the *lowest* value of $\frac{c^k_{r,i}}{c^k_{w,i}}$) exceeds Y_i. Our aim is to prevent that respondents get any option where they would have to borrow (mentally) against their retirement income in order to realize this option. Otherwise, we do not make any attempt to chose the profiles $\left(c^k_{w,i}, c^k_{r,i}\right)$ such that they are based on a particularly realistic scenario of, for instance, age-income profiles since this is not of any interest for the purpose of our question.

We set W to 25, R to 61 (the average retirement age in the Netherlands), and D to 86. We present to respondents profiles for two different levels of the interest rate, one for 1 percent and once for 6 percent. This will allow us to infer the elasticity-of-intertemporal-substitution parameter. Finally, we choose the profiles $\left(c^k_{w,i}, c^k_{r,i}\right)$ such that the ratios $\frac{c^k_{r,i}}{c^k_{w,i}}$ correspond to .5, .64, .76, .88, 1, and 1.4. We believe that these values include the range of replacement rates that are commonly deemed reasonable. All values of $\left(c^k_{w,i}, c^k_{r,i}\right)$ are rounded to entire multiples of 50 or 20, depending on the magnitude of Y_i.

Respondents get the following introduction text.

> Below you find four options of how you could spend your money over your lifetime. For each option the first column indicates how much your household could spend on average per month from age 25 until retirement. Thus, this refers to your total (working) age from age 25 until retirement, NOT just the remaining (working) age. The second column indicates how much your household could spend during retirement. Please think of all your expenditures, such as food, clothing, accommodation, insurance, traveling etc. Assume that the numbers below show what you can spend after having already paid for taxes. Assume also that prices of the things you spend your money on remain the same in the future as today (no inflation). If you had a choice, which option would you like most?

For single households and respondents that are already retired the text is adapted accordingly.

Respondents get then first a table with four profiles $\left(c^k_{w,i}, c^k_{r,i}\right)$, as shown in Table 1, for

Table 1: Options of expenditures profiles

	Monthly spending during working life (age 25 until retirement), in Euros	*Monthly spending during retirement, in Euros*
Option A	2200	2200
Option B	2300	2000
Option C	2400	1800
Option D	2500	1600

which $\frac{c^k_{r,i}}{c^k_{w,i}}$ corresponds to .64, .76, .88, 1.[8] If a respondent choses an option at the border, she is presented with another choice. The new choice set involves the option that she has selected before, and a new more extreme option, either with a replacement rate of .5 or of 1.4, depending on the previous choice.

We include a randomization treatment as follows. Half of our respondents sees the options arranged with decreasing replacement rates. The other half are presented with the options arranged in the opposite order.

2.3 Questions on Lower Bounds of Old-Age Expenditures

Based on models of habit formation (see Campbell and Cochrane, 1999, and Gomes and Michaelides, 2003) and loss aversion (see Bowman et al., 1999, and Binswanger, 2007) we hypothesize that individuals may have the idea of a minimum consumption/expenditure level during retirement below which they would never want to fall.[9] We present respondents the following question.

> This question refers to the overall level of spending that applies to you [and your partner] during retirement. What is a minimal level of monthly spending that you never want to fall below during retirement, at all costs? Please think of all your

[8] The numbers in Table 1 correspond to a total net household income of 2500 Euros, i.e. the sample average.

[9] Note that for most habit levels marginal utility is infinity at the habit level and not defined below the habit level. Binswanger (2006, 2007) provides a model of lexicographic loss aversion where individuals would never want to consumer below the habit level or reference point. This model happens to explain observed savings and asset-allocation choices particularly well.

expenditures, such as food, clothing, accommodation, insurance etc. Assume that prices of the things you spend your money on remain the same in the future as today (no inflation).

2.4 Questions on Risk Preferences

A "Non-Parametric" Measure of Risk Preferences

A first couple of questions aim at measuring risk preferences in a "non-parametric" way. We simply ask respondents to rate certain risky retirement-income prospects. The prospects were again based on information about respondents' income. Respondents first see the following introduction text.

> The future is uncertain. It is not possible to know today with full certainty how much money you [and your partner] will have at your disposal during retirement. The total income (including pensions, income from personal savings etc.) that you [and your partner] will have at your disposal will depend, among other things, on how the economy will perform, e.g. how wages, interest rates, financial returns etc. will develop. The next questions refer to this aspect.
>
> How satisfied would you be with each of the following scenarios from the perspective of today? Please assume that the numbers you see below include income from all sources that you may have during retirement. Assume also that the amounts are net of taxes and refer to you [and your partner].

They are then presented with a number of scenarios. Specifically they are asked:

> How satisfied would you be with each of the following scenarios from the perspective of today?
>
> There is a 90 percent chance that your total income during retirement will be [$X_{h,i}$] per month, and a 10 percent chance that it will be [$X_{l,i}$] per month.

(...)

Respondents are asked to rate these prospects on the following scale: Completely unsatisfied, somewhat unsatisfied, somewhat satisfied, completely satisfied, I don't know. We intentionally leave out "neither satisfied nor unsatisfied" for two reasons. First, respondents may choose this category if they mean, in fact, that they don't know. Second, we want to avoid an uneven number of answer categories since the mid-point provides a strong focal point. We randomize the order in which the response options appear. Half of respondents see the options arranged in an "increasing" order, i.e. from "completely unsatisfied" to "completely satisfied." The other half sees the options arranged in the opposite order.

In total we present five prospects. The values of $(X_{h,i}, X_{l,i})$ are chosen such that $\left(\frac{X_{h,i}}{Y_i}, \frac{X_{l,i}}{Y_i}\right)$ corresponds to $(.95, .8)$, $(1.05, .75)$, $(1.15, .7)$, $(1.25, .65)$, $(.9, .85)$.[10] Y_i denotes again a respondent's total net annual household income during working life. Half of respondents see the profiles in the order as reported above. The other half see the profiles in a strictly decreasing order of riskiness. We chose the first non-monotonic order to check for order effects. We were speculating that individuals might dislike any risk and find even the first option quite unacceptable. But after being confronted with options that are far more risky, they would appreciate the low-risk profile. Since we did not want to repeat the first profile, we chose a similar low-risk profile.

According to a stylized calculation these risky profiles can be interpreted in terms of equity shares as follows. Consider a hypothetical setting in which individuals earn an annual income of $Y_{w,i}$ during working life and, for simplicity, there is no pension system at all. Assume that the real risk-free interest rate is given by r, and individuals save such as to achieve a target replacement rate $\hat{\rho}$. This leads to a target saving rate $\hat{s}$. Working-age expenditures $c_{w,i}$ are given by $(1 - \hat{s})\, Y_{w,i}$. Retirement expenditures $c_{r,i}$ are determined by

$$\sum_{t=W}^{R-1} \hat{s} Y_{w,i} \left(1 + r\right)^{R-t} = \sum_{t=R}^{D-1} \left(\frac{1}{1+r}\right)^{t-R} c_{r,i}$$

[10] All values of $(X_{h,i}, X_{l,i})$ are rounded to entire multiples of 50 or 20, depending on their magnitude.

If a share α of savings $\hat{s}Y_{w,i}$ is invested in stocks, then the return on the individual's portfolio at a particular age t (i.e within a particular year) is given by $r_t^p(\alpha)$, which is now risky. Assume that all savings are invested in risk-free assets during retirement. For a given history of portfolio returns, retirement expenditures $c_{r,i}$ are then determined by

$$\sum_{t=W}^{R-1}\left(\prod_{s=1}^{R-t}\left(1+r_{t+s}^{p}(\alpha)\right)\right)\hat{s}Y_{w,i}=\sum_{t=R}^{D-1}\left(\frac{1}{1+r}\right)^{t-R}c_{r,i}.$$

Ex ante, the level of $c_{r,i}$ that will be realized is not known. However, it is possible to simulate the distribution of $c_{r,i}$ for given assumptions about stock returns.

Specifically, the replacement rates that correspond to the options $(X_{h,i}, X_{l,i})$ are derived as follows. We assume that the risk-free interest rate is given by 2 percent and set $\hat{\rho}$ to .85, the typical after-tax replacement rate in the Netherlands. Furthermore, we set R to 65 rather than 61. We do so since we believe that retirement ages are likely to be increased in the future and since equity investments in the spirit of individual retirement accounts are an option for the future rather than currently available, at least in many European countries. (In the US the legal retirement age has already been increased to 67.)

Under the above assumptions the target savings rate $\hat{s}$ amounts to 19 percent (remember that there is not pension system at all). We assume that stock returns are lognormally distributed, such that their expected level-return equals 4.8 percent. This conservative value corresponds to the international average in the 20th century (see Shiller,2005). We set the standard deviation of level-returns to the historical value of US stock-returns which amounts to .157. Under these assumptions we derive the distribution of $c_{r,i}/\left(1-\hat{s}\right)Y_{w,i}$ for α-values of .2, .4, .6, .8, and .1. The resulting values for the *tenth percentiles* of the distribution of $c_{r,i}/\left(1-\hat{s}\right)Y_{w,i}$ correspond (roughly) to the values of $\frac{X_{l,i}}{Y_i}$. The values for the *median* correspond to the values of $\frac{X_{h,i}}{Y_i}$.

The fact that a survey must be sufficiently clear-cut poses strict limits on the degree of precision with which we can present a random profile to respondents. After some experimentation we decided to frame profiles in terms of the 10-percent/90-percent profiles as explained above,

although this does not exactly correspond to the simulated distribution of replacement rates. In particular, we neglect its very downside risk. However, we are not particularly worried by this for the following reason. Our calculation assumes away any income guarantees provided by a pension system. In reality, it seems likely that a minimal income would remain guaranteed by a pay-as-you-go system. In the presence of such guarantees effective old-age income would never be so low as in the case where there would be no pension system at all and long-run stock returns would take on, say, their first percentile.

Measuring Relative Risk Aversion

We also elicit the parameter of relative risk aversion. In order to do so, we use the most widespread instrument, a multiple price list (see Holt and Laury, 2002). In contrast to the existing literature, our question is explicitly framed in terms of old-age provision. Specifically, respondents get the following question.

> In the following table we present five choices to you. You can always choose between two different types of income during retirement, income of type A and of type B. Please assume that these incomes include all sources of income that you may have during retirement. If you choose income type A, the total income during retirement of you [and your partner] will always be [Z_i^s] Euros per month, independent of the performance of the economy. If you choose type B the total income during retirement of you [and your partner] depends on the performance of the economy (e.g. on returns in financial markets). If the economic performance is unfavorable it will be [Z_i^{rl}] Euros per month. If the performance is favorable it will be [Z_i^{rh}] Euros per month. The five choices differ only in terms of the chance that the favorable or unfavorable economic performance will materialize. Which income type would you choose?
>
> A: [Z_i^s] Euros, or
>
> B: [$1 - \pi$] percent chance of [Z_i^{rl}], and [π] percent chance of [Z_i^{rh}].

(. . .)

The probability π is set to 50, 60, 70, 80, 90 percent. We set Z_i^s to $.85Y_i$. Remember again that .85 is a typical net replacement rate in the Netherlands. We set Z_i^{rl} to $.7Y_i$ and Z_i^{rh} to Y_i. These values are convenient for identifying a large range of values of the relative-risk-aversion parameter. All numbers are again rounded to entire multiples of 50 or 20, depending on their magnitude.

2.5 Question Order in the Survey

We randomize not only the order of options and responses within a certain question, but also the order of the questions in the survey. Half of respondents start with the question on expenditure profiles in the absence of risk and get the question on desired minimum expenditure levels thereafter. For the other half of respondents the order is reversed. Thereafter, all respondents see first the questions on rating risky retirement profiles and finally the relative-risk-aversion question. As already mentioned, our questionnaire contains several other short questions. Some of them are discussed in the next section.[11]

3 Results

3.1 Preferred Profiles in the Absence of Risk

677 out of 835 respondents answer the question on preferred expenditure profiles. The response rate is thus 81 percent. The mean age of those who answer this question is 52. Table 2 shows the percentage of respondents that chose a particular expenditure path. For simplicity, we refer to the expenditure path by means of "replacement rates," i.e. the ratios of old-age expenditures to working-life expenditures.

[11] The full survey is available from the authors upon request.

Table 2: Preferred expenditure profiles in the absence of risk

		1 percent interest rate		6 percent interest rate
"Replacement rate"	Full sample	Treatment "up"	treatment "down"	Full sample
50 percent	0	0	0	0
64 percent	6.61	5.19	8.08	4.02
76 percent	23.2	21.61	24.85	14.73
88 percent	37	34.58	39.52	35.71
100 percent	24.96	30.26	19.46	24.4
140 percent	8.22	8.36	8.08	21.13

NOTE: Number of observations is 677. All numbers are percentages.

The second column in Table 2 refers to the full sample for the case that the interest rate amounts to 1 percent. It reveals that most respondents prefer a replacement rate of either 76, 88, or 100 percent. In contrast to Barsky et al. (1997) we do not find that a large majority go for either a flat or even increasing profile. We speculate that this has to do with the fact that, first, our question is explicitly framed in terms of old-age provision and, second, that the numbers that specify the options are tied to respondents' personal income situation. While the replacement rates are low in comparison to the mentioned studies, they are rather high in comparison to the ad-hoc benchmark net replacement-rates of 67 percent that is prevalent in the UK (see Banks et al., 2005).

The third and fourth column in Table 2 show how the answers are influenced by the order in which the options are arranged in the question. In the "up" treatment we present the options such that expenditures during working life increase from top to the bottom. In the "down" treatment working-life expenditures decrease. Comparing the third and fourth column in Table 2 shows that respondents are more likely to chose a flat profile in the up-treatment (the difference is statistically significant at the 5-percent level according to a Kolmogorov-Smirnov test). In the up-treatment the flat profile corresponds to the first option. We speculate that respondents start reading the table with the option at the top. The option in the first row is likely to provide an "anchor" relative to which the other options are evaluated. But this only occurs if the first option is considered reasonable. This seems to happen in the up-treatment, where the first option corresponds to a replacement rate of 100 percent. In contrast, respondents apparently do

not like the first option in the down-treatment, which corresponds to a replacement rate of 64 percent. Thus, it does not provide an anchor in this treatment.

The last column in Table 2 refers to an interest rate of 6 percent. In this case, the randomization of the order in which the options are arranged does not have a significant influence on respondents' choices. Consistent with standard models of intertemporal decision making, many choose a higher replacement rate. In particular, the 140-percent option is much more popular under the high-interest-rate scenario. Nevertheless, a majority of respondents (55 percent) make the same choice for both interest rates. 44 percent choose a higher replacement rate for an interest rate of 6 percent. 11 percent choose a lower replacement rate such that their choice is inconsistent with standard economic models.

Given that we observe choices for two different interest-rate scenarios, we can calculate implied values for the elasticity of intertemporal substitution (EIS) under the assumption that respondents' utility is of the constant relative risk aversion type and that their choices fulfill the Euler-equation which characterizes an optimal expenditure path. Clearly, the EIS is zero for respondents that make twice the same choice. For those who chose a higher replacement rate with a higher interest rate the upper quartile bounds of the distribution of the EIS parameter are .10, .19 and .26, respectively. The sample average, including those with a zero EIS, amounts to .07.

Results from a multivariate regression analysis (available from the authors upon request) show that the only characteristic that appears to have a significant influence on choices is whether the respondent has a university degree (11 percent of our sample do have such a degree). The marginal effect of having a university degree is a six percent lower replacement rate. All other characteristics such as income, financial wealth, home-ownership, age, household size or being retired do not appear to be associated with respondents' choices. Our interpretation of this is that the observed heterogeneity reflects to a major part differences in preferences.

Immediately after the questions on preferred expenditure profiles we asked respondents the following question.

> With respect to the last questions about spending during working life and during retirement, how much do you agree or disagree with the following statement: *Even if I spent a long time thinking about those questions, I would not know what I should answer.*

The answer categories are: Completely disagree, somewhat disagree, somewhat agree, completely agree. The results are the following. 15.36 percent completely disagree with this statement; 23 percent disagree somewhat; 45 percent agree somewhat; and 17 percent fully agree. We do not find any evidence that those who disagree make systematically different choices. In particular, a Kolmogorov-Smirnov test indicates that the distribution across answers categories does not differ if stratified according to this question.

3.2 Lower Bounds of Old-Age Expenditures

651 out of 835 respondents answer the question on a desired minimum expenditure level during retirement. The response rate is thus 78 percent. The average age of those who answer this question is 52.[12] Half of respondents answer this question before the questions on expenditure profiles discussed in the last subsection. For the other half the order is reversed. For ease of terminology, we will refer to the desired minimum expenditures as a subsistence level, being aware that this is not meant literally.

The mean indicated subsistence level amounts to 1753 (year-2007) Euros, the median is 1600 Euros, the 10th percentile amounts to 900 Euros while the 90th percentile amounts to 2600 Euros. While there are essentially no outliers in the responses to the question about subsistence levels, the data are skewed and non-normal. We therefore use median regressions to investigate how the answers vary with respondents' characteristics. This imposes less restrictive assumptions than the ordinary-least-squares model.

Table 3 shows the results from various median regressions for the subsistence level. Note that the income variable refers to total net monthly working-life income of the respondent's

[12]The upper quartile bounds of the age distribution are 36, 54, 65, respectively.

household. For retired respondents this income is calculated as explained in Section 2.2. A striking result is that only relatively few variables are consistently significant across specifications. Most important are variables related to income. Beyond these, we find that the non-retired seem to underestimate the costs of their most basic desires by about 250 to 300 Euros. This result has potentially important implications for advising people about their needs during retirement. Finally, having a university degree leads to a lower reported subsistence level. This is consistent with our finding from the previous subsection that those with a university degree choose a lower "expenditure replacement-rate."

According to all specifications, the subsistence level increases monotonically with income, but the increase is substantially less than one for one. This strongly suggests that minimum acceptable replacement rates decrease with income.

For its transparency and the fact that the relationship between income and the subsistence level is not forced to follow a particular functional form, Model 6 is our preferred specification. Using Model 6, and neglecting all other variables except the constant, we obtain minimum expenditure targets of 1050, 1500, 1600, 1950, and 2450 year-2007 Euros for the five income quintiles, respectively. Dividing these numbers by the median incomes for each income quintile may provide a hint on adequate minimum replacement-rates.[13] In particular, we obtain minimum replacement rates of 77, 81, 69, 67, and 65 percent, respectively. Note that these minimum replacement rate are generally lower than the replacement rates that have been chosen for the expenditure-profile questions discussed in the last subsection. The latter questions correspond to average desirable replacement rates rather than minimum replacement-rates.

Our measure for minimally acceptable replacement rates may potentially be biased if productivity between cohorts differed substantially, i.e. if birth year and income were positively correlated. To see this note that our estimations presume that age-income profiles are shaped in a way as if the profile identified in a cross-sectional regression were the true age-income profile. (This follows simply from the fact that we do run cross-sectional regressions with age and

[13]Median incomes for the five income quintiles in our sample are 1359, 1835, 2300, 2875, and 3765 year-2007 Euros, respectively.

income as independent variables.) The cross-sectional age profile for our sample is rather flat. However, this would also be observed if true age-income profiles were more steeply upward sloping and subsequent cohorts earned higher incomes than earlier cohorts at all ages.

If replacement rates are understood as the ratio of the subsistence level to, say, the last working-life income, then the minimum replacement rates identified above may be too high. Two factors may, however, confine this bias. First, the median age among those who answer the subsistence question is already 54. Thus, for the median respondent income is not expected to raise much until retirement. (Note also that the average retirement age in the Netherlands is around 61.) Second, if income increased substantially until retirement the desired minimal expenditures would be likely to raise as well. Overall, we believe that our estimates provide sensible upper bounds for minimal replacement rates.

There is one caveat concerning the absolute magnitudes of the indicated minimum expenditure levels. They are subject to a significant order effect.[14] In case that individuals answer the subsistence-expenditure question before the profile question, the upper quintile bounds for subsistence levels (in terms of raw values) are 1000, 1500, 1800 and 2000, respectively. In the opposite case the quintile bounds are 1200, 1500, 2000, 2500, respectively. Thus, they are shifted upwards by more than 200 Euros. It seems that "warming up" by answering the profile questions makes respondents much more conservative. Alternatively, they may take the option they choose in case of the profile questions as an anchor. However, this would not necessarily explain why they then indicate higher numbers in case of the subsistence question. After all, there were options with relatively low levels of retirement expenditures available in the profile questions.[15]

Table 4 repeats Model 6 from Table 3 for the two randomization treatments. The second column in Table 4 simply repeats the next to last column of Table 3. The third column uses only observations of respondents that answer the subsistence question before the profile question.

[14] According to a Kolmogorov-Smirnov test, the order effect is significant at the 5-percent level.

[15] We plan to field our questionnaire also in the US. Doing so will allow us to add questions that may offer clarification about the origin of this order effect.

Table 3: Median regressions for subsistence level

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Income	.42***	.41***	.54***	.65***	.68***	
Income sq.			-.13*10^{-4}***	-.33*10^{-4}***	$-.34 * 10^{-4}$***	
Income quintile 2						450.00***
Income quintile 3						550.00***
Income quintile 4						900.00***
Income quintile 5						1400.00***
Fin. net-wealth				$.46 \cdot 10^{-3}$	$.12 \cdot 10^{-3}$	
Fin. net-wealth squared				$.17 \cdot 10^{-8}$*	$-.14 \cdot 10^{-8}$*	
Net-wealth quintile2						$.22 \cdot 10^{-11}$
Net-wealth quintile3						-50.00
Net-wealth quintile 4						-100.00*
Net-wealth quintile 5						-50.00
Age		3.47**	12.77	-10.22	3.51	$-.16 \cdot 10^{-11}$
Age squared			-.10	.12	-.04	$.15 \cdot 10^{-13}$
Household size					-.27	$.15 \cdot 10^{-11}$
Home ownership					-40.75	$-.20 \cdot 10^{-11}$
Retired					270.82**	250.00***
Vocational training					2.84	50.00
University degree					-120.00	-150.00**
Constant	669.75***	506.73***	99.03	503.49	221.47	1050.00***
Pseudo R^2	.19	.20	.25	.27	.28	.27
Number of observations	651	651	651	514	513	577

NOTE: Income refers to total net monthly working-life income of the respondent's household. For retired respondent's this income is calculated as explained in Section 2.2. Relative risk aversion refers to the coefficient of relative risk aversion, measured as explained in Section 2.4 and 3.4. One asterisk denotes significant at the 10-percent level, two asterisks at the 5-percent level, three asterisks at the one-percent level.

Table 4: Median regressions for subsistence level: Order effects

	All observations	Treatment "before"	Treatment "after"
Income quintile 2	450.00***	378.54***	437.07***
Income quintile 3	550.00***	494.66***	639.27***
Income quintile 4	900.00***	748.22***	942.31***
Income quintile 5	1400.00***	1337.00***	1428.11***
Net-wealth quintile2	$.22 * 10^{-11}$	176.93	25.65
Net-wealth quintile3	-50.00	-182.44	61.20
Net-wealth quintile 4	-100.00*	-171.79	-40.25
Net-wealth quintile 5	-50.00	-29.16	3.51
Age	$-.16 * 10^{-11}$	-39.25**	12.06
Age squared	$.15 * 10^{-13}$	.37**	-.13
Household size	$.15 * 10^{-11}$	18.58	-1.16
Home ownership	$-.20 * 10^{-11}$	38.94	-37.6335
Retired	250.00***	137.51	281.84***
Vocational training	50.00	-32.58	48.12
University degree	-150.00**	-331.23**	139.22
Constant	1050.00***	2002.52***	771.19**
Pseudo R^2	.27	.28	284
Number of observations	577	293	.29

NOTE: Income refers to total net monthly working-life income of the respondent's household. For retired respondent's this income is calculated as explained in Section 2.2. One asterisk denotes significant at the 10-percent level, two asterisks at the 5-percent level, three asterisks at the one-percent level.

Table 5: Rating of risky retirement prospects

	Fully unsatisfied	Somewhat unsatisfied	Somewhat satisfied	Fully satisfied
Scenario 90/85	6.58	12.97	27.82	52.63
Scenario 95/80	6.03	10.17	37.29	46.52
Scenario 105/75	3.77	15.09	42.64	38.49
Scenario 115/70	6.77	21.43	41.35	30.45
Scenario 125/65	14.74	22.5	31.76	31

NOTE: All numbers are percentages. Number of observations amount to 532, 531, 530, 532, and 529 for the five scenarios, respectively. The scenarios x_h/x_l refer to a situation where a replacement rate of x_h is realized with a probability of 90 percent and a replacement rate of x_l with a probability of 10 percent.

The fourth row uses observations from respondents that answer the profile question first. The different values of the coefficients hide that the minimum replacement rates that are obtained for these specifications do not differ greatly. In case of the "before" treatment, these are 72, 74, 64, 60, and 62 percent for the five quintiles, respectively. In the case of the "after" treatment these are 75, 80, 72, 68, and 65 percent, respectively.[16]

3.3 "Non-Parametric" Measures of Risk-Preferences

About 530 respondents answer our rating questions on risk aversion. The response rate is thus 63 percent. The main reason that it is lower than for the other questions is that this question has not been asked to retired respondents. Consistent with this fact, the average age of those who answer the question is 46, thus about roughly 6 years lower than for the preferred-profile and subsistence questions.

Table 5 contains the results. Recall that the scenarios x_h/x_l refer to a situation where a replacement rate of x_h is realized with a probability of 90 percent and a replacement rate of x_l with a probability of 10 percent. (However, respondents get absolute numbers, not replacement rates.) Clearly, respondents like the "safe" scenarios with replacement rates around 80 or 90 percent. While such replacement rates are rather high, they correspond well to the after-tax replacement rate of 85 percent that is prevalent in the Netherlands.

More surprising is the fact that a clear majority is still at least somewhat satisfied with the

[16]These numbers are obtained taking into account the coefficients for the income quintiles as well as for age and age squared. Age is set to 60.

option that is most risky. This is particularly striking if we recall that, according to a stylized calculation, this scenario can be interpreted as corresponding to an equity share of 80 percent. (In this case, the low replacement rate corresponds to the 10th percentile of the "true" distribution of replacement rates whereas the high replacement rate corresponds to the median.) Note that we omit the very downside risk, i.e. percentiles lower than the tenth are out of the picture.

Another surprising result is that, contrary to what we expected, many respondents are happy with all presented options. 241 out of 530 respondents (i.e. 45 percent) are at least "somewhat satisfied" with all prospects. In contrast, only 14 respondents always indicate to be fully or somewhat unsatisfied. We believe that this result is, to some degree, a fortunate one. While it indicates that individuals do not really know what they want (see below), it also implies that they are apparently open to experimentation. It is not true, as seems sometimes to be asserted in Europe, that individuals seem to be unhappy if they have to bear the slightest amount of risk.

Multivariate ordered probit regressions (available upon request) indicate that income has a systematic influence on the reported degree of satisfaction. Other variables such as age, household size, home-ownership do not have any systematic influence. Financial net-worth does show up significant in some regressions while not in others. Exploring the role of income further, we find that low-income individuals are less satisfied with the 90/85 and the 95/80 option than high-income individuals. (This effect is statistically significant, e.g. when comparing the lowest income quartile with the highest.) For the other prospects income is not associated with reported satisfaction.

As mentioned in Section 2, we include a randomization treatment for the order in which the prospects appear. Half of respondents get the profiles in the order 95/80, 105/75, 115/70, 125/65, 90/85, while the other half get questions in the order 125/65, 115/70, 105/75, 95/80, 90/85. The order has a significant effect on the rating of the prospect that appears first. In particular, respondents are *more* satisfied with a prospect if they are presented with this prospect as the first one. Among those respondents that start with the 95/80-prospect, 5, 7, 35, and 53 percent are completely unsatisfied, somewhat unsatisfied, somewhat satisfied and completely

satisfied, respectively. For the other respondents the percentages are 6, 13, 39, and 40. Among those who start with the 125/65-prospect, 9, 21, 31, and 37 percent are completely unsatisfied, somewhat unsatisfied, somewhat satisfied and completely satisfied, respectively. For the other group the percentages are 20, 24, 22, and 23 percent.

Apparently, respondents that see the riskiest project first are not shocked by its riskiness but somehow tend to consider normal what they see first. This is a potentially important result since it suggests that individuals would not necessarily obstruct to any pension reform plans that would expose them to more risk. We repeat that this result was surprising to us, since many believe that Europeans are so used to safe pensions that they are frightened by the idea of bearing any risk during retirement. It should be kept in mind, however, that our prospects refer to total income during retirement, not just to pension income.

As in the case of the questions on preferred expenditure profiles we asked respondents the following question, immediately after they were rating the five risky income prospects.

> With respect to the last questions about uncertain incomes during retirement, how much do you agree or disagree with the following statement: *Even if I spent a long time thinking about those questions, I would not know what I should answer.*

The percentage of respondents who fully disagree, somewhat disagree, somewhat agree or fully agree is 12, 24, 43, and 21, respectively. Thus, a majority agrees at least somewhat. This is in line with the fact that many respondents are satisfied with all prospects. We do not find any evidence that those who disagree give systematically different answers.

It is interesting to ask what option an agent with constant-relative-risk-aversion (CRRA) preferences would prefer most. Straightforward calculations show that up to a level of relative risk aversion (RRA) of 5 the prospect 125/65 would be the most preferred. If RRA lies between 5 and 7 then the prospect 115/70 is most preferred. The prospect 105/75 is most preferred for the range or RRA values from 7 to 11. The prospect 95/80 is most preferred for the range from 11 to 19. If RRA exceeds 19 then the most preferred prospect is 90/85.

Table 6 indicates the certainty-equivalence replacement rates for each of the prospects for

RRA values of 5, 7, 11 and 19. While the differences across prospects are substantial for either low or high values of RRA, they are only modest for values around 7. If CRRA preferences provide a good description of respondents' tastes, then this suggests that those respondents that are satisfied with all prospects (45 percent of those respondents who answer our rating question fall into this category) would be those with RRA values, say, between 6 and 10. We should thus observe that respondents with RRA values between 6 and 10 are more likely to be satisfied with all prospects than either those with an RRA value lower than 5 or higher than 10.

Since we do elicit relative risk aversion (see Section 2.4 and 3.4), we are, in fact, able to test this hypothesis. We do so by defining a dummy variable which takes on a value of one if a respondent indicates to be at least somewhat satisfied with all prospects, and zero otherwise. We define also dummy variables for low (say, below 6) and high values (say, above 10) of measured RRA. We run then ordered probit regressions with the dummy for being always satisfied as the dependent variable and dummies for low and high RRA values as independent variables. We find that those with a high value of RRA are significantly less likely to be satisfied with all prospects than those with intermediate RRA values. This is consistent with the above hypothesis. However, we do not find that those with low RRA values are less likely to be satisfied with all prospects than those with intermediate RRA values.[17] This is not consistent with the above hypothesis. We conclude that CRRA preferences do *not* convey *sufficient* information on individual preferences and, taken at face value, would lead to wrong conclusions. However, we do find that those with a low RRA value are significantly more satisfied with the prospects 105/75, 115/70, and 125/65. Thus, measured RRA does convey *some* information on individual preferences.

3.4 Measuring Relative Risk Aversion

We elicit relative risk aversion (RRA) by means of a multiple-price-list format (Holt and Laury, 2002) as explained in Section 2. 660 respondents answer our RRA questions. The response

[17] Detailed results are available upon request.

Table 6: Certainty equivalence values of risky replacement rates

Prospect	Coefficient of relative risk aversion			
	5	7	11	19
125/65	101.86	92.84	81.72	73.87
115/70	101.80	96.49	87.59	79.55
105/75	98.64	96.56	91.90	85.14
95/80	92.79	92.41	91.49	89.20
90/85	89.43	89.40	89.33	89.18

rate is thus 79 percent. The mean age of those who respond is 52. 601 respondents answer the questions in a consistent way, i.e. they switch only once from the safe to the risky option and do not switch back.

Under constant RRA (CRRA) preferences, expected utility of a random prospect $\tilde{x}$ is defined as

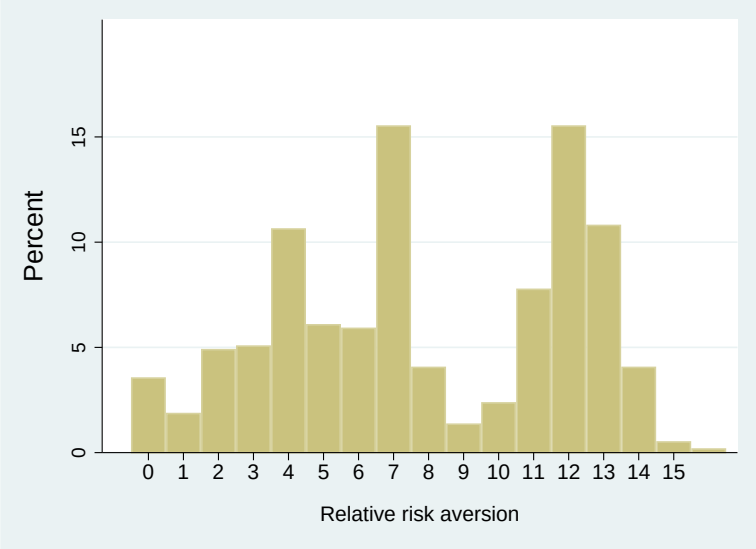
$$U(\tilde{x}) = E\left[\frac{1}{1-\theta}\tilde{x}^{1-\theta}\right],$$

where θ denotes the RRA parameter and E the mathematical expectation operator. It is important to note that CRRA preferences are linearly homogeneous. Thus, it does not matter whether preferences are defined over absolute old-age expenditure levels or whether these are divided by current income. Therefore, preferences can be understood as directly defined over replacement rates.

Due to the discrete nature of the question format we can obviously not identify any arbitrary value of the RRA parameter. Rather, we infer the highest value of the RRA parameter that is consistent with where a respondent switches from the safe to the risky option. It follows from the linear homogeneity of CRRA preferences that if all respondents saw levels of old-age expenditures in the questionnaire that are strictly proportional to each other (across respondents), then we would be able to identify strictly the same set of RRA values across respondents.

Our question is designed in a way such that the the expenditure level corresponding to the safe option represents 85 percent of a respondent's current total net household income. The low-value for the risky option corresponds to 70 percent of household income and the high-

Figure 1: The distribution of relative risk aversion



value to 100 percent. However, the expenditure levels that respondents see in the questionnaire are rounded to entire multiples of 50 or 20. Thus, they are not strictly proportional across respondents. Hence, we are not able to identify strictly the same set of RRA values across respondents.

This is reflected in Figure 1 which shows the resulting distribution of the RRA parameter. The spikes correspond to RRA values that belong to the set of RRA values that we would exclusively identify if all numbers would be strictly proportional across respondents. Due to rounding the overall picture is more fuzzy.[18]

The message that Figure 1 conveys seems to be clear-cut: There is an enormous degree of heterogeneity. Using multivariate regression analysis we do not find any evidence that the measured RRA coefficient is systematically influenced by variables such as income, wealth, age, education, home-ownership or similar characteristics of respondents.

The question that remains open is whether CRRA preferences are a sufficiently good mea-

[18]We believe that presenting respondents "raw" numbers that are not rounded would only nominally "solve" this problem. Options involving non-rounded numbers look quite messy and would certainly not help to improve the quality of the answers we obtain.

sure of individuals' "true" preferences. We have already discussed in the last subsection that measured RRA values are not consistently able to predict which respondents are likely to be satisfied with all prospects that we presented in the rating questions. On the other hand, RRA values are a significant predictors of reported satisfaction with the most risky prospects there. Concerning subsistence expenditure levels, the predictive power of RRA values is rather weak.[19] Our conclusion is that RRA values do convey useful information on individual risk preferences, but this picture can be substantially completed by means of the answers to questions such as our subsistence or rating questions.

4 Conclusion

The aim of this study was to provide quantitative measures of adequate old-age provision. In particular, our aim was to do so without reference to a specific preference model. We make an attempt to accomplish this aim by fielding a specifically designed survey module with the Dutch CentER Panel.

A first set of questions in our survey investigates preferred expenditure profiles over the life cycle in the absence of risk. Our findings suggests that people aim for a profile where expenditures during retirement amount to between 70 and 100 percent of working-life expenditures. While this range is relatively large it clearly suggests that a situation in which it is very likely that the "expenditure replacement-rate" is below 70 percent should be deemed inadequate.

We also address adequate old-age provision from the angle of a minimal level of expenditures during retirement that is desired "at all costs." We calibrate minimum acceptable replacement rates of 77, 81, 69, 67, and 65 percent for the five income quintiles respectively.

Turning to risk aversion, our finding is pretty much that "many things go," based on a set of questions where respondents are asked to rate risky retirement-income profiles. Contrary to our expectations, many respondents are satisfied with almost all options that are presented to

[19] This follows from OLS regressions with subsistence levels as the dependent and RRA values and various other characteristics as the independent variables. Results are available upon request.

them. In particular, 45 percent of respondents are satisfied with any option, ranging from what can be interpreted to reflect very low to very high equity investments, according to a stylized calculation. This finding is, at least partly, inconsistent with standard preferences such as CRRA utility. However, this finding has a clear upside: Respondents appear to be open to many things!

We also make an attempt to measure the coefficient of relative risk aversion. To our knowledge we are the first to do so in an explicit old-age provision context. We find a huge amount of heterogeneity. We also find that measured RRA values do convey information on individual preferences, but that they do not represent a sufficient description of individual preferences.

Our study has potentially important implications for pension reform, especially in Europe. It suggests a target replacement rate of between 70 and 100 percent that would decrease with income. (In many European countries pension replacement rates do, in fact, not depend on income. The Netherlands is one such case.) Our calibrated minimum replacement rates may provide useful benchmarks for the part of retirement income that should be provided by a public pension scheme. Beyond a guaranteed minimum income, people appear to be very open to bear risk in order to benefit from the upside potential of equity investments.

Our results face three limitations. First, they apply to a European country where most people have been given no own responsibility for their old-age provision. Instead they have got a relatively generous guaranteed pension income from a public pension scheme. It is conceivable that preferences of many residents may be influenced by the design of the public pension system. In particular, the desire for a guaranteed minimum income may be stronger than in a country without generous income guarantees, such as the US.

A second limitation is that our sample size is relatively small. This becomes clear if we look at the number of observations within particular "cells." For instance, the number of respondents with age between 50 and 60 that answer the subsistence question and belong to the first income quintile is only 20. A third limitation is that the CentER Panel may suffer from sample attrition, i.e. members with a systematically higher interest in answering questions stay in the panel while others drop out. The "survivors" may have systematically different preferences with respect to

old-age provision.

We will address the first limitation by fielding our questionnaire in the US with the American Life Panel (ALP) at RAND. This will allow us to investigate the influence of cultural factors on what is deemed adequate old-age provision.

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