Using stated-preference data to estimate a structural model of retirement and savings

Luc Bissonnette†

September 11, 2011

Abstract

This paper proposes to estimate a life-cycle model of retirement and savings based on stated-preference data, obtained by asking survey respondents to evaluate hypothetical retirement scenarios. These models are usually estimated using revealed preferences inferred from actual retirement plans, an approach requiring a substantial amount of information concerning the details of these plans, the availability of alternative plans, and respondents’ expectations. Using a stated preference approach simplifies the problem by providing the relevant information on available plans to the respondents. I show that answers to simple questions are sufficient to estimate the model. The econometric specification I propose, a rank-ordered logit model, is easy to estimate and is, to some extent, robust to heterogeneity in answering behavior. The estimated parameters are sensible and comparable to findings from the past literature, despite the modest size of the sample used and the limited information available. For instance, I find a yearly discount parameter between 0.95 and 0.97. The implications of these results are illustrated with simulations, with a particular emphasis on simulating the effect of a recent reform of the Dutch social security system.

Keywords: Aging and retirement; structural econometrics; stated-preferences; life-cycle model.
JEL Codes: C81, D91, H55, J26.

*I want to thank Rob Alessie, Marike Knoef, Katie Carman, Martin Salm, Arthur van Soest, and Hanka Voňková for valuable help and insightful comments. I am also grateful for funding by Netspar. Remaining mistakes are mine. So are typos.
†NETSPAR and CIRPEE, Université Laval. Contact: Luc.Bissonnette@ecn.ulaval.ca
1 Introduction

It is well documented that populations of developed countries are aging, a trend casting doubt on whether the current pension systems are sustainable. To curb the cost of social security, political reforms are needed around the world. For instance, in the Netherlands, where the dependence ratio is projected to double by 2040 to around 2:5, measures were already taken to reduce the cost of the system by delaying eligibility to social security (known as AOW, in Dutch) by two years (see Bovenberg and Gradus, 2008). Predicting how people will react to these reforms is quite challenging. Will they decide to delay retirement by full two years? Will they decrease consumption to still be able to retire as early as they used to? Or will they, as economic theory would predict in many cases, use a mix of these two solutions in their retirement planning. The life-cycle theory helps us to evaluate behavioural adjustment. To obtain quantitative predictions based on such model, we need to calibrate or to estimate the preference parameters. Doing so is not a trivial task and usually requires a substantial amount of information on individuals’ characteristics, their behaviour, and their pension plans.

There is a vast literature on estimation of preferences for retirement. A frequently used approach is to assume that the respondent evaluates the benefits of retiring at various ages, for instance every year between age 60 and 70, and that the planned retirement age is the one with the highest value. The variable of interest is often the age at which a respondent plans to retire. International comparison of preferences for retirement are available in two volumes edited by Gruber and Wise (1999, 2004) based on the option-value model of Stock and Wise (1990). An alternative literature estimated structural retirement models derived form the life-cycle theory relying on administrative data (see for instance Gustman and Steinmeier, 1986; Rust and Phelan, 1997, for early examples). A life-cycle model is estimated based not only on the preferred retirement age, but also on assets accumulated by the respondent. This structural approach is the one that I want to emulate in this paper.

One of the main challenges in estimating detailed retirement models is to characterize correctly the choice set of the economic agents. While we may have information on behaviour under his actual plan, and while for a given set of parameters we can forecast how he would act under an alternative plan, the challenge is whether or not a respondent believes that alternative trajectories to retirement are available to him. Beyond that, even characterizing the perceived actual retirement trajectory may be quite challenging. There is substantial evidence that many individuals do not understand their own retirement plans (see for instance Gustman and Steinmeier, 2005; Lusardi and Mitchell, 2007), or, as we show in a previous paper (c.f. Bissonnette and van Soest, 2011), that some respondents don’t seem to anticipate future changes in their pensions. Therefore, when we observe respondents behaviour, we may not be able to know exactly what respondents are reacting...
to, as disentangling preferences and expectations may turn out to be particularly challenging (see Hurd, 2009, for a review of retirement expectations).

In this paper, I explore an alternative approach to the estimation of retirement models based mainly on stated preferences for retirement. In spirit, this work is not that different from the work of Gusman and Steinmeier. As a matter of fact, I estimate a life-cycle model very close to theirs, but without relying on the precise information from administrative sources that they used, but rather focusing on self-reported information. The main difference is that I rely on questions in which survey respondents are asked to rate retirement scenarios on a 10-point scale, under the assumptions that these plans were available to them. The exact phrasing of the questions is discussed below. I then consider the value of their accumulated assets and their current wage to evaluate each retirement scenario with a life-cycle value function. This, in turn, allows me to predict optimal retirement age and saving behavior under different scenarios and under various conditions. The stated-preference approach has the advantage of explicitly laying down the choice set to the respondents. This, in turn, allows to estimate a model of preferences without having to control for the availability of a given scenario or for the expectations of a respondent.

Economists have usually been reluctant to use subjective data such as stated-preferences and tend to prefer revealed-preference analysis. Discussions on this topic are presented, for instance, by Bertrand and Mullainathan (2001) or Dominitz and van Soest (2008). Common objections include the fear that respondents may under- or over-state their preferences for a certain outcome when asked hypothetical questions (mostly in cases where some answers are seen as socially desirable), that they may not be willing to answer honestly the questions, or that they won’t think carefully about their answers. These are certainly valid concerns. In the application that I propose here, however, the hypothetical scenarios are easy to understand and there does not seem to be a socially desirable answer. I therefore believe that it is relevant to investigate the information contained in these answers. Should stated-preference data be a viable alternative to revealed-preference analysis, it would allow to estimate a model where not all the information for a respondent is available or to induce experimentally some variations in pensions plans.

Stated-preference data for retirement were studied before by van Soest et al. (2006) and Voňková and van Soest (2009), the latter paper using the same dataset I use in this paper. This second paper estimates a structural model of retirement that would lead to the observed evaluation of the theoretical scenarios. The approach used is quite different from the one I propose here. Conceptually, their approach is to reproduce the distribution of observed evaluations of the scenarios, based on a multivariate model analogous to a multivariate ordered probit model. While the reporting model is complex and takes many factors into account, the economic retirement model is fairly simple, and ignores important aspects of the life-cycle theory, such as the possibility to accumulate assets or
the survival probabilities of respondents. Nevertheless, the estimated model allows for simulations of economic behavior under the various scenarios, and the authors exploit this property to predict the probability that the respondents would retire at a certain age given two different retirement scenarios. While using the same data as Voňková and van Soest (2009), the analysis I propose in this paper proposes to estimate a more detailed life-cycle model of retirement and saving, by allowing intertemporal assets allocation and by explicitly accounting for survival probabilities. This approach allows not only to predict retirement timing, but also yields predictions concerning consumption and savings.

A word of warning is needed before going further. My aim in writing this paper is not to argue about the superiority of stated vs. revealed preferences analysis. As discussed above, both approaches have merits. However, in some cases, one of the approaches may simply not be applicable. For instance, information on alternative retirement plans not chosen by respondents is not available in the dataset I use. While information on the expected replacement rate conditional on retiring at the expected retirement age is available, I do not observe the expected replacement rates for the alternative paths to retirement. The focus of the paper is partly methodological, as I am interested in the information needed to estimate a full model of retirement based on stated-preferences, and partly substantial, as I also study the implications of a model estimated with subjective data from the point of view of a policy maker taking the estimated model at face value.

The remainder of the paper is organized as follow. Section 2 describes briefly the Dutch pension system and then discusses the hypothetical scenarios that respondents were asked to evaluate. The assumptions required in order to describe the future of respondents are also listed in this section. Section 3 introduces the economic model, and then explains an econometric approach to estimate the parameters of this model. Section 4 presents the results of the estimation. Section 5 presents some simulations based on the estimated model, illustrating the implications of the results. Section 6 concludes.

### 2 Real and Hypothetical Institutions

One of the main advantages of the stated preference approach used in this paper is the simplicity of the future that respondents have to evaluate. The scenarios are written in plain words, and do not require institutional knowledge of the pension system or understanding of their current retirement scheme. As a matter of fact, research on financial literacy (see for instance Gustman and Steimmeier, 2005) shows that individuals may not have a good understanding of their own pension plans. Nevertheless, we would ideally want to use retirement scenarios to which respondents can relate. Understanding the institutional environment of the respondents is therefore an important
part of the analysis, although in an indirect manner. For this reason, I decided to structure this section as follows: I will first describe briefly the main features of the Dutch pension system, then introduce the hypothetical retirement plans presented to respondents, and finally mention something about the assumptions needed to model the hypothetical future of these respondents.

2.1 On the Dutch pension system

The description of the Dutch pension system contained in this part is based on more detailed articles written by de Vos and Kapteyn (2004) and Bovenberg and Gradus (2008). Other useful sources of information are the yearly publication by the OECD titled Pension at Glance (e.g., OECD 2011) and the report written by Capretta (2007). I refer readers interested in additional details to these publications. Before going further, I want to stress that the data used in this paper were elicited between 2006 and 2008. Hence, some more recent changes discussed by Bovenberg and Gradus may not have been in place when the respondents answered the survey.

Let us think about the Dutch pension system in terms of three pillars. The first pillar, the AOW, is a minimum pension provided by the government, and is a form of social security. This public pension is linked to the minimum wage. For instance, singles receive 70% of the minimum wage after the age of 65 and an individual in a two-person household receives 50% of this amount. Then, as a second pillar, a large fraction of the labor force (about 90% according to Bovenberg and Gradus) are entitled to an occupational pension. This large proportion is explained by the fact that participation to the pension scheme is mandatory if an employer offers it. According to de Vos and Kapteyn: "until recently, more than 99 percent of the pension schemes were of the defined-benefit type, most of them being defined on the basis of final pay". Bovenberg and Gradus report that career-average schemes, however, are becoming more common. According to the OECD, the first and second pillar are often integrated, so that workers are offered a 70% replacement rate if they retire at age 65 and had a stable career. Finally, third pillar pension, individual provisions, is relatively small in the Netherlands.

Another important element in the Dutch system is the large prevalence of early retirement, due to a very generous pay-as-you-go option (called VUT) that were first set in place with the intention to curb unemployment by increasing the number of retiree. Given the high costs associated with this program, it was decided in 2005 that VUT would be abolished. Nevertheless, according to Capretta (2007): "With over two-thirds of men (and over four-fifths of women) exiting the workforce by age 60, early retirement is still the norm." It should also be noted that reaching age 65 is a legitimate reason for dismissal and that it is not possible to delay payment of AOW beyond this age. In effect, 65 is the mandatory retirement age for most occupations. Hence, whereas Dutch in the labor force
may plan to retire early, they may not perceive that staying in the labor force past 65 is an option for them, or at least can consider it as riskier than usually acknowledged. A brief analysis on this point is presented by van Soest et al. (2006). Respondents in their sample were asked the earliest and latest age at which they could retire according to their employer’s pension plans. They report that the earliest age varies from 55 to 65 (median of 62, mean of 61.7) and that latest retirement was concentrated at age 65. Another important aspect is that the most frequently used answer for early retirement is also 65, implying that a large fraction of respondents do not think that they have any flexibility regarding their retirement age. This information is certainly relevant for the modelling of revealed preference data, where allowing respondents to retire at any time between 60 and 70 would assume that respondents can choose from options that are not perceived by them as available. However, by asking respondents to evaluate hypothetical scenarios as if they were available to them, this information is not crucial in our modelling and estimation.

Finally, it is worth noting that the Dutch government, as most governments in developed countries, is in the process of reforming social security in order to curb future costs. Among the policies evaluated, a progressive increase of the eligibility age to AOW from age 65 to 67 is probably the most likely element of reform. In Bissonnette and van Soest (2011), we showed that while most respondents seem to anticipate such a reform, some respondents reported a probability of 0 to its realization. This heterogeneity in beliefs could affect the valuation of the scenarios. A respondent who is certain that he will have to retire at 67 due to a policy change may be more "satisfied" by the retirement scenario at 65 than a respondent who does not forecast this change. We will see, however, that the econometric model proposed takes the relative ranking of observations into account, and hence, is not influenced by how respondents perceive our scenarios relative to their own anticipations concerning their retirement.

2.2 On stated-preference data

With this institutional framework in mind, we now turn our attention to the data used in this analysis, paying particular attention to the simple hypothetical scenarios that respondents had to evaluate and from which we derive stated preferences.

To obtain the data for the analysis, I rely on two datasets from CentERdata, an institute affiliated with Tilburg University. The data belong to the CentERpanel, an ongoing internet panel of about 2000 households in a given time period. Respondents to the panel are sampled to be representative of the Dutch population. Measures are even taken to ensure that families without access to Internet can still be included in the sample.1

1More information on the CentERpanel is available via the CentERdata website: www.centerdata.nl/en
The first dataset, briefly mentioned above, is the *Netspar Pension Barometer Survey*. The *Pension Barometer Survey* is an ongoing high-frequency panel interested, as its name implies, in various perceptions concerning the future of retirement. Among the themes studied via this panel are expectations (e.g. Bissonnette and van Soest [2011] Van der Wiel [2008, 2009]), satisfaction with pension (e.g. De Bresser and van Soest [2009]), and the perception of the 2008 financial crisis (e.g. Bissonnette and van Soest [2010]). I focus my attention on the yearly survey sent to respondents in the years 2006 to 2008. In these waves, respondents were asked to evaluate various retirement scenarios using a 10-point scale (1 being "Very Unattractive" and 10, "Very Attractive"). The three scenarios I analyze here all concern full retirement at either 62, 65, or 68. Replacement rates $x$ were defined as a percentage of the last net earnings before retirement, should the respondent have a similar job to the one he has now. As discussed above, this way of thinking about pension is analogous to the Dutch institutional setting. Questions were phrased as follow:

What do you think about the following? Please provide answers on a scale from 1 (Very unattractive) to 10 (Very attractive).

[Respondents current working hour] till age A, full retirement at age A. Disposable pension income is $x\%$ of the last net earnings.

Respondents were assigned randomly a set of replacement rates for these scenarios. For instance, in 2006 or 2007, respondents could receive in a given wave either low values for all three scenarios (45% for age 62, 60% for age 65, and 80% for age 68), medium values for these scenarios (50%, 65%, 85%), or high values (55%, 70%, 90%). Values where slightly different in 2008 to allow for additional variation, but respondents would still receive either low, medium, or high values to all scenarios. Considering the 3 waves of the panel, respondents therefore faced one of 6 sets of replacements rates.

I interpret the replacement rate of a given retirement scenarios as a substitute for social security and professional pension (the first and second pillar pension). I still allow respondents to accumulate assets to save for retirement. In turn, this implies that I must take into account the accumulated assets at the time respondents evaluate the scenario. While this information is not available in the *Pension Barometer Survey*, it is available for most respondents through the *Dutch National Bank Household Survey* (henceforth DHS), another yearly survey from *CenterData*. The definition of wealth I use in this paper is simply the sum of the value of different assets included in the DHS. A complete list of the assets included is included in Appendix A. For this analysis, I excluded housing wealth and mortgage debt. Analysis of these assets can be found, for instance, in Euwals et al. (2004) or Bissonnette and van Soest (2010).
2.3 Creating the future

While a lot of information is available through the two sources named above, some elements of the future must be assumed in order to construct the full income path of the respondents and to describe their mortality risk. I describe these elements here. Please note that all variables are described in terms of real values, as we do not consider inflation in the model.

Given that the pension income is described in terms of the replacement rate of the yearly wage, the major challenge is to construct sensible wage paths for the respondents. An ideal case would probably ask the respondents how much they expect to get before retirement, an information that will be available in subsequent waves of the Pension Barometer Survey but is not yet available in the waves used here. An alternative is to rely on an external prediction of income growth. I use this approach, and calibrate my model based on the results of the study of Knoef et al. (2009), who present microsimulations of income growth in the Netherlands. I use their finding that they expect the growth of real income of the 50-64 to be 0.6% between 2008 and 2020. I therefore impute this income growth to everyone. A more refined projection by characteristics such as education or by quantile of income would be possible and desirable, but I leave this for future research.

Another problem concerns the expected real interest rate. For this part, I follow standard practice and present a sensitivity analysis using various assumed values. I hence assume that respondents all expect the same interest rate. Allowing for heterogenous expectations concerning the interest rate would require formal treatment in subsequent work.

Finally, the theoretical model includes the survival probabilities to various ages. The best approach here would again be to consider heterogenous subjective survival age, using information revealed to the respondents (e.g. Gan et al., 2005). For the sake of simplicity, however, I consider that all respondents of a given age and gender have similar mortality expectations. To determine the probability of survival, I consider the cohort life-tables as forecasted by Statistics Netherlands (CBS). The life-tables contain forecasts of mortality until year 2060, meaning that projections of survival probabilities are not known toward the end of the life course for respondents born later than 1960. In order to circumvent this problem, I assign the last predicted survival probability to younger cohorts. For instance, the last predicted probability of survival to age 85 is for a respondents born in 1975. Respondents born after that year are assigned the same probability of survival as those born in 1975. Given that these later periods are quite substantially discounted in the model, this approach should have only a limited impact on the estimation results.
3 Life-Cycle Model

The main objective of this paper is to estimate a structural model of retirement and savings based on the valuation of retirement scenarios described in the previous section. I present in this section the approach I use to do so. I first introduce the underlying economic model, then, discuss the econometric approach used to estimate the parameters of the theoretical model.

3.1 The economic model

Let us first lay down the theoretical model of retirement. The problem we face is fairly common in the life-cycle theory (see on that topic Browning and Lusardi 1996, Browning and Crossley 2001). Let us denote the consumption, leisure, and accumulated assets at the end of period \( t \) by \( C_t \), \( L_t \), and \( A_t \) respectively. For now, let us assume that \( L_t \) can only take the value of 0 or 1, as respondents either work or are retired. Extension to partial retirement would be straightforward, as discussed by Gustman and Steinmeier (2005). Additionally, let us denote \( s_{at} \) the probability to survive from age \( a \) to age \( t \). We consider an intertemporal, separable utility function given by

\[
U_a = \sum_{t=a}^{T} s_{at} \rho^{t-a} u(C_t, L_t) \tag{1}
\]

where \( \rho \) is a parameter of time preference. For the sake of simplicity, I assume that respondents have a probability of survival to age 68 equal to 1. After that, there is a positive probability of dying at each time period. This assumption is made to avoid additional assumptions concerning the credit market under an uncertain lifespan (see Yaari 1965, for an early example).

Let us denote \( \omega_t \) the wage for time period \( t \), \( \pi_t(r) \) the pension amount received at time \( t \) for a given retirement age \( r \), and let’s use \( \iota \) to denote the real interest rate. Respondents face the following constraints:

\[
(1 + \iota)A_{t-1} + \omega_t(1 - L_t) + \pi_t(r)L_t \geq A_t + C_t \quad t = a...T \tag{2}
\]

\[
A_t \geq 0 \quad t = a...T \tag{3}
\]

The first constraint is a conventional budget constraint. The second constraint states that while respondents are allowed to borrow against their future wages, we do not allow them to borrow against their pension. It is often assume that respondents must hold positive asset values at each time period. However, I observe many respondents with debts in the current time period. I therefore decided to allow respondents to borrow against their future wage. As mentioned above, however, I
decided to prevent respondents to borrow in the years with uncertain survival status in order to keep the credit market simple. I therefore arbitrarily chose to force respondents to enter retirement without debts.

One of the implicit assumptions of this model is that there is no bequest motive (see Hurd 1989, for a discussion), and that hence:

\[ A_T = 0 \]

There may still be some accidental bequests should a respondent pass away while holding wealth. I assume, however, that a respondent derives no utility from this bequest.

As for the utility function, I use a separable utility function with constant relative risk aversion for consumption. This function was chosen for the sake of comparability with structural estimations reviewed above. Generally speaking, it has the form:

\[
u(C_t, L_t) = \frac{1}{\gamma} C_t^\gamma + \lambda L_t\]

where the parameters \( \gamma \) and \( \lambda \) vary across individuals according to respondents characteristics, as discussed below in Section 3.2. When specified in this way, the coefficient of relative risk aversion for consumption is equal to \( 1 - \gamma \). Should the parameter \( \gamma \) be equal to 0, the model becomes a model with logarithmic utility.

3.2 The econometric model

While working with revealed preferences often forces econometricians to estimate a model based only on the alternative providing the highest utility to a respondent, the use of stated preferences allows to use more information concerning preferences. In the analysis of the same dataset, Voňková and van Soest (2009) exploited the fact that respondents used a response scale from 1 to 10 as a measure of the level of preferences, and estimated a multivariate ordered probit. I use an alternative approach here and only consider the ordering of the answers, ranking alternatives according to preference relations. My main motivation for doing so is that there is no straightforward way to map the value of the utility function to a valuation system from 1 to 10. Consider for instance the case of two identical respondents, but at different ages. Even in absence of a stochastic element in the model, these respondents would have different values for the various scenarios, although they are likely to rank the scenarios in the same way.
The implicit assumption made is that reported answers are an unspecified monotonic transformation of the intrinsic value held by respondents for a particular scenario. In some cases, the transformation leads respondents to report the same value for various scenarios. In such cases, the answers are considered as uninformative. We discuss below how we deal with such observations.

I assume a simple model or random utility where the value of a scenario with retirement age \( r \) for a given age \( a \) is given by:

\[
V_r(A_{a-1}, \omega_a) = \max_{A_a} \left( \frac{1}{\gamma} C^y_a + \exp(x\beta + \alpha)L_a + s_{a(a+1)} \rho E(V_r(A_a, \omega_{a+1})) \right) + \sigma_v \varepsilon_r
\]  

(5)

Most of the respondents observed characteristics are included in vector \( x \). Details on the included characteristics are presented below in Section 4.2. The model includes two types of unobserved terms: the unobserved heterogeneity \( \alpha \) in preference for leisure and the retirement specific error term \( \varepsilon_r \). The error terms \( \varepsilon_r \) capture mood effects and reporting error, and represent variations in preferences at the moment the respondent is asked to evaluate the scenarios. For the sake of simplicity and tractability, I assume error terms \( \varepsilon_r \) are i.i.d. distributed with an extreme value type 1 distribution, leading to an econometric model of the logit family. This error term does not have a persistent effect for the expected value function at time \( a + 1 \) and has an expected value of 0 in the future. Persistence in preferences is captured only by the mean of heterogeneity in preference for leisure. The term \( \alpha \) is stable over the years a respondent answered the questionnaire and across retirement scenarios in a given year. I assume that this term is normally distributed with standard error \( \sigma_{\alpha} \), to be estimated. It follows that a systematic preference for early retirement over the years is captured by mean of a high value of \( \alpha \), while reporting once a high preference for this scenario would be captured by a high draw of the error term at this period. Finally, in the estimation procedure, the parameter \( \rho \) to be between 0 and 1, as I enforce the constraint that respondents have preference for present consumption.

To alleviate the notation for the exposition of the econometric model, let us denote:

\[
V_r(a) = V_r(A_{a-1}, \omega_a)
\]

\[
V_r(a)/\sigma_v = V^*_r(a) + \varepsilon_r
\]

I use the evaluation of the various scenarios to rank the alternatives. The model can conceptually be characterized as a rank-logit model (see [Beggs et al., 1981]). Suppose that you can obtain the self-reported value, on a 10-point scale, of three retirement paths denoted 1, 2, and 3. In the best case, I am able to determine the full ranking of the three scenarios. Say that a respondent expresses that he prefers retirement path 1 over 2 over 3. In such a case, the likelihood contribution of the
respondents is given by

\[
L(V_1(a) > V_2(a) > V_3(a)) = \frac{\exp V_1^*(a)}{\sum_{z \in \{1,2,3\}} \exp V_z^*(a)} \frac{\exp V_3^*(a)}{\sum_{z \in \{2,3\}} \exp V_z^*(a)}
\]  (6)

It can however happen that a respondent gives the same value to two or three scenarios, and hence do not reveal their full ranking. In such cases, I need an additional assumption in order to use the rank-logit model, namely that the ties are are exogenous, and do not depend on the characteristics of the respondents, such as ranking capabilities (see [Fok et al., 2010] for an example with unobserved heterogeneity in capabilities). The approach I follow in cases of partial ranking is to either maximize the probability that a scenario would be preferred to the other two or the probability that an observation would be ranked last according to the information available.

Suppose that the respondent prefers 1 to 2 and to 3, but did not express a preference between 2 and 3, then, the contribution is given by:

\[
L(V_1(a) > V_2(a), V_1(a) > V_3(a)) = \frac{\exp V_1^*(a)}{\sum_{z \in \{1,2,3\}} \exp V_z^*(a)}
\]  (7)

Then, in a case where 1 and 2 are preferred to 3, but where there can’t be discrimination between 1 and 2, the contribution is given by:

\[
L(V_1(a) > V_3(a), V_2(a) > V_3(a)) = \frac{\exp V_1^*(a)}{\sum_{z \in \{1,2,3\}} \exp V_z^*(a)} \frac{\exp V_2^*(a)}{\sum_{z \in \{2,3\}} \exp V_z^*(a)} + \frac{\exp V_2^*(a)}{\sum_{z \in \{1,2,3\}} \exp V_z^*(a)} \frac{\exp V_1^*(a)}{\sum_{z \in \{1,3\}} \exp V_z^*(a)}
\]  (8)

This expression corresponds to the sum of the two probabilities associated with the scenarios in which 3 is ranked last.

Obviously, a respondent that gives the same value to all scenarios would contribute a constant term to the likelihood and is omitted for the maximization.

4 Empirical Analysis

I present in this section the results of the empirical analysis. I first discuss the sample used to estimate the model using simple descriptive statistics. This discussion is followed by the results of the estimations.
4.1 Selecting the sample

One of the limitations of this paper lies in the selection process of included observations. Due to data limitations, I cannot estimate a full model of retirement for the couples. The simplest way to do so would be to include the working status of the spouse in a respondent utility function (e.g. Gustman and Steinmeier 2004). However, this working status is not specified in the description of the retirement scenarios, where everything is phrased in terms of individual behavior. In order to include as many respondents as possible, I decided to divide equally household wealth and income among the two household members. This is obviously problematic, as it will underestimate the retirement cost of the high earner and overestimate the retirement cost of the low earner. However, not doing so would clearly over estimate the consumption of the highest earner and underestimate consumption of the lower earner. A better analysis of household behavior is a step that will require further investigation, and data, in future research. Nevertheless, I restrict my sample to singles and couples where both members are observed. Then, each respondent is allocated the mean income within the couple and half of the total values of the assets. The marital status of the respondents enters the model through the leisure term, as described in Section 4.2.

After restricting the respondents to singles and "half-couples" aged less than 61, merging the dataset with the DHS, and removing observations with insufficient information, I retain a sample of 607 respondents, forming a panel of 963 observations (respondent-year). Table 1 presents the distribution of the rankings as observed in the sample. Each of the first six columns of the table corresponds to the six different sets of replacement rates that were presented to the respondent. The seventh column pool all respondents together irrespective of the replacement rate that was presented to them. This table ignores the fact that some respondents are observed more than once over time.

There is a lot of information in this table, and it is not immediately easy to synthesize its content. Let us consider the last column first. We see that across the scenarios, the ranking observed the most frequently is such that retiring at 68 is preferred to retiring at 65, in turn preferred to retiring at 62. If we focus only on this results, it would indicate that late retirement is the favored option. It is not exactly so. Let us consider only cases where the preferred option is known, excluding the 139 respondents for whom only the least preferred option is known, and the 135 respondents for whom no ranking is available. Out of these 689 respondents, 21.9% prefer the scenario with retirement at 62, 39.3% prefer retirement at 65, and 38.8% prefer late retirement. As for cases where only the least preferred scenario is reported, only 12 respondents selected retiring at 65, while 82 reported that early retirement was undesirable and 45 disliked late retirement. This would show that under the heterogenous retirement rates selected for these samples, the preferred option would be standard retirement at 65. We also see that in the first column, where early replacement rates are the lowest, respondents seem to express preference for late retirement, with 48% of 163 respondents
Table 1: Distribution for the ranking of retirement scenarios by set of hypothetical replacement rates.

<table>
<thead>
<tr>
<th>Replacement rates when retiring at 62/65/68</th>
<th>45/60/80</th>
<th>50/65/75</th>
<th>50/65/85</th>
<th>50/70/85</th>
<th>50/75/95</th>
<th>55/70/90</th>
<th>Pooled</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{62} &gt; V_{65} &gt; V_{68}$</td>
<td>14</td>
<td>14</td>
<td>16</td>
<td>9</td>
<td>5</td>
<td>17</td>
<td>75</td>
</tr>
<tr>
<td>$V_{62} &gt; V_{68} &gt; V_{65}$</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>$V_{65} &gt; V_{62} &gt; V_{68}$</td>
<td>13</td>
<td>7</td>
<td>13</td>
<td>16</td>
<td>12</td>
<td>32</td>
<td>93</td>
</tr>
<tr>
<td>$V_{65} &gt; V_{68} &gt; V_{62}$</td>
<td>16</td>
<td>3</td>
<td>11</td>
<td>13</td>
<td>13</td>
<td>21</td>
<td>77</td>
</tr>
<tr>
<td>$V_{68} &gt; V_{62} &gt; V_{65}$</td>
<td>4</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>$V_{68} &gt; V_{65} &gt; V_{62}$</td>
<td>56</td>
<td>10</td>
<td>44</td>
<td>11</td>
<td>14</td>
<td>43</td>
<td>178</td>
</tr>
</tbody>
</table>

Total - Full ranking: 106 34 92 50 44 118 444

$V_{62} > V_{65}, V_{62} > V_{68}$

Total - Full ranking: 18 5 28 7 4 8 70

$V_{65} > V_{62}, V_{65} > V_{68}$

Total - Full ranking: 17 9 27 9 8 31 101

$V_{68} > V_{62}, V_{68} > V_{65}$

Total - Full ranking: 22 7 30 5 3 7 74

$V_{62} < V_{65}, V_{62} < V_{68}$

Total - Full ranking: 15 9 12 4 15 27 82

$V_{65} < V_{62}, V_{65} < V_{68}$

Total - Full ranking: 3 3 3 1 0 2 12

$V_{68} < V_{62}, V_{68} < V_{65}$

Total - Full ranking: 16 5 10 2 1 11 45

Total - Partial ranking: 91 38 110 28 31 86 384

Included observations: 197 72 202 78 75 204 828

No ranking available: 37 12 40 6 11 29 135

Total: 234 84 242 84 86 233 963
Table 2: Frequency of the values used by respondents when all scenarios were evaluated equally, all years pooled

<table>
<thead>
<tr>
<th>Value</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Very Unattractive</td>
<td>96</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>10 Very Attractive</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>135</td>
</tr>
</tbody>
</table>

for whom the preferred option is known. To illustrate the impact of a variation in replacement rates, consider the sixth column with more generous replacement rates than in the first one. In that case, respondents prefer standard retirement, with 51% of 164 respondents for whom the preferred option is known. This indicates that respondents are sensitive to the replacement rate offered to them.

A substantial fraction of respondents use the same value for all scenarios. As mentioned above, these respondents contribute a constant term to the likelihood and are excluded for the purpose of the maximization. This is an obvious drawback compared to the approach of Voňková and van Soest (2009), who exploited the intensity of preference rather than simply the relative ranking. To illustrate part of the information that we forego, consider Table 2 presenting the frequency of the values used when the three scenarios were evaluated with the same answer. A deeper look at these respondents shows that 96 out of the 135 evaluated the 3 scenarios using the answer of 1. Hence, taken at face value, all of the proposed scenarios were deemed as "very unattractive". Values of 2 and 5 were also frequently used, 9 and 17 times respectively. One explanation could be that respondents genuinely value all scenarios equally. This is plausible, for instance, if a respondent has a much more interesting retirement plan available. This would lead to the large fraction of low answers observed. If this is the right explanation, there is genuinely no information concerning preferences that can be extracted from these observations. An alternative interpretation is that the respondents gave the same answer to the questions in a way that can be compared to non-response. Omitting these observations could then induce a selection bias. I acknowledge that one must be careful in extrapolating the coming analysis to infer preferences outside of this sample.

If I do not take into consideration the 135 cases where respondents gave the same ranking to all
observations, I retain an unbalanced panel of 828 observations, coming from 498 individuals. While the observations lost may lead to a selection problem, I ignore this fact for the remainder of this analysis.

4.2 Independent variables

Let’s discuss briefly the independent variables and how they enter the model. The model allows the parameter of risk aversion to vary by gender. This parameter has a value of $\gamma_0$ for women and $\gamma_0 + \gamma_{\text{men}}$ for men. For the other characteristics, most of the covariates enter the model through the preference for leisure. I include in this term variables to control for education, gender, age, and marital status. Age is included by means of a quadratic function using the age of the respondents in 2006 minus 22 (the age of the youngest respondent in 2006). Age in this model is a time-invariant regressor aimed at capturing cohort effects rather than age effects. Marital status is included by means of a dummy variable if the respondent belongs to a couple, and an additional term interacting this marital status and the dummy $\text{men}$. Table 3 presents basic descriptive statistics for the independent variables.

Table 3: Descriptive statistics of independent variables at the first time period a respondent is observed (N=498)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>43.06</td>
<td>43.00</td>
<td>9.18</td>
</tr>
<tr>
<td>Male</td>
<td>0.52</td>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>Educ. Med.</td>
<td>0.17</td>
<td>0.00</td>
<td>0.37</td>
</tr>
<tr>
<td>Educ. High.</td>
<td>0.81</td>
<td>1.00</td>
<td>0.39</td>
</tr>
<tr>
<td>Partner</td>
<td>0.51</td>
<td>1.00</td>
<td>0.50</td>
</tr>
<tr>
<td>Net yearly wage</td>
<td>19,930.74</td>
<td>19,350.00</td>
<td>5,885.20</td>
</tr>
<tr>
<td>Net assets/debts</td>
<td>39,941.08</td>
<td>15,771.57</td>
<td>75,074.76</td>
</tr>
</tbody>
</table>

We see that the resulting sample has about as many men than women, and as many singles and non-singles. As we can see from the education dummies, the sample is highly educated, with most respondents having what is considered as a high level of education. This seemingly high level of education may partially be explained by the fact that we focus on employed respondents, but nevertheless hints that selection may be a problem.
4.3 Estimation results

Estimation results are presented in Table 4. Results are presented for two groups: the singles only in the left half of the table, and singles and the "half-couples" described above in the right half. Then, for each of these two groups, the model was estimated using a 1%, 2% and 3% interest rate.

The results presented in the first two columns are generally quite imprecise. None of the personal characteristics included in the model have a significant effect. This is an obvious drawback of the use of a rank-ordered logit to estimate the problem at hand. The estimated values of the discount parameter are between 0.95 and 0.97 in all cases, hinting that studies reviewed above seemed to have chosen plausible values in their calibration.

Adding respondents with a partner leads to slightly different conclusions. First, note that the dummy for whether a respondent is in a couple or not is significant at 10%-significance level (with all \( p \)-values smaller than 6%). The estimated values of the discount parameter did not change much, staying between 0.95 and 0.97. I now find a significant age trend. The effect of this trend for an interest rate of 2% and for the extended sample (column 5 in Table 4) is represented in Figure 1.

The graph presents:

\[
\hat{\lambda}_{age} = \exp\left(\hat{\beta}_{age/10} (age - 22)/10 + \hat{\beta}_{age-sq./1000} (age - 22)^2/1000\right),
\]

as a function of \( age \). This term can be interpreted as the ratio of predicted value for the leisure parameter of a respondent of a given age compared to a respondent aged 22. Remember that age is a time-constant variable in this model, so that preference for leisure is assumed to be constant for a respondent and not affected by his own aging. We see in the figure that the respondents with the highest value for leisure are 41.9 years old and have a predicted value of \( \lambda \) almost 25% higher than respondents aged 22 with the same observed and unobserved characteristics. While this decrease in value for leisure past 42 may look strange at first sight, a plausible explanation is that we focus on employed respondents and that respondents with high value for leisure are likely to benefit from early retirement, leading to a selection effect in older respondents.

5 Simulations

Due to the structural nature of the model, I can use the results to predict the behavior of respondents under various scenarios. In this section, I therefore explore the impact of various hypotheses on actual behaviour, paying particular attention to the possible reaction to a delay of 2 years of eligibility to social security.
Table 4: Estimation results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Singles only 1% interest</th>
<th>Singles only 2% interest</th>
<th>Singles only 3% interest</th>
<th>Singles and &quot;half-couples&quot; 1% interest</th>
<th>Singles and &quot;half-couples&quot; 2% interest</th>
<th>Singles and &quot;half-couples&quot; 3% interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \rho )</td>
<td>0.965***</td>
<td>0.956***</td>
<td>0.949***</td>
<td>0.968***</td>
<td>0.963***</td>
<td>0.960***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.011)</td>
<td>(0.010)</td>
<td>(0.007)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>( \gamma_0 )</td>
<td>-0.170**</td>
<td>-0.162***</td>
<td>-0.159**</td>
<td>-0.117**</td>
<td>-0.118**</td>
<td>-0.109**</td>
</tr>
<tr>
<td></td>
<td>(0.055)</td>
<td>(0.058)</td>
<td>(0.063)</td>
<td>(0.044)</td>
<td>(0.047)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>( \gamma_{men} )</td>
<td>0.021</td>
<td>0.016</td>
<td>0.011</td>
<td>0.018</td>
<td>0.015</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.026)</td>
<td>(0.025)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>( \beta_0 )</td>
<td>-1.109**</td>
<td>-1.196**</td>
<td>-1.410**</td>
<td>-0.750*</td>
<td>-0.889*</td>
<td>-0.981**</td>
</tr>
<tr>
<td></td>
<td>(0.543)</td>
<td>(0.565)</td>
<td>(0.605)</td>
<td>(0.430)</td>
<td>(0.456)</td>
<td>(0.044)</td>
</tr>
<tr>
<td>( \beta_{men} )</td>
<td>0.130</td>
<td>0.089</td>
<td>0.050</td>
<td>0.096</td>
<td>0.069</td>
<td>0.021</td>
</tr>
<tr>
<td></td>
<td>(0.281)</td>
<td>(0.279)</td>
<td>(0.278)</td>
<td>(0.169)</td>
<td>(0.172)</td>
<td>(0.173)</td>
</tr>
<tr>
<td>( \beta_{educ. , med.} )</td>
<td>0.051</td>
<td>0.073</td>
<td>0.059</td>
<td>0.080</td>
<td>0.076</td>
<td>0.071</td>
</tr>
<tr>
<td></td>
<td>(0.143)</td>
<td>(0.150)</td>
<td>(0.160)</td>
<td>(0.125)</td>
<td>(0.136)</td>
<td>(0.143)</td>
</tr>
<tr>
<td>( \beta_{educ. , high.} )</td>
<td>-0.011</td>
<td>-0.029</td>
<td>-0.053</td>
<td>0.022</td>
<td>0.015</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>(0.133)</td>
<td>(0.140)</td>
<td>(0.151)</td>
<td>(0.123)</td>
<td>(0.133)</td>
<td>(0.140)</td>
</tr>
<tr>
<td>( \beta_{partner} )</td>
<td></td>
<td></td>
<td></td>
<td>0.105**</td>
<td>0.107*</td>
<td>0.110*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.052)</td>
<td>(0.055)</td>
<td>(0.058)</td>
</tr>
<tr>
<td>( \beta_{partner \times , men} )</td>
<td></td>
<td></td>
<td></td>
<td>0.044</td>
<td>-0.046</td>
<td>-0.049</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.066)</td>
<td>(0.070)</td>
<td>(0.074)</td>
</tr>
<tr>
<td>( \beta_{age/10} )</td>
<td>0.042</td>
<td>0.119</td>
<td>0.258</td>
<td>0.163*</td>
<td>0.234**</td>
<td>0.327***</td>
</tr>
<tr>
<td></td>
<td>(0.140)</td>
<td>(0.153)</td>
<td>(0.173)</td>
<td>(0.092)</td>
<td>(0.101)</td>
<td>(0.114)</td>
</tr>
<tr>
<td>( \beta_{age-sqr/1000} )</td>
<td>-0.204</td>
<td>-0.349</td>
<td>-0.582</td>
<td>-0.461**</td>
<td>-0.588**</td>
<td>-0.738***</td>
</tr>
<tr>
<td></td>
<td>(0.336)</td>
<td>(0.359)</td>
<td>(0.395)</td>
<td>(0.216)</td>
<td>(0.237)</td>
<td>(0.259)</td>
</tr>
<tr>
<td>( \sigma_\lambda )</td>
<td>0.224</td>
<td>0.224</td>
<td>0.227</td>
<td>0.236</td>
<td>0.246</td>
<td>0.256</td>
</tr>
<tr>
<td>( \sigma_\epsilon )</td>
<td>0.117</td>
<td>0.100</td>
<td>0.088</td>
<td>0.197</td>
<td>0.177</td>
<td>0.174</td>
</tr>
<tr>
<td>N. Ind.</td>
<td>242</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>411</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard errors between parentheses
Variable \( age \) is age in 2006 minus 22
The estimated parameter \( \rho \) constrained to be between 0 and 1
Figure 1: Estimated relation between age and preference for leisure for the extended sample with a 2% interest rate. Age at time $t = 1$ is on the horizontal axis. The vertical axis represents the value of $\hat{\lambda}_{age}$, the predicted ratio of the value of the leisure parameter $\lambda$ for a respondent of a given age compared to a respondent aged 22.
5.1 Initial results

Consider the original scenarios proposed to the respondents. For each scenario, I can predict the probability that a respondent would prefer this scenario over the others. Consider Simulation (1) in Table 5, presenting the average probability to retire at a given age given the heterogeneous replacement rates presented to the respondents. We see that the model predicts large heterogeneity in retirement behavior. While the median and modal retirement age would be 65, the proportion of respondents that would choose to retire at 62 or 68 is substantial. Based on the discussion presented in Section 4.1, it is not surprising that the model predicts about the same proportion of respondent with preference for retirement at 65 and at 68. However, the share of preference for early retirement seems quite high, although not entirely off the mark. The results presented here are in line, at least qualitatively, with the description of the Dutch pension system made by Capretta (2007). However, these results are at odds with Voňková and van Soest (2009), who find a strong preference for standard retirement at 65. The difference in results between this paper and theirs could be due to a different subsample, focus on different stated-preference questions or to the method itself.

The results of this initial simulation are not that interesting per se, given that each respondent faced a different replacement rate. In what follows, we will consider alternative simulations where respondents are offered comparable scenarios.

5.2 Reference scenario

For the remainder of the section, I want to offer comparable replacement rates to all respondents conditional on their retirement at a given age. I start from a common scenario where respondents are offered a 70% replacement rate of their final income should they retire at 65. This scenario will serve as a benchmark. I use this information to compute replacement rates under alternative scenarios. One important concept in the determination of the replacement rate is the annuity factor for a given retirement age $r$, given by:

$$A(r) = \sum_{t=r}^{100} \frac{s_{rt}}{(1 + \iota)^{t-r}}$$

(9)

Remember that both income at 64 and survival probabilities will vary by respondents, however, subscript $\iota$ is omitted for ease of presentation.

I assume that pensions are defined in terms of the last wage, as it was the case in the hypothetical scenarios. Following a description in the OECD guide for pensions, the replacement rate at 65 is
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rep. rate</td>
<td>%</td>
<td>Rep. rate</td>
<td>%</td>
<td>Rep. rate</td>
</tr>
<tr>
<td>61</td>
<td>45/50/55</td>
<td>30.0</td>
<td>56.31</td>
<td>46.1</td>
<td>52.47</td>
</tr>
<tr>
<td>62</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>63</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>64</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>65</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>66</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>67</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>68</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>69</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
<tr>
<td>70</td>
<td>60/65/70/75</td>
<td>35.6</td>
<td>70.00</td>
<td>28.7</td>
<td>70.00</td>
</tr>
</tbody>
</table>

Mean age ret. | 65.1 | 64.3 | 64.5 | 64.3 | 64.8

\(^a\) Mean replacement rate over the sample
define as 1.75% times the number of years worked, assuming a full career of 40 years. For each respondent, I compute the pension wealth at age 65 for a given retirement age given by:

\[ PW(r \mid 65) = 1.75\% \left( r - 25 \right) A(65) \omega_{64} \]  

(10)

Which obviously implies that the value of the pension wealth at 65 for someone retiring at 65 is given by.

\[ PW(65 \mid 65) = 70\% A(65) \omega_{64} \]  

(11)

The scheme used here has a strange contribution pattern, in the sense that the contribution’s value at age 65 is the same independently of the age at which it was made, and that hence, the real value contributed at each time period is increasing over time. For the sake of comparison with previous studies, I present here an analysis with a 2% real-interest rate. Given the current economic situation at the time of writing these lines, the real interest rate is probably larger than it should be.

I first want to compute various scenarios under actuarial neutrality, taking into account both increase in pension wealth due contribution as time goes by and mortality risk. In the simple setting developed here, the actuarially fair replacement rate is given by:

\[ \text{reprate}_r = \frac{(1 + \iota)^{r-65} PW(r \mid 65)}{s_{65,r} A(r) \omega_r} \]  

(12)

Note that \( s_{65,r} \) is equal to one if \( r < 65 \) in our model where there is no mortality between 62 and 68.

Simulation (2) in Table 5 presents a simulation of retirement scenarios with the same retirement ages that were used before, but with actuarially neutral replacement rates. To simplify the presentation, the replacement rates presented in the table are the average of the replacement rates offered to each respondent for a given retirement age. On average, these rates are close to the most generous hypothetical scenarios presented to the respondents. These rates would lead to a substantial fraction of the workers retiring at age 62, as almost half of them would be predicted to retire at that age under this progression.

To allow for more flexibility in retirement, Simulation (3) allows a respondent to retire at every age between 61 and 70. The average retirement age in this model is predicted to be 64.5 years old.

While the fact that each respondent receives a different set of replacement rates enforces the concept of actuarial neutrality, this approach to pension plans is not realistic. An alternative approach would be to use the same replacement rates for every individuals, by using, for instance, the
same rates used by Voňková and van Soest (2009). This was done in Simulation (4), allowing us to assess the impact of variations in replacement rates. We see that using this rate leads to an average retirement age of 64.3, a diminution of 0.2 years, or about two months. It is important to stress that despite the seemingly small differences in replacement rates, the heterogeneity in Simulations (2) explains part of the variation in mean retirement age. Results of Simulation (2) would be different if all respondents were offered the average rates.

5.3 Delayed eligibility to AOW

As discussed above, the current reform in social security should delay eligibility to the pension by 2 years, from age 65 to 67. I discussed in Section 2 that public and private pensions in the Netherlands are often integrated, with the aim to offer a given gross replacement rate to a worker retiring at 65. Hence, a shock to social security like the pension reform is not straightforward to implement in my simulations, as I must make additional assumptions concerning how the occupational pensions schemes would adjust.

The approach I consider is to interpret the pension reform as a shock on the value of the pension wealth at 65 that would be absorbed by the occupational pension. I simply remove two years of social security from the pension wealth computed in Equation 11 and compute new replacement rates based on Equation 12. Given that the scenarios are expressed in terms of net income, I approximate the value of social security to be the value received by singles in 2008, and assume that everyone pays on this amount the lowest rate of income tax. This leads to a gross yearly value of 12,718 Euros on which a 33.60% tax is paid. Considering the delay of two years proposed, the net total reduction of $PW(65 | 65)$ is therefore of 16,724 Euros.

This last Simulation, numbered (5), is presented in Table 5. We see, for instance, that the average age of retirement increases by 0.3 years, an increase of four months. The impact of this delayed payment to social security may look quite small at first glance. It has to be stressed that the Netherlands is a country where individuals accumulate a large pension wealth during their lifetime. According to the most recent OECD report on pension available at the time of writing (cf OECD 2011), the median Dutch man accumulates 12.8 times his net income in pension wealth while the median Dutch women accumulates 14.6 times her net income. These numbers are among the highest in the countries reviewed in the publication. Thus, a reduction by two year of public pension on the total pension wealth does not have an effect as strong as one may expect at first.

An important aspect that must not be overlooked is that the reform is expected to have different effects on different individuals. For respondents with lower income, for instance, social security
represents a larger share of the pension wealth than for richer individuals. Other factors may affect behaviour. Younger respondents have more time to adjust their behaviour to a policy change like delayed eligibility to AOW than older respondents. Even leaving aside differences in preferences, we therefore predict more important changes in behaviour for older respondents who do not have time to adjust their consumption over a long period of time. To see how this is translated in terms of the current model, consider Figure [2] presenting scatterplots of the predicted delay in retirement of our respondents by income (left panel) and age (right panel).\(^2\) We see that at any given level of income and at any given age, the model predicts a substantial variation in behaviour. In both cases, the average trends are correctly predicted.

Another way by which the respondents can adapt to the change in policy is by reducing their consumption.\(^3\) The structural model used in this paper allows predictions on consumption and savings. It is therefore possible to predict changes in consumption that would be induced by the

\(^2\)One respondent with very low income was excluded from the graph. This respondent was predicted to delay retirement by almost two years.

\(^3\)Given the discrete nature of the model a consumption increase is possible. Given that a respondent can only retire once a year, he may decide to delay retirement and to increase consumption. This situation is never predicted by the simulations.
policy described above. Let us consider the immediate effect of the reform on consumption. To do so, let us consider the largest variation that the reform could induce in the model at the current time period and for a respondent planning to retire at 65. We compare the predicted consumption before and after the reform. This simulation is equivalent to the case of a respondent who did not forecast the change in policy and who learns of this change at the current time period. Given that most respondents seem to anticipate the reform, and given that many of them may delay retirement, the difference in consumption path is likely to overestimate the observed effect and should be interpreted as an upper bound on predicted consumption change. Consider Figure 3 presenting scatterplots of the predicted variation by income (left panel) and by age (right panel). We hardly see a systematic

![Figure 3: Predicted variation of consumption for current year by current income (left panel) and age (right panel), assuming that retirement is fixed at 65.](image)

effect of income on the immediate consumption decline, should retirement be fixed at 65. We also see that age is an important factor in the prediction. As we forecasted, older respondents would have to adapt their consumption more than younger. Remember that the current reform of AOW is gradual, and that a full delay in eligibility will only be in effect for respondents aged 55 or more. Note also that a lot of younger respondents would not change their consumption at all. This is due to the fact that they were prevented to borrow from their pensions, and therefore still plan to enter retirement with a value of accumulated assets equal to 0, as they did before.

To summarize these simulations, it seems that the model predicts that poorer respondents would
tend to delay retirement more than higher earners should this reform pass, and to predict that a
decrease of consumption is mostly caused by age. There is nevertheless a lot of heterogeneity in the
predicted reaction to this reform.

6 Discussion and Conclusion

In this paper, I used simple questions where respondents are asked to state their preferences to
estimate a life-cycle model of retirement and savings. I find that the estimated model yields plausible
estimation of parameters, generally in line with results from the literature, and showed that many
of the problems I faced came from the small sample size or from unavailable data that could easily
be elicited. Respondents seems to answer the questions in a way that is consistent over time, as seen
from the importance of the random-effects in the analysis. The scenarios I analyze are both easy to
understand and are in line with the defined-benefit pension plans predominant in the Netherlands,
which means that they may relate to them even if they do not have access to such retirement plans.
Thus, at first glance, I could not find any obvious reason not to use stated preferences in the analysis
of retirement and savings.

Of course, not finding evidence against the use of such data is different from finding evidence
in favor of them. The next logical step for this project is to try to compare the predictions of this
estimated model with actual behavior. Failing to reconcile stated and revealed preferences would
probably cast doubt on the usefulness of the stated-preference approach. Still, if what people report
is what they plan or hope to achieve, or if it reflects their preferences at a given point in time,
there may be some usefulness for the current analysis. A simple and straightforward application is
to evaluate how a population may vote on some propositions. Understanding this is important if
policy makers want to have the support of the population when proposing pension reforms, notably
in states where votes and referendums are omnipresent. The state of California, for instance, would
be a good example.

For the sake of the discussion, let’s assume that stated preferences are a good substitute for
revealed preferences in the study of retirement and savings. In this case, we undoubtedly want to
improve the simple model I presented here. Many of the shortcomings of this research are not due to
the absence of an appropriate theory or to the high cost of eliciting the relevant data, but rather to
the modest sample size available at the time of writing these lines or to the lack of a required piece
of information in the dataset. These problems are not a serious barrier to future research. Eliciting
data of this type is not particularly expensive or challenging, mostly with access to panels such as
the CentERpanel. There are a lot of interesting and important factors that we may want to control
The structural form dictates well how to augment the model, and, once the new value function is computed, the econometric model requires only minor adjustments, if any.

Future research topics may include better measurement of risk aversion or may rely on dynamically inconsistent preferences (e.g., Laibson [1997]). These last two examples would require cleverly designed future scenarios, both easy to understand for the respondents and complete enough to identify the model used. The fact that researchers can easily vary the assessed scenarios in an experimental manner should be a useful tool to actually identify these effects. Household structure and joint retirement are other interesting topics. I did not take into account, for instance, the number of children or dependent family members in each household. Again, the decision to exclude these characteristics in the model was mostly driven by the relatively small size of the sample available. We can nevertheless think of an extension to this model that would take these elements into account. In this case, we would probably want to allow the utility from consumption to vary according to the number of family members, but could think that the value of leisure after retirement should not be affected (assuming that the children are no longer living with their parents, naturally). Finally, some health related variables, like self-assessed health, should probably be included in the leisure parameter. It would also be interesting to measure perceived spouse’s health, and see how it affects retirement plans. Subjective survival probabilities could also be used in order to control for heterogeneity in frailty among the respondents. While these last variables were not available in the dataset, eliciting them does not pose a great challenge. Some of this information will be available in the 2011 yearly wave of the Pension Barometer Survey, allowing me (and hopefully other researchers) to improve the realism of the model.

References


A Assets and debts definitions

I list here the list of assets and debt used in the aggregated definition. This list is the same as presented in some work I co-authored (Bissonnette and van Soest, 2010). The value of accumulated asset used in computation is the difference between wealth and debt at the beginning of the year. The element included are as follow:

On the wealth is the sum of the total amounts of the following elements:

1. Checking account
2. Employer-sponsored saving plan
3. Savings accounts
4. Deposit books
5. Savings certificates
6. Single-premium insurance policies
7. Endowment insurance policies
8. Growth funds
9. Bonds
10. Shares
11. All kinds of options
12. Real estate not used for housing
13. Money lent to family
14. Investment not mentioned before
15. Stocks for substantial holding
16. Business equity

The debt is the sum of the total amounts of these elements:

1. Private loans
2. Extended lines of credit
3. Debt with mail-order firms
4. Hire-purchase contracts
5. Loans from family and friends
6. Study loans
7. Credit card debts
8. Loans not mentioned before