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Pension Risk, Retirement Saving and Insurance

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Abstract

Using a representative sample of Italian investors, we estimate the risk associated with pension benefits by eliciting for each individual the subjective distribution of the replacement rate as a summary indicator of social security wealth. We find substantial heterogeneity of pension risk and show that it is consistently related to observable features in the pension system that have different effects on individuals with different characteristics. We then relate subjective pension risk to individuals' financial decisions. We find that people try to attenuate the adverse consequences of pension wealth uncertainty by increasing demand for targeted retirement saving and for insurance. Individuals facing more pension wealth risk tend to enroll more often in private pension funds, invest more in life insurance and buy more private health insurance. These effects are consistent with people becoming more risk-averse when pension wealth becomes less predictable, leading them to search for greater financial security.

Keywords: Pension Risk, Retirement Saving, Insurance
JEL Classification: H55, E21

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1. Introduction

As a reflection of the still incomplete process of pension reform and of the nature of the reforms adopted, there is a widespread belief that for the citizens of most industrialized countries, pension entitlements have become much more uncertain than in the past. It is fair to say that even an informed worker would find it difficult to estimate her pension benefits at retirement. The long-term nature of pension arrangements makes it all the more difficult to predict what the eventual pension will be and particularly for the young. Their longer time horizons mean that young people are more subject to two fundamental sources of pension uncertainty that occur particularly in countries such as Italy, where future benefits are closely linked to contributions.

The first source of uncertainty in Italy is based on the reforms already undertaken, which have resulted in lower public pension coverage, and also, and by design, in greater benefit uncertainty: future pensions will reflect idiosyncratic income risk during a working life, future fluctuations in aggregate GDP growth, and population-wide survival rates. The second source of uncertainty lies in the reforms that have still to be introduced, because the reform process is incomplete. Being unable to predict pension benefits can be of first order importance to consumer welfare, particularly where perceptions of the true uncertainty are biased, and not sufficient action is taken to buffer against risk. Thus, understanding how much uncertainty is perceived, whether what is perceived is consistent with the reality, and whether an individual should respond to this uncertainty are of primary relevance.

In this paper we investigate each of these three aspects. We rely on the 2006 UniCredit Customer Survey (UCS), which covers a random sample of customers of UniCredit, one of the largest banks in Europe. The survey asks for detailed information on income, assets and demographic variables and, quite uniquely, elicits the subjective probability distribution of the replacement rate for each individual in the sample. We rely on the subjective distributions to quantify the amount of uncertainty about future pensions that working-age individuals perceive. We find substantial heterogeneity in the expected replacement rate, which ranges from as low as 20 percent to ratios as high as full

coverage, with an average of 67 percent. Furthermore, expectations are held with significant uncertainty: the average standard deviation of the subjective replacement rate is 20 percent, with considerable differences across sample participants.

Though we cannot check whether the perceived *level* of uncertainty is close to the *actual* level of uncertainty that individuals face, we show that subjective uncertainty varies across individuals in ways that are consistent with what we might expect a priori, due to observable heterogeneity in information sets and in the way that people with different characteristics are affected by current pension schemes. For example, we find that individuals a long way from retirement and who thus face more career uncertainty report more subjective pension risk and that people with higher labor income risk are more uncertain about pension benefits. These features are implied by the design of the new pension system in Italy, and reassure us that people are likely to be aware of the risks they face, a necessary condition for them to be able to caution properly against them.

Prudent individuals should have strong incentives to adjust their savings and financial decisions in order to caution against the risk of having to curtail consumption after retirement. Intuitively, people who perceive greater pension risk should increase retirement saving to buffer against the additional source of risk. Hence, we investigate whether pension risk leads individuals to revise their demand for retirement savings (life insurance and pension funds) and increases the propensity to insure against other risks (in particular, health and casualty risks).

We find that the propensity to enroll in a private pension fund and to invest in life insurance are negatively associated with the expected replacement rate (a 10 percentage point increase in the replacement rate reduces the demand for private pension funds by 2 percentage points) and positively associated with the perceived riskiness of social security benefits (a 1 point increase in the standard deviation is associated with a 3 percentage point increase in pension fund ownership). We also find that the propensity to enroll in health insurance plans is higher for those who perceive greater pension risk. Overall, our results lend support to models of investor behavior in which background uncertainty (as measured by pension risk) affects portfolio and insurance decisions (Kimball, 1992; Gollier and Pratt, 1996).

This is not the first study to measure subjective pension risk. Manski (2004) and Dominitz and Manski (2006) used telephone surveys to measure probabilistic beliefs about pension benefits, while Delavande and Rohwedder (2008) relied on an Internet survey to elicit the subjective probability distributions of pension benefits. Despite their different survey techniques, these authors also find substantial heterogeneity in expected benefits and large uncertainty. However, unlike in our case, they do not have information on consumers' financial decisions and thus were unable to study whether and how they respond to pension risk.

Our paper also has ties to a more traditional and large literature on the relation between pension wealth and the accumulation of private wealth, pioneered by Feldstein (1974) and Feldstein and Pellechio (1979), who studied the displacement effect of pension wealth on national saving using US time series and microeconomic data. Since then, researchers have used individual level data to estimate the displacement effect in the US and other countries imputing pension wealth from legislation, see Gale (1998) and Attanasio and Rohwedder (2003). The evidence suggests that pension wealth crowds out private savings, but by far less than one to one.[1] In contrast to studies that impute social security wealth based on legislation or that rely on point expectations, we study the portfolio effects of higher moments of future pension wealth, based on information on the respondent-specific probability distributions of replacement rates.

Our paper is organized as follows. Section 2 describes the pension rules in Italy and clarifies the sources of uncertainty about social security benefits. Section 3 presents data on the respondent-specific subjective distributions of replacement rates and provides descriptive evidence on the extent of heterogeneity in respondents' beliefs about pension entitlements. In Section 4 we test whether people facing higher pension risk (as measured

[1] Other related research looks at how pension wealth affects the retirement and labor participation decisions of the elderly, and simulates the effects of policy reforms (Gruber and Wise, 1999, 2004). Using Italian survey data, Attanasio and Brugiavini (2003) estimate the displacement effect exploiting changes in pension wealth across cohorts and employment groups induced by the 1992-95 Italian pension reforms. Bottazzi, Jappelli and Padula (2006) study the impact of Italian pension reforms relying on an estimate of pension wealth based on expected retirement age and expected replacement rate, rather than computations based on legislation.

by the standard deviation of the respondent social security risk) show increased demand for private pension funds, life insurance and health insurance. Section 5 concludes.

2. Pension risk in the current regime

Until the early 1990s, the Italian social security system had high replacement rates (first pension benefit to last income ratio), earnings-based benefits, indexation of pensions to real earnings and cost of living, generous provision for early retirement, and a large range of social pensions (i.e., old-age income assistance). This resulted in the ratio of pension benefits to GNP reaching almost 16 percent in 1992, the highest value among the industrialized countries.

The high pension benefits burden on the state budget prompted several reforms, implemented between 1992 and 2008. The main features of these reforms were increase to the retirement age and to the minimum years of contributions for pension eligibility, abolition of seniority pensions for all those starting to work after 1995, and a new formula to compute benefits.[2]

As of 2009, benefits and eligibility vary according to number of years of contributions at end 1995. A defined benefit formula applies to those with 18 years or more of contributions in 1995: we term this formula the "earnings model" and the workers to whom it applies as the "old". A notionally defined "contribution model" applies to those who entered the labor market after 1995 (the "young"), while benefits for those who had less than 18 years of contributions in 1995 (the "middle-aged") are computed according to a "pro-rata" model. The upper panel in Table 1 summarizes the pension award formulas. For the old, pension benefits are proportional to the average of the last 10 years salary (15 for the self-employed), with an accrual rate of 2 percent for each year of contribution. For the young, benefits are linked to lifetime contributions, capitalized at retirement on the basis of a 5-year moving average of GDP growth, and

[2] Seniority pensions were *de-facto* re-introduced in 2004 for everyone, including those who started working after 1995.

then transformed in flow benefits using an annuitization factor based on retirement age and life expectancy:[3]

$$\gamma\tau\sum_{t=0}^{N-1} w_t(1+g)^{N-1-t} \qquad (1)$$

where w is gross individual earnings, N is retirement age, τ is the contribution rate, g a 5-year moving average of the GDP growth rate and γ the annuitization factor. Since τ=0.33 for private and public employees, and 0.20 for the self-employed, the latter will receive substantially lower pensions than the former. The pro-rata regime applies to the middle-aged. For them pensions are earnings-related for working years before 1995, and contributions-related after 1995. Thus, there is considerable heterogeneity in the current regime: more generous provisions for workers closer to retirement, and different contribution rates for employed (private and public) and self-employed people.

Also, pension eligibility depends on the pension regime. In the earnings and pro-rata regimes, for retirement in 2008-09 retirement age is 60 years (61 for self-employed), with a minimum working career of 35 years of contributions. For those who will retire in 2010-2013, retirement age is 61 (62 for self-employed), increasing to 62 (63 for self-employed) for those retiring in 2014 or later. In the contribution regime pension eligibility is either 40 years of contribution, or 65 years of age (60 for females), as shown in the lower panel of Table 1. Thus future pension benefits of Italian workers depend on a wide set of variables, including year of birth, occupation and the earnings profile. To forecast pension benefits workers must also take account of population aging (reflected in the annuitization factor) and future growth, both of which are likely to prompt further reforms.

In this paper we focus on the replacement rate, defined as the ratio of the first pension payment to the last salary payment, as a synthetic indicator of pension wealth. Even without considering possible changes in future legislation, forecasting one's pension is not an easy task because future benefits depend on the timing and volatility of earnings. To illustrate this effect, we assume that log-earnings have a deterministic component

[3] Currently, γ increases from 4.720 percent for somebody retiring at 57 to 6.136 percent for somebody retiring at 65.

growing at the constant 2 percent rate, and that, in each period, earnings are hit by permanent and transitory shocks. The Appendix shows that under these assumptions the first two moments of the replacement rate depend on the standard deviation of permanent (σ_v) and transitory (σ_u) income shocks. We use the income process to simulate a benchmark "true" pension risk over the life-cycle, measured by the coefficient of variation of the replacement rate distribution. We then compare simulated pension risk with the risk that people perceive over the life cycle as measured in our survey.

We start with the contribution method and simulate the replacement rate distribution using equation (1). To isolate the role of earnings risk, we assume that the average GDP growth rate is 1.5 percent per year, the annuitization factor γ is 0.0551 (under the current rules, this is the annuitization factor for those retiring at age 62), and the standard deviation of transitory and permanent income shocks is 1 percent. Under these assumptions the expected replacement rate is 61.7 percent for an employee (τ=0.33) and 37.4 percent for a self-employed individual (τ=0.20).

Figure 1 plots the coefficient of variation of the replacement rate distribution against age. Pension risk is about four times higher for someone just entering the labor market (at age 25) than for someone retiring after 37 years at age 62. Doubling the standard deviation of permanent income shocks (σ_v=0.02) doubles the pension risk (see the dashed line in Figure 1).[4]

Uncertainty about future GDP growth and demographic developments (as reflected in the γ factor) are two further sources of pension risk. Their effects are documented in Figure 2, which displays three lines: the continuous line refers to the baseline case, the dashed line assumes that the growth rate of GDP is uncertain and uniformly distributed between 1 and 2 percent, and the dotted line assumes that the annuitization factor is uncertain and uniformly distributed between 5 and 6 percent. The figure shows that pension risk increases by about 3 percentage points at each age when aggregate GDP growth is uncertain; the effect of demographic risk is quantitatively similar in each case.

[4] The Appendix shows that the coefficient of variation of the replacement rate 1 year before retirement is almost equal to the standard deviation of permanent income shocks.

Pension risk also depends on the pension regime. Figure 3 compares regimes for a private employee. If pensions are proportional based on the last 10 years of earnings, pension risk is much lower, especially at the young end: the coefficient of variation is constant at 1.4 percent until age 52 (10 years before retirement), and then falls gradually to less then 1 percent just before retirement. Not surprisingly, in the pro-rata regime, risk is at values between the earnings model and the contribution model.

In summary, our simulations show that pension risk is higher for young workers and workers with riskier earnings, such as the self-employed. Also, in the new contribution-based regime, demographic risk and aggregate income uncertainty raise pension risk. To check whether people actually perceive the pension risk implied by the current legislation, in Section 3 we use subjective expectations of replacement rates to construct individual replacement rate distributions. Since the pension risk that individuals should perceive is not directly observable, because it depends on unobservable aggregate uncertainty (including political risk related to future reforms), we cannot check whether the *level* of perceived pension risk is consistent with the actual risk individuals face. However, we can check whether observable differences in perceived pension risk vary in a way that is consistent with what is implied by the simulations discussed above.

3. The subjective probability distribution of the replacement rate

Several surveys attempt to measure the subjective expectations of Social Security benefits. For the US, Bernheim analyzes the accuracy of pre-retirement expectations concerning social security benefits in the Retirement History Survey, and Gustman and Steinmeier (1999, 2005) study point expectations of the level of future benefits available in the Health and Retirement Study. Disney and Tanner (1999) and Bottazzi, Jappelli and Padula (2006) analyze point expectations of the replacement rate respectively for the UK and Italy. Of course, point expectations do not provide information about pension uncertainty.

Dominitz and Manski (2006) go a step further; based on information from the Survey of Economic Expectations (SEE), they provide information about the probabilistic expectations of social security retirement benefits. SEE was a telephone survey, addressed to individuals aged between 18–69 who were first asked to report the lowest possible and highest possible levels of their future benefits. Their responses were used to set thresholds for up to six probabilistic questions about the level of benefits. The subjective probabilities elicited from respondents were used to fit a respondent-specific parametric distribution following the procedure described in Manski (2004). Since the SEE asks only for basic demographic information (age, gender, education), and does not inquire about portfolio choice, it is not possible to relate pension subjective probabilities to outcomes such as portfolio choice or the demand for insurance.[5]

Delavande and Rohwedder (2008) measured the distribution of the level of future pension benefits via an Internet survey of respondents to the Health and Retirement Study which is representative of the US population aged 51 and over. They obtained a distribution of pension benefits using the Dominitz and Manski percent chance format and a visual representation of future benefits.[6] Both formats generate a similar central tendency, but the percent chance format generates a more widely dispersed distribution. Furthermore, the dispersion of the elicited distribution is correlated to other sources of uncertainty (such as years to expected claiming age and subjective probability of losing one's job in the next year), in the expected direction for both designs. Overall, their findings suggest that the main advantage of the visual over the percent chance format is that it minimizes the loss of observations due to inconsistencies.[7]

In line with British and Italian evidence, we focus on the subjective replacement rate as an indicator of social security wealth, rather than on the level of future pension benefits. Therefore, we cannot compare subjective pension uncertainty using previous US evidence. For instance, workers might be uncertain about their future level of benefits, but much less uncertain about their replacement rate. For example, consider a public

[5] As the SEE is based on telephone interviews the variables are potentially subject to higher measurement error than would be the case with face to face interviews.
[6] Respondents are asked to allocate a total of 20 balls across 7 bins to represent what they believe are the chances of their future Social Security benefits falling into any one of these categories.
[7] In the percent chance format about 20 percent of responses are lost due to inconsistencies.

employee at the time when benefits were proportional to income received in the last year of paid work. Since income in the last year is uncertain, she might be uncertain about the level of benefit, although she knows the replacement rate with certainty.

In our paper we use subjective expectations available from the 2006 UniCredit Survey (UCS), a national representative sample of the eligible population of UniCredit Group customers. The sample design is similar to that used by the Bank of Italy Survey of Household Income and Wealth (SHIW). The interviews were conducted between May and September 2007 by a leading poll agency using Computer Assisted Personal Interviews. The total sample size is 1,686 customers; the replacement rate questions were addressed to 1,024 working individuals (employees and self-employed). The Appendix includes further details on the survey, and compare sample statistics with the 2006 SHIW. In the rest of this section we describe our elicitation method, the central tendency and dispersion of subjective distributions, and the correlations between pension uncertainty and the variables affecting income uncertainty.

3.1. Elicitation method

To elicit pension expectations in the UCS we follow a similar procedure to Dominitz and Manski (2006). All employees and self-employed (1,024 observations) are first asked to report the minimum (y_m) and maximum (y_M) values of the future replacement rate and then to rank on a scale from 0 to 100 the probability that the replacement rate will be less than the mid-point between the minimum and the maximum, $Prob(y \leq (y_m + y_M)/2) = \pi$. The wording of the questions is reported in the Appendix.

To estimate the moments of the subjective distributions of the replacement rate, we assume the subjective distribution is either uniform or triangular. Based on the range of the distribution and on the subjective probability elicited, we can compute the respondent-specific mean, standard deviation and coefficient of variation. The formulae for these statistics are reported in the Appendix.

We set to missing observations for which y_m, y_M or π are missing, and for which respondents provide inconsistent answers ($y_m \geq y_M$). Therefore the usable answers to

estimate the subjective distribution are 72.7 percent of the eligible sample (1,024 employees). This is higher than the 66 percent value in Dominitz and Manski (2006), but lower than the 97 percent of usable answers in Delavande and Rohwedder (2008). Whether these differences are due to sample characteristics, elicitation method or survey design (telephone, Internet or face to face interviews) is beyond the scope of this paper.

3.2. Descriptive statistics

Table 2 reports cross-sectional statistics of the central tendency and dispersion of the subjective replacement rate distribution. The average expected replacement rate for the sample is 66 percent (for both the uniform and triangular distributions), close to the statutory rate for an average individual in the sample (the median is 70 percent).[8] Although there is substantial heterogeneity in expected replacement rates (the coefficient of variation is 29 percent), expectations on average are in line with legislation. The dispersion of the subjective replacement rate depends on the assumptions made about the distribution. Assuming that the distribution is uniform, the average of the respondent-specific coefficient of variation is 5.08 percent (3.64 percent using the triangular distribution). The median coefficients of variation are slightly lower (3.85 and 2.73 percent, respectively).

While cross-sectional averages are useful to describe the subjective distribution of the average individual, they hide important differences across individuals. Figure 4 plots the cross-sectional distribution of the mean and coefficient of variation of the 744 respondent-specific distributions. The figure highlights considerably heterogeneity in the responses. For instance, 10 percent of respondents expect a replacement rate of less than 40 percent, while another 10 percent expect it to be over 85 percent. In terms of perceived risk, for almost 5 percent of respondents the coefficient of variation is close to 1 percent, while for 9.6 percent it exceeds 10 percent. The next step in the analysis is to show whether pension expectations are related to individual characteristics. We are particularly

[8] Bottazzi, Jappelli and Padula (2006) provide details on computation of the statutory rate, and a comparison of statutory and point expectations of the replacement rates in the SHIW.

interested in checking whether subjective probabilities correlate with characteristics (such as cohort and occupation) that are predicted to influence pension uncertainty based on some of the features of the current pension regime.

3.3. Determinants of subjective probabilities

Figure 5 presents kernel-smoothed means of the average and coefficient of variation of the respondent-specific replacement rate distributions, by education and age. In this figure and the rest of the paper we focus on the triangular distributions (by construction, the uniform distribution is more dispersed, but the results are qualitatively similar). The graphs in Figure 5 show that the expected replacement rate increases with age (upper-left panel), but is not strongly correlated to education (bottom-left panel). In particular, 35-years old workers expect a replacement rate of 63 percent, while workers close to retirement expect a replacement rate of 70 percent or higher. As explained in Section 2, a positive relation between age and expected replacement rate mirrors the features of the current pension legislation, which grants more generous pensions to workers close to retirement.

The dispersion of the replacement rate distribution declines substantially during the life-cycle, signaling that younger workers perceive substantially more risk than workers close to retirement: in the upper-right panel the coefficient of variation is 4.5 percent for 30-year olds and about 3 percent for workers over 60. The lower-right panel shows that workers with lower levels of education face substantially higher pension risk than workers with a high-school or a college degree, reflecting the higher income risk related to blue-collar jobs.

To investigate these relations in more depth, in Figure 6 we present kernel-smoothed 0.25, 0.50, and 0.75-quantile regressions of the subjective central tendency and dispersion of the subjective distributions by age and education groups. Figure 6 shows that pension risk is substantial among young persons for each quantile (upper-right panel), confirming the evidence in Dominitz and Manski (2006). Even middle-aged workers tend to be rather uncertain about their future pension entitlements. That this uncertainty about

benefits should decrease with age, is in line with the simulations in Section 2 as well as the intuition, because income risk and uncertainty about the future structure of social security should decrease with approaching retirement.

Figure 7 explores the relation between subjective expectations and occupation, by plotting the mean and coefficient of variation of the respondent-specific distributions by occupation and income deciles. We find that expected replacement rates do not vary with income (upper-left panel), while the relation between income and the coefficient of variation is non-linear (upper-right panel): uncertainty is greatest at the lowest and highest ends of the income distribution. Furthermore, professionals and the self-employed, who will receive lower pensions because of their lower contribution rates, do indeed expect their pensions to be lower (lower-left panel). They also perceive greater pension risk; given the pension award formula, this is in line with the fact that they also face higher income risk, as shown by the simulations in Figure 3.

3.4. Regressions analysis

Table 3 presents the measures of the central tendency and dispersion of the respondent-specific distributions of the replacement rate in relation to demographic characteristics (age, gender, education), occupation (dummies for private employees and self-employed), region of residence and income. Other variables (e.g. sector of occupation) are excluded from the regression because the coefficients were not statistically different from zero.

The estimates in column 1 confirm that older workers expect a higher replacement rate than younger workers, owing to the more generous pension award formula (linked to average wages in the 10 or 15 years before retirement rather then contributions over the entire career). Private sector employees expect a replacement rate that is 4 percent lower than the reference omitted category (public employees), while the self-employed expect a replacement rate of 11.5 points lower. Residents in the Centre of Italy expect a higher replacement rate than individuals living in the North (the coefficient is 6.2), and in the South (8 points higher).

In addition to formal education (measured by years of schooling), financial literacy might affect the ability to process financial information and perceive risk. Column 2 of Table 3 includes in the set of regressors an index of financial literacy computed from survey responses. We computed this index by defining two dummy variables equal to 1 if respondents answered questions on interest rates and inflation correctly,[9] four dummies that measure the ability to rank asset riskiness correctly,[10] and two dummies related to ability to understand financial diversification and rank the risks among specific portfolios.[11] The index ranges from 0 (no questions answered correctly) to 8 (all correct answers), with a median of 3. Column 2 shows that people with above average financial literacy tend to expect a lower replacement rate. However, the coefficients are not statistically different from zero.

In columns 3 and 4 of Table 3 the dependent variable is the standard deviation of the respondent-specific subjective distribution of the replacement rate. Pension benefits are more uncertain for the self-employed than for employees, consistent with their greater income volatility and different pension regime. Perceived pension risk falls with age, in line with the descriptive analysis and the finding of Dominitz and Manski (2006). The age coefficient captures several effects: first and most importantly, lifetime income risk is higher for younger workers; second, pension regimes differ according to age - earnings-related for older workers and contribution-based for younger ones; third, in the contribution regime benefits depend on a broader range of variables, including GDP growth expectations and demographic risk, which are likely to vary with age. Moreover, as discussed in Section 2, the contribution method potentially amplifies the effect of income uncertainty on pension risk. Finally, individuals presumably have a stronger

[9] The interest rate question is: Suppose that in the next 6 months interest rates will increase. Do you think it is a good idea to buy fixed interest rate bonds today? The inflation question is: Suppose that a savings account earns an interest rate of 2 percent per year (net of costs). If the annual inflation rate is 2 percent, after two years (with no withdrawals), do you think that you could buy more than you could buy today / less / the same / don't know?

[10] We consider whether the respondents' rankings of asset categories satisfy each of the following inequalities: (a) bonds are at least as risky as transaction accounts; (b) stocks are at least as risky as bonds; (c) equity mutual funds are at least as risky as bond mutual funds; (d) housing is riskier than transaction accounts.

[11] The list of portfolios is: 70 percent invested in T-bills and 30 percent in a European equity fund; 70 percent in T-bills, 15 percent in a European equity fund, and 15 percent in 2-3 stocks; 70 percent in T-bills and 30 percent in 2-3 stocks; 70 percent in T-bills and 30 percent in a stock I know well.

incentive to learn about benefits as retirement approaches, reducing perceived uncertainty.

The standard deviation of the replacement rate distribution is positively associated with the index of financial literacy: increasing the index by 1 raises the pension risk by 0.8 percentage points, about 5 percent of the sample mean. This finding suggests that more financially informed investors may also be more aware that pensions are risky.

For robustness, in columns 5 and 6 of Table 3 we report regressions where the dependent variable is the coefficient of variation of the replacement rate distribution. The results confirm that perceived pension risk is greater for the self-employed, and smaller nearer to retirement. In this case the coefficients of education, financial literacy and region of residence are not statistically different from zero.

Table 3, therefore, shows that there is substantial predictable heterogeneity in the subjective distributions of the replacement rate, and that the effects of observable variables, such as age and occupation, are consistent with how the distribution of pension benefits is reflected in people's expectations. Next we investigate whether individuals react to perceived pension risk, by looking at how it affects the demand for retirement saving and insurance.

4. The demand for retirement saving

People who expect a lower replacement rate could supplement their public pension by increasing retirement saving. This link relates to the offset between social security and private wealth, which has received much attention since the seminal work of Feldstein (1974). Our data on subjective probabilities allow us to focus on a related but unexplored question: does pension risk increase the demand for retirement saving above any effect that expected replacement rates may have? Following the standard arguments, we would expect participation in private pension funds and life insurance – the two main vehicles for retirement saving – to be negatively associated with the expected replacement rate; however, under the assumption that individuals dislike risk and become more risk averse

when pension risk increases, we also expect demand for private pension funds and life insurance to be positively associated with the riskiness of social security, as measured by the standard deviations of the subjective distributions. Importantly, our data allow us to distinguish between these two channels.[12]

Previous evidence on life insurance and pension funds refers mostly to the effectiveness of tax incentives for saving. Since the mid 1980s, Italian legislators have tried to encourage investment in private pension funds and life insurance through tax incentives. Preferential fiscal treatment of life insurance contributions was introduced in 1986, and later extended to pension fund contributions. More recent policy interventions have been directed at shifting contributions from severance payments funds to individual and occupational pension plans.[13] Whether these measures have been effective in increasing savings is an open question, although the evidence in Jappelli and Pistaferri (2003) suggests that fiscal incentives have not induced large reallocations of household portfolios. Here, we investigate a different issue, e.g. whether pension expectations affect the demand for discretionary retirement saving.

4.1. Descriptive analysis

Figure 8 plots the fraction of individuals with private pension funds and life insurance, against the expected replacement rate (Figure 8 also includes health and casualty insurance, which are discussed in Section 5). The upper-left graph shows a negative relation between pension funds ownership and the replacement rate: people who expect relatively low coverage from their public pension (the expected rate is less than 70 percent) exhibit a greater propensity to invest in private pension funds (about 25 percent). Among those who expect high coverage, pension fund ownership is only 10 percent. For life insurance the relation is essentially flat (upper-right panel).

The upper-left panel in Figure 9 shows that among those who perceive public pensions as being relatively safe (a coefficient of variation of 2 percent or less)

[12] Since wealth amounts are subject to considerable measurement error, in this section we focus on the decision to enroll in a retirement saving plan.
[13] Since 2007 workers can choose to redirect contributions to severance pay to private pension funds.

participation in pension funds is considerably lower (15 percent) than among those who perceive higher risk (participation of at least 20 percent for those with coefficient of variation greater than 6 percent). There is also a positive relation between life insurance ownership and pension risk (upper-right graph).

4.2. Regression analysis

We focus first on the demand for retirement saving, and relate the probability of ownership of private pension funds and life insurance to the central tendency and dispersion of the replacement rate distribution. The probit regressions in Table 4 control for demographic variables (age, gender, education), employment type, region of residence, income and, in some specifications, indicators of financial literacy and risk aversion.[14] Table 4 reports the marginal effects and associated standard errors.

The coefficient of the expected replacement rate is negative, while the coefficient of the standard deviation pension risk is positive; both coefficients are sizable and statistically different from zero. A 10-percentage point increase in the expected replacement rate reduces the probability of owning a pension fund by 2 percentage points, while a one standard deviation increase in the cross-sectional distribution of subjective standard deviations is associated with a 3-point increase in ownership. Thus, variation in uncertainty is economically at least as important as variation in expected replacement, which is the focus in the literature.

Ownership probability is negatively related to age, is lower in the South, and increases with income. The remaining columns in Table 4 show that pension fund ownership is positively associated with financial literacy, and that people who are more risk averse invest less in pension funds. The last column in Table 4 also controls for

[14] The dummy is based on the following question: "In managing your financial investment, you think you are a person that is interested in investments that offer the possibility of: (1) a high return, with a high risk of losing the capital; (2) a good return, and reasonable safety; (3) a moderate return, but at the same time a good degree of safety; (4) a low return, without any risk of losing the capital." The risk aversion dummy is defined as (3) or (4).

expected retirement age and standard deviation of the distribution of retirement age.[15] The magnitude and significance of the coefficients of the expected replacement rate and of the standard deviation of the replacement rate are not affected.

Table 5 presents the propensity to own a life insurance policy. We find that life insurance ownership is highest among the young and people in more risky occupations. The coefficient of the standard deviation of the replacement rate distribution is positive in all specifications, but statistically different from zero only in the first two columns.

5. The demand for health and casualty insurance

Individuals who expect pensions to be risky presumably will tend to protect themselves from other sources of risk. Here, we focus on the demand for health and casualty insurance, and test the hypothesis that the propensity to insure against these risks is negatively related to pension risk, as measured by the standard deviation of the replacement rate distribution.

The data in Figures 8 and 9 lend some support to the hypothesis that pension expectations affect the demand for insurance. Figure 8 (lower panels) shows a negative relation between health or casualty insurance and the expected replacement rate. Figure 9 shows that the proportion of individuals with health insurance is less than 15 percent for those who perceive relatively low pension risk, and over 20 percent for those who perceive above average pension risk.

The probit regressions reported in Table 6 confirm a negative association between the expected replacement rate and the propensity to have health insurance. The effect of the standard deviation of the replacement rate is positive and statistically different from zero, suggesting that pension risk induces people to insure against health risk. We also find that the demand for health insurance is higher for the young, and positively

[15] Interviewees were asked to provide minimum and maximum values for expected retirement age, and indicate the probability that it would be greater than the mid-point of the range. We apply the same procedure used for replacement rates to estimate the respondent-specific subjective distributions for retirement age.

associated with education, income and self-employment. Controlling for financial literacy, risk aversion and the respondent-specific expectation and standard deviation of retirement age does not change the results.

Finally, Table 7 reports the regressions for casualty insurance. Some of the patterns are similar to those for health insurance: education, self-employment and income are positively associated with the probability of having casualty insurance. In this case, the coefficient of pension risk is not statistically different from zero. This could be interpreted as in retirement, health risk is more relevant than casualty risk, leading people exposed to pension risk to anticipate its adverse consequences on health expenditures.

6. Conclusions

There is a large literature on the offset between pension and private wealth. The baseline life-cycle model prescribes that as pension wealth decreases private wealth should increase accordingly. A crucial assumption in this literature is that pension wealth is not risky. Our paper deviates from this assumption, recognizing that pension entitlements are risky in their own right, and investigates the link between pension risk and household investment in dedicated pension saving vehicles.

We use a representative sample of the clientele of a leading European bank to elicit information on the respondent-specific distribution of the replacement rate and characterize the main features of this subjective distribution, highlighting the extent of individual heterogeneity in perceptions. Our survey provides data on subjective probabilities, and also information on financial and insurance decisions and demographic and economic characteristics of respondents. It thus offers the opportunity of conducting a systematic exploration of how perceived pension risk is correlated with individual characteristics and how it conditions people's financial decisions.

We find that the expected replacement rate on average is close to the statutory value, but with important differences across individuals. The expected replacement rate is

higher for older people and lower for the self-employed, confirming previous evidence that is consistent with the current social security system rules. Pension risk falls when people approach retirement, and it is lower for public employees and higher for the self-employed, consistent with the design of the current pension system, suggesting that those who should perceive more pension risk do indeed do so. However, our evidence also shows that heterogeneity in perceived pension risk is only partially explained by socio-demographic variables, suggesting that eliciting subjective expectations remains crucial to understanding people's beliefs about future pensions.

In terms of the effect of pension risk on financial choices, we find that the demand for retirement saving is negatively related to expectations of a higher pension, and that people who experience greater public pension risk also choose to increase private retirement saving. We also find that the demand for health insurance is positively related to pension risk, while we detect no effect for casualty insurance.

Our results suggest that the perception of pension risk affects the household portfolio choices in relation to retirement and, thus, imply that overly optimistic (or pessimistic) expectations of pension benefits might lead to potentially large biases in household portfolios.

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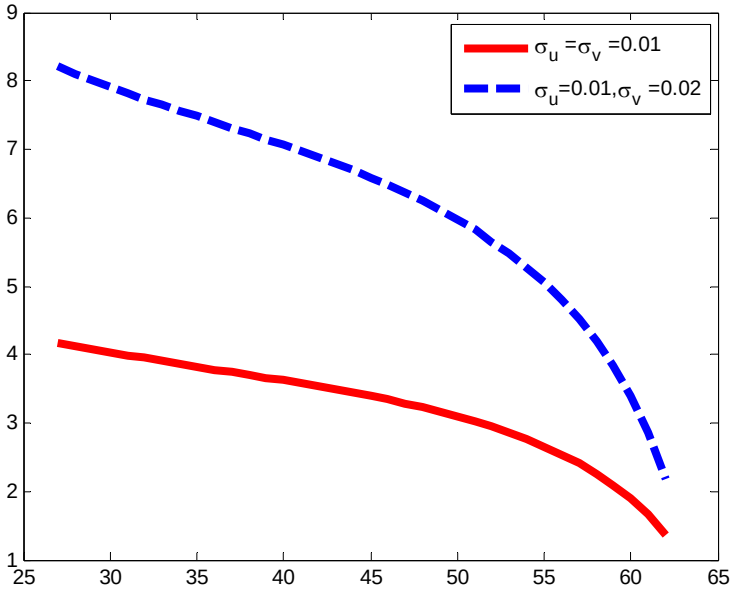
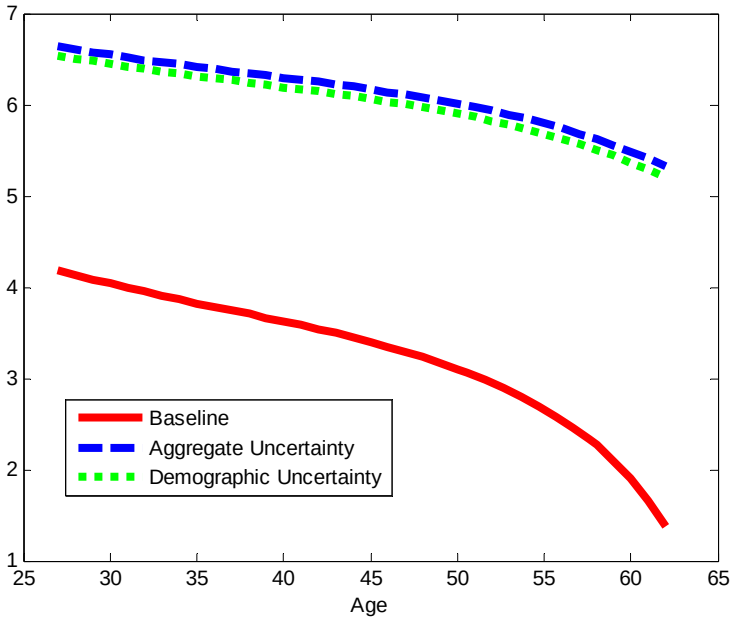
Figure 1
Coefficient of variation of replacement rate for a private employee



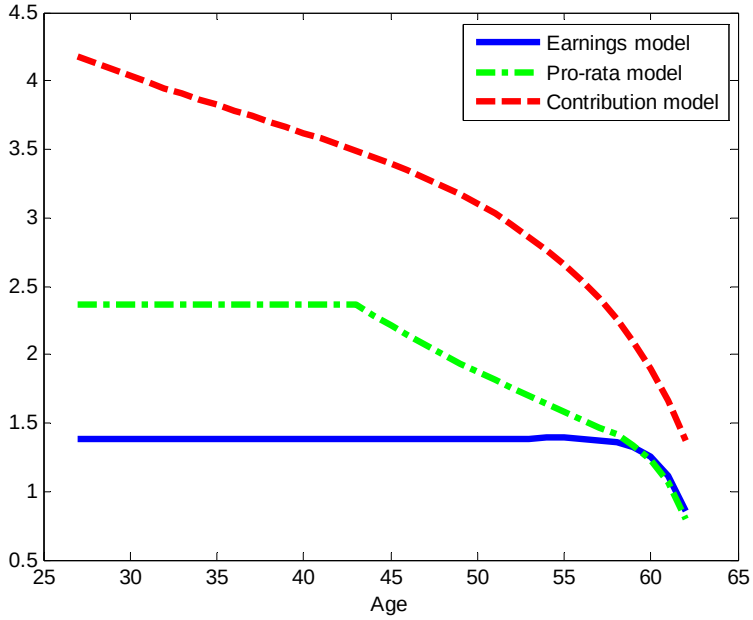
Note: The simulations assume that the growth rates of individual annual earnings and aggregate GDP are 2 percent and 1.5 percent, respectively, the retirement age is 62, the number of years of contribution is 37, the annuitization factor is 0.0551 and the mean of transitory and permanent income shocks is 1. The continuous line is obtained by setting the standard deviations of permanent (σ_v) and transitory (σ_u) income shocks to 1 percent, the dashed line by setting σ_u =0.01) and σ_v =0.02.

Figure 2
Coefficient of variation of replacement rate, with aggregate and demographic risk



Note: The simulations assume that the growth rate of annual earnings is 2 percent, the retirement age is 62, the number of years of contribution is 37, the mean of transitory and permanent income shocks is 1, and $\sigma_u = \sigma_v = 0.01$. The continuous line is obtained by setting the annuitization factor to 0.0551 and the GDP growth rate to 1.5 percent, the dashed line assuming that the GDP growth is uniformly distributed between 1 and 2 percent and the annuitization factor is 0.0551, the dotted line that the annuitization factor is uniformly distributed between 5 and 6 percent and the GDP growth rate is 1.5 percent.

Figure 3
Coefficient of variation of replacement rate in different pension regimes



Note: The simulations assume that the growth rate of earnings and aggregate GDP are 2 percent and 1.5 percent per year, respectively, the retirement age is 62, the number of years of contribution is 37, the annuitization factor is 0.0551, the mean of transitory and permanent income shocks is 1 and $\sigma_u = \sigma_v = 0.01$. In the pro-rata regime the year of job market entry is 1977. The continuous line refers to the earnings model, the dot-dashed line to the pro-rata regime, the dashed line to the contribution model.

Figure 4
Expected replacement rate and coefficient of variation of the replacement rate distribution

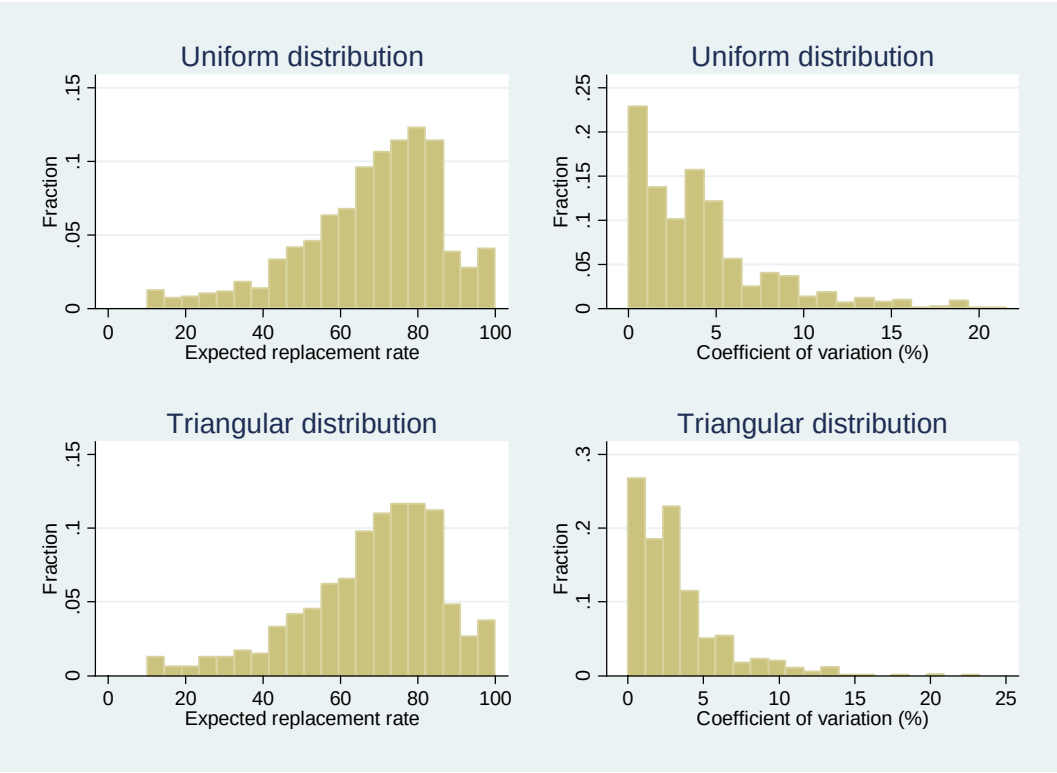


Figure 5
The expected replacement rate and the coefficient of variation of the replacement rate distribution, by age and education

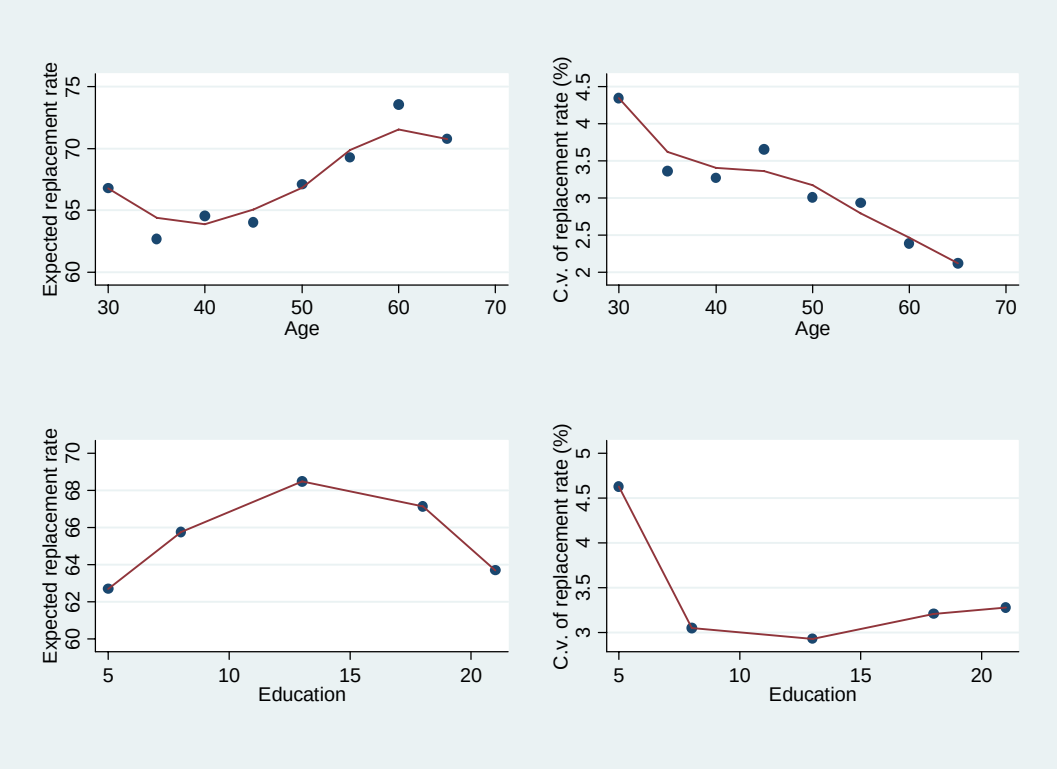


Figure 6
Quantiles of the expected replacement and coefficient of variation of the replacement rate distribution, by age and education

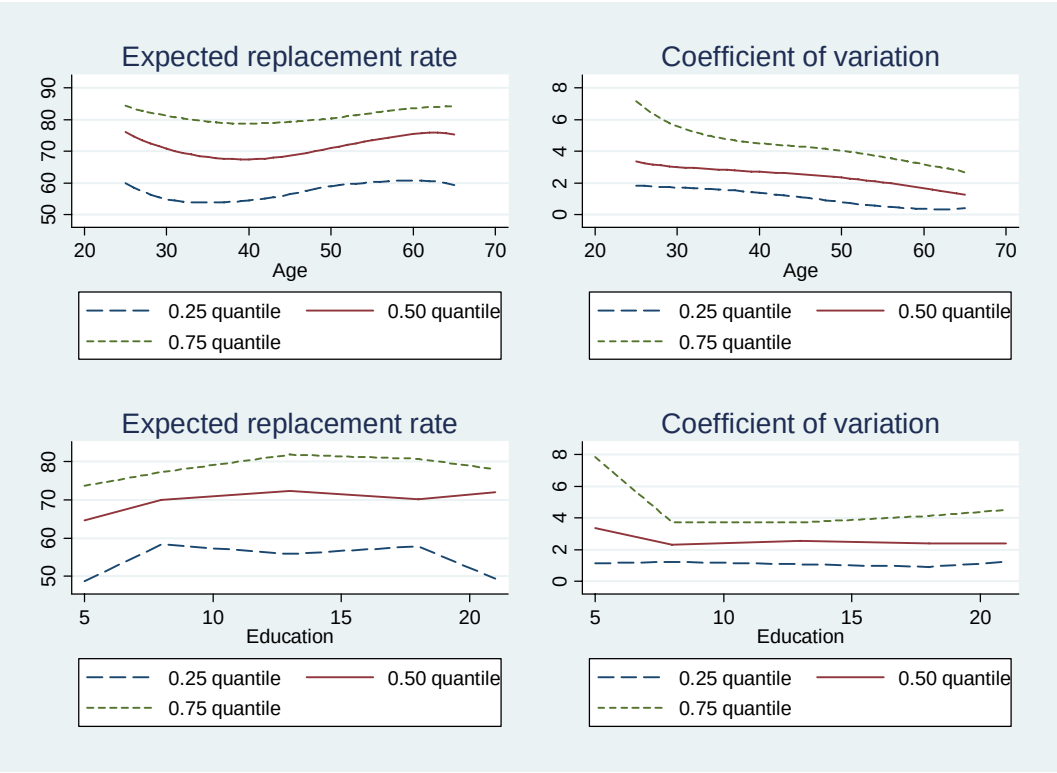


Figure 7
The replacement rate distribution, by income and occupation

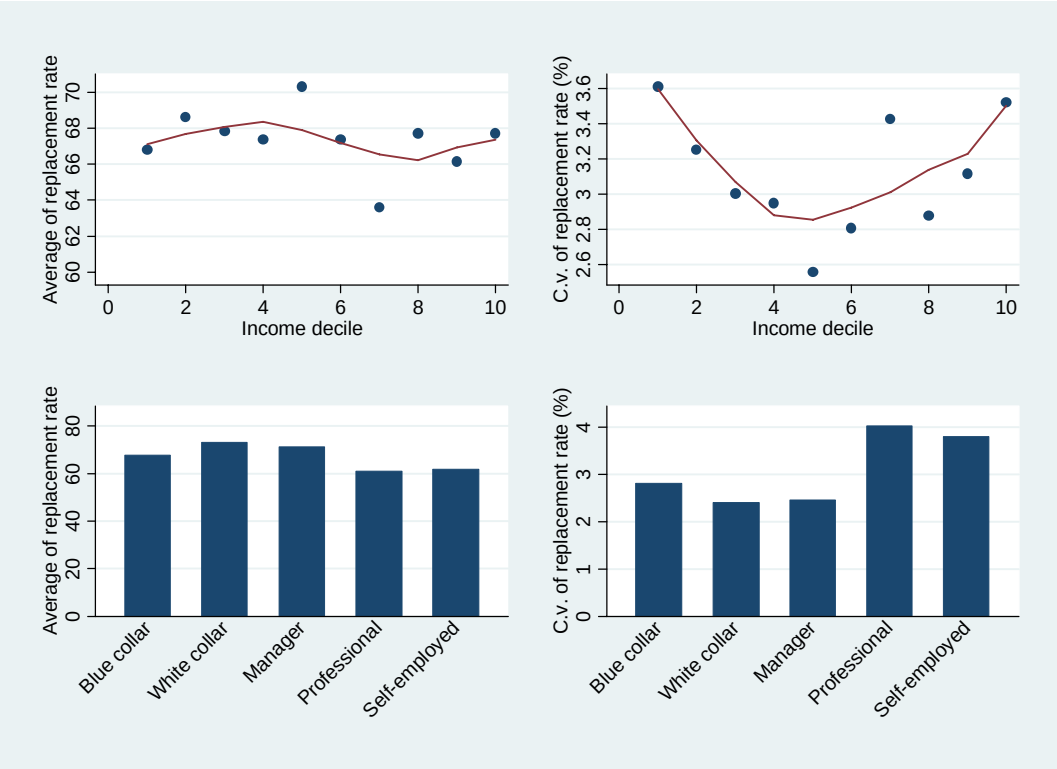


Figure 8
Retirement saving, health insurance and the replacement rate distribution

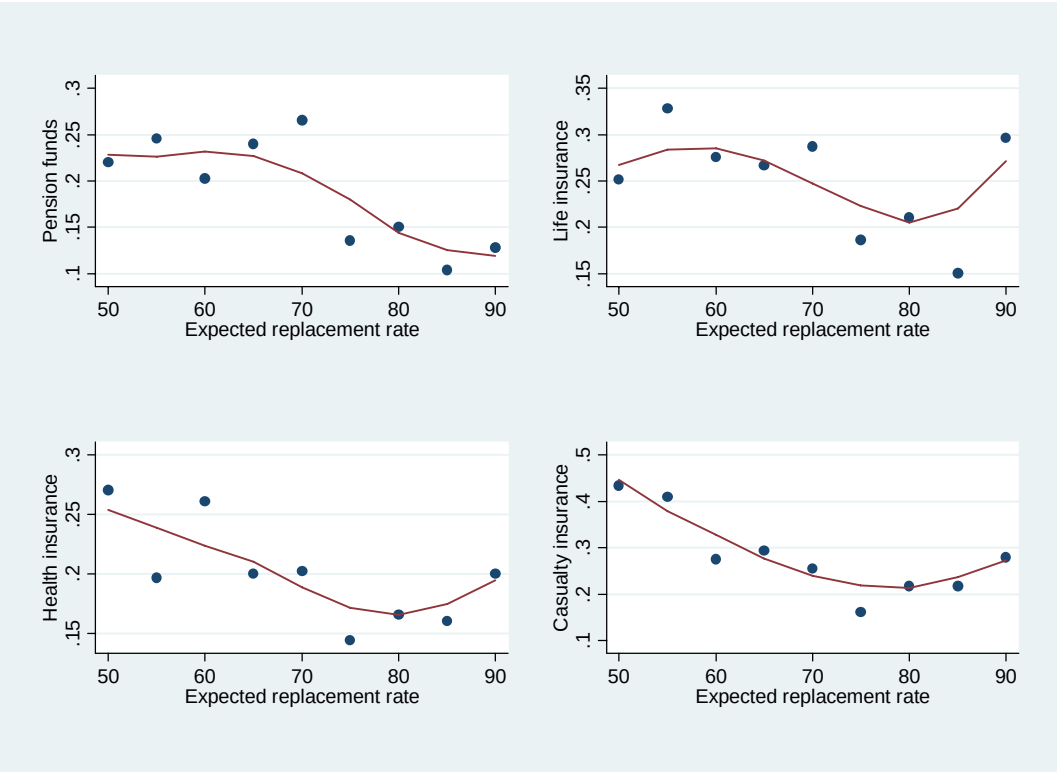


Figure 9
Retirement saving, health insurance and the coefficient of variation of the replacement rate distribution

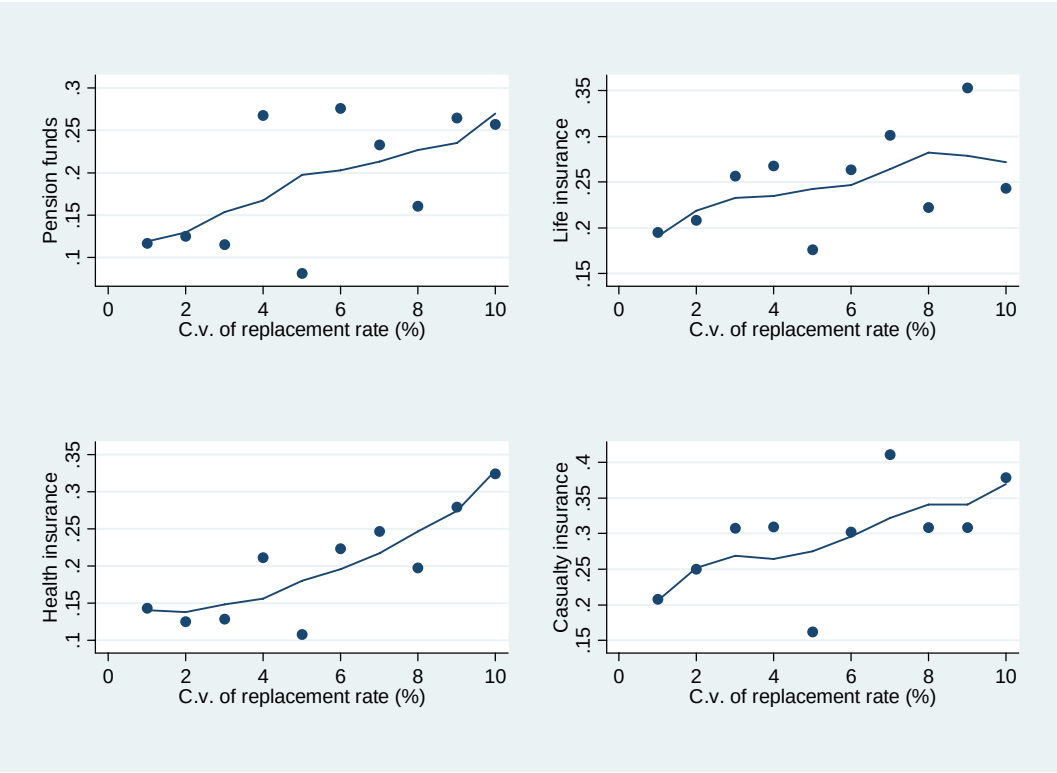


Table 1
Pension award formula

	Pension award formula		
	Private sector	*Public sector*	*Self-employed*
Old	2% × years of contribution × average of last 10 years of earnings	2% × years of contribution × average of last 10 years of earnings	2% × years of contribution × average of last 15 years of earnings.
Middle-aged	Earnings model before 1995, contribution model after 1995.		
Young	Contributions (33% of gross wage for employees and 20% for self-employed) are capitalized on the basis of the 5-year moving average of GDP growth. The capitalized sum is multiplied by a coefficient that varies by retirement age, taking into account life expectancy.		
	Pension eligibility		
	Seniority pensions Minimum years of contribution	Old age pensions Retirement age	
Old and Middle-aged retiring in		*Private employees*	*Public employees*	*Self-employed*
2008-09	35	60	60	61
2010-13	35	61	61	62
After 2014	35	62	62	63
Young	40	65 (60)	65 (60)	65 (60)

Note. Old, middle-aged and young refer, respectively, to workers with more than 18 years of contributions in 1995, less than 18 years of contribution in 1995, and who started working after 1995. Figures in parentheses are retirement ages for women.

Table 2
Cross-sectional statistics of the subjective replacement rate distribution

Statistics of the subjective distributions	Cross-sectional statistics				
	Mean	Median	Standard deviation	Minimum	Maximum
Mean					
Uniform	65.57	70.00	18.78	1.30	98.75
Triangular	65.68	70.00	18.71	1.37	98.33
Standard deviation					
Uniform	2.90	2.71	1.74	0.14	8.53
Triangular	2.08	1.93	1.24	0.12	6.04
Coefficient of variation					
Uniform	5.08	3.85	3.93	0.29	30.09
Triangular	3.64	2.73	2.77	0.24	20.67

Note. The table reports cross-sectional statistics computed from the moments of the subjective replacement rate distributions.

Table 3
Determinants of the replacement rate distribution

	Expected replacement rate		*Standard deviation*		*Coefficient of variation*	
	(1)	(2)	(3)	(4)	(5)	(6)
Age	0.222	0.222	-0.008	-0.008	-0.030	-0.030
	(0.063)***	(0.063)***	(0.004)*	(0.004)*	(0.010)***	(0.010)***
Male	-1.505	-1.443	0.054	0.036	0.003	-0.017
	(1.514)	(1.518)	(0.107)	(0.107)	(0.233)	(0.233)
Education	0.046	0.058	-0.009	-0.012	-0.020	-0.023
	(0.175)	(0.176)	(0.012)	(0.012)	(0.027)	(0.027)
Private	-3.964	-3.897	0.201	0.181	0.622	0.600
	(3.111)	(3.114)	(0.219)	(0.219)	(0.479)	(0.479)
Self-employed	-11.517	-11.559	0.198	0.210	1.275	1.289
	(1.333)***	(1.336)***	(0.094)**	(0.094)**	(0.205)***	(0.205)***
Resident in the Centre	6.227	6.152	0.177	0.199	-0.094	-0.069
	(1.592)***	(1.598)***	(0.112)	(0.112)*	(0.245)	(0.246)
Resident in the South	8.533	8.500	0.138	0.147	-0.368	-0.357
	(1.580)***	(1.581)***	(0.111)	(0.111)	(0.243)	(0.243)
Log income	-0.558	-0.523	0.050	0.040	0.159	0.148
	(0.979)	(0.981)	(0.069)	(0.069)	(0.151)	(0.151)
Index of financial literacy		-0.283		0.082		0.094
		(0.464)		(0.033)**		(0.071)
Constant	63.370	63.778	1.815	1.696	3.065	2.929
	(10.325)***	(10.351)***	(0.728)**	(0.727)**	(1.588)*	(1.591)*
Observations	744	744	744	744	744	744
R-squared	0.14	0.14	0.02	0.03	0.07	0.07

Note. Standard errors are reported in parentheses. *** indicate statistical significance at the 1% confidence level, ** statistical significance at the 5% level, * statistical significance at the 10% level.

Table 4
Probability of investing in pension funds

	(1)	*(2)*	*(3)*	*(4)*
Expected replacement rate	-0.002	-0.002	-0.002	-0.002
	(0.001)**	(0.001)**	(0.001)**	(0.001)**
S.d. of replacement rate	0.029	0.029	0.027	0.030
	(0.011)***	(0.011)***	(0.011)**	(0.011)***
Age	-0.002	-0.002	-0.002	-0.003
	(0.001)*	(0.001)*	(0.001)	(0.001)*
Male	0.054	0.054	0.045	0.048
	(0.031)*	(0.031)*	(0.031)	(0.031)
Education	0.005	0.005	0.004	0.005
	(0.004)	(0.004)	(0.004)	(0.004)
Private	-0.055	-0.055	-0.065	-0.064
	(0.056)	(0.056)	(0.052)	(0.052)
Self-employed	-0.031	-0.031	-0.029	-0.022
	(0.031)	(0.031)	(0.030)	(0.031)
Resident in the Centre	-0.042	-0.042	-0.039	-0.038
	(0.032)	(0.032)	(0.032)	(0.032)
Resident in the South	-0.101	-0.101	-0.099	-0.101
	(0.030)***	(0.030)***	(0.030)***	(0.030)***
Log income	0.040	0.040	0.036	0.038
	(0.022)*	(0.022)*	(0.022)*	(0.022)*
Index of financial literacy		0.001	0.001	0.001
		(0.010)	(0.010)	(0.010)
High risk aversion			-0.116	-0.116
			(0.031)***	(0.031)***
Retirement age (average)				-0.002
				(0.003)
Retirement age (s.d.)				-0.038
				(0.025)
Observations	744	744	744	744

Note. The table reports marginal effects. Asymptotic standard errors are reported in parentheses. *** indicate statistical significance at the 1% confidence level, ** statistical significance at the 5% level, * statistical significance at the 10% level.

Table 5
Probability of investing in life insurance

	(1)	*(2)*	*(3)*	*(4)*
Expected replacement rate	-0.000	0.000	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
S.d. of replacement rate	0.025	0.021	0.020	0.019
	(0.013)**	(0.013)*	(0.013)	(0.013)
Age	-0.001	-0.001	-0.001	-0.000
	(0.002)	(0.002)	(0.002)	(0.002)
Male	0.005	-0.004	-0.010	-0.007
	(0.037)	(0.038)	(0.038)	(0.039)
Education	0.004	0.003	0.002	0.003
	(0.004)	(0.004)	(0.004)	(0.005)
Private	-0.104	-0.110	-0.118	-0.115
	(0.059)*	(0.058)*	(0.055)**	(0.056)**
Self-employed	0.069	0.078	0.078	0.076
	(0.035)**	(0.035)**	(0.035)**	(0.035)**
Resident in the Centre	-0.039	-0.031	-0.029	-0.033
	(0.038)	(0.038)	(0.039)	(0.038)
Resident in the South	-0.048	-0.045	-0.042	-0.043
	(0.038)	(0.038)	(0.038)	(0.038)
Log income	0.044	0.041	0.037	0.036
	(0.024)*	(0.024)*	(0.024)	(0.024)
Index of financial literacy		0.033	0.033	0.033
		(0.012)***	(0.012)***	(0.012)***
High risk aversion			-0.104	-0.103
			(0.040)***	(0.040)***
Expected retirement age				-0.002
				(0.003)
S.d. of retirement age				0.030
				(0.024)
Observations	744	744	744	744

Note. The table reports marginal effects. Asymptotic standard errors are reported in parentheses. *** indicate statistical significance at the 1% confidence level, ** statistical significance at the 5% level, * statistical significance at the 10% level.

Table 6
Probability of having health insurance

	(1)	*(2)*	*(3)*	*(4)*
Expected replacement rate	-0.001	-0.001	-0.001	-0.001
	(0.001)*	(0.001)*	(0.001)*	(0.001)*
S.d. of replacement rate	0.033	0.031	0.031	0.031
	(0.011)***	(0.011)***	(0.011)***	(0.011)***
Age	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Male	0.004	0.000	-0.001	-0.000
	(0.034)	(0.034)	(0.035)	(0.035)
Education	0.013	0.012	0.012	0.012
	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Private	-0.048	-0.051	-0.053	-0.052
	(0.053)	(0.052)	(0.052)	(0.052)
Self-employed	0.089	0.093	0.093	0.092
	(0.031)***	(0.031)***	(0.031)***	(0.032)***
Resident in the Centre	-0.075	-0.071	-0.070	-0.072
	(0.032)**	(0.032)**	(0.032)**	(0.032)**
Resident in the South	-0.045	-0.043	-0.042	-0.042
	(0.033)	(0.033)	(0.033)	(0.033)
Log income	0.079	0.077	0.076	0.076
	(0.021)***	(0.021)***	(0.021)***	(0.021)***
Index of financial literacy		0.016	0.016	0.015
		(0.010)	(0.010)	(0.010)
High risk aversion			-0.029	-0.028
			(0.041)	(0.041)
Expected retirement age				-0.001
				(0.003)
S.d. of retirement age				0.014
				(0.022)
Observations	744	744	744	744

Note. The table reports marginal effects. Asymptotic standard errors are reported in parentheses. *** indicate statistical significance at the 1% confidence level, ** statistical significance at the 5% level, * statistical significance at the 10% level.

Table 7
Probability of having casualty insurance

	(1)	*(2)*	*(3)*	*(4)*
Expected replacement rate	-0.003	-0.002	-0.003	-0.002
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
S.d. of replacement rate	-0.015	-0.017	-0.018	-0.018
	(0.014)	(0.014)	(0.014)	(0.014)
Age	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Male	0.098	0.096	0.092	0.087
	(0.038)***	(0.038)**	(0.038)**	(0.039)**
Education	0.007	0.006	0.006	0.005
	(0.005)	(0.005)	(0.005)	(0.005)
Private	-0.067	-0.069	-0.078	-0.082
	(0.069)	(0.068)	(0.067)	(0.066)
Self-employed	0.193	0.196	0.196	0.193
	(0.036)***	(0.036)***	(0.036)***	(0.037)***
Resident in the Centre	0.001	0.006	0.009	0.013
	(0.042)	(0.042)	(0.043)	(0.043)
Resident in the South	-0.093	-0.091	-0.087	-0.085
	(0.040)**	(0.040)**	(0.040)**	(0.040)**
Log income	0.098	0.096	0.094	0.094
	(0.026)***	(0.026)***	(0.026)***	(0.026)***
Index of financial literacy		0.015	0.015	0.015
		(0.012)	(0.012)	(0.012)
High risk aversion			-0.083	-0.084
			(0.045)*	(0.045)*
Expected retirement age				0.004
				(0.003)
S.d. of retirement age				-0.014
				(0.026)
Observations	744	744	744	744

Note. The table reports marginal effects. Asymptotic standard errors are reported in parentheses. *** indicate statistical significance at the 1% confidence level, ** statistical significance at the 5% level, * statistical significance at the 10% level.

Appendix

A1. The survey

The 2006 UniCredit Survey (UCS) is a national representative sample of the eligible population of UniCredit Group customers. The eligible population of customers excludes customers under 20 and over 80, and customers with assets of less than 10,000 Euros with UniCredit. The sampled population size is around 1.3 million customers. The survey was aimed at acquiring information on the behavior and expectations of UniCredit Group customers and focused on multi-banking, attitude towards saving and investing, financial literacy and propensity for risk, pensions and need for insurance.

The sampling scheme is similar to that of the Bank of Italy Survey of Household Income and Wealth (SHIW). The population is stratified along two criteria: geographical area of residence (North-East, North-West, Central and Southern Italy) and wealth held with UniCredit as of June 30 2006. The sample size is 1,686 customers, of whom 1,580 are from UniCredit Retail Bank, and 106 from UniCredit Private Bank (the upper tier customer bank). The survey was administered between May 1 and September 30 of 2007 by a leading Italian polling agency, which also conducts the SHIW for the Bank of Italy. Most interviewers had substantial experience of administering the SHIW, which is likely to increase the quality of the data. The UCS was piloted in the first quarter of 2007, and the Computer Assisted Personal Interview methodology was employed for all interviews. To overcome some of the problems arising from non-responses, the sample was balanced ex-post with respect to the true distribution of assets, area of residence, city size, gender, age and education of the eligible population.

The questionnaire comprises 9 sections. Sections A and B refer, respectively, to respondent and household demographic and occupation variables. Section C focuses on saving, investment and financial risk. Section D asks detailed questions about financial wealth and portfolio allocation, and Section E enquires about consumer debt and mortgages. By design, Sections A, B, D and E allow a perfect matching with the SHIW questionnaire. Questions on real estate and entrepreneurial activities are included in Section F. Section G contains questions on subjective expectations, and section H focuses on insurance and private pension funds. The last two sections ask about income and expectations and need for insurance and pension products.

As shown in Table A1, compared with the Italian population, as surveyed by the 2006 Bank of Italy SHIW, UniCredit Group customers are older, more educated, less likely to work in the manufacturing sector, and more likely to live in the North.

A2. Wording of questions

The UCS uses three questions to elicit the subjective probability distribution of the replacement rate. All employees and self-employed are asked to report the minimum (y_m) and the maximum (y_M) replacement rate he or she expects after retirement, and the probability that the replacement rate is less than the midpoint of the support of the distribution, $Prob(y \leq (y_m + y_M)/2) = \pi$. All respondents are first asked:

Think about when you will retire, and consider only the public pension (i.e., exclude private pension if you have one).

(a) *At the time of retirement, what is the minimum fraction of labor income that you expect to receive?*

(b) *And what is the maximum value?*

(c) *What are the chances that the fraction will be greater than X (where X is computed by the interviewer as (a+b)/2? In other words, if you were to assign a score between 0 and 100 to the chance that the fraction will be greater than X, what score would you assign? ("0" if you are certain to receive a pension greater than X, "100" if you are certain to receive a pension less than X). The following table is shown to the respondent:*

0	10	20	30	40	50	60	70	80	90	100
I am sure I will earn more than *X*									I am sure I will earn less than *X*	

A3. The subjective probability distribution of the replacement rate

Let $f(y)$ denote the distribution of the replacement rate for each individual. The survey provides information on the support of the distribution $[y_m, y_M]$ and on the probability mass to the left of the mid-point of the support, $Prob(y \leq (y_m + y_M)/2) = \pi$. Knowing the support of the distribution, we can express the expected value and variance of y as:

$$E(y) = \int_{y_m}^{y_M} y f(y) dy$$

$$Var(y) = \left[\int_{y_m}^{y_M} y^2 f(y) dy - \left(\int_{y_m}^{y_M} y \ f(y) dy \right)^2 \right].$$

We consider two assumptions concerning $f(y)$. The first is that y is uniformly distributed over each of the two intervals $[y_m, (y_m + y_M)/2]$ and $((y_m + y_M)/2, y_M]$. If $\pi = 0.5$ the distribution collapses to a single uniform distribution defined in the interval $[y_m, y_M]$. A second possibility is to assume that

the distribution is triangular over the same two intervals; if π=0.5 the distribution again collapses to a single triangular distribution over the interval [y_m, y_M]. Note that in both cases $E(y)$ and $Var(y)$ depend only on the three known parameters (y_m, y_M, and π). The triangular distribution is a more plausible description of the probability distribution of the replacement rate, because outcomes further away from the mid-point receive less weight. Figures A1 and A2 show the p.d.f. under the uniform and the triangular assumptions.

Figure A3 plots the raw data, i.e. the subjective distributions of y_m, y_M, 1-π and y_M - y_m. Slightly less than 30 percent of respondents report a limited range of the subjective distribution; instead, for 30 percent the range of the replacement rate is between 10 and 15 percent.

A4. The moments of the replacement rate distribution

We assume that before retirement the income process is given by:

$$Y_t = g^t Y_0 P_t U_t$$
$$P_t = P_{t-1} V_t$$

where $\{\ln U_t\}$ and $\{\ln V_t\}$ are Gaussian white-noise random terms with mean and standard deviations, respectively, equal to μ_u and σ_u and to μ_v and σ_v. Here we refer to the case of a private employee. The calculations for public employees and self-employed are similar and available upon request.

A4.1. Earnings model

In the earnings model the replacement rate is:

$$\frac{0.02}{U_T}\left[\frac{1}{5}\sum_{t=1}^{4}\delta^t U_{T-t}\tilde{P}_{T-t}\right] \qquad \text{(A1)}$$

where T is years of contribution at retirement; δ is the ratio between growth factor of prices and growth factor of income and:

$$\tilde{P}_t = \frac{1}{\prod_{s=t+1}^{T} V_s}$$

To compute the average, the standard deviation and the coefficient of variation of the replacement rate distribution, we need the first two moments of the term inside the braces in equation (A1). These are:

$$\mu_{1|t} = 0.02e^{-\mu_u+0.5\sigma_u^2}\left[\frac{1}{5}\sum_{s=1}^{4}\delta^s E_t(U_{T-s}\tilde{P}_{T-s})\right]$$

$$\mu_{2|t} = 4*10^{-4}e^{-2\mu_u+2\sigma_u^2}\ \frac{1}{25}\left[\sum_{s=1}^{4}\delta^{2s}E_t(U^2{}_{T-s}\tilde{P}^2{}_{T-s}) + 2\sum_{s=1}^{3}\sum_{r=s+1}^{4}\delta^s\delta^r E_t(U_{T-s}\tilde{P}_{T-s}U_{T-s}\tilde{P}_{T-s})\right]$$

A4.2. Contribution model

The replacement rate in the contribution model is:

$$\{\frac{\gamma\tau}{U_T}[\sum_{t=1}^{T-1}\alpha^{T-t}U_t\tilde{P}_t]\} + \gamma\tau \qquad \text{(A2)}$$

where γ, τ and α respectively are the annuitization factor, the payroll rate, and the ratio of growth factor of GDP to growth factor of income. The first two moments of the term inside the braces in (A2) are:

$$\mu_{1|t} = \gamma\tau e^{-\mu_u+0.5\sigma_u^2}\sum_{s=1}^{T-1}\alpha^{T-s}E_t(U_s\tilde{P}_s)$$

$$\mu_{2|t} = (\gamma\tau)^2 e^{-2\mu_u+2\sigma_u^2}\left[\sum_{s=1}^{T-1}\alpha^{2(T-s)}E_t(U^2{}_s\tilde{P}^2{}_s) + 2\sum_{s=1}^{T-2}\sum_{r=s+1}^{T-1}\alpha^{T-s}\alpha^{T-r}E_t(U_s\tilde{P}_sU_r\tilde{P}_r)\right]$$

A4.3. Pro-rata model

The replacement rate in the pro-rata model is:

$$\frac{1}{U_T}\left[0.02\frac{t_{1992}}{5}\sum_{t=1}^{4}\delta^t U_{T-t}\tilde{P}_{T-t} + \gamma\tau\sum_{t=t_{1995}}^{T-1}\alpha^{T-t}U_t\tilde{P}_t\right] + (0.02\frac{t_{1992}}{5} + 0.06 + \gamma\tau) \qquad \text{(A3)}$$

The first two moments of the term inside the braces of A3 are:

$$\mu_{1|t} = e^{-\mu_u+0.5\sigma_u^2}\left[0.02\frac{t_{1992}}{5}\sum_{s=1}^{4}\delta^s E_t(U_{T-s}\tilde{P}_{T-s}) + \gamma\tau\sum_{s=t_{1995}}^{T-1}\alpha^{T-s}E_t(U_s\tilde{P}_s)\right]$$

$$\mu_{2|t} = e^{-2\mu_u+2\sigma_u^2}\{4*10^{-4}\ \frac{t_{1992}^2}{25}\left[\sum_{s=1}^{4}\delta^{2s}E_t(U^2{}_{T-s}\tilde{P}^2{}_{T-s}) + 2\sum_{s=1}^{3}\sum_{r=s+1}^{4}\delta^s\delta^r E_t(U_{T-s}\tilde{P}_{T-s}U_{T-s}\tilde{P}_{T-s})\right] +$$

$$+ (\gamma\tau)^2\left[\sum_{s=t_{1995}}^{T-1}\alpha^{2(T-s)}E_t(U^2{}_s\tilde{P}^2{}_s) + 2\sum_{s=t_{1995}}^{T-2}\sum_{r=s+1}^{T-1}\alpha^{T-s}\alpha^{T-r}E_t(U_s\tilde{P}_sU_r\tilde{P}_r)\right] +$$

$$+ 2*0.02*\frac{t_{1992}}{5}*\gamma\tau\sum_{s=1}^{4}\sum_{r=t_{1995}}^{T-1}\delta^s\alpha^{T-r}E_t(U_{T-s}\tilde{P}_{T-s}U_r\tilde{P}_r)\}$$

Table A1: UCS – SHIW comparison

	UCS	*SHIW* *Highest income earner*	*SHIW* *Bank account holder*
Gender			
Male	0.69	0.69	0.71
Female	0.31	0.31	0.29
Age			
up to 30	0.04	0.06	0.06
31 to 40	0.18	0.19	0.20
41 to 50	0.22	0.22	0.22
51 to 65	0.36	0.24	0.24
over 65	0.20	0.29	0.27
Education			
elementary school	0.10	0.27	0.22
middle school	0.29	0.36	0.37
high school	0.41	0.27	0.30
university degree	0.20	0.10	0.10
Sector of activity			
Agriculture	0.03	0.03	0.03
Industry	0.13	0.21	0.23
Public Administration	0.19	0.15	0.17
other sector	0.30	0.19	0.20
not employed	0.35	0.40	0.37
Household size			
1 member	0.21	0.25	0.23
2 members	0.29	0.28	0.29
3 members	0.26	0.21	0.22
4 members	0.20	0.18	0.19
5 or more members	0.04	0.07	0.06
Geographical area			
Northern Italy	0.73	0.48	0.52
Central Italy	0.14	0.20	0.21
South and Islands	0.13	0.32	0.27

Note: The table compares sample means of selected demographic variables in the UCS and 2006 SHIW. Means are computed using sample weights.

Figure A1
The uniform distribution

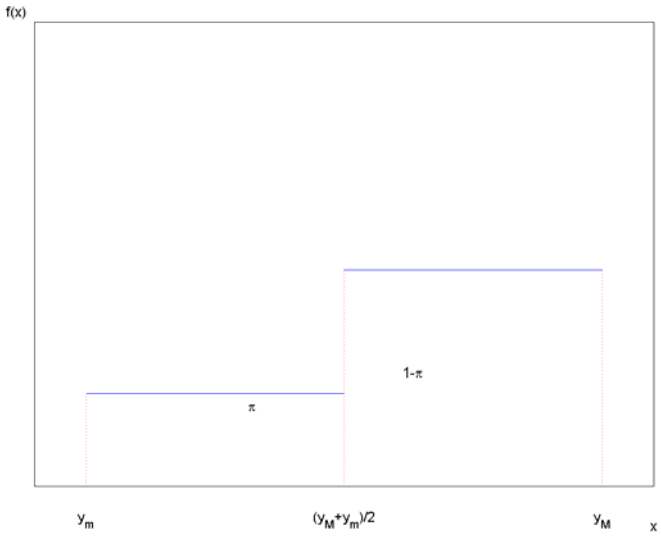


Figure A2
The triangular distribution

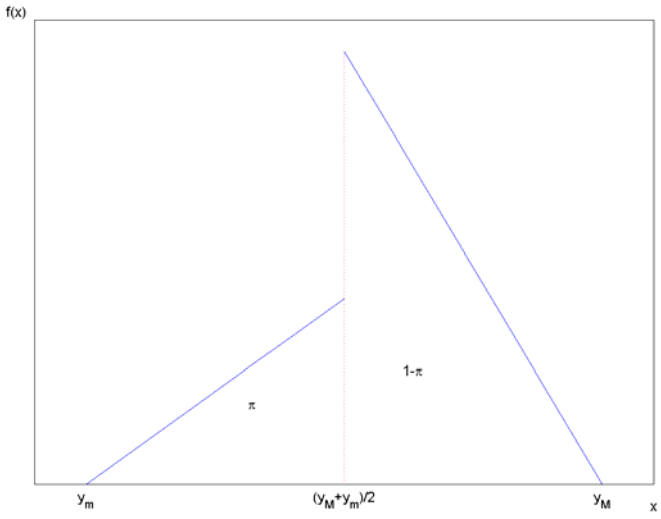


Figure A3
The subjective replacement rate