



Network for Studies on Pensions, Aging and Retirement

Netspar DISCUSSION PAPERS

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Discussion Paper 09/2010-066

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10 September 2010

Abstract

Using a representative sample of Italian investors, we estimate the risk associated with social security benefits by eliciting for each individual the subjective distribution of the replacement rate as a summary indicator of social security wealth. Pension risk varies across individuals in a way that is consistent with what one can 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. In particular, individuals a long way from retirement and who thus face more career uncertainty report more subjective pension risk. We also find that individuals who report higher pension risk are more likely to enroll in pension funds and health insurance plans.

Keywords: Pension Risk, Subjective Probabilities

JEL Classification: H55, E21

Acknowledgments. We are grateful to Michael Hurd, Federica Teppa, Mathis Wagner and participants in the 2008 Fundación Ramón Areces Conference on *Population Ageing and its Economic Consequences* (Madrid, 20-21 November 2008), the Netspar-SIFR Conference on *Pension Plans and Product Design* (Stockholm, 8-9 June 2009) and the CERP Conference on *Saving for Old Age in a Financial Turmoil: New Challenges for Households, Providers and Policy-Makers* (Torino, 24-25 September 2009) for helpful comments and suggestions; and to the UniCredit Group, and particularly Daniele Fano and Laura Marzorati, for allowing us contribute to the design of the UniCredit Customer Survey.

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 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 how individuals 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, with over 5 million customers in Italy. 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 these risks. In the paper we also find that individuals who report higher pension risk are more likely to enroll in pension funds and health insurance plans.

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 simple elicitation method of subjective probabilities delivers also a high response rate (92 percent of the eligible sample).

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, with subjective expectations one can study the portfolio effects of higher moments of future pension wealth, based on information on the respondent-specific probability distributions of replacement rates.

The 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 evidence on the extent of heterogeneity in respondents' beliefs about pension entitlements. In Section 4 we relate pension risk (as measured by the standard deviation of the respondent social security risk) to the demand for private pension funds and health insurance. Section 5 concludes.

2. Pension risk in the current pension 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

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.

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

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

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 $\tau=0.33$ 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.

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

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

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. While we recognize that pension wealth also depends on retirement age, which is possibly uncertain, we argue that uncertainty in retirement age is less important than in replacement rate, partly because individuals can control more directly retirement age within a relatively narrow window set by the law. To verify this claim, we exploit our data, which also record subjective expectation on retirement age.

Even without considering possible changes in future legislation, forecasting one's pension is not an easy task because future benefits depend on the on timing and volatility of earnings. To illustrate this effect, we assume that log-earnings have a deterministic component 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 ($\tau=0.33$) and 37.4 percent for a self-employed individual ($\tau=0.20$).

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 ($\sigma_v=0.02$) 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.

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 than 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

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.

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 (1988) analyzes the accuracy of pre-retirement expectations concerning social security benefits in the Retirement History Survey, and Gustman and Steinmeier (1989, 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 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 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 this 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

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.

addressed to 1,024 working individuals (employees and self-employed). The Appendix includes further details on the survey, and compares 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 rely on the same assumptions and methods first used by Guiso, Jappelli and Pistaferri (2002) for income risk. In particular, we assume that the subjective distribution is either uniform or triangular, and based on the elicited values of y_m , y_M and π , we compute the respondent-specific mean, standard deviation and coefficient of variation. The formulae for these statistics are reported in the Appendix.⁸

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 92 percent of the eligible sample (1,024 employees). This is much higher than the 66 percent value in Dominitz and Manski (2006), but is lower than the 97 percent of usable answers in Delavande and Rohwedder (2008). Whether these differences are due to sample characteristics, elicitation method or

⁸ We assume that y_m and y_M represent the actual minimum and maximum of the distribution. This is potentially a strong assumption. In Dominitz and Manski (1997) the elicited minimum and maximum typically turned out to be about the 0.2 and 0.8 quantiles of the subjective distributions. In Delavande et al. (2010), they seem to be the actual minimum and maximum.

survey design (telephone, internet or face to face interviews) is beyond the scope of this paper. A promising avenue of research is to embed in general surveys experimental questions on preference traits or beliefs, as in Scheubel, Schunk and Winter (2009), who focus on expected work ability and investigate the drivers of people's answers to opinion pools.

3.2. Descriptive statistics

The top panel of Table 2 reports cross-sectional statistics of the central tendency and dispersion of the subjective replacement rate distribution. The median expected replacement rate for the sample of 940 valid observations is 71 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).⁹ Although there is substantial heterogeneity in expected replacement rates, on average, expectations 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 median of the respondent-specific coefficient of variation is 3.4 percent (2.4 percent using the triangular distribution). The average coefficients of variation are slightly higher (4.34 and 3.11 percent, respectively).

The data also allow to estimate the subjective distribution of retirement age. Interviewees were asked to provide minimum and maximum values for expected retirement age, and to indicate the probability that it would be greater than the mid-point of the range. We thus apply the same procedure used for replacement rates to estimate the respondent-specific subjective distributions of retirement age. The cross-sectional statistics of the central tendency and dispersion of that distribution are reported in the bottom panel of Table 2. The median is just below 64 for both the uniform and the triangular distributions, in line with current legislation. Uncertainty on retirement age, while not negligible, is much less pronounced than for replacement rates: on average, the

⁹ 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.

coefficient of variation is 1.47 percent using the uniform distribution (1.06 using the triangular). Furthermore, given the pension rules, the replacement rate depends on retirement age, and therefore replacement rate uncertainty should reflect also retirement age uncertainty.¹⁰ Therefore, in the rest of the section we focus on the replacement rate as the main driver of pension risk¹¹

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 940 respondent-specific distributions. The figure highlights considerable 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 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. Heterogeneity in subjective probabilities

The subjective expectations allow to quantify the extent of heterogeneity in individuals beliefs and to assess how individuals' characteristics are related to the 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

¹⁰ The cross-sectional correlation between the coefficient of variation of the replacement rate and the coefficient of variation of retirement age is 0.18 for both the uniform and triangular distributions.

¹¹ In some regressions in section 4 we control for the separate effect of retirement age uncertainty and find no effect on pension funds or insurance ownership.

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 than contributions over the entire career).¹² Public sector employees expect a replacement rate that is 5.1 percent higher than the reference omitted category (private employees), while the self-employed expect a replacement rate of 6.7 points lower. Residents in the Centre of Italy expect a higher replacement rate than individuals living in the North (the coefficient is 5.1), and in the South (6.2 points higher). These effects are likely to reflect regional heterogeneity in the occupation and income distribution. 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,¹³ four dummies that measure the ability to rank asset

¹² The data are a single cross-section, and do not allow to distinguish age from cohort effects.

¹³ 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?

riskiness correctly,¹⁴ and two dummies related to ability to understand financial diversification and rank the risks among specific portfolios.¹⁵ 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 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: an increase of the index by 1, is associated with an increase in the standard deviation by 0.1 points, about 6 percent of the sample mean. This

¹⁴ 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.

¹⁵ 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.

finding suggests that more financially informed investors may also be more aware that pensions are risky.¹⁶

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 near 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 if pension risk is associated with portfolio choice, and particularly the demand for retirement saving and health insurance.

4. Retirement saving and health insurance

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 issue: 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 to be negatively associated with the expected replacement rate; however, if individuals dislike risk and become more risk averse when pension risk increases, the demand for private pension funds might be positively

¹⁶ We recognize that causality could run in the opposite direction. Individuals who know that they face high public pension risk may have invested in acquiring financial knowledge to better plan for their retirement.

associated with the riskiness of social security, as measured by the standard deviations of the subjective distributions.¹⁷

We restrict respondents to be less than 60 years of age (the typical retirement age of private and public employees), and therefore the sample is reduced to 795 observations. We then relate the probability of ownership of private pension funds to the central tendency and dispersion of the replacement rate distribution.¹⁸ Table 4 reports the marginal effects and associated standard errors. In the first column the coefficient of the expected replacement rate is negative, while the coefficient of the standard deviation pension risk is positive; both coefficients are statistically different from zero at the 10 percent level. A 10-percentage point increase in the expected replacement rate reduces the probability of owning a pension fund by 1 percentage point, while a one standard deviation increase in the cross-sectional distribution of subjective standard deviations is associated with a 1.6-points 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.¹⁹

In the second column of Table 4 we relate pension fund ownership to a set of additional regressors: the index of financial literacy, a dummy for high risk aversion,²⁰ the expected retirement age and its standard deviation. While literacy and retirement age have no effect on ownership, we find that people who are more risk averse invest more in pension funds. The finding that retirement age risk does not affect pension funds

¹⁷ 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. 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.

¹⁸ Since wealth amounts are subject to considerable measurement error, in this section we focus on the decision to enroll in a retirement saving plan.

¹⁹ The sample proportion of individuals with a pension fund is 13 percent, in line with population data.

²⁰ The dummy is based on the following question: "In managing your financial investment, you are a person that is interested in investments that offer: (1) high returns, with a high risk of losing the capital; (2) good returns, and moderate safety; (3) moderate returns, and good safety; (4) low returns, and no risk of losing the capital." The risk aversion dummy equals one if the response is (4).

ownership lends further support to our hypothesis that replacement rate uncertainty is the main driver of overall pension risk.

Individuals who expect pensions to be risky might also tend to protect themselves from other sources of risk, such as health risk. While in Italy the health system provides universal coverage, the quality of health care varies considerably across Italian regions, and affects health outcomes (Jappelli and Padula, 2003). It is therefore interesting to estimate the correlation between health insurance and pension risk. The probit regressions reported in columns (3) and (4) of Table 4 confirm a negative association between the expected replacement rate and the propensity to have health insurance. We also find that the demand for health insurance is positively associated with education, income and self-employment. The results are similar if we control for financial literacy, risk aversion and the respondent-specific expectation and standard deviation of retirement age.

Overall, the regressions detect a statistically significant correlation between the subjective probabilities of replacement rates and the propensity to insure. Even though they do not provide evidence of a causal link between these variables, they are consistent with models of investors' behavior in which background uncertainty (as measured by pension risk) affects portfolio and insurance decisions (Kimball, 1992; Gollier and Pratt, 1996). In future research it would be interesting to study if the correlation arises because insurance decisions respond to background uncertainty, or is the result of omitted preference traits affecting economic decisions and risk perception.

5. Conclusions

Using a representative sample of Italian investors, we estimate the risk associated with social security benefits by eliciting for each individual the subjective distribution of the replacement rate as a summary indicator of social security wealth. We characterize the main features of this subjective distribution, highlighting the extent of individual heterogeneity in perceptions. The survey provides 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.

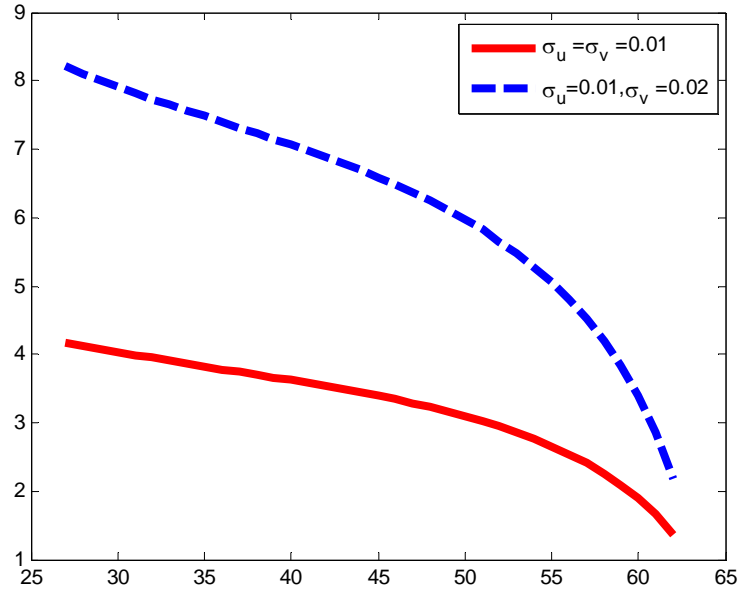
We find that the expected replacement rate is, on average, close to the statutory value, but with important differences across individuals. The expected replacement rate is higher for older people and lower for the self-employed, confirming previous evidence that is consistent with the current social 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 the last part of the paper we find that people who perceive greater public pension risk also invest more in private pension funds and health insurance. The results suggest that the perception of pension risk is associated with household portfolio decisions, and imply that overly optimistic (or pessimistic) expectations of pension benefits might lead to potentially large biases in household portfolios.

References

- Attanasio, Orazio P., and Agar Brugiavini (2003), "Social Security and Households' Saving," *Quarterly Journal of Economics* 118, 1075-1119.
- Attanasio, Orazio P., and Susan Rohwedder (2003), "Pension Wealth and Household Saving: Evidence from Pension Reforms in the United Kingdom," *American Economic Review* 93, 1499-1521.
- Bernheim, B. Douglas (1988), "Social Security Benefits: An Empirical Study of Expectations and Realizations," *Issues in Contemporary Retirement*, R.R Campbell and E. Lazear eds. Stanford: Hoover Institution.
- Bottazzi, Renata, Tullio Jappelli and Mario Padula (2006), "Retirement expectations, pension reforms, and their impact on private wealth accumulation," *Journal of Public Economics* 90, 2187-2212.
- Disney, Richard, and Sarah Tanner (1999), "What Can We Learn from Retirement Expectations Data?," IFS Working Paper n. W99/17. London: Institute for Fiscal Studies.
- Delavande, Adeline and Susann Rohwedder (2008), "Eliciting Subjective Expectations in Internet Surveys," WP 589, RAND Labor and Population Working Paper Series.
- Delavande Adeline, Giné Xavier and David McKenzie (2010), "Eliciting Probabilistic Expectations with Visual Aids in Developing Countries: How sensitive are answers to variations in elicitation design?" World Bank, mimeo.
- Dominitz Jeff and Manski Charles (1997) "Using Expectations Data to Study Subjective Income Expectations," *Journal of the American Statistical Association* 92, 855-67.
- Dominitz, Jeff and Charles F. Manski (2006), "Measuring Pension-Benefit Expectations Probabilistically," *Labour* 20, 201-236.
- Feldstein, Martin (1974), "Social Security, Induced Retirement and Aggregate Capital Accumulation," *Journal of Political Economy* 82, 357-74.
- Feldstein, Martin, and Anthony Pellechio (1979), "Social Security and Household Accumulation: New Microeconomic Evidence," *Review of Economics and Statistics* 61, 361-68.
- Gale, William G. (1998), "The Effect of Pension Wealth on Household Wealth: a Reevaluation of Theory and Evidence," *Journal of Political Economy* 106, 706-23.

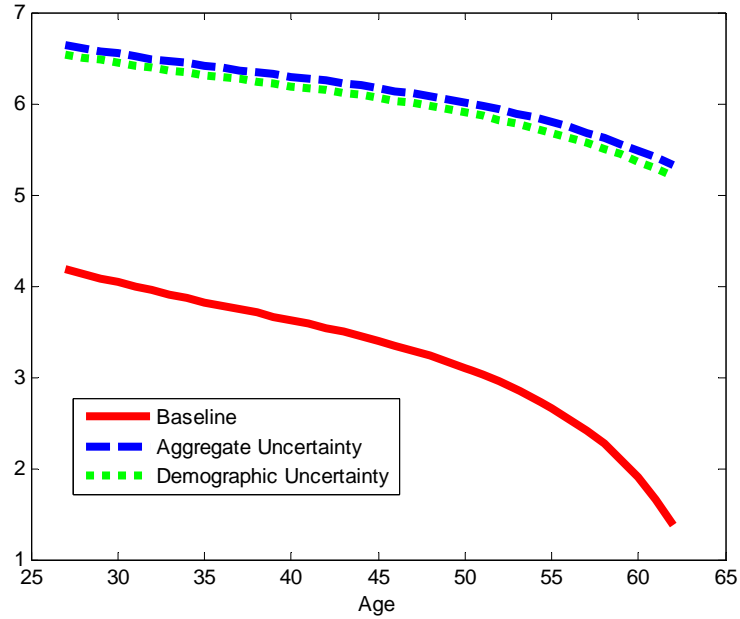
- Gollier Christian, and John W. Pratt (1996), "Risk Vulnerability and the Tempering Effect of Background Risk," *Econometrica* 4, 1109-1124.
- Gruber, Jonathan, and David A. Wise (1999), *Social Security and Retirement Around the World*. Chicago: The University of Chicago Press.
- Gruber, Jonathan, and David A. Wise (2004), *Social Security Programs and Retirement Around the World: Micro Estimation*. Chicago: The University of Chicago Press.
- Guiso, Luigi, Tullio Jappelli and Luigi Pistaferri (2002), "An empirical analysis of earnings and employment risk," *Journal of Business and Economic Statistics* 20, 241-253
- Gustman, Alan L., and Thomas L. Steinmeier (1989), "An Analysis of Pension Benefit Formulas, Pension Wealth and Incentives from Pensions," *Research in Labor Economics* 10, 53-106.
- Gustman, Alan L., and Thomas L. Steinmeier (2005), "Imperfect Knowledge, Retirement and Saving," *Industrial Relations* 44, 373 -95.
- Jappelli, Tullio, and Mario Padula (2003), "The Quality of Health Care: Evidence from Italy," *Giornale degli Economisti* 62, 7-34.
- Jappelli, Tullio, and Luigi Pistaferri (2003), "Tax Incentives and the Demand for Life Insurance: Evidence from Italy," *Journal of Public Economics* 87, 1779-99.
- Kimball, Miles (1992), "Precautionary Motives for Holding Assets," in John Eatwell, Murray Milgate and Peter Newman (Eds.) *The New Palgrave Dictionary of Money and Finance*. London: MacMillan.
- Manski, Charles (2004), "Measuring Expectations," *Econometrica* 72, 1329-1376.
- Scheubel, Beatrice, Daniel Schunk, and Joachim Winter (2009), "Don't Raise the Retirement Age! An Experiment on Opposition to Pension Reforms and East-West Differences in Germany," CESifo Working Paper No.2752, Munich.

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



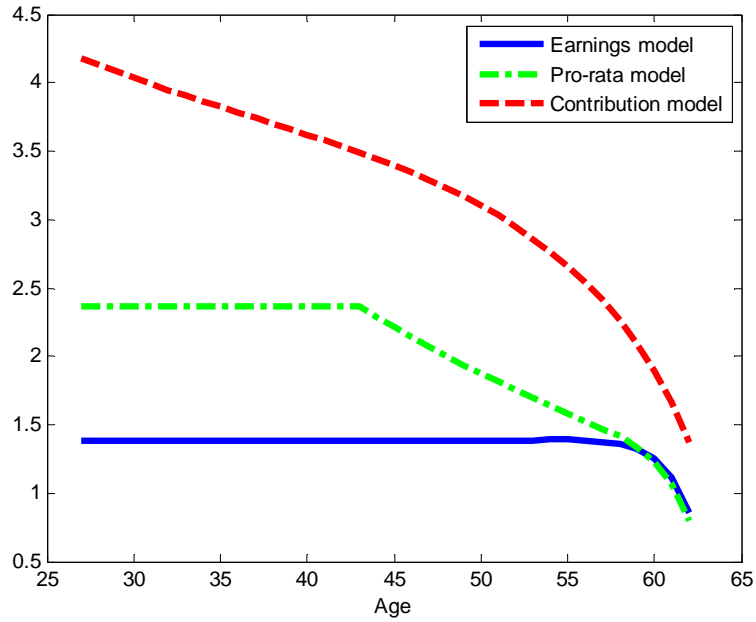
Note: The simulations assume that the growth rates of individual annual earnings and aggregate GDP are 2 percent and 1.5 percent, respectively, the retirement age is 62, the number of years of contribution is 37, the annuitization factor is 0.0551 and the mean of transitory and permanent income shocks 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 to 0.01 and σ_v to 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

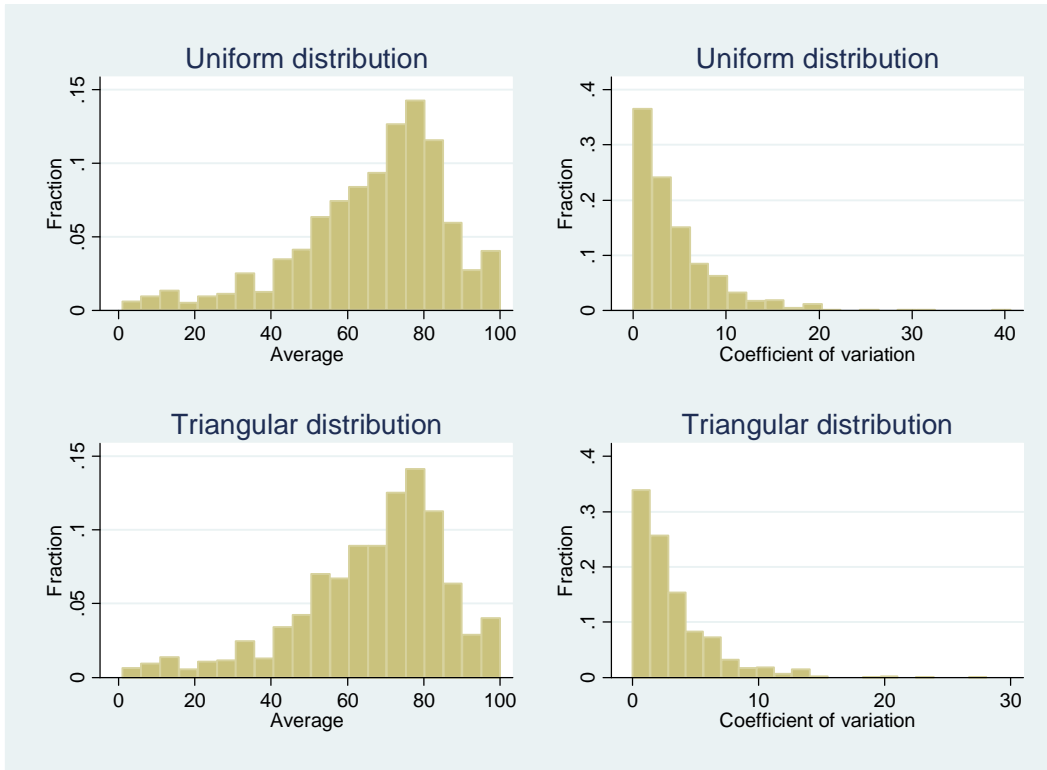


Figure 5
The expected replacement rate and the coefficient of variation of the replacement rate distribution, by age and education

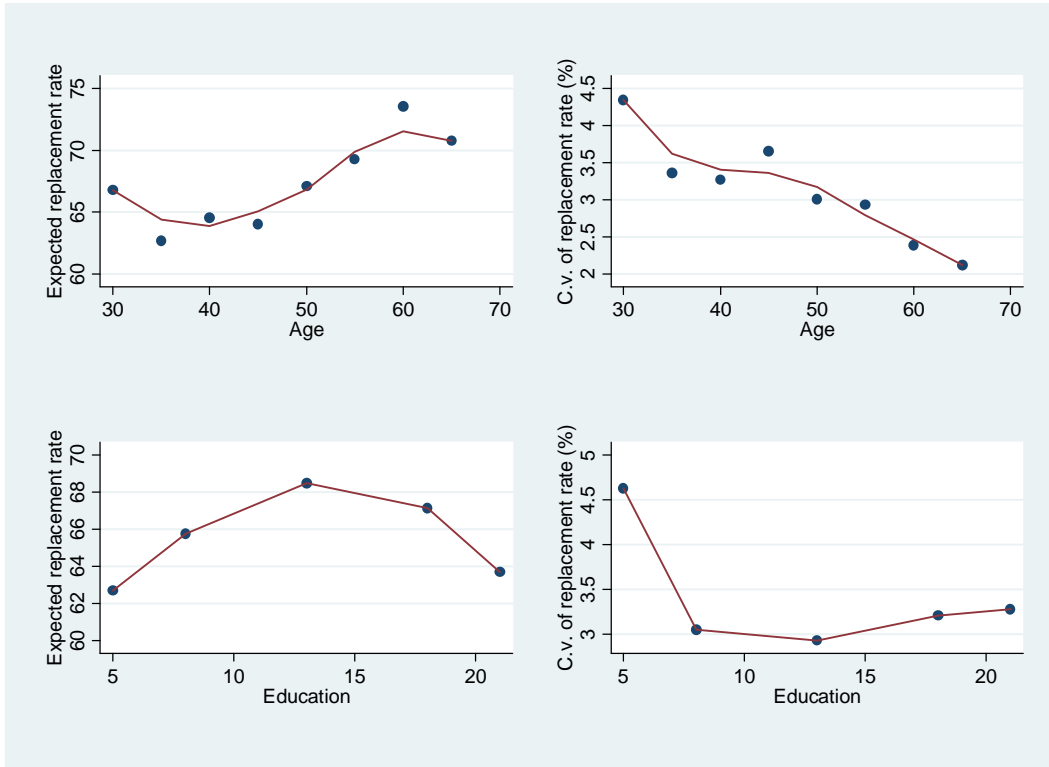


Figure 6
Quantiles of the expected replacement rate and coefficient of variation of the replacement rate distribution, by age and education

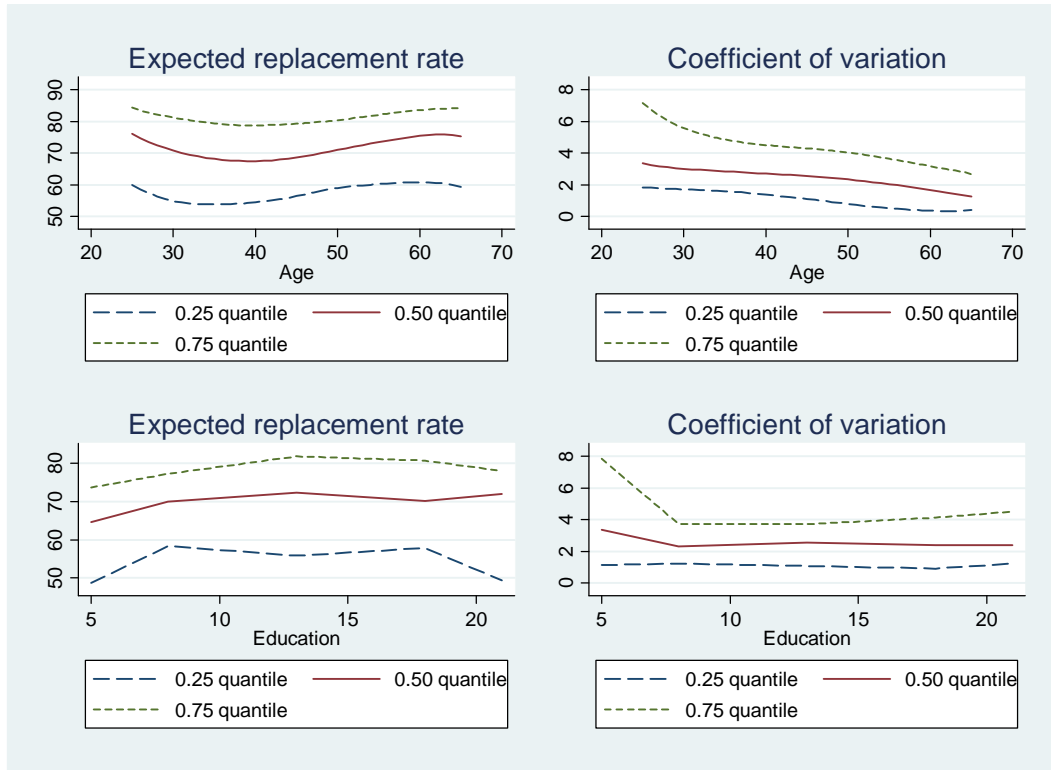


Figure 7
The replacement rate distribution, by income and occupation

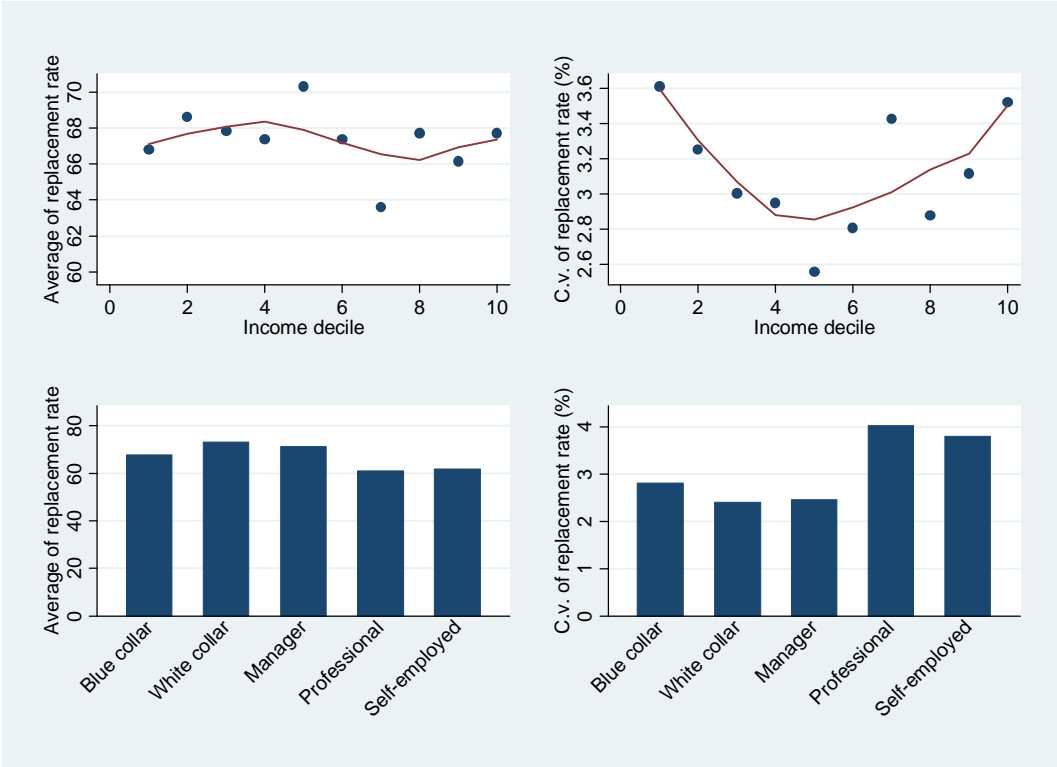


Table 1
Pension award formula and eligibility rules

	<i>Pension award formula</i>			
<i>Old</i>	<i>Private sector</i> 2% × years of contribution × average of last 10 years of earnings	<i>Public sector</i> 2% × years of contribution × average of last 10 years of earnings	<i>Self-employed</i> 2% × years of contribution × average of last 15 years of earnings.	
<i>Middle-aged</i>	Earnings model before 1995, contribution model after 1995.			
<i>Young</i>	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.			
	<i>Pension eligibility rules</i>			
	Seniority pensions Minimum years of contribution	Old age pensions Retirement age		
<i>Old and Middle-aged retiring in</i>		<i>Private employees</i>	<i>Public employees</i>	<i>Self-employed</i>
2008-09	35	60	60	61
2010-13	35	61	61	62
After 2014	35	62	62	63
<i>Young</i>	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 and retirement age distributions

Statistics of the subjective distributions	Cross-sectional statistics				
	Mean	Median	Standard deviation	Minimum	Maximum
Replacement rate					
Mean					
Uniform	67.15	71.13	19.54	1.00	100.00
Triangular	67.24	71.33	19.48	1.00	100.00
Standard deviation					
Uniform	2.48	2.47	2.24	0.00	17.06
Triangular	1.78	1.78	1.59	0.00	12.08
Coefficient of variation					
Uniform	4.34	3.40	4.56	0.00	40.62
Triangular	3.11	2.41	3.22	0.00	28.10
Retirement age					
Mean					
Uniform	64.37	63.75	5.88	21.05	100.00
Triangular	64.36	63.68	5.85	21.20	100.00
Standard deviation					
Uniform	0.95	0.85	0.92	0.00	11.37
Triangular	0.68	0.60	0.65	0.00	8.06
Coefficient of variation					
Uniform	1.47	1.34	1.39	0.00	15.80
Triangular	1.06	0.96	0.99	0.00	11.29

Note. The table reports cross-sectional statistics computed from the moments of the subjective replacement rate and retirement age distributions. The number of observations is 940.

Table 3
Determinants of the replacement rate distribution

	<i>Expected replacement rate</i>		<i>Standard deviation</i>		<i>Coefficient of variation</i>	
	(1)	(2)	(3)	(4)	(5)	(6)
Male	-2.162 (1.452)	-2.082 (1.454)	0.178 (0.122)	0.158 (0.122)	0.231 (0.245)	0.210 (0.245)
Age	0.227 (0.060)***	0.227 (0.060)***	-0.016 (0.005)***	-0.016 (0.005)***	-0.033 (0.010)***	-0.034 (0.010)***
Education	-0.349 (0.181)*	-0.332 (0.182)*	0.014 (0.015)	0.010 (0.015)	0.045 (0.031)	0.041 (0.031)
Public sector	5.159 (1.484)***	5.193 (1.485)***	-0.279 (0.125)**	-0.287 (0.124)**	-0.856 (0.250)***	-0.865 (0.250)***
Self-employed	-6.851 (1.556)***	-6.867 (1.556)***	0.253 (0.131)*	0.257 (0.130)**	0.844 (0.262)***	0.848 (0.262)***
Resident in the Centre	5.129 (1.516)***	5.038 (1.519)***	0.298 (0.127)**	0.320 (0.127)**	0.284 (0.256)	0.308 (0.256)
Resident in the South	6.210 (1.501)***	6.158 (1.502)***	0.072 (0.126)	0.084 (0.126)	-0.260 (0.253)	-0.246 (0.253)
Log income	-0.404 (0.916)	-0.356 (0.918)	-0.020 (0.077)	-0.032 (0.077)	0.067 (0.154)	0.054 (0.155)
Index of financial lit.		-0.440 (0.435)		0.106 (0.036)***		0.116 (0.073)
Constant	64.120 (9.454)***	64.797 (9.478)***	2.358 (0.793)***	2.194 (0.792)***	3.253 (1.594)**	3.075 (1.596)*
Observations	940	940	940	940	940	940
R-squared	0.08	0.09	0.03	0.04	0.05	0.05

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 having a pension fund and health insurance

	<i>Pension funds</i>		<i>Health insurance</i>	
	(1)	(2)	(3)	(4)
Replacement rate (average)	-0.001 (0.001)*	-0.001 (0.001)*	-0.000 (0.001)	-0.000 (0.001)
Replacement rate (s.d.)	0.016 (0.009)*	0.016 (0.009)*	0.022 (0.008)***	0.018 (0.009)**
Age	0.000 (0.002)	-0.000 (0.002)	0.002 (0.002)	0.002 (0.002)
Male	0.084 (0.029)***	0.080 (0.029)***	-0.016 (0.032)	-0.022 (0.033)
Education	0.005 (0.004)	0.005 (0.004)	0.010 (0.004)***	0.009 (0.004)**
private	-0.085 (0.053)	-0.090 (0.050)*	-0.050 (0.055)	-0.057 (0.053)
Self-employed	-0.027 (0.030)	-0.018 (0.031)	0.104 (0.031)***	0.102 (0.032)***
Resident in the Centre	-0.059 (0.031)*	-0.057 (0.031)*	-0.069 (0.030)**	-0.069 (0.030)**
Resident in the South	-0.097 (0.030)***	-0.099 (0.030)***	-0.055 (0.031)*	-0.052 (0.031)*
Log income	0.040 (0.021)*	0.037 (0.021)*	0.076 (0.020)***	0.072 (0.020)***
Index of financial literacy		-0.000 (0.010)		0.008 (0.010)
Low risk aversion		0.100 (0.033)***		0.053 (0.036)
Retirement age (average)		-0.002 (0.003)		0.001 (0.003)
Retirement age (s.d.)		-0.025 (0.025)		0.027 (0.024)
Observations	795	795	795	795

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, $Prob(y \leq (y_m + y_M)/2) = \pi$.²¹ Knowing the support of the distribution, we can express the expected value and variance of y as:

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

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

21

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 $\pi=0.5$ 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 $y_m, y_M, 1-\pi$ 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:

$$\begin{aligned} Y_t &= g^t Y_0 P_t U_t \\ P_t &= P_{t-1} V_t \end{aligned}$$

where Y_t are earnings at time t , P_t the permanent component of earnings and $\ln U_t$ 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:

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

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:

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

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

A4.2. Contribution model

The replacement rate in the contribution model is:

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

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:

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

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

A4.3. Pro-rata model

The replacement rate in the pro-rata model is:

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

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

$$\begin{aligned}
\mu_{1|t} &= e^{-\mu_u + 0.5\sigma_u^2} \left[0.02 \frac{t_{1992}}{5} \sum_{s=1}^4 \delta^s E_t(U_{T-s} \tilde{P}_{T-s}) + \gamma\tau \sum_{s=t_{1995}}^{T-1} \alpha^{T-s} E_t(U_s \tilde{P}_s) \right] \\
\mu_{2|t} &= e^{-2\mu_u + 2\sigma_u^2} \left\{ 4 * 10^{-4} \frac{t_{1992}^2}{25} \left[\sum_{s=1}^4 \delta^{2s} E_t(U_{T-s}^2 \tilde{P}_{T-s}^2) + 2 \sum_{s=1}^3 \sum_{r=s+1}^4 \delta^s \delta^r E_t(U_{T-s} \tilde{P}_{T-s} U_{T-s} \tilde{P}_{T-s}) \right] + \right. \\
&+ (\gamma\tau)^2 \left[\sum_{s=t_{1995}}^{T-1} \alpha^{2(T-s)} E_t(U_s^2 \tilde{P}_s^2) + 2 \sum_{s=t_{1995}}^{T-2} \sum_{r=s+1}^{T-1} \alpha^{T-s} \alpha^{T-r} E_t(U_s \tilde{P}_s U_r \tilde{P}_r) \right] + \\
&\left. + 2 * 0.02 * \frac{t_{1992}}{5} * \gamma\tau \sum_{s=1}^4 \sum_{r=t_{1995}}^{T-1} \delta^s \alpha^{T-r} E_t(U_{T-s} \tilde{P}_{T-s} U_r \tilde{P}_r) \right\}
\end{aligned}$$

Table A1: UCS – SHIW comparison

	<i>UCS</i>	<i>SHIW</i> <i>Highest income earner</i>	<i>SHIW</i> <i>Bank account holder</i>
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

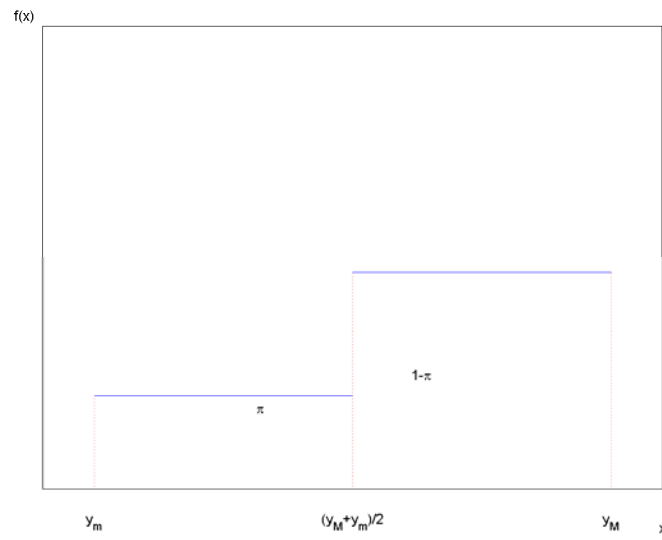


Figure A2
The triangular distribution

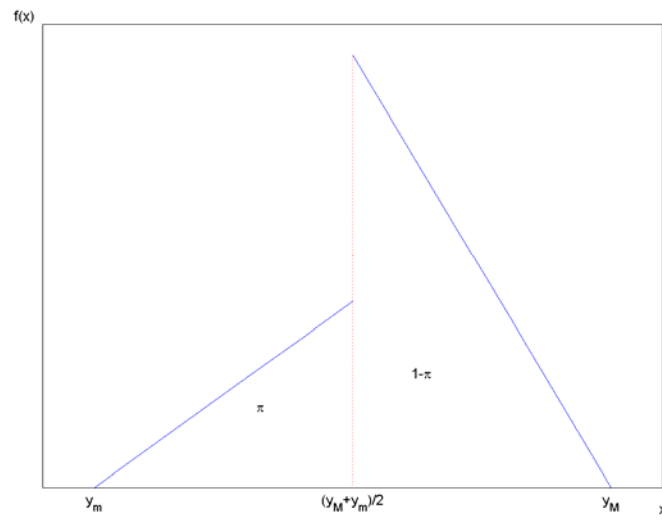


Figure A3
The subjective replacement rate

