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Retirement expectations, pension reforms, and their impact on private wealth accumulation

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Abstract

We estimate the effect of pension reforms on households' expectations of retirement outcomes and private wealth accumulation decisions exploiting a decade of intense Italian pension reforms as a source of exogenous variation in expected pension wealth. The Survey of Household Income and Wealth, a large random sample of the Italian population, elicits expectations of the age at which workers expect to retire and of the ratio of pension benefits to pre-retirement income between 1989 and 2002. We find that workers have revised expectations in the direction suggested by the reform and that there is substantial offset between private wealth and perceived pension wealth, particularly by workers that are better informed about their pension wealth.

JEL classification: H55; E21
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1. Introduction

In all industrialized countries pension benefits represent a major component of retirement income, and therefore social security arrangements can have important effects on households' intertemporal choices. One of the most important issues in this area is to what extent individuals perceive and react to changes in pension legislation. Is private wealth a good substitute for

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mandated accumulation in the form of social security contributions? Do people increase their saving and labor supply in response to a reduction in pension benefits?

Answers to these questions usually proceed in two steps. In a first step, researchers estimate expected pension wealth, that is, the expected present discounted value of future benefits that workers are entitled to. In a second step, expected pension wealth is related to discretionary wealth and/or labor supply behavior. Even in the simplest scenarios, estimating future pension benefits is a difficult task. For the working population, expected pension wealth depends, among other variables, on the age at which workers expect to retire and on the expected ratio of pension benefits to pre-retirement earnings (the replacement rate). The standard approach taken in the literature is to estimate these variables from current and projected legislation on pension eligibility rules, accrual rates of contributions, productivity growth and mortality projections. In this paper we instead take a different approach: we compute expected pension wealth by using individual expectations of retirement age and replacement rate.

The Survey of Household Income and Wealth (SHIW), a large representative survey of the Italian population carried out by the Bank of Italy, elicits retirement age and replacement rate expectations from 1989 to 2002. This is not the only survey eliciting such expectations but, to our knowledge, it is the only survey in which this information is available for an extended period spanning a set of intense pension reforms. During the period, the Italian government enacted three reforms (in 1992, 1995, and 1997), whose ultimate effect was to increase the retirement age and to reduce the replacement rate of young workers relative to older cohorts.

The availability of individual expectations enables us to assess the degree of workers' information by comparing the expected replacement rate to a replacement rate computed with the relevant pension legislation (for a given retirement age). Moreover, the pension reforms that take place in the observation period provide us with the opportunity to estimate the impact of these reforms on individual expectations. In particular, we can analyze whether the groups most affected by the reforms have perceived these changes correctly. Believing in the importance of subjective expectations to determine individual decisions, we use subjective expectations of retirement age and replacement rate to construct a measure of expected pension wealth and we relate it to discretionary wealth. We then show that the relationship between expected pension wealth and discretionary wealth differs according to the degree of individual information about pension legislation and the changes implied by the reform.

The standard life-cycle hypothesis posits that a change in expected pension benefits should offset private wealth one-for-one. This offset is what Feldstein (1974) calls the substitution effect —pension wealth crowds out discretionary wealth. There are several potential counter-effects to a complete crowding out. Bequest motives, short-sightedness, liquidity constraints, risk associated with future reforms, and non-marketable future benefits are among the most cited reasons to explain why the offset between private and pension wealth might well be less than one-for-one. But there is another element that plays a major role in our analysis: individual information about pensions. Information might be especially important at times of pension reforms, because people might not immediately understand how the reform will affect their benefits or because changes in expectations occur slowly.

Feldstein (1974) and Feldstein and Pellechio (1979) pioneered the analysis of the displacement effect of pension wealth on national saving using U.S. time series and microeconomic data, respectively. Since then, a growing literature has used individual level data to provide evidence on the degree of substitution between discretionary accumulation and pension wealth in the U.S. and other countries imputing pension wealth from legislation (see Gale, 1998; Bernheim, 2002). Existing microeconometric evidence suggests that pension wealth crowds out discretionary

wealth, but at a rate of considerably less than one-for-one. Other related and influential research looks at how pension entitlements affect retirement and labor participation decisions of the elderly, and simulates the effects of policy reforms (see Gruber and Wise, 1999, 2004).

Using SHIW data for the years 1989–1995, Attanasio and Brugiavini (2003) exploit the changes in pension wealth across cohorts and employment groups induced by the 1992 Italian pension reform. They model the response of the change in private wealth relative to income (the saving rate) to the level of social security wealth relative to income. This amounts to assuming that saving changes permanently when social security wealth changes. In the long run, this implies a very large effect of a pension reform on private wealth.

In this paper, we take the standard approach and relate the level of private wealth (relative to income) to the level of social security wealth (relative to income). We look at the combined impact of three pension reforms (1992, 1995 and 1997) and rely on an estimate of pension wealth based on the expected retirement age and expected replacement rate, rather than computed from legislation.

Given the nature of our data, we are able to distinguish the effect of pension reforms on workers' expectations, and the effect of expectation revisions on discretionary wealth. This distinction proves to be an important one for estimating the offset between pension wealth and discretionary wealth, since this offset is stronger among workers with more accurate expectations of pension provisions than among those with less accurate expectations. In this sense, our contribution adds significantly to the debate on individual savings decisions in relation to pension reforms by highlighting the importance of information and expectation errors about pension provisions. To the extent that expectations will eventually fully adjust to the new pension regime, the offset estimated for the group of workers with more accurate expectations gives us an estimate of the long run change in the stock of private wealth.

The paper is therefore also closely related to the literature that analyzes the accuracy of subjective expectations of retirement age and social security benefits (see Bernheim, 1990; Disney and Tanner, 1999; Dominitz et al., 2002; Gustman and Steinmeier, 2005). This literature has been concerned with a set of issues, which are, to a large extent, preliminary to the analysis of the effect of pension wealth on private wealth accumulation. Specifically, it analyses the degree of workers' knowledge of retirement benefits they are entitled to, the relation between planned and actual retirement age, and the determinants of the probability distribution of expected retirement age.

The paper is organized as follows. Section 2 illustrates the Italian pension reforms of the last decade and discusses previous evidence. Section 3 presents the data on expectations of retirement outcomes available in the 1989–2002 SHIW and estimates the impact of pension reforms on the expected retirement age and replacement rate, exploiting the variation in the impact of the legislation changes on different demographic and economic groups. We also evaluate the accuracy of pension expectations by comparing the expected replacement rate with a statutory rate. We find that, on average, the expectation error of the replacement rate is about 3 percentage points, but for 14% of the sample the expected replacement rate underestimates or overestimates the statutory rate by at least 25 percentage points. After the three pension reforms there has been an increase in expectation errors, particularly for the groups most affected by the reforms. Workers have revised expectations in the direction suggested by the reform, but the adjustment is far from complete.

Section 4 relates discretionary wealth to a measure of expected pension wealth constructed with expectation data. The empirical estimates suggest an offset between private wealth and expected pension wealth of about 50%. This, however, results from considerable differences

between "informed" and "uninformed" workers: the offset coefficient is between −0.4 and −0.8 in the former group, and between −0.2 and −0.4 in the latter. Section 5 concludes by drawing attention to the crucial role of financial information and suggesting that in the coming decades a problem of inadequate savings could emerge for the cohorts most affected by the reforms and, within this group, for those who are less informed about pension rules.

2. The Italian pension system: a decade of reforms

Until recently, the Italian social security system featured high replacement rates, earnings-based benefits, indexation of pensions to real earnings and cost of living, generous provisions for early retirement, and a large number of social pensions (i.e., old-age income assistance). These features of the social security system were gradually implemented and extended during the post-war period, and especially between 1967 and 1975. The result was that the ratio of pension benefits to GNP reached almost 16% in 1992, the highest value among industrialized countries.

The late eighties and early nineties saw increasing alarm over the growing imbalance of the social security system expressed not only by economists and in official government documents, but also in the media. In the second half of 1992 the Amato government presented a fiscal package containing a major reform of the social security system. In 1995 Italy underwent a second major reform of the social security system, known as Dini reform. Social security legislation was further refined in December of 1997 by the Prodi government.

The main features of the reforms were an increase in the retirement age and minimum years of contributions for pension eligibility, abolition of seniority pensions for all those who started working after 1995, a gradual reduction in pension benefits, and indexation of pension benefits to prices rather than to wages. The three reforms maintained the generous provisions of the pre-1992 regime for the relatively old workers, who in 1995 had at least 18 years of contributions, and different rules for private employees, public sector employees and self-employed.

Although the current regime combines some features of each of the three reforms, we do not detail their specific aspects.[1] In fact, we compare pension regimes and individual expectations *before the 1992 reform* and *after the 1997 reform*, omitting the transitional years between the Amato and Prodi reforms (1992–1997). Our data set allows us to observe workers in two regimes, one with generous provisions (before the Amato reform, or simply the pre-reform period) and one–10 years later–with much lower benefits (after the Prodi reform, or the post-reform period), at least for some categories of workers. We regard the availability of low frequency microeconomic data as a major improvement with respect to previous evidence.

The top panel of Table 1 compares statutory retirement ages in the pre-1992 regime with the post-1997 regime. For brevity we refer to workers with more than 18 years of contributions in 1995 as the "old", to those with less than 18 years of contributions in 1995 as the "middle-aged", and to those who started working after 1995 as the "young". In the new regime the young are entitled to a flexible retirement age (from 57 to 65), subject to incentives. For those already working in 1995 (the old and the middle-aged), the reform raises minimum retirement age for old age pensions of private sector employees (65 for men and 60 for women), but not for public employees and self-employed. For the old and middle-aged, the reform raises minimum years of contributions for both seniority pensions and old age pensions; for the young, whose pension award formula is entirely contribution based (see below) the minimum years of contributions is just 5 years.

[1] Brugiavini (1999) provides ample details on the specific features of the sequence of the three Italian pension reforms.

Table 1
Retirement age and pension award formula before and after the pension reforms

		Retirement age						
		Old age pensions				Seniority pensions		
		Minimum retirement age			Minimum years of contributions	Minimum years of contributions		
		Private sector	Public sector	Self-employed		Private sector	Public sector	Self-employed
Pre-1992 regime	All workers	60 (55)	65 (60)	65 (60)	15	35	20	35
Post-1997 regime	Old	Progressively rising to 65 (60)	65 (60)	65 (60)	Progressively rising to 20	40 before age 57 35 after age 57		40 before age 58 35 after age 58
	Middle-aged	Progressively rising to 65 (60)	65 (60)	65 (60)	Progressively rising to 20	40 before age 57 35 after age 57		40 before age 58 35 after age 58
	Young	Subject to incentives: 57–65			5	Abolished		

		Pension award formula		
		Private sector	Public sector	Self-employed
Pre-1992 regime	*All workers* Earnings model	2% × years of contributions × average of the last 5 years of earnings	2.33% × years of contributions × last year of earnings	2% × years of contributions × average of the last 10 years of earnings
Post-1997 regime	*Old* Earnings model	Gradually to 2% × years of contributions × average of last 10 years of earnings	Gradually to 2% × years of contributions × average of last 10 years of earnings	Gradually to 2% × years of contributions × average of last 15 years of earnings
	Middle-aged Pro-rata model	Earnings model before 1995, contribution model after 1995.		
	Young Contribution model	Contributions (33% of gross wage for employees and 20% for self-employed) are capitalized on the basis of 5-years moving average of GDP growth. The capitalized sum is then multiplied by a coefficient that varies by retirement age, taking into account life expectancy.		

Old, middle-aged and young refer, respectively, to workers with more than 18 years of contributions in 1995, less than 18 years of contributions in 1995, and who start working after 1995. In the top panel female retirement age is reported in parenthesis when different from males.

The bottom panel of Table 1 summarizes the pension award formula in the pre-1992 regime and the post-1997 regime, which we detail here. In the *pre-reform* regime social security benefits were computed according to an earnings-based formula, $\rho N \bar{w}_R$, where ρ, N and $\bar{w}_R$ are, respectively, the accrual rate, the years of contributions and the average of the last R years of salary.[2] The shift to the new regime dramatically altered the pension award

[2] The accrual rate was 2% for private employees and self-employed, and ranged from 2.2% to 2.5% for public employees, depending on the years of contribution. R was 5 for private employees, 1 for public employees, and 10 for the self-employed.

formula for new cohorts, but retained the main features of the pre-1992 formula for older workers.

In the *post-reform* regime pensions are computed distinguishing between three cases: an earnings model for the old, a contribution model for the young, and a pro-rata model for the middle-aged (less than 18 years of contributions as of 1995). In each case, different rules apply to public employees, private employees and self-employed.

For older workers, pensions are still computed using the earnings model, and are the sum of two components. The first component is $\rho\alpha_{92}\overline{w}_R$, where α_{92} is the number of years of contributions at the end of 1992. The second component reflects a gradual increase of R to 10 for private and public employees and to 15 for the self-employed.[3] In practice, for realistic earnings growth rates, the second component has a small impact on the final pension with respect to the pre-reform regime.

For the young benefits are computed according to a contribution model, $\gamma\tau\sum_0^{N-1} w_t(1+g)^{N-1-t}$, where τ is the contribution rate and g a 5-year moving average of the GDP growth rate. Contributions are proportional to earnings, capitalized on the basis of a 5-year moving average, and then transformed in flow benefits using a coefficient (γ), set by legislators, that depends on retirement age and life expectancy.[4] Since the contribution rate τ is 33% for private and public employees and 20% for the self-employed, in the new regime the self-employed will receive substantially lower pensions than employees. The contributions-based model has identical minimum retirement age for males and females, in both old age and seniority pensions. However, the new regime applies only to the young cohorts, who entered the labor market after 1995, and will presumably start to retire after the year 2030.

For the middle-aged (less than 18 years of contributions as of 1995), pensions are computed according to a "pro-rata model": earnings-related for working years before 1995, and contributions-related afterwards.

In Table 2 we provide an example showing how the replacement rate changed after the reform. As explained in Table 1, retirement age is not mandatory in Italy, and replacement rates depend on years of contributions. To compute replacement rates one therefore needs to make a particular choice of retirement age. In the top panel of Table 2 we compute replacement rates for somebody retiring at age 60, with 35 years of contributions. The example posits that the growth rate of earnings is 2%, and that the aggregate GDP growth rate is 1.5%. We distinguish between three categories of workers (private, public, self-employed), three cohorts (old, middle age, young) and two periods (before and after the reform). The replacement rate is defined as the ratio of the first year's pension to the last year's earnings.[5]

In the pre-reform regime the replacement rates were the same for old, middle-aged and young workers, because the earnings model applied to all. However, in that regime replacement rates differed considerably across occupational groups: 67.3% for private employees, 81.6% for public employees and 64.1% for the self-employed. The higher rates for public employees reflect more

[3] Namely, for years of contributions between 1992 and 1995, R is increased by 1; for years of contributions between 1995 and the year of retirement, R is increased by a minimum of 5 and 2/3 of the years of contributions between 1995 and the year of retirement. For instance, for those retiring in 2000 R is increased by 3; for those retiring in 2005 it is increased by 5. The second component is therefore $\rho(\alpha_{95}-\alpha_{92})\overline{w}'_R+\rho(N-\alpha_{95})\overline{w}''_R$, where α_{95} is years of contribution at end of 1995, $R'=R+1$ and $R''=R+\min[5,\ \mathrm{int}((2/3)\times(N-\alpha_{95}))]$. Therefore, the pension for the old is: $\rho\left[\alpha_{92}\left(1-\frac{R}{R'}\right)+\alpha_{95}\left(\frac{R}{R'}-\frac{R}{R''}\right)+N\frac{R}{R''}\right]\overline{w}_R$.

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

[5] We do not distinguish here between males and females. For given retirement age, they have the same pension accrual formula.

Table 2
The replacement rate before and after the pension reforms

	Pre-reform	Post-reform	Difference
Retirement age: 60			
Private employees			
Old	67.3	66.3	−1
Middle-aged	67.3	58.2	−9.1
Young	67.3	54.9	−12.4
Public employees			
Old	81.6	76.5	−5.1
Middle-aged	81.6	61.0	−20.6
Young	81.6	54.9	−26.7
Self-employed			
Old	64.1	63.3	−0.8
Middle-aged	64.1	41.7	−22.4
Young	64.1	33.3	−30.8
Retirement age: 62			
Private employees			
Old	71.2	70.1	−1.0
Middle-aged	71.2	64.0	−7.1
Young	71.2	61.7	−9.4
Public employees			
Old	86.2	81.2	−5.0
Middle-aged	86.2	66.9	−19.3
Young	86.2	61.7	−24.5
Self-employed			
Old	67.8	66.9	−0.9
Middle-aged	67.8	45.2	−22.6
Young	67.8	37.4	−30.4

The replacement rate is computed on the basis of legislation and a given retirement age. In the post-reform regime, for the "middle-aged" and the "young" the replacement rate is calculated on the assumptions that the growth rate of earnings and aggregate GDP are 2% and 1.5% per year, respectively. In the top panel the retirement age is 60, and each worker contributes for 35 years before retiring; in the post-reform regime, the "old" contributes 25 years before 1995 and 10 years after, and the "middle-aged" 10 years before 1995 and 25 years after. In the lower panel, the retirement age is 62, and each worker contributes for 37 years before retiring; in the post-reform regime, the "old" contributes 27 years before 1995 and 10 years after, and the "middle-aged" 10 years before 1995 and 27 years after.

generous accrual rates and pension award formulas (pensionable earnings were just the last salary).

In the post-reform regime workers are distinguished according to the number of years of contributions in 1995. In our example we still posit that each worker plans to retire after 35 years of work, but distinguish between an old worker with 25 years of contributions in 1995, a middle-aged worker with 10 years of contributions in 1995, and a young person who starts working in 1996. After the reform, the replacement rates of old private employees and self-employed are practically unaffected (−1.0 and −0.8 percentage points), while that of old public employees falls by 5.1 percentage points. This differential effect is largely due to the reduced accrual rate of public employees (from 2.33% to 2%). In contrast, middle-aged and especially young workers

experience a dramatic reduction in replacement rates. For private employees the change is −9.1 percentage points for the middle-aged and −12.4 percentage points for the young; for public employees, −20.6 and −26.7 percentage points, respectively; and for the self-employed −22.4 and −30.8 percentage points.

The example shows that the pension reforms reduced pension benefits for the middle-aged and the young, and for all cohorts of public employees. The implied magnitudes of change are substantial, as for some of the categories involved the replacement rate falls by over 20 percentage points. Since the replacement rate is a function of the years of contributions, these magnitudes of change are sensitive to the choice of retirement age.

In the lower panel of Table 2 we raise years of contributions and retirement age to 37 and 62, respectively. The replacement rates are 4 to 5 percentage points higher for each of the groups considered, although the changes after the reform are similar. In particular, old private employees and old self-employed workers are basically unaffected by the reform. The Italian pension reforms therefore provide a quasi-experimental framework to analyze the impact of reforms on individual expectations. Since the reform affects some population groups (the middle-aged, the young, and public employees) more dramatically than others (old private employees and old self-employed), we will be able to compare the changes in expectations of different groups of individuals before and after the reform.

3. Expectations of retirement outcomes

The life-cycle model of saving assumes perfect information and requires that individuals can construct consumption and saving plans. The perfect information assumption is challenged on several grounds. On the theoretical side, it has been argued that misinformation can explain some of the empirical failures of the standard life-cycle model (Thaler, 1994). The available empirical evidence for the U.S. shows that workers are not well informed about their pension benefits (Bernheim, 1988; Mitchell, 1988; Gustman and Steinmeier, 1989). This lack of empirical support for the perfect information assumption motivates a series of studies on the determinants of imperfect knowledge of retirement outcomes.

In general, the literature finds that expectations are informative about retirement outcomes, but also uncovers substantial heterogeneity across the population and reveals that many workers lack knowledge of the details of their pension plans. The earliest paper is by Bernheim (1990), who compares retirement expectations and realizations in the U.S. Retirement History Survey and finds that men and wealthier individuals make more accurate plans. Disney and Tanner (1999) analyze expectations of retirement age in the U.K. Retirement Survey, and find that marital status and education have a significant effect in explaining systematic deviations of expectations from outcomes.[6] Lusardi (1999) investigates the effect of unmeasured cost of planning on saving and household portfolio choice and shows that households' wealth holdings are quite low before retirement and badly diversified. Gustman and Steinmeier (2005) match data from the Health and Retirement Study with administrative data, and quantify individuals' misinformation on social security benefits. They find only a weak relation between expected retirement benefits and benefits estimated on the basis of social security earnings records and employers' descriptions of pension plans.

[6] The focus of the paper is on the distribution of actual retirement age, conditional on a given expected retirement age, rather than on the overall distribution of expectations and realizations.

In this paper, like most of the recent studies, we use point expectations.[7] We first look at expected retirement age and then use this information to focus on expected replacement rate, defined as the expected ratio of the first pension to the last salary. For any given expected retirement age, the replacement rate is a convenient summary indicator of the generosity of the pension system and a good proxy for expected pension wealth.

The survey–the SHIW–is a large random sample of the Italian population drawn by the Bank of Italy every 2 years. Sample design, interviewing procedure, response rates and a comparison between sample and population means are reported in Appendix A (available in the online version). The survey covers several important topics related to retirement and pensions and collects data on the subjective assessment of expected retirement age and replacement rate. All workers (public employees, private employees, self-employed) are asked the following questions:

- When do you expect to retire?
- Think about when you will retire, and consider only the public pension (that is, exclude private pensions, if you have one). At the time of retirement, what fraction of labor income will your public pension be?

In Italy less than 10% of the workers are covered by occupational pension schemes, so for the overwhelming majority the social security replacement rate coincides with the overall replacement rate. The first question is posed in each survey year from 1989 to 2002; the second question only in 1989, 1991, 2000 and 2002. Since we are interested in studying workers' expectations about retirement income, we focus on the group aged 20 to 50 years. This implies that we include in our sample individuals born between 1939 (who were 50 years old in 1989) and 1982 (20 years old in 2002). The composition of the sample of older workers is likely to reflect self-selection into higher expected retirement ages, and so these workers are dropped from the analysis. A small number of individuals younger than 20 are also excluded (less than 1% of the sample). We focus on how expectations change after the reform and therefore drop workers that are interviewed in the transitional years.

We define as the pre-reform period the pooled 1989–1991 sample, while the post-reform period is the pooled 2000–2002 sample. Finally, we consider only workers who are employed or self-employed in the survey year, excluding the unemployed, retirees and other individuals not in the labor force. Overall, we have valid responses on both expected retirement age and expected replacement rate for 9724 males and 5925 females.

As explained in Section 2, the pension reform has different effects depending on whether workers had contributed for more or less than 18 years at the end of 1995, and different again for those who started working after 1995. The SHIW records the age at which individuals started working. This allows us to compute the years of contribution at the end of 1995 for each worker and to define our groups accordingly.[8]

[7] Some studies focus on the subjective probability distribution of retirement outcomes, rather than on point expectations of retirement age and benefits. Hurd and McGarry (1995) analyze the subjective probability distribution of the chance of working full-time past age 62 and of living to age 75 in the U.S. Health and Retirement Study. Dominitz et al. (2002) use the Survey of Economic Expectations, which elicits the subjective probability distributions of eligibility for social security benefits and of the level of benefits. They report a high degree of uncertainty about future benefits even for people only 10 years from retirement.

[8] Our imputation procedure assumes no unemployment spells during the working life and is therefore subject to a certain amount of measurement error. As a sensitivity check, we assume that each individual starts working and contributing at age 20 (or 22) and define years of contribution as current age less 20 (or 22). These alternative definitions do not affect any of our results.

3.1. Descriptive analysis

Table 3 displays expected retirement age by gender, three occupation groups, and cohort. Males expect to retire 2 years later than females; the self-employed 3 years later than private or public employees. Individuals in the middle-aged group have very similar expected retirement age if working in the private or in the public sector, both before and after the reform. After the reform, expected retirement age increases for all groups considered, and especially for females and the middle-aged. No comparison is possible for the young, who are only observed after the reform. The patterns suggest that workers most affected by the reforms understand the direction of the changes that have taken place in the pension system.

Table 4 reports expected replacement rates for males and females in the various employment groups and cohorts considered. On average, the rate is high for all groups, reflecting the generous provisions of the Italian social security system. The expected replacement rates range from 65.3% to 81.8% before the reform, and from 57.3% to 79.9% afterwards.

Before the reform, public employees display the highest expected replacement rate (for males, 81.8% for the old, and 80.6% for the middle-aged), reflecting more generous accrual rates for this group. The self-employed, which is the group with the least generous pension award formula, report the lowest replacement rates (for males, 69% for the old and 71.1% for the middle-aged). On average, females expect a replacement rate between 2 and 3 percentage points lower than males, consistent with shorter working careers.

After the reform, expected replacement rates fall for both males and females, and for all employment groups considered. For males, the reduction for the middle-aged is stronger than for the old, particularly for private employees (where the middle-aged show an 8.4 percentage points reduction) and the self-employed (with a 12.2 percentage points reduction); these relatively large downward revisions are consistent with the changes introduced by the pension reform. Replacement rates also fall for females, but the difference between the old and the middle-aged is not as large as that for males.

Table 3
Expected retirement age: descriptive statistics

	Males			Females		
	Pre-reform	Post-reform	Difference	Pre-reform	Post-reform	Difference
Private employees						
Old	58.8	60.7	1.9	55.7	58.8	3.0
Middle-aged	59.8	62.3	2.6	56.4	60.1	3.7
Young		63.1			61.1	
Public employees						
Old	59.4	60.6	1.2	56.9	59.8	3.0
Middle-aged	59.5	62.2	2.7	56.7	60.8	4.1
Young		63.9			61.4	
Self-employed						
Old	62.1	63.1	1.0	59.0	60.4	1.4
Middle-aged	61.6	64.1	2.5	58.0	61.7	3.7
Young		64.3			61.8	

Data are drawn from the 1989–2000 SHIW. The pre-reform period is 1989–1991, the post-reform period is 2000–2002. The "old" have at least 18 years of contributions in 1995, the "middle-aged" less than 18 years of contributions in 1995, the "young" entered the labor market after 1995.

Table 4
Expected replacement rate: descriptive statistics

	Males			Females		
	Pre-reform	Post-reform	Difference	Pre-reform	Post-reform	Difference
Private employees						
Old	79.2	74.9	−4.3	77.2	71.1	−6.1
Middle-aged	79.2	70.8	−8.4	76.9	70.0	−6.9
Young		67.9			67.2	
Public employees						
Old	81.8	79.9	−1.9	78.3	74.0	−4.3
Middle-aged	80.6	76.6	−4.0	78.3	72.8	−5.5
Young		73.9			69.1	
Self-employed						
Old	69.0	61.2	−7.8	65.3	57.3	−8.0
Middle-aged	71.1	59.0	−12.1	69.7	58.9	−10.8
Young		61.8			57.4	

Data are drawn from the 1989–2000 SHIW. The pre-reform period is 1989–1991, the post-reform period is 2000–2002. The "old" have at least 18 years of contributions in 1995, the "middle-aged" less than 18 years of contributions in 1995, the "young" entered the labor market after 1995.

The descriptive analysis has two important limitations. First, expectations should be compared with their statutory levels. We know from Table 2 that statutory replacement rates depend on retirement age, which is a choice variable. We therefore compute a "statutory rate" conditioning on a reported expected retirement age. Thus, the statutory rates after the reform reflect not only differences in pension rules across groups and pension regimes, but also the increase in retirement age documented in Table 3. In order to compare individual expectations to their statutory counterparts, in Section 3.2 we focus on the determinants of the expectation errors, defined as the difference between expected and statutory replacement rates.

The second limitation is that differences over time in expected replacement rates capture not only the effects of the reform but also other economy-wide phenomena. To compare expectations before and after the pension reform, and to account for economy-wide factors potentially affecting the various groups over time, in Section 3.3 we use a difference-in-difference methodology.

3.2. Expectation errors

Table 5 reports the statutory replacement rate evaluated at the average expected retirement age for each employment, cohort, and gender group. The patterns in Table 5 are similar to those in Table 2, even though in the earlier table the retirement age was exogenously set to 60 or 62. By comparing the figures in Table 5 to those in earlier tables, we can assess whether or not individuals in particular groups had accurate expectations of their pensions, on average, and also whether or not these expectations were revised to accurately reflect the reforms that took place. The comparison between Tables 4 and 5 shows that before the reform private employees were, on average, overestimating the replacement rate, as were middle-aged workers from all groups with the exception of male public employees (who, on average, underestimated the replacement rate). After the reform the overestimation of the replacement rate at the average is common to middle-aged workers across all employment groups. Group averages, however, hide important within-group heterogeneity and the literature has shown that expectation errors are related to variables

Table 5
Statutory replacement rate: descriptive statistics

	Males			Females		
	Pre-reform	Post-reform	Difference	Pre-reform	Post-reform	Difference
Private employees						
Old	71.2	71.5	0.3	67.3	71.5	4.2
Middle-aged	71.2	66.8	−4.4	67.3	62.1	−5.2
Young		67			61.2	
Public employees						
Old	86.2	80	−6.2	79.2	79.5	0.3
Middle-aged	83.9	69.2	−14.7	76.9	65.4	−11.5
Young		66.2			55.3	
Self-employed						
Old	71.5	69.9	−1.5	67.8	69.9	2.1
Middle-aged	69.6	49.2	−20.4	62.3	45.2	−17.1
Young		41.1			35.5	

The statutory replacement rate is computed on the basis of the relevant pension legislation and of average expected retirement age for each cell in data drawn from the 1989–2000 SHIW. The pre-reform period is 1989–1991, the post-reform period is 2000–2002. The "old" have at least 18 years of contributions in 1995, the "middle-aged" less than 18 years of contributions in 1995, the "young" entered the labor market after 1995.

other than employment or cohort. Therefore, we calculate statutory replacement rates for each worker, and the corresponding deviation from the expected rate. We then analyze the distribution of the expectation error (Figs. 1 and 2) and its determinants in a regression framework (Table 6).

Fig. 1 displays the cross-sectional distribution of the difference between the statutory and expected replacement rates before and after the reform (1989–1991 and 2000–2002, respectively). On average, expectation errors are small: workers overestimate the replacement rate by 3.1 percentage points before the reform, and 3.5 percentage points after. But for some workers expectation errors are large: for about 14% of the sample expectation errors are larger

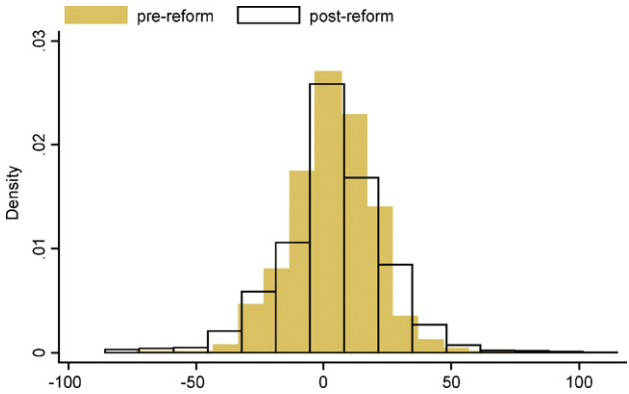

Fig. 1. Expectation error distribution before and after the pension reforms. Note: the figure plots the expectation error in the pre-reform (1989–1991) and post-reform (2000–2002) regimes. The expectation error is defined as the difference between the expected replacement rate and the statutory replacement rate.

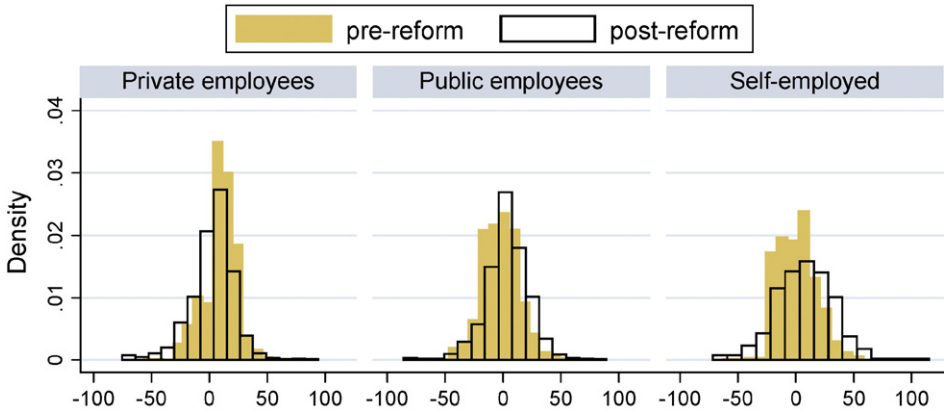

Fig. 2. Expectation error distribution before and after the pension reforms, by employment groups. Note: the figure plots the expectation error in the pre-reform (1989–1991) and post-reform (2000–2002) regimes for three employment groups. The expectation error is defined as the difference between the expected replacement rate and the statutory replacement rate.

than 25 percentage points, and this is true for more individuals after the reform than before the reform (19% and 9% of the sample, respectively). Fig. 1 shows also that the distribution of expectation errors fans out after the reform, which we interpret as an indication that the reform has increased uncertainty about retirement rules, at least temporarily. Indeed, the standard

Table 6
Regressions for the expectation error in the replacement rate

	Absolute expectation error		Probability of errors greater than 25 percentage points: marginal effects	
	Males	Females	Males	Females
Age	−0.083 (0.017)**	−0.111 (0.024)**	−0.002 (0.000)**	−0.003 (0.001)**
Public employee	−0.645 (0.302)*	−1.137 (0.384)**	−0.004 (0.009)	−0.012 (0.012)
Self-employed	3.794 (0.313)**	3.170 (0.512)**	0.084 (0.010)**	0.086 (0.017)**
Retired household member	−3.010 (0.865)**	−3.213 (1.118)**	−0.091 (0.026)**	−0.072 (0.034)*
Multiple earners	−0.642 (0.274)*	−0.805 (0.524)	−0.018 (0.008)*	−0.018 (0.016)
Age at the first job	0.239 (0.058)**	0.575 (0.055)**	0.008 (0.001)**	0.015 (0.001)**
Central Italy	0.584 (0.325)	0.824 (0.423)	0.014 (0.010)	0.017 (0.013)
Southern Italy	1.156 (0.290)**	0.954 (0.422)*	0.034 (0.009)**	0.023 (0.013)
Income	0.012 (0.014)	−0.015 (0.028)	0.000 (0.000)	−0.001 (0.001)
High school degree	−0.207 (0.273)	−0.787 (0.389)*	−0.011 (0.008)	−0.028 (0.012)*
College degree	0.553 (0.510)	−0.844 (0.584)	0.007 (0.014)	−0.009 (0.016)
Post-reform	2.523 (0.252)**	2.429 (0.358)**	0.085 (0.007)**	0.084 (0.010)**
Constant	9.696 (1.320)**	6.350 (1.462)**		
Observations	9186	5519	9186	5519

The expectation error is the difference between the expected and the statutory replacement rate. The latter is computed on the basis of the relevant pension legislation and the individual's expected retirement age. The first two columns report OLS estimates of the absolute value of the expectation error. The third and fourth columns report marginal effects of a probit where the dependent variable equals one if the expectation error is larger than 25 percentage points. Data are drawn from 1989–1991 (pre-reform) and 2000–2002 (post-reform) SHIW. Standard errors are reported in parenthesis. Two stars indicate statistical significance at the 1% confidence level; one star at the 5% level.

deviation of the expectation error increases appreciably after the reform, from 16 to 20 percentage points.

The unconditional distribution of expectation errors conceals group differences, as shown in Fig. 2. Examination of the pattern for private employees confirms that this group tends to overestimate the replacement rate before the reform but also that after the reform many more individuals underestimate the replacement rate and that some make much bigger errors than they did before the reform. Public employees before the reform make small expectation errors on average but more than 50% of individuals either overestimate or underestimate the replacement rate by more than 10 percentage points; the fraction of public employees who overestimate the replacement rate increases after the reform. The post-reform period features an increase in the standard deviation of the expectation error for all occupation groups, and the increase is larger for private employees (from 13 to 18 percentage points) and self-employed (from 17 to 24 percentage points) than for public employees (from 15 to 18 percentage points). Furthermore, the fraction of respondents that overestimates or underestimates the replacement rates by at least 25 percentage points increases for all groups, and particularly for those most affected by the reform (from 10% to 14% for private employees, from 10% to 16% for public employees, and from 11% to 29% for the self-employed).

To explore the determinants of understanding about pension outcomes, we define two measures of misinformation: the absolute value of the expectation error, and a dummy variable equal to one if the respondent overestimates or underestimates the replacement rate by more than 25 percentage points.[9] In Table 6 we relate both indicators to a set of demographics and economic variables designed to control for the costs and the incentives to acquire and process information on retirement matters. We report separate regressions for males and females.

In the first two regressions the age coefficient is negative, confirming Gustman and Steinmeier's (2005) finding that workers closer to retirement are able to perform better pension calculations. Errors are lower for public employees, possibly because this is a highly unionized sector. Given the close link between earnings and replacement rates, income risk might be associated with higher expectation errors. Indeed, we find that the coefficients of "self-employed" and "resident in the South", two variables related to income risk, are negative.

Gustman and Steinmeier (2005) highlight the importance of acquiring information through relatives and friends, and indeed the presence of a retired person in the household is associated with lower expectation errors. Word of mouth is also likely to be more effective for those living in households with multiple earners, accounting for the negative association between multiple earners and misinformation. As in Mitchell (1988), we find that expectation errors are positively related with age of entry into the labor market: other things equal, less experienced workers form less accurate expectations. Finally, the regressions in Table 6 confirm that expectation errors increase after the reform, which is consistent with the descriptive analysis and the intuition that the reform is associated with greater uncertainty.

The probit for whether workers overestimate or underestimate the replacement rate by more than 25 percentage points delivers similar results. Large mistakes increase after the reform by 8%, and are negatively associated with respondent's age. Furthermore, mistakes are lower for those living with a retired relative or in a multiple earner household.

Overall, the descriptive and regression analysis suggests that, on average, expectation errors are in the range of 3% before and after the reform, and that pension information improves as people approach retirement or when they can learn from peers or from those who are already

[9] As a robustness check we use squared expectation errors as the dependent variable. The results are unchanged.

retired. The evidence also suggests that the precision of expectations falls after the reform, particularly for the groups affected by the reform.

3.3. Difference-in-difference estimates

To gain further insights into the process of expectation formation, we exploit a unique feature of our data, which is that pension expectations are elicited before and after a period of intense reforms. This allows us to use a difference-in-difference framework to study how expected retirement age and expected replacement rate have been affected by the pension reforms. As with other studies that use a quasi-experimental framework, our tests rely on the assumptions that the pension reform is exogenous with respect to individual decisions–in particular, with respect to retirement age–and changes in sample composition.

As far as the first assumption is concerned, we believe that the possible endogeneity of the reform can be safely ruled out. The reform was not implemented in order to offset different paths of retirement ages by different cohorts or employment groups. Rather, the 1992 reform was part of a major deficit-reduction package, prompted by a severe political crisis coupled with the dramatic devaluation of the lira; it was closely followed by the deepest recession of the post-war era. The 1995 and 1997 reforms were prompted by the huge projected deficits of the social security system and the attempt to meet the Maastricht criteria.

The second assumption posits that shifts in sample composition are exogenous with respect to pension expectations. Cohorts and gender are obviously determined at birth. As far as employment groups are concerned, we require that mobility across various sectors (for instance, from public to private employment or self-employment) are independent of pension expectations, i.e. that workers did not switch jobs as a result of the pension reform itself. Since the SHIW has a rotating panel component, we can check the validity of this assumption by computing the transition rates across the three employment groups between each pair of adjacent survey years from 1989 to 2002; Appendix A (available in the online version) reports the transition rates for 1989–1991 and 2000–2002. We find that, in each period, the probability of not changing sector is about 90% for each of the three groups. Furthermore, we do not reject the hypothesis that the degree of sector mobility is the same before and after the reform for each of the estimated transition matrices.[10] Although we cannot test directly the hypothesis that workers did not change sector as a consequence of the reform, we take this as indirect evidence that the pension reform has not changed the overall pattern of workers' mobility across sectors.

We can identify the effect of the reform on expected retirement age and replacement rate because there is one group of individuals (old private employees) that was unaffected by the reform, while other groups (public employees, self-employed, the young and the middle-aged) were affected and should have revised their expectations downward. Therefore to disentangle the effect of the reforms on expectations from other effects, such as common trends in determinants of labor supply and business cycle effects, we compare the difference over time in the replacement rate of the middle-aged with the same difference for the old. Our approach does not require panel data. What we need to observe is a representative sample of the various groups in each of the two

[10] As an example, consider the Shorrocks mobility index in 1989–1991 (12.5%) and 2000–2002 (13%). The statistical test does not reject the hypothesis that mobility is the same in the two periods (the associated statistic is 0.12 and is normally distributed with mean zero and variance equal to one). The same test can be performed for each of the transition matrices (1991–1993, 1993–1995, 1995–1998, 1998–2000), and in all cases we do not reject the hypothesis that mobility is constant.

periods and therefore rely on repeated cross-sectional data. The young cannot be used to evaluate the effect of the reform because they entered the labor market after 1995. Since they were sampled only after the reform was in place, they are dropped from the analysis.

We pool all data from pre- and post-reform periods and specify a reduced form for the expected retirement age and replacement rate; we denote by y the relevant variable of interest. We assume that before the reform y is a linear function of socio-demographic variables X, employment status (private, public, self-employed) and depends on whether the years of contributions as of 1995 are more or less than 18:

$$y_i = X_i\beta + \alpha_1 + \alpha_2 \mathrm{PUB}_i + \alpha_3 \mathrm{SELF}_i + \delta_1 M_i + \delta_2 M_i{*}\mathrm{PUB}_i + \delta_3 M_i{*}\mathrm{SELF}_i + \varepsilon_i \quad (1)$$

The reference group in the regression equation is the group of old, private employees; the dummy variable M equals 1 for the middle-aged (less than 18 years of contributions as of 1995). The α coefficients capture the different rules applying to public employees (PUB) and self-employed (SELF) relative to private employees, whereas the δ coefficients measure the potential differences between middle-aged and old of the three employment groups.

After the reform y potentially shifts for all groups, so we augment the previous equation with terms that interact the cohort (M), the post-reform period (POST, where POST equals one for the post-reform period) and the employment status (SELF, PUB):

$$\begin{aligned} y_i = {} & X_i\beta + \alpha_1 + \alpha_2 \mathrm{PUB}_i + \alpha_3 \mathrm{SELF}_i + \delta_1 M_i + \delta_2 M_i{*}\mathrm{PUB}_i + \delta_3 M_i{*}\mathrm{SELF}_i \\ & + \phi_1 \mathrm{POST}_i + \phi_2 \mathrm{POST}_i{*}\mathrm{PUB}_i + \phi_3 \mathrm{POST}_i{*}\mathrm{SELF}_i + \gamma_1 \mathrm{POST}_i{*}M_i{*}\mathrm{PRIV}_i \\ & + \gamma_2 \mathrm{POST}_i{*}M_i{*}\mathrm{PUB}_i + \gamma_3 \mathrm{POST}_i{*}M_i{*}\mathrm{SELF}_i + \varepsilon_i \end{aligned} \quad (2)$$

The ϕ coefficients capture the change in y after the reform for the three employment groups: ϕ_1 measures the change for old private employees and ϕ_2 and ϕ_3 the additional effects for public employees and self-employed. The γ coefficients measure the change in y for the middle-aged due to the reform, and are our main parameters of interest. We expect the reform to increase retirement age and to reduce the replacement rate, and that this effect should be largest for public employees and for the self-employed, as shown in Section 2. The model is estimated separately for males and females, omitting the transitional 1993–1997 period.

Table 7 reports the results for expected retirement age. In the first specification we drop the control vector X, and regress expected retirement age on a set of group dummies. The results indicate that after the reform expected retirement age increases for all middle-aged workers, and particularly for public employees (1.449) and self-employed (1.475).

The second regression adds to the basic specification regional and educational dummies and annual earnings (in thousand Euro). We find that expected retirement age is considerably higher in the South (the coefficient is 1.682) and for workers with a college degree (2.971 years).[11] On the other hand, each thousand Euro of income reduces expected retirement age by 0.015 years. The two regressions for females in Table 7 confirm most of the patterns found for males, though the effects for middle-aged females are somewhat larger, particularly for self-employed, who raise their retirement age by around 2 years.

Table 8 focuses on the expected replacement rate. We find a 4 percentage point reduction in the replacement rate for middle-aged private employees and self-employed after the reform, and a 2 percentage point reduction for middle-aged public employees. If we use the statutory replacement

[11] The positive effect of the dummy for the South is likely to arise from the fact that workers in the South enter the labor market later than in other parts of the country, and therefore qualify later for a pension.

Table 7
The effect of the pension reform on the expected retirement age: regression results

	Males		Females	
Private employee, middle-aged, after the reform	0.686 (0.277)*	0.575 (0.269)*	0.704 (0.412)	0.689 (0.405)
Public employee, middle-aged, after the reform	1.449 (0.392)**	1.091 (0.381)**	1.110 (0.387)**	0.875 (0.380)*
Self-employed, middle-aged, after the reform	1.475 (0.437)**	1.572 (0.424)**	2.285 (0.690)**	2.353 (0.678)**
Public employee	0.605 (0.202)**	−0.003 (0.197)	1.112 (0.278)**	0.302 (0.280)
Self-employed	3.257 (0.243)**	3.152 (0.237)**	3.283 (0.410)**	3.180 (0.403)**
Middle-aged	0.953 (0.198)**	0.868 (0.193)**	0.670 (0.297)*	0.513 (0.293)
Public employee, middle-aged	−0.818 (0.333)*	−0.925 (0.323)**	−0.849 (0.402)*	−0.663 (0.395)
Self-employed, middle-aged	−1.459 (0.388)**	−1.873 (0.377)**	−1.650 (0.603)**	−1.922 (0.593)**
Post-reform	1.887 (0.207)**	2.084 (0.201)**	3.017 (0.328)**	3.073 (0.322)**
Public employee, after the reform	−0.659 (0.354)	−0.524 (0.343)	−0.029 (0.443)	0.235 (0.435)
Self-employed, after the reform	−0.857 (0.381)*	−0.882 (0.370)*	−1.621 (0.612)**	−1.628 (0.602)**
Central Italy		0.513 (0.121)**		0.653 (0.151)**
Southern Italy		1.682 (0.104)**		1.536 (0.149)**
Earnings		−0.015 (0.005)**		−0.006 (0.010)
High school degree		1.177 (0.100)**		0.540 (0.139)**
University school degree		2.971 (0.163)**		1.976 (0.201)**
Constant	58.804 (0.123)**	57.801 (0.157)**	55.740 (0.213)**	55.128 (0.252)**
Observations	9724	9724	5925	5925
R-squared	0.12	0.17	0.15	0.18

The dependent variable is the expected retirement age. The regressions are estimated by OLS. Data are drawn from 1989–1991 (pre-reform) and 2000–2002 (post-reform) SHIW. Standard errors are reported in parenthesis. Two stars indicate statistical significance at the 1% confidence level; one star at the 5% level.

rates in Table 5 as benchmark, the percentage point reduction in replacement rates after the reform, for the middle-aged in relation to the old, should be of 4.7 for private employees, 8.5 for public employees and 18.9 for the self-employed, suggesting that only private employees change their expected replacement rates as required by the reform. The second regression adds to the basic specification regional and educational dummies and annual earnings (in thousand Euro). Working in the South and the level of income are positively related to the replacement rate. The effect of the education dummies is positive, although university degree is not statistically different from zero for males.

The regressions for females uncover an across-the-board reduction in the replacement rate after the reform, but the employment dummies interacted with the *M* and POST dummies signal no differential effect by employment groups or cohort after the reform. The corresponding coefficients are not statistically different from zero, while Table 5 implies a large reduction in the replacement rate for each employment group.

In summary, the regressions suggest that most groups have revised their expectations in the direction implied by the reform. But the revision to the new pension rules has been far from complete. Two interpretations of the results are possible: an anticipation effect, or lack of information. If the reform had been anticipated, people would have adjusted downward the expected replacement rate (and upward the retirement age) even before the reform. This explanation clashes with the fact that, on average, the 1989–1991 expected replacement rates were quite close to–or even overestimated–the statutory rates. Furthermore, the distribution of expectation errors before the reform (grey histograms in Fig. 2) shows that in all employment

Table 8
The effect of the reform on the expected replacement rate: regression results

	Males		Females	
Private employee, middle-aged, after the reform	−4.143 (0.962)**	−4.299 (0.960)**	−0.825 (1.430)	−0.904 (1.421)
Public employee, middle-aged, after the reform	−2.032 (1.361)	−2.350 (1.360)	−1.211 (1.341)	−1.412 (1.335)
Self-employed, middle-aged, after the reform	−4.283 (1.516)**	−4.536 (1.513)**	−2.805 (2.393)	−2.830 (2.379)
Public employee	2.650 (0.699)**	2.389 (0.704)**	1.070 (0.963)	−0.372 (0.981)
Self-employed	−10.170 (0.844)**	−10.488 (0.844)**	−11.878 (1.421)**	−12.040 (1.416)**
Middle-aged	0.051 (0.686)	0.353 (0.688)	−0.314 (1.030)	−0.463 (1.029)
Public employee, middle-aged	−1.313 (1.155)	−1.418 (1.152)	0.337 (1.393)	0.603 (1.385)
Self-employed, middle-aged	2.057 (1.348)	1.847 (1.346)	4.657 (2.093)*	4.076 (2.081)
Post-reform	−4.298 (0.717)**	−4.139 (0.717)**	−6.088 (1.137)**	−5.927 (1.130)**
Public employee, after the reform	2.365 (1.228)	2.461 (1.225)*	1.805 (1.535)	2.244 (1.527)
Self-employed, after the reform	−3.508 (1.320)**	−3.409 (1.319)**	−1.895 (2.124)	−1.876 (2.113)
Central Italy		0.548 (0.433)		0.283 (0.531)
Southern Italy		1.114 (0.371)**		2.445 (0.522)**
Earnings		0.099 (0.017)**		0.185 (0.033)**
High school degree		0.950 (0.355)**		2.024 (0.487)**
University school degree		0.142 (0.583)		1.727 (0.706)*
Constant	79.191 (0.427)**	76.604 (0.562)**	77.192 (0.739)**	73.468 (0.884)**
Observations	9724	9724	5925	5925
R-squared	0.16	0.16	0.11	0.12

The dependent variable is the expected replacement rate. The regressions are estimated by OLS. Data are drawn from 1989–1991 (pre-reform) and 2000–2002 (post-reform) SHIW. Standard errors are reported in parenthesis. Two stars indicate statistical significance at the 1% confidence level; one star at the 5% level.

groups a substantial fraction of workers make non-negligible errors; this is particularly true for public employees, whose distribution is centered around zero, and for whom, therefore, looking at the whole distribution rather than at the mean is particularly important. Finally, the anticipation effect should be stronger in the years immediately before the reform; however, dropping 1991 and defining the pre-reform period as just 1989 does not change the results with respect to estimates in Table 8. Therefore, the most likely explanation for our findings is that, as of 2002, many workers did not fully understand the implications of the new pension regime and had not yet updated their pension expectations accordingly.

4. The offset between pension wealth and private wealth accumulation

The analysis presented in the previous section suggests that people reacted to the pension reform by raising expectations of retirement age and reducing perceived replacement rates (and therefore expected pension wealth). However, the magnitude of the expectation revision is considerably lower than the actual magnitudes implied by the reform. This is an important first step in evaluating the effect of pension reforms on individual behavior. The next step relates perceived pension wealth to private accumulation, accounting for the different degree of workers' information. We use the expectation error in social security wealth as an index of the workers' knowledge of their pension entitlements and to identify two groups in the sample, which we will call "informed" and "uninformed" workers. Accordingly, in this section we estimate the offset for the whole sample and also for the informed and uniformed workers samples.

Our empirical specification relates private wealth relative to income to pension wealth (relative to income) and to a set of observable variables potentially correlated with private wealth. This is different from Attanasio and Brugiavini (2003) who model the response of the change in private wealth relative to income (the saving rate) to the level of pension wealth relative to income. This amounts to assuming that saving changes permanently when social security wealth changes. Our specification implicitly posits that the saving effect is temporary, aiming to estimate the change in the stock of private wealth after the change in expected pension wealth induced by the reforms. More specifically, we estimate the following equation:

$$\mathrm{WY}_{it} = \alpha + \mathrm{SSWY}_{it}\delta + X_{it}\gamma + \theta_t + \varepsilon_{it} \tag{3}$$

where WY_{it} is private wealth of household i at time t, scaled by household disposable income, SSWY_{it} is the ratio of expected pension wealth retirement (evaluated at time t) to earnings, X_{it} is a vector that includes age of the household head,[12] disposable income, year dummies, education dummies, and region dummies;[13] θ_t represents time effects. Age, income, and education are proxies for lifetime earnings, while year dummies capture macroeconomic effects. Private wealth is defined as financial assets plus real assets (real estates and businesses) minus financial debt.

4.1. The construction of pension wealth

We calculate the ratio of expected pension wealth (at retirement) to earnings (evaluated at time t) in a way that keeps the computation as simple as possible while being tailored to the inclusion of elicited expectations of the replacement rate and the retirement age. To do this, we use the following proxy for each worker's pension wealth-to-income ratio:

$$\mathrm{SSWY}_t = \left[P(N_t|t)\left(\frac{1+g_u}{1+r}\right)^{N_t-t}\sigma_t\right]\sum_{\tau=N_t}^{T} P(\tau|N_t)\left(\frac{1+g_N}{1+r}\right)^{\tau-N_t} \tag{4}$$

where σ_t is the expected replacement rate and N_t is the expected retirement age elicited at time t,[14] T is the maximum length of life, $p(\tau|N)$ is the probability of surviving to age τ, conditional on being alive at age N, g_u is the growth rate of earnings for group u, r is the real interest rate, and g_N is the growth rate of pension benefits during retirement—assumed to be the same for all groups.

In the survey we observe σ_t and N_t for each individual. In the empirical estimates we will check the sensitivity of the results with respect to the assumption of point expectations for N_t, allowing for some dispersion around the reported expected retirement age. Survival probabilities are taken from the Italian life tables, by age and gender, for the years 1990 and 2000, so that the change in life expectancy over time, and in particular before and after the reform, is accounted for.[15] The growth rate of earnings (g_u) is estimated from our data at 0.015 for individuals with university degree and at 0.008 for individuals with less than university degree.[16] We assume that after retirement pensions are constant in real terms (g_N=0) and that the real interest rate is equal to 2%.

[12] We define the head of the household as the partner with higher earnings.

[13] In the regressions, the reference group is private employees with less than 13 years of education and living in Northern Italy.

[14] t is equal to 1989, 1991, 2000, 2002, the survey years in which the expected replacement rate is elicited.

[15] Data source: *Italian Statistical Annex* (Rome: ISTAT, 1990 and 2000).

[16] The growth rates were obtained from a median regression of log-earnings on sex and employment dummies and full interaction of age with a college dummy. Data source: SHIW, years 1989–2002, individuals with age 20–60.

Armed with this information, we can compute the expected ratio of pension wealth-to-income for each individual in the sample. In households with more than one member, we define the household expected pension wealth-to-income ratio at retirement as the weighted sum of both partners' expected pension wealth-to-income ratio.[17]

The individual expected pension wealth-to-income ratio is adjusted by the factor suggested by Gale (1998). This factor rescales the expected pension wealth and depends on the number of years people have contributed to their pension plan as well as for when in their life cycle they have experienced some shock that should have made them revise their consumption and savings plans (the reforms, in our case). Omitting to adjust for this factor would produce an underestimate of the offset between pension wealth and private wealth, i.e. the estimates for the pension wealth coefficient would be biased towards zero. The adjustment depends on the utility function that is chosen for the underlying life-cycle model and on the values for the discount rate, the interest rate and the time preference rate. We use the adjustment developed in Gale (1998) for the constant relative risk aversion utility function and set the discount rate and the interest rate equal to 2%; details are reported in Appendix A (available in the online version).

4.2. Regression estimates

Table 9 presents OLS estimates of the relation between pension wealth and private wealth. OLS estimates are inefficient if the disturbance term is heteroskedastic. Standard errors are therefore corrected using the White's (1980) heteroskedasticity-consistent covariance matrix estimator. The specification relates the private wealth–income ratio to pension wealth, time dummies, age, employment dummies, a dummy for middle-aged, employment dummies interacted with the middle-aged dummies and with time dummies, education and regional dummies and income.

The key coefficient of interest is the offset between private and pension wealth, which is −0.286 and statistically different from zero at the 1% level (the standard error is 0.027). The estimates also indicate that the wealth–income ratio increases with age during the working lifetime (recall that individuals over 50 are excluded) and with income. The latter should not affect the wealth–income ratio if preferences are homothetic. The regression coefficient, on the other hand, can hardly be interpreted as evidence for or against homothetic preferences since other variables (employment, education or residence in the South) also proxy for lifetime earnings. Residence in the South reduces wealth accumulation; education has an opposite effect. These variables are related to household resources, but may also capture other effects. For instance, there is evidence that the better educated are more likely to report financial assets (Brandolini and Cannari, 1994); households with higher education may have easier access to capital markets and to better investment opportunities; thrift may be correlated with schooling. Finally, the wealth–income ratio for public employees is not statistically different from that of private employees but the self-employed have a higher wealth–income ratio.

We then split the sample according to the difference between the statutory and expected pension wealth–income ratio. In particular, we consider as "Informed" households where the difference is less than one, in absolute value; the rest of the sample is "Uninformed."[18] The

[17] Weights are given by the ratio of each partner's income to the joint income of the couple.

[18] The median of the absolute value of the difference between statutory and expected pension wealth is 1.

estimated offset for the informed is larger in absolute value (−0.379) than that for the uninformed (−0.237); both coefficients are statistically different from zero at the 1% level.[19]

The OLS results might understate the offset between pension wealth and private wealth if pension wealth and private wealth are positively correlated. This might be the case if thrift and hard work are correlated tastes, and people with these traits choose to save more and to retire with higher pension wealth. Since the pension reforms provide us with an exogenous source of variation for pension wealth, we can perform instrumental variable estimation and remove this source of bias from our estimates.

We use as instruments the interaction between the three employment dummies, a dummy for the post-reform period and a dummy for middle-aged. The validity of these instruments rests on the fact that the rules for computing pension wealth change exogenously for the middle-aged after the reform, depending on employment group membership. It also depends on the assumption that the middle-aged did not switch jobs after the reform to offset the impact of the pension reform on their retirement wealth. Under this reasonable assumption, which is corroborated by the evidence on employment transition matrices reported in Appendix A (available in the online version), the instruments are also exogenous with respect to private wealth accumulation decisions. Attanasio and Brugiavini (2003) use similar employment-group instruments for pension wealth in their study of the impact of the 1992 Italian pension reform on the household saving rate.

To assess the quality of our instruments we perform the test of the over-identifying restrictions and the rank test. The Hansen-Sargan test does not reject the over-identifying restrictions: the test is equal to 0.503 and is distributed as a Chi-square with 2 degrees of freedom (the p-value is 0.77). We check the rank condition regressing pension wealth on the full set of instruments and testing the null that the coefficients of the instruments are jointly equal to zero. The F-test rejects this null at 1% level and implies that the rank condition is satisfied. The results from the instrumental variables estimation are reported in the last three columns of Table 9. They indicate higher offset rates between private wealth and pension wealth than in the OLS estimates. The sample splits deliver again considerably higher offset rates for the informed (−0.81) than for the uninformed (−0.44).

To check the sensitivity of the results to the assumption of point expectations used to compute social security wealth, we allow for some dispersion around the point estimate of the expected retirement age in Eq. (4). We perturb retirement age by adding a draw from a discrete uniform distribution with zero mean and variance equal to 2. In the IV regressions, the offset rates are −0.659 (standard error 0.312) in the total sample, and −0.946 and −0.383 in the sample of informed and uninformed workers, respectively. As a further check, we double the variance and the results do not change appreciably.[20]

We perform several other sensitivity tests. The results are not affected if one uses the least absolute deviations estimator or if one includes other variables, such as family size, number of income recipients, and a quadratic term in age. We also check the sensitivity of the results with respect to the particular assumptions used to calculate the Gale adjustment factor (the interest rate, the discount factor and the coefficient of relative risk-aversion) described in the appendix and find that adopting an interest rate and a discount rate greater than 2% implies slightly lower offsets.

[19] In a specification including only pension wealth, age and year dummies, the offset between private wealth and pension wealth is −0.419 (standard error of 0.025). In the sample of informed workers, the offset is −0.547 (standard error of 0.043); in the sample of uninformed it is −0.347 (standard error of 0.033).

[20] The OLS offset coefficients are also similar to those reported in Table 9: −0.228 for the total sample, −0.359 for the informed, and −0.269 for the uninformed.

Table 9
The offset between private wealth and pension wealth: OLS and IV estimates

	OLS			IV		
	Total sample	Informed	Uninformed	Total sample	Informed	Uninformed
SSW/disposable income	−0.286 (0.027)**	−0.379 (0.047)**	−0.237 (0.036)**	−0.645 (0.303)*	−0.810 (0.321)*	−0.441 (0.426)
Year 1991	0.732 (0.098)**	0.794 (0.140)**	0.663 (0.137)**	0.736 (0.100)**	0.831 (0.144)**	0.657 (0.138)**
Year 2000	0.935 (0.134)**	1.049 (0.190)**	0.881 (0.190)**	0.613 (0.309)*	0.858 (0.247)**	0.642 (0.537)
Year 2002	0.994 (0.140)**	0.924 (0.200)**	1.104 (0.199)**	0.686 (0.300)*	0.747 (0.247)**	0.879 (0.514)
Age	0.083 (0.009)**	0.085 (0.013)**	0.084 (0.012)**	0.109 (0.024)**	0.113 (0.025)**	0.100 (0.036)**
Public employee	0.078 (0.113)	0.121 (0.156)	0.038 (0.169)	0.057 (0.119)	0.235 (0.182)	−0.004 (0.196)
Self-employed	1.775 (0.194)**	1.866 (0.275)**	1.639 (0.272)**	1.337 (0.421)**	1.566 (0.352)**	1.298 (0.776)
Middle-aged	−0.544 (0.149)**	−0.688 (0.221)**	−0.489 (0.206)*	−1.226 (0.580)*	−1.385 (0.542)*	−0.961 (0.986)
Public employee, middle-aged	0.095 (0.168)	0.101 (0.234)	0.158 (0.247)	0.146 (0.180)	0.056 (0.238)	0.249 (0.331)
Self-employed, middle-aged	−0.239 (0.271)	0.095 (0.376)	−0.443 (0.399)	0.076 (0.409)	0.345 (0.448)	−0.184 (0.700)
Public employee, after the reform	0.194 (0.165)	0.283 (0.225)	0.053 (0.243)	0.205 (0.167)	0.222 (0.235)	0.036 (0.250)
Self-employed, after the reform	0.891 (0.262)**	0.880 (0.369)*	0.943 (0.380)*	0.952 (0.261)**	0.827 (0.375)*	0.982 (0.384)*
Central Italy	0.251 (0.103)*	0.269 (0.142)	0.228 (0.150)	0.161 (0.127)	0.166 (0.158)	0.190 (0.169)
Southern Italy	−0.032 (0.090)	−0.028 (0.128)	−0.031 (0.128)	−0.125 (0.120)	−0.117 (0.143)	−0.088 (0.174)
Income	0.019 (0.003)**	0.018 (0.003)**	0.019 (0.004)**	0.014 (0.005)**	0.012 (0.006)	0.017 (0.005)**
High school degree	0.613 (0.087)**	0.823 (0.121)**	0.405 (0.125)**	0.631 (0.089)**	0.871 (0.128)**	0.397 (0.125)**
College degree	0.605 (0.131)**	0.781 (0.186)**	0.499 (0.184)**	0.627 (0.131)**	0.872 (0.196)**	0.460 (0.201)*
Constant	−0.378 (0.360)	−0.295 (0.537)	−0.427 (0.484)	0.268 (0.635)	0.203 (0.636)	0.012 (1.017)
Observations	9315	4687	4628	9315	4687	4628
R-squared	0.14	0.16	0.13			

The dependent variable is the wealth–income ratio. Informed and uninformed individuals are defined on the basis of the difference in expected and statutory pension wealth–income ratio (SSWY). We define as "Informed" someone who reports an absolute difference between SSWY constructed with the expected replacement rate and SSWY constructed with the statutory rate less than 1, and "Uninformed" those with a difference greater than 1, in absolute value. Data are drawn from 1989–1991 (pre-reform) and 2000–2002 (post-reform) SHIW. Standard errors are reported in parenthesis. Two stars indicate statistical significance at the 1% confidence level; one star at the 5% level.

4.3. Comparison with previous studies and implications

Using SHIW data for the years 1989–95, Attanasio and Brugiavini (2003) exploit the changes in pension wealth across cohorts and employment groups due to the 1992 pension reform in order to estimate the crowding out effect of pension wealth. They model the response of the change in private wealth relative to income (the household saving rate) to the level of social security wealth relative to income. This amounts to assuming that saving changes permanently when social security wealth changes. In the long run, this implies a very large effect of a pension reform on private wealth.

Attanasio and Brugiavini conduct a miniature policy experiment to show that if a pension reform reduces social security wealth for a "typical" individual by 10% of its initial value (about 3 years of income according to Attanasio-Brugiavini, Table II, p. 1096), the first year after the reform the private saving rate of this individual increases by 4.4 percentage points (from 4.2% to 8.6%). Since according to their estimates different age-groups and different individuals respond differently to the pension reform, this result cannot be generalized to the entire sample or to the population at large. In the long run, given their specification, the estimated offset coefficients between social security wealth and private wealth do not provide a round number for the effects of the 1992 pension reform on the change in aggregate saving, wealth and the capital stock.[21]

In this paper we relate the level of private wealth (relative to income) to the level of social security wealth (relative to income). The results can be used to estimate the change in the stock of private wealth when households have fully adjusted to the new pension regime after the three reforms (1992, 1995 and 1997). We rely on a measure of pension wealth based on the expected retirement age and expected replacement rate, rather than computed from legislation, and estimate the offset between pension wealth and discretionary wealth according to the accuracy of workers' information about pension arrangements. The regressions show that workers whose expectations are closer to the statutory levels ("Informed") have larger offsets.[22] To the extent that in the long-run expectations adjust fully to the new pension regime, the estimates for the informed measure the long-run impact of the reform on discretionary wealth.

To provide a sense of the magnitudes involved, we compute the pension wealth for a male belonging to the so-called middle-aged group, with 13 years of education (i.e. a non-university graduate), who expects to retire at age 62. Table 10 reports pension wealth for such an individual conditional on being a private or a public employee, or self-employed, and in both pre- and post-reform regimes. After the reform pension wealth falls for each employment group, and the reduction is larger for public employees and the self-employed. According to our estimates, the

[21] For Italy, three earlier studies sought to evaluate the degree of substitution between social security and private wealth. Brugiavini (1987), using data from the 1984 SHIW, finds a rather small substitution (around 10%) between social security and private wealth accumulation. Jappelli (1995) finds an offset coefficient around 20% in the 1989–1991 SHIW. Rossi and Visco (1994), using aggregate time series, estimate that social security wealth offsets private wealth by 21% (32% using an instrumental variables procedure), concluding that the development of a generous social security system explains about one fourth of the 7.2 percentage-point decline in the Italian private saving rate between 1962–1972 and 1980–1990.

[22] If we estimated the offset between pension wealth and discretionary wealth using the statutory pension wealth–income ratio (in a similar fashion to previous studies), the OLS coefficient would be −0.38 (significant at 1% level), which is close to what we find for the informed group but much higher than the offset that we estimate for the uninformed (−0.24).

Table 10
Change in the wealth–income ratio for informed and uninformed workers and employment groups

	Pension wealth–income ratio			Changes in private wealth–income ratio	
	Pre-reform	Post-reform	Difference	Informed	Uninformed
Private employees	11.0	9.9	−1.1	0.9	0.3
Public employees	13.4	10.3	−3.1	2.5	1.0
Self-employed	10.5	7.0	−3.5	2.8	1.1

In the pre-reform case, pension wealth is computed for a male worker, without college degree, who expects to retire at age 62 and to contribute 37 years (10 years before 1995 and 27 after). In the post-reform case, the replacement rate is based on the assumptions that the growth rates of earnings and GDP are 2% and 1.5% per year, respectively. The change in the private wealth–income ratio for informed workers assumes that expected SSWY (the pension wealth–income ratio) equals statutory SSWY, i.e. that they perceive the full change in pension wealth, and that the offset coefficient is −0.810, as in the IV estimates of Table 9; the change in the private wealth–income ratio for uninformed workers assumes that this group only perceives 70% of the change in pension wealth and that the offset coefficient is −0.441, as in the IV estimates of Table 9.

reduction in pension wealth prompts an increase in private wealth.[23] If we use the IV estimated offsets in Table 9,[24] then under the assumption that informed workers perceive the entire reduction in pension wealth, the private wealth-to-income ratio increases by 0.9 for private employees, 2.5 for public employees and 2.8 for self-employed.[25]

The drawback of our static specification, of course, is that we cannot estimate how saving changes during the adjustment process that follows the pension reform. But our data indicate that private wealth adjusts slowly, since many workers do not perceive the full change in social security wealth. Furthermore, our estimated coefficient for the uninformed means that for a large portion of the working population there is far from full crowding out of private accumulation several years after the pension reform. This makes the question of whether the uninformed are saving enough for their retirement of central interest.

5. Conclusions

The Survey of Household Income and Wealth, a large representative sample of the Italian population, elicits expectations of replacement rates from workers interviewed in the years between 1989 and 2002, a period of intense pension reforms. The reforms reduced replacement rates and increased retirement ages, and had different impacts on different cohorts and employment groups. This exogenous variation in replacement rates allows us to study the effect of pension reforms on expectations, and how changes in expected social security wealth were reflected in private wealth accumulation decisions.

We find that pension reforms indeed affected expectations of retirement benefits. However, the revision in expectations is limited, and many individuals have still not

[23] If uninformed workers perceive only 70% of the reduction in pension wealth, the private wealth-income ratio increases by only 0.3 for private employees, 1.0 for public employees, and 1.1 for self-employed.

[24] These coefficients are −0.810 for the informed and −0.441 for the uninformed.

[25] Comparing the change in the statutory to the expected pension wealth–income ratio reveals that, among the middle aged, the informed have perceived almost fully the reduction in the pension wealth–income ratio, and the uninformed have perceived only about 70% of the reduction in the statutory ratio. On average, for the informed the difference between the statutory pension wealth–income ratio before and after the reform is −1.28; the difference in the expected counterparts is −1.27. For the uninformed the corresponding differences are −3.64 and −2.54.

completely updated their expectations. For instance, while the perceived replacement rate of the self-employed falls by about 10 percentage points between 1989–1991 and 2000–2002, in reality the rate falls by about 20 points. Moreover, the offset between pension wealth and expected private wealth is only partial, in the order of 30% in the total sample (60% in the IV estimation). Most importantly, the offset coefficient is higher for people that are more informed about their future benefits. Once expectations adjust fully to the new rules, the offset between private wealth and pension wealth is likely to be higher. This suggests that the effect of pension reform depends critically on the extent of the knowledge and information that individuals have about the social security system and changes to it, and has three important policy implications.

First, the descriptive and econometric analysis implies that some workers lack information to fully understand pension rules, thus making a case for investing public resources in the dissemination of information about pension rights, especially during periods of intense reform. Campaigns to increase financial literacy and the understanding of pension rules, and to provide individuals with regular statements of their expected retirement income, are important steps in this direction.[26] Second, the paper suggests that if one wants to use observations of past pension reforms to make predictions about likely responses to new reforms, then one needs to estimate how responses in the past were limited by inaccurate updating of expectations, and how the new reform will affect expectations. Finally, given the dramatic reduction in replacement rates implied by the pension reform, combined with an incomplete offset between pension wealth and private wealth, it is likely that some individuals, especially the younger cohorts most affected by the reform, might not be saving enough for their old age. This might have a long-term impact on the well being of future retirees in the coming decades, when the generations affected by the pension reform will start to retire.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.pubeco.2006.03.005.

[26] Indeed, the 1995 reform requires the social security agency to inform workers about pension rights, as in Sweden. In practice, this part of the reform has not been implemented. See also Boeri et al. (2001) for an analysis of workers' perceptions about social security in Europe.

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