Social Security and Labour Supply: the Italian 1992 Reform as a Natural Experiment

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November 2006

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Abstract

This paper provides new evidence about the effects of economic incentives embedded in the Italian Social Security system on retirement decisions. The 1992 reform is an interesting example since it was implemented when: (a) the system was very generous to retirees; (b) the demographic context was dramatic; (c) an early retirement provision, and no actuarial fairness, distorted retirement choices. I use the reform as a natural experiment and exploit its differential effect on individuals belonging to different groups, namely blue- and white-collar workers. I find evidence that Social Security wealth has a larger impact on retirement choices compared to estimates in previous studies.

JEL classification: C90, J14, J26.
Keywords: Social Security Wealth; Retirement, Natural Experiment.

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1 Introduction

Italy is facing a demographic transition which will cause an increase of the dependency ratio from 27% in 2000 to over 54% in 2050. This dramatic population ageing - coming both from fertility rates reduction and life expectancy increase - might make the Social Security system unsustainable in the long run, especially if low activity and employment rates are also taken into account (see figure ??). This paper is intended to provide new evidence about the effect of financial incentives on retirement decisions using an econometric technique which differs from the ones adopted in previous studies regarding the Italian Social Security system. By exploiting variation in explanatory variables generated by changes in a state law, I get a source of exogenous variation. These studies, called natural experiments, examine outcome measures for observations in treatment and comparison groups (white- and blue-collar workers in this case) that are not randomly assigned. Krueger and Pischke (1992) point out that most of the contribution to the literature suffers from an identification problem: the variation in economic incentives needed to estimate their effect on retirement behaviour cannot be considered independent of other unobserved individual characteristics that also correlate with retirement behaviour. For example, if I want to estimate the effects of Social Security programs on labour supply, it is often times difficult to distinguish the effect of individual benefit entitlement from that of past labour supply and earnings that typically determine that benefit entitlement. This problem is exacerbated when I use proxies for the relevant benefit variables so that idiosyncratic and potentially endogenous variation in the benefit variables is lost. Thus, structural parameters cannot be identified robustly on the basis of observed behaviour, and estimated reduced-form effects of incentive variables cannot be interpreted as causal effects. Some attempts can be found in the relevant literature: Krueger and Pischke (1992) exploit a natural experiment in the USA provided by the 1977 amendments to the Social Security Act which created an unexpected reduction in Social Security wealth for the "notch generation". Gruber (1996) uses exogenous variation in disability benefits generosity across similar workers provided by the 1987 reform in Quebec. Baker and Benjamin (1999) identify the casual effect of sequential early retirement provisions in Canada by comparing regions with different timing of introduction. Coile and Gruber (2000a, 2000b) build incentive variables that minimize the spurious correlation problem by capturing incentives to work in all future years, and apply a rich set of controls from previous income and work experience. Red and Haugen (2003) use a new subsidized early retirement option assigned quasi-randomly to two-thirds of Norwegian elderly workers as a natural experiment. They find the new option reduced employment substantially and the effect escalated over time. As to the Italian literature, Brugiavini and Peracchi (2003, 2004) evaluate the impact of SSW on the probability of retirement and find a positive relationship: individuals with higher SSW are more likely to retire. To my knowledge, Brugiavini (1997) is the only study - applied to the Italian Social Security system - which exploits exogenous variation induced by a reform to identify the effect of pension wealth on retirement decisions. The methodology adopted is a difference-in-difference estimator. This paper differs from the analysis by Brugiavini in different ways. First of all, the data set was drawn from the panel component of the Bank of Italy survey, with the consequent bias due to reported income and pension benefits, whereas my data is extracted from the administrative archive of the Italian Social Security Institute (I.N.P.S.), and it is high-quality data. Secondly, Brugiavini (1997) estimates changes in expected retirement ages taken from the answers to the survey, while my dependent variable is a dummy for actual retirement status. Finally, her analysis is an application of the difference-in-difference estimator since the model is linear and she can compute the expected value of the dependent variable given different values of the relevant dummies, whereas I use a non-linear model and a dichotomous dependent variable. This is the first study applied to the Italian Social Security system that identifies the causal effect of Social Security wealth on retirement behaviour by exploiting a pension reform as a natural experiment. The work is structured as follows: section 2 clarifies the details of the 1992 reform, section 3 explains the concept of Social Security wealth and derives standard incentive measures; section 4 contains the estimates of age-earnings profiles necessary to build Social Security benefits; section 5 and 6 describe the empirical specification and the main econometric issues; section 7 and 8 present some preliminary evidence of the effect of the pension reform on individual retirement behaviour and the main results of the paper respectively; section 9 illustrates some policy simulations and section 10 concludes.

2 Institutional details of the Amato reform

In 1991 Italy had one of the most generous Social Security systems in the world which was already known to be unsustainable in the long run. Issues concerning the reform of the pension system were debated in those years, and a change in the legislation was widely expected. It is important to underline that the type of reform that would have been implemented was not obvious, as well as who and to what extent would have been affected the most by the reform. The exact change in Social Security wealth might not have been fully anticipated, and this can help identify the relation between pension wealth and retirement decision purged from endogenous factors. The Italian Social Security system is made up of three major funds: one for private sector employees, one for public-sector employees and one for self-employed. Since the sample is extracted from the private sector employees fund, the following description focuses on the changes introduced by the reform for such workers. The main changes concern the criteria of eligibility for old age and early retirement provisions and the size of the benefits paid. The reform envisioned an increase in the normal retirement age in the private sector from 60 to 65 for men and from 55 to 60 for women, an increase in the minimum number of years of payroll tax to claim a pension benefit from 15 to 20, and a reduction in benefits obtained through the substitution of a final salary type with a career average earnings method of computation. One of the main drawbacks of the Amato reform is the very long transitional period supposed to be completed only by 2032. Then, the differential treatment for workers having accrued a different number of contributive years in 1992, thus belonging to different birth cohorts, introduced a further element of distinction. It left almost untouched Social Security rights of workers who retired before 1993, but not the rights of those who - even if close to retirement - actually retired after the reform was legislated by the Parliament, whereas it heavily affected young workers. What really matters for the analysis is the differential effect concerning the type of occupation: blue-collar and white-collar workers. In order to disentangle the effect of the reform from the effect of occupational change, I exclude workers who changed occupation over time. Furthermore, because individuals affected at that time by the reform are only those at risk, that is individuals between 50 and 65 years of age, this excludes the possibility of exploiting the differential effect between young and old employees. A comparison between the benefit computation formula before and after the 1992 reform (see table **??**) clearly illustrates that the change from a final salary type to a whole working life computation affected much more white collars who typically have a steeper earning profile later in their career than blue collars.

$$B_t(r) = \frac{\sum_{s=0}^{4} Y_{R-s}}{5} \gamma_R min(cyrs_R, 40) \tag{1}$$

Indeed, the formula above implied an average of the last five years real earnings (converted to real values through a price index), whereas formula (**??**) contains an average of career earnings converted to real values through a price index and an additional 1 percent for each year of payroll tax. The rate of return of pensionable earnings at age r was slightly changed by the reform and it is a decreasing function of pensionable earnings[1].

$$B_t(r) = \gamma_R min(cyrs_R, 40) \frac{\sum_{s=R-n}^{R-1} Y_s (1 + 0.001)^{R-s}}{n} \tag{2}$$

3 SSW and retirement choices

This section is devoted to a brief description of standard financial incentives embedded in any Social Security system. The Social Security wealth (SSW, from now on) for a worker of age a were he to retire at age r is defined as the expected present value of future pension benefits

$$SSW_r = \sum_{s=r+1}^{S} \rho_s B_s(r) \tag{3}$$

[1]It was 2 per cent if pensionable earnings did not exceed a reference level legislated annually, 1.50% if they were between the reference level and 1.33 times the reference level, 1.25% if they were between 1.33 and 1.66 times the reference level, 1.25% if they exceeded 1.66 times the reference level. From 1993, the number of income brackets increased from four to five, and the rate of return for the highest earnings bracket was lowered from 1% to 0.90%.

S is the age of certain death, $\rho_s = \beta^{s-a}\pi_s$ is a discount factor that depends on the rate of time discount β and the survival probability π at age s conditional on being alive at age r, and $B_s(r)$ is the pension benefit expected at age $s+1$ in case of retirement at age r. Pension benefits are gross of taxes. The concept of SSW allows to define two different incentive measures: the one-year Social Security accrual and the peak value (Gruber and Wise, 1999; Coile and Gruber, 2000a). The first one is the difference in SSW from postponing retirement from age a to age $a+1$

$$SSA_a = SSW_{a+1} - SSW_a \tag{4}$$

$$SSA_a = \sum_{s=a+2}^{S} \rho_s[B_s(a+1) - B_s(a)] - \rho_{a+1}B_{a+1}(a) \tag{5}$$

The first term of the right-hand side is the expected present value of the increment in the flow of pension benefits, while the second one is the present value of the pension benefits foregone. Thus, the Social Security accrual is negative if the present value of the expected increase in annual pension benefits is lower than the present value of the benefits foregone. The second measure is the peak value:

$$PV_a = max_r SSW_r - SSW_a, \qquad r = a+1, ..., R(6)$$

where R is the mandatory retirement age. The peak value is the maximum difference in SSW between retiring at future ages and retiring at the current age. The utility analog of the peak value is given by the option value

$$OV_a = max_r V_r - V_a, \qquad r = a+1, ..., R(7)$$

where $Va = \sum_{s=a+1}^{S} \rho_s[\kappa B_s(r)]^\gamma$ is the intertemporal expected utility of retiring at age a, while

$$V_r = \sum_{s=a+1}^{r} \rho_s(W_s - C_s)^\gamma + \sum_{s=r+1}^{R} \rho_s(\kappa B_S(r))^\gamma \tag{8}$$

is the intertemporal utility of retiring at age $r > a$. Since earnings are gross of taxes and of Social Security contributions, I subtract from them the amount of contributions C_s paid at the relevant age in order to avoid that pension benefits come for free to the employees. The option value is the maximum utility difference between retiring at future ages and retiring at age a. Following Stock and Wise (1990), I parametrize the model by choosing $\gamma = 1$ and $\kappa = 1.25$. Under these assumptions, $V_a = 1.25SSW_a$ and $V_r = \sum_{s=a+1}^{r} \rho_s(W_s - C_s) + 1.25SSW_r$.

4 Data

The original sample contains more than 3.6 millions observations corresponding about to more than 360,000 individuals over a long time period (1973-2003) selected according to the date of birth and representative of 1/90 of the private sector employees population. This data has some important advantages: it spans a long time period and contains information on gross earnings which are the basis for the computation of Social Security benefits (they are used by I.N.P.S. to compute pension benefits). However, there are few drawbacks, and some of them have been overcome with the new release (CLAP - *Longitudinal Sample of Active and Pensioners*) provided by the Ministry of Labour and Social Policies:

- the data set only covers private-sector employees, excluding public-sector employees and self-employed. Even within the private sector the coverage is not full and a small fraction of them is not included;
- the reason for a worker dropping off the archive is not always known, but the range of possibilities is reduced since there is information about unemployment benefits, mobility lists, etc.;
- important covariates are missing, there are very few demographic controls, I do not know marital status and cannot say much about differential mortality;
- information about the amount of pension benefits lack;
- unlike previous data, there is precise information about year of retirement.

I draw a sub sample (corresponding to the 50% of the initial one) for computational issues. The first selection is carried out focusing on workers between 16 and 70 years of age, and dropping observations for which age is missing and individuals who work less than 26 days a year. I exclude from the sample workers belonging to special I.N.P.S. funds (airline pilots and journalists, nursery school teachers, etc.). In order to estimate earnings profiles and calculate Social Security wealth and incentive measures, I perform a further selection of the sample by including only workers who are present in the sample for an uninterrupted period of at least five years. I only keep workers who do not have substantial gaps in their records (more than 10 years missing) because I do not know whether in that time span they were engaged in other labour market or non-labour market activities.

5 Age-earnings profiles

As mentioned in the previous section, any worker can enter and exit the archive at any time, therefore I have an unbalanced panel. Computing individual age-earnings profiles is the first step necessary to obtain SSW and the incentive variables. Modelling lifetime profiles of earnings is crucial in the estimation of SSW at the individual level. The information available to model age-earnings profiles in the sample consists only of age, gender, occupation and region of working activity (the region where the firm is located). I use a fixed effects model in order to get different age-earnings profiles for each employee in the sample. I regress the logarithm of annual and monthly wage on a third-degree polynomial of age and on working experience. Working experience is computed as the difference between potential labour market experience and missing years, i.e. the years when an employee leaves the archive plus years of unemployment since they are not valid to accrue seniority on the job and thus they cannot contribute to increase individual wages. Potential experience is given by the difference between age and the average age of entry into the labour market imputed combining information about the initial occupational level - used as a proxy of employees schooling attainment - with cohort- and sex-specific data from the Bank of Italy survey. A similar computation is carried out for contributive years. Departing from the analysis conducted by Brugiavini and Peracchi (2003), I do not include years of contribution as a covariate in the fixed effects model since those years count in unemployment periods - in line with the Italian legislation - but cannot be a valid predictor of the evolution of individual wage through age. The model is fitted separately to men and women using the subset of stable workers. Table 1 shows the estimated coefficients, sample sizes, the average number of observations per worker and a measure of goodness of fit. The results are for two different earnings measures: annual and full-year earnings. The last measure is intended to account for the fact that people typically work only part of the year in their first and last year in the sample. Figures 3 and 4 show the age-earnings profiles of a reference worker, who started working when he was 17 years old, and whose fixed effect is equal to the average. Figures 5 and 6 show the evolution across cohorts of the mean value of the estimated fixed effects. Computing SSW requires assuming a forecasting model for future earnings. For individuals at risk (aged 50-70), following the approach by Brugiavini and Peracchi (2003), I assume that age-earnings profiles are completely flat after the last year of observed earnings. The jump-off point for the earnings projections is the average of the last three years of observed earnings in order to smooth out the impact of extraordinary recession or expansion episodes. This might seem to underestimate future earnings growth, especially for younger cohorts, but since the sample at risk consists mainly of older cohorts, the problem is not severe.

6 Empirical specification

I model the conditional probability of exit from employment (conditional on being employed in period $t-1$) and regress it on Social Security wealth, as defined in section

3, expected earnings, age and other controls. I add dummies for the level of education[2] and geographical area. If SSW is aimed at capturing an income effect, the incentive variables are consistent with the presence of a substitution effect in retirement decisions. Thus, a positive coefficient on Social Security wealth points to an income effect, whereby individuals who accumulate money in earlier years retire earlier since a higher Social Security wealth will induce individuals to consume more of all goods, including leisure. Since the 1992 reform did not affect the structure of the incentives which represent the economic advantage deriving from postponing retirement by one or more years, I do not include any incentive in the empirical specification. After the reform there is still a defined-benefit, non-actuarially fair system: what has been actually changed by the reform is the absolute level of SSW and not its variation between couples of years. The other relevant factor for retirement decisions are expected earnings. Individuals who expect low future earnings have worse future opportunities by continuing working than individuals with high expected earnings, thus they should be induced to retire earlier. Furthermore, I include the interaction of age and a dummy for white collar workers to allow for different preferences in retirement decisions: I assume that older employees are more likely to retire because leisure becomes more and more expensive and they prefer to spend their time in other activities; and preferences might differ between white and blue collars. Denoting the observable characteristics as X_{it} and Social Security wealth as SSW_{it}, the conditional probability model is expressed as

$$Pr(D_{it} = 1) = G(\alpha' X_{it} + \beta' SSW_{it} + x_t + f_c) \tag{9}$$

where the term x_t represents a time effect and f_c are group effects, and G is the cumulative distribution function of unobservables in the conditional exit model, assumed to be Normal, and α and β are unknown response parameters.

7 Econometric issues

I estimate equation (**??**) on individual panel data: the estimation procedure raises some econometric issues. First, Social Security wealth, i.e. the present discounted value of future pension benefits, is not observed and needs to be imputed. The resulting variable is therefore affected by measurement error, which is likely to introduce a bias in the estimated coefficients. Standard assumption in these cases is that measurement error is uncorrelated with the unobserved explanatory variable, and thus estimated coefficients are biased toward zero. In a non-linear model, the direction of the bias is not clear, and in some cases it might be away from zero (Pudney, 2001; Stefanski and Carroll, 1985). A second source of bias is introduced by the possibility that individual and unobserved heterogeneity in retirement behaviour is related to individual variables used to estimate SSW, that means SSW is an endogenous regressor. In order to take

[2] I do not have direct information on educational attainments, thus I impute the level of education by matching sex- and cohort-specific data from the survey by the Bank of Italy.

these problems into account, I use an Instrumental Variable technique, taking as instruments the group dummy interacted with the time dummy, where the first is defined so to capture systematic differences in SSW between blue- and white-collar workers, and especially in its time evolution. The change in law, represented by the interaction of time and group dummies, is a good candidate since it is correlated, by construction, to the endogenous variable SSW but not with the error process. The method implies the use of a sudden unexpected change in Social Security rules. Identification requires that SSW varies in a way that is not fully explained by group and time dummies. I test this hypothesis by checking the significance of interaction terms in a regression of SSW on group, time dummies, and their interaction. The reform allows the implementation of such a technique as it induced changes in SSW that were different across the groups I have defined. So the application of the natural experiment makes crucial the variation across groups for the identification of the coefficient attached to SSW, and I define two groups in order to maximize such variation in the sample. SSW is estimated separately for men and women assuming a real discount factor of 3 per cent. Pension benefits are defined in real terms and the indexation rules prevailing under each legislation are implemented. To avoid the complications due to changes over time in the income tax schedule, I only present calculations before income taxes.

8 Estimates of SSW and effect of the Amato reform

After the first selections (see section 4), I keep the time period between 1987 and 1995 needed to estimate the effect of SSW in order to have a number of years before the reform sufficient to control individuals retirement behaviour, and some years after the reform but before other reforms were legislated.

I take the same implicit assumption made by Attanasio and Brugiavini (2003): the recession episode of 1993, with a fall in consumer expenditure and in household disposable income, should not have differently affected the groups I consider, at least for the variables influencing retirement decisions. I divide the working sample into groups chosen to maximize the variation in Social Security wealth determined by the Amato reform. I am careful in retaining only those employees who do not change their occupation over time. The final sample is made up of 916 workers (6,837 observations): 682 blue collars and 234 white collars, 765 males and 151 females. Mean and standard deviation for the relevant variables characterizing the final sample are shown in table 3. The mean for dummy variables represents the proportion of that group: for example, 17% of employees are females and 75% are blue collars. The mean value of Social Security wealth is about 207,393 euro, the mean expected earnings are equal to 24,168 euro. Looking at the pattern of the exit rates by year for individuals at risk of retirement (aged 50-65) around the reform years, I observe constantly increasing exit rates for both males and females from 1987 to 1991 when women have a peak in their hazard rate while males show a stable hazard. There is a drop in retirement rates between 1992 and 1993, and from 1993 the exits start increasing again. That is clear evidence that workers anticipated the reform and left the labour market as soon as they satisfied the requirements to get a pension benefit in order to avoid the changes implied by the reform. To account for this pattern of exit rates and to magnify the impact of the reform, I compute Social Security wealth according to the new rules as were they legislated in 1991 and without the transitional phase. That is, I observe retirement rates and a certain behaviour of employees, and I try to capture it in the econometric model. Figure 6 illustrates the evolution of median Social Security wealth by occupation over 7 years (1989-1995). Blue collars observe a decrease in SSW from 1989 to 1993 (left side of the graph), whereas it is striking the drop in median SSW for white collars between 1991 and 1992 (right side of the graph). In table 4, I have percentage changes in mean values for SSW between three couples of years: the year before and after the reform (1991-1992), between two years before 1991 (1989-1990) and two years after 1991 (1993-1994). The table clearly shows the relevant decline in Social Security wealth between 1991 and 1992, and the differential impact on different groups of workers. Blue collars experiment a reduction in mean SSW of 9%, and this drop starts in 1989. On the other side, white collars have a very consistent decrease in their mean SSW of 23% due to the reform. Thus, the variability due to the reform comes both from the definition of groups (blue-collars versus white-collars) and time (pre-reform and post-reform years) effects.

9 Effect of SSW on retirement decisions

I use a regression for each employee in the sample relating the conditional probability of exit from employment to expected earnings, an interaction of age and a dummy for white collars, dummies for the level of education and geographical area, time and group dummies. I experiment two different specifications: one includes dummy variables for education level and geographical area. The dummy variable for education should capture different retirement behaviours due to a different labour market attachment of people with different level of schooling (no-education or elementary education versus high school education). The dummy for geographical area is meant to measure the effect of working in the North compared to working in the South of Italy on retirement choices: people working in the Southern part of the country might have a lower probability to retire since they have more discontinuous careers. The interaction of a linear term in age and a dummy for white collar workers is introduced to account for the relevance of age - different according to workers occupation - in retirement decisions in terms of preferences. Finally, the time dummy is aimed at capturing the effect of the reform over all workers who did not retire before 1993 (via the change in requirements), while the group dummy should retain the effect of the reform on employees with different occupation. I expect a negative sign attached to both the dummy variables, as after the reform was passed, there has been a change in requirement to claim a pension benefit and at the same time white-collars have been affected more than blue-collars by the change in the law. Table 5 shows the results for two different specifications: the dependent variable is retirement status, Social Security wealth is computed according to the formula explained in section 3 and assuming $\gamma = 1$ (risk aversion parameter) and $\beta = 0.97$ (time discount factor). Columns 3 and 4 of table 5 show the coefficients of interest estimated by Instrumental Variables where the instrument is the interaction between time and group dummies. In order to check the rank condition on this estimator, I regress the estimates of SSW on all the variables of interest and on the interaction between time and group dummies, and test for the significance of the last term. The null hypothesis is rejected $[F(1,1755) = 95,66; F(1,1757) = 87,94]$ for either specifications. The third column of table 5 shows the marginal effects of a probit model estimated by maximum likelihood. Social Security wealth has the positive expected effect on the probability of retirement, that is employees with larger SSW have a higher probability of retiring from the labour market. The dummy for geographical area has different signs in the two models, and it is not statistically significant, whereas individuals with high expected earnings are less likely to exit the labour market. The interaction term has a positive impact on the retirement probability as I explained above, and being less educated increases the probability of retirement since those employees are likely to have a lower attachment to the labour market. I cannot identify the effect of being a white-collar relative to being a blue-collar after the reform relative to before, since I use the interaction of time and group dummies as an instrument for SSW. The two dummy variables, one for years after 1991 and one for being a white-collar worker, have the expected signs: being in the labour market after the implementation of the reform reduces the exit probability since the rules become tighter (in the first specification), and being a white-collar implies an analogous effect because the reform extended the earnings reference period to calculate pension benefits. The marginal effect of SSW on the probability of retirement is 0.00844 under the specification excluding controls for education and geographical area, and it decreases to 0.00762 with the full specification. It means that a drop of $10,000$ euro in SSW decreases the probability of retirement by around 0.08%. Standard errors in the first two columns of table 5 are bootstrapped standard errors allowing for dependence over time in the unobservables for the same individual who survives in the panel more than one period before retiring. Standard errors in the last two columns are robust standard errors allowing for cluster effects based on different employees[3]. I calculate the exit probability predicted by the two specifications for different levels of SSW to carry out a policy experiment: I take the average individual, so that he has mean values of all continuous variables and the reference category of dummy variables. I suppose that Social Security wealth decreases by 15% (a drop of almost $31,109$ euro, roughly equal to the decrease observed in the sample after the reform) and I feed this change through the estimates for the average individual. I get a predicted exit probability dropping from 6.4% to 3.9% with model 1-IV in table 5, and from 6% to 3.7% with model 2-IV. Thus, the reform had a substantial effect on the retirement probability, and that points to a significant effect of Social Security wealth on the supply side of the labour market. What really matters is the increase in the marginal effect of Social Security wealth on

[3]As documented by Moulton (1990), Donald and Lang (2001) and by Bertrand, Duflo and Mullainathan (2004), standard errors might dramatically understate the standard deviation of the estimator when I regress outcomes at the individual level (probability of retirement) on a policy that applies to all individuals in the group (the 1992 reform). I take account of this fact by correcting standard errors in two ways: in the simple probit regression I correct standard errors by using block boostrap method, and in the IV probit regression by using a robust covariance estimator according to a formula developed by Liang and Zeger (1986) and implemented in STATA with the cluster command.

the probability of retirement in the IV probit compared to the probit regression: that is, the marginal effect increases for both the specifications, without and with control variables, from 0.00084 to 0.0084 and from 0.00082 to 0.00762, respectively. That is due to the two sources of bias, measurement error and endogeneity, which go in the same direction.

10 Simulations of retirement choices under different pension reforms

There are different ways to simulate reforms of the Social Security system, and one of these is to exploit probit models estimates to investigate how retirement rates, the implied employment rates and the related incentive measures would have been under different policy regimes.

I carry out simulations separately for men and women using a simulation sample. The age-earnings profiles are those of representative individuals with earnings equal to actual earnings registered in the archive for the relevant cohorts (individuals born in 1950, 1951, 1952 and 1955) plus the difference, at the actual age of entry into the labour market, between actual wages and their median values computed by year of birth, sex, age and level of education. I use this method to build earnings in order to have some variability in the data since such employees (belonging to the above mentioned cohorts and whose age of entry into the labour market was respectively 23, 22, 22 and 25 - in order to match the crucial levels of age and seniority used in the last legislated reform) do not exist in the sample. The earnings are projected forward and backward to cover the necessary time span, regardless of actual retirement or actual entry into the sample. I add two cohorts of workers (1935 for males and 1940 for females) in order to have variability in requirements to claim a pension benefit, since employees born in 1950, 1951, 1952 and 1955, with a certain imposed number of years of contributions, can get a seniority pension benefit through the accrued contributive years requirement that was only marginally changed by the 1995 reform (which I do not take into account). The maintained assumption, throughout all the simulated reforms, is that policy changes are not anticipated. I perform four types of simulations carried out for same number of pension reforms:

- Pre-1992;
- Pre-1992;
- Age-Shift Reform;
- Actuarial Adjustment Reform;
- Maroni Reform.

The first regime features the pension system before the 90s reforms, and it is the reference case for the other reforms. The Age-Shift reform differs from the reference case and from the last reform because it is a policy exercise: it simply shifts forward the two requirements of age and years of contribution by three years. The Actuarial Adjustment reform features an early retirement age of 60 and a normal retirement age of 65, where pensionable earnings are equal to the average of the last five years of contribution, and benefits replace 60% of pensionable earnings when an employee retires at age 65 with 40 contributive years. It consists of an actuarial reduction of 6% per year for early claiming and an actuarial increase of 6per year for later claiming. Simulations of the last two pension reforms is particularly relevant from a political economy perspective. To better understand the point, it may be useful to think of the Age-Shift reform as a policy change workers would strongly oppose since it explicitly moves forward the requirements of age and contributive years to get a pension benefit. This is very true in countries where the median voter gets old at a fast rate. On the other hand, the Actuarial Adjustment reform does not change requirements, but it makes retirement more expensive at early ages in terms of foregone pension benefit and, on the other side, it gives a premium by introducing an actuarially fair pension formula to workers who postpone retirement. All this really matters when policy-makers have to choose the reform to implement and have to choose which one could guarantee the best output in terms of budget savings at the minimum cost in terms of votes.

The Maroni reform is the most important in policy terms because it is the last reform passed by the Italian Parliament and it took effect from January 2008 (see Santoro (2004) to know the effectiveness of anticipated reforms). Its most evident change is the increase of the age requirement to claim a seniority pension benefit: it is 57 under the Dini-Prodi regime and it will be 60 year of age until 2009, 61 from 2010 until 2013 and 62 from 2014 on.

For each individual in the simulation sample, I compute the value of SSW and the implied incentive measures under the different regimes, while individual earnings profiles are assumed constant across regimes and built according to the model described in section 5.

I show the distribution of SSW and related incentive measures in figures 7 and 8 by comparing across regimes, and separately for men and women, the corresponding age-profiles. The pre-1992 regime shows a hump-shaped profile of SSW, while under the other regimes the age profile of SSW is strongly shifted downward especially over the 50-60 age range and it is characterized by an almost continuous increase at least under the Actuarial Adjustment regime. The Actuarial Adjustment and the Age Shift reforms imply the largest reduction until age 60, whereas the Maroni regime lies in between the pre-1992 and the 3-Years Age Shift regime. The related age profile of SSW shows an increasing path until age 57 where there is a peak followed by another increase until around age 61 when SSW starts a slow decline.

The age profiles of the incentive measures vary substantially across regimes. In the case of men, the pre-1992 regime is characterized by age profiles becoming negative as soon as a worker gets 35 years of contribution, and in many cases this happens by age 55. This is clear evidence of an early retirement incentive induced by the pre-92 pension system. That system has been changed by the Amato and the subsequent Dini-Prodi reform. The Age Shift policy design illustrates a 5-years shift of the age the incentive measures become negative at: this is due to the requirements introduced by the Dini-Prodi reform and to the 3-years shift of this policy experiment. The last legislated reform features a further shift with respect to the 1997 reform since the 1-year accrual and the peak value become negative at about age 61, while at that age the option value turns to zero. Finally, the Actuarial Adjustment reform is the only one featuring positive incentive measures until age 70. For females, the evolution through ages of SSW and incentive measures is shown in figure 10 and is analogous to that of males with the relevant differences in terms of ages the incentives become negative at.

I fit a probit model to a sample of employees aged at least 50 in 1987 in order to reduce composition effects as younger cohorts of workers get higher wages at each age and by this way impact on the effect of SSW on the probability of retirement. Then, I use individual values of SSW and incentive measures to get predicted age-profiles of exit rates into retirement and the implied employment rates under each regime. This is to sketch the effect of different reforms on the labour market, and more precisely on the supply side (that is on workers choices). I carry out the simulations using a specification in which retirement probability is a function of SSW, expected earnings, pensionable earnings, the 1-year accrual, a linear term in age and age dummies at observed spikes that are added as predictors to standard covariates. For men and women separately, figure 11 represents predicted median age profiles of retirement rates and implied employment rates conditional on employment at age 50 under each regime. For males, exit rates are very similar until age 55 when the pre-1992 regime implies the highest exit rates. The other regimes are characterized by very similar exit and employment pattern: the 3-years Age Shift reform implies exit rates slightly above those implied by the Actuarial Adjustment and Maroni reforms which in turn imply a higher employment rate. For females, the pre-1992 regime implies the highest exit rate and the lowest employment rate. Under the Actuarial Adjustment reform and the 3-years Age Shift regime there are very close retirement rates, while the Maroni reform shows the lowest exit rates and consequently the highest employment rates.

It is worth noting that the median retirement age, i.e. the age at which more than half of the workers employed at age 50 is retired, is 60 under the pre-1992, 64 under the Maroni regime for males and around 63 under the two policy experiments. For females, the median retirement age is lower under the pre-1992 regime (50% of the workers employed at age 50 is retired by age 58) than under all the other regimes (between age 64 and age 67). The surprising evidence consists of the higher employment rate for women with respect to men at later ages. I attribute this fact to the higher proportion of white collar and managers amongst women in my sample (47% of females against 29% of males).

11 Concluding remarks

A critical parameter for the design of Social Security policies is the responsiveness of individuals labour supply to pension benefits generosity. Estimating this parameter is notoriously hard in a simple reduced-form specification. Thus, I exploit exogenous variation in Social Security wealth induced by the 1992. The event is particularly interesting since it did not change the unfunded nature of the defined-benefits pension system, but it did change the present discounted value of future pension benefits for many Italian private sector workers. The most important fact is that the change in public pension wealth was not uniform across workers, and the differential impact allows me to identify the effect of Social Security wealth on retirement behaviour. The first step of the analysis consists of estimating the level of SSW for each worker in the sample. Secondly, since my measure of Social Security wealth might be subject to measurement error and might be related to individual and unobserved heterogeneity in retirement behaviour, I implement an instrumental variable technique where the instrument is the interaction of group and time dummies. The estimated coefficient points to a positive income effect: workers with higher public pension wealth are more likely to retire: a $10,000$ euro increase in SSW rises the probability of retirement by around 0.08%. The marginal effect of SSW on the probability of retirement is higher than in previous studies (see - for example - Brugiavini and Peracchi (2003)). That means endogenity and measurement error heavily bias estimated coefficients and need to be taken into account in order to get the causal effect. The second part of the paper is devoted to simulations of retirement choices under different pension reforms. The most important result is the change of retirement patterns across reforms: I observe a decrease of retirement rates and a corresponding increase of employment rates, for both males and females, when the system moves from the pre-1992 regime to the reform legislated by the Italian Parliament in 2004. That implies the Italian Social Security system is moving in the right direction.

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Figure 1: Fertility rate and life expectancy at birth

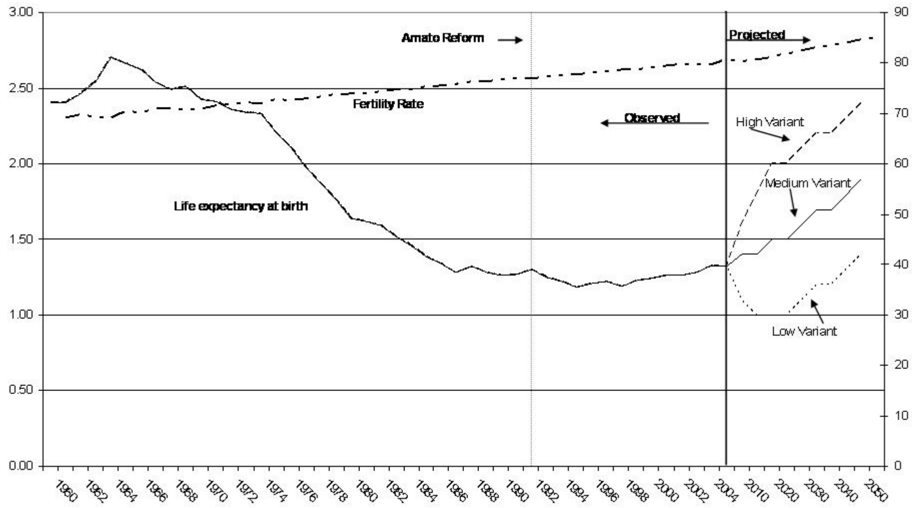

Figure 2: Features of the Social Security System before and after the 1992 reform

	Pre-reform	Post-reform (steady state)
Normal retirement age	60 (men) 55 (women)	65 (men) 60 (women)
Pensionable earnings	Average of final 5 years' real earnings (converted to real values through price index)	Career average earnings (converted to real values through price index + 1% for each year of tax payment)
Pension benefit	Fraction of PE given by a factor of 2% for each year in the system (at most 40)	Fraction of PE given by a factor of 2% for each year in the system (at most 40)
Indexation of pension	Cost of living plus real earnings growth	Cost of living
Years of contributions	15	20
Early retirement provision	Any age if 35 years of pay-roll taxes	Any age if 35 years of pay-roll taxes

Figure 3: Estimated coefficients of the fixed effects model for log-earnings

	Annual earnings		**Full-time earnings**	
	Men	**Women**	**Men**	**Women**
cons	10.05366**	9.63241**	10.14061**	9.76192**
age	-0.022428**	0.00199	-0.00829*	0.00610
age^2	-0.000601**	-0.00047**	0.00018*	-0.00019
age^3	0.00003**	-0.000004	0.00004**	-0.000005
exp	0.016324**	-0.00288	0.01542**	0.00178
N	9,058	4,872	9,012	4,845
$\overline{T}$	11	10.1	9.1	8.5
R^2	0.0557	0.0134	0.0527	0.0111

Significance levels : $***$: 10% $*$: 5% $**$: 1%

Figure 4: Descriptive statistics

Variables	**Mean**	**Std Dev**
Sex	0.17	0.37
Age	57.13	3.61
Occupation		
Blue Collars	0.75	0.43
White Collars	0.25	0.43
Geographical dummies		
North	0.41	0.49
South	0.55	0.50
Education dummies		
Less than sec. ed. or no ed.	0.75	0.43
Secondary education	0.25	0.43
Retired	0.05	0.21
Continuous variables		
Expected Earnings	24,168	15,600
SSW	207,394	92,498

Figure 5: Mean value and percentage change in SSW by occupation

Groups	1989	1990	1991	1992	1993
Blue collars	212,264	209,220	195,538	178,197	169,949
White collars	279,117	288,296	285,310	217,988	157,641

% changes in mean SSW			
Groups	1990-1989	1992-1991	1994-1993
Blue collars	-1.43	-8.87	2.44
White collars	3.29	-23.60	6.79

Figure 6: Estimates of the effect of SSW on retirement probability: basic (M1) and full specification (M2) (Probit and IV-Probit)

	M1	**M2**	**M1 - IV**	**M2 - IV**
Variables		dy/dx		
Social Security Wealth$_t$	0.00084	0.00082	0.00844*	0.00762*
	(0.00076)	(0.00075)	(0.02920)	(0.03046)
Expected Earnings	-0.01043	-0.00931	-0.03889*	-0.03483*
	(0.00682)	(0.00687)	(0.12874)	(0.13247)
Less or no education		-0.02035		0.07551*
		(0.03278)		(0.34078)
South		0.01240		-0.00927
		(0.00992)		(0.10215)
Age*white	0.00829**	0.00803**	0.00675***	0.00662***
	(0.00252)	(0.00259)	(0.03184)	(0.03278)
Sex	0.03770***	-0.01695	-0.00130	-0.00031
	(0.0117)	(0.01248)	(0.18189)	(0.18309)
Post91	-0.05939**	0.06076**	0.10746**	0.10393**
	(0.01261)	(0.01107)	(0.11221)	(0.11547)
Group	-0.37129*	-0.24014	-0.22715	-0.16474
	(0.16866)	(0.21004)	(1.88657)	(1.76484)
Loglikelihood	-349.77	-347.35	-6400.62	-6394.26

Significance levels : $***$: 10% $*$: 5% $**$: 1%

Figure 7: Age-earnings profiles - males

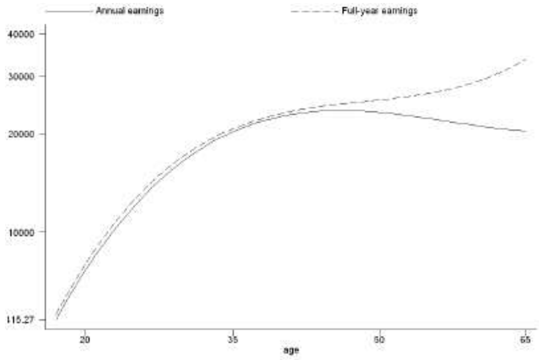

Figure 8: Age-earnings profiles - females

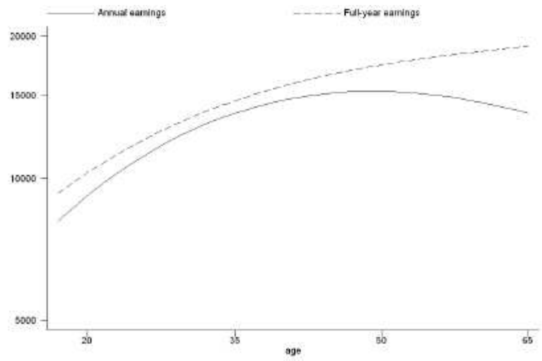

Figure 9: Average fixed effect - males

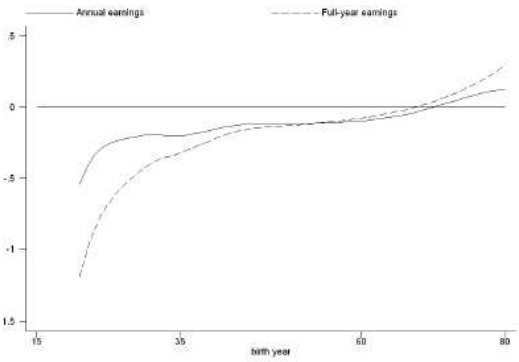

Figure 10: Average fixed effect - females

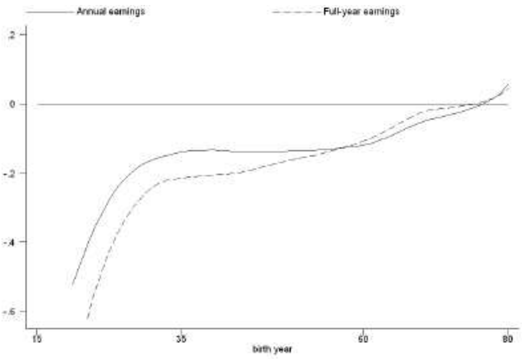

Figure 11: Median SSW by occupation

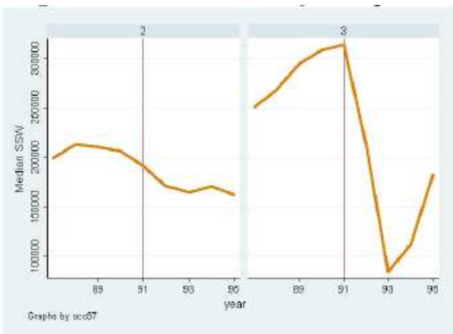

Figure 12: Age-profiles of median values of accrual, peak and option value, SSW by regime - Males

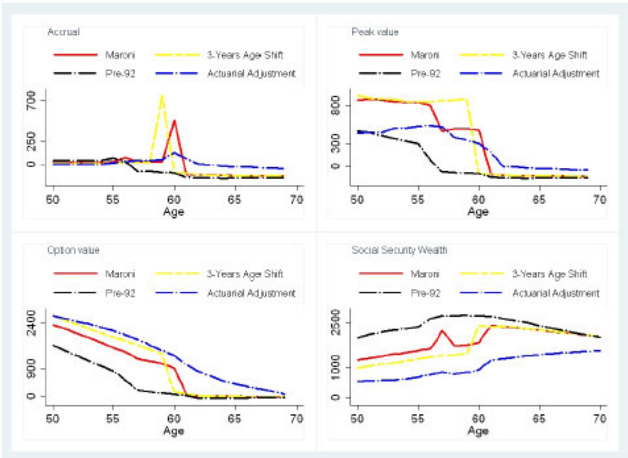

Figure 13: Age-profiles of median values of accrual, peak and option value, SSW by regime - Females

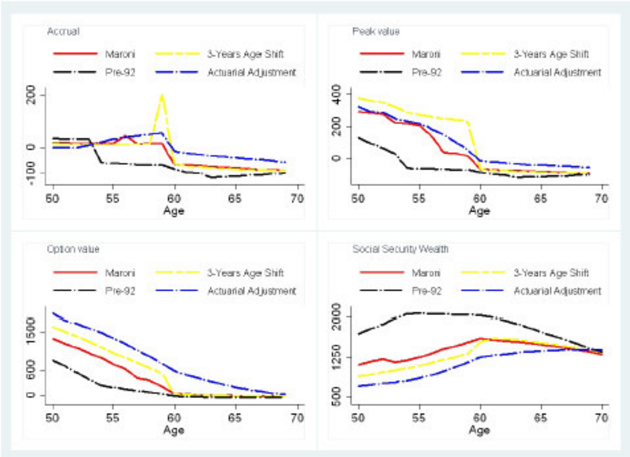

Figure 14: Predicted median age-profiles of exit rates into retirement and employment rates conditional on being employed at age 50