Social security wealth and retirement decisions in Italy*

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Abstract

This paper uses administrative data to study the retirement decisions of Italian private-sector non-agricultural employees during the period 1977–1997. Our analysis tries to assess the importance of the financial incentives built into the social security system. The basic idea is very simple: at any given age, and based on the available information, workers compare the expected present value of two alternatives: retiring today or working one more year, and then choose the best one.

A key role in this kind of comparisons is played by social security wealth, whose level and changes reflect the expectations about the profile of future earnings and the institutional features of the social security system. The various incentive measures that we consider differ in the precise weight given to the social security wealth that workers accrue as they continue to work.

Our model does not provide a structural representation of the retirement process. A worker's decision is modeled here following a "quasi reduced-form" approach, with the incentive measures entering as predictors of the worker's choice in addition to standard variables. The estimated models are then used to predict retirement probabilities under alternative policies that change social security wealth and derived incentive measures.

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1 Introduction

This paper uses microeconomic data from the administrative archives of the Italian National Social Security Institute (INPS), the largest social security administration in Italy, to study the retirement decisions of Italian private-sector non-agricultural employees during the period 1977–1997. Our analysis tries to assess the importance of the financial incentives built into the social security system. The basic idea is very simple: at any given age, and based on the information that they have available, workers compare the expected present value of two alternatives: retiring today or working one more year, and then choose the best one.

A key role in this kind of comparisons is played by social security wealth (SSW), defined here as the expected discounted value of the future stream of pension benefits. The level of SSW and its changes over time reflect a person's expectations about the profile of her future earnings and the institutional features of the social security system. The various incentive measures that we consider differ in the precise weight given to the SSW that workers accrue as they continue to work.

Our model does not provide a structural representation of the retirement process. A worker's decision is modeled following a "quasi reduced-form" approach, with the incentive measures entering as predictors of the worker's choice in addition to standard variables, such as gender, age, education level, etc. The estimated models are then used to predict retirement probabilities under alternative policies that change SSW and derived incentive measures.

To our knowledge, Miniaci (1998), Spataro (2000), Colombino (2001), and Brugiavini and Peracchi (2001) are the only studies currently available in Italy which try to explain individual decisions to retire from the labor force. While Miniaci (1998) is just a reduced-form, the other three studies take a more structural approach.

We depart from the above studies both because of the model that we consider and the microeconomic data that we use. This paper relies on a stripped down version of the option value model of Stock and Wise (1990) and uses data from the administrative archives of the INPS. Unlike Brugiavini and Peracchi (2001), whose model and data are similar to those employed here, we use a new release of the INPS data and make several changes to the way in which SSW is estimated for each person in the sample.

The rest of the paper is organized as follows. Section 2 describes the main rules of the Italian social security system. Section 3 describes the data. Section 4 describes the calculation of SSW and related incentive measures. Section 5 presents the results obtained by fitting various models to the observed exit rates into retirement. Section 6 uses the estimated models to predict exit rates into retirement and the implied employment rates under alternative social security regimes. Finally, Section 7 offers some conclusions.

2 A brief overview of the Italian system

The Italian social security system is based on a variety of institutions administering public pension programs. Currently, about two thirds of the labor force is insured with the INPS. The Institute is responsible for a number of separate funds, of which the most important covers the private-sector non-agricultural employees (Fondo Pensioni Lavoratori Dipendenti or FPLD). We focus on the FPLD since our data consist only of private-sector employees.

Because the basic aspects of the system are well documented elsewhere (see e.g. Brugiavini 1999 and Franco 2002), we only describe very briefly the rules (eligibility, pensionable earnings, benefit computatation, indexation and taxation of benefits) that are particularly relevant for computing SSW and related incentive measures for our sample.

A key modeling problem is how to incorporate people's expectations about future changes to the system. The problem is especially delicate for the period after 1992, when a sequence of legislated changes thoroughly modified the system originally designed in 1969. The main reforms took place in 1992, 1995 and 1997. They are known, respectively, as the Amato, Dini and Prodi reforms, from the names of the Prime Ministers at the time. In addition, smaller changes to the system have been made nearly every year since 1992.

Of the three main reforms of the 1990s, the Dini reform appears as the most radical, because it completely redesigns the system by modifying the eligibility rules and by changing the benefit formula back from defined-benefits to defined-contributions (the type of formula in place prior to 1969). However, because it will only be introduced gradually, through a very long transitional period, the direct effects of the Dini reform over the period that we consider are small compared to the less radical Amato reform.

Keeping track of all the changes to the system, and the different periods and categories of workers to which they apply, is not an easy task. To simplify things, our modeling exercise focuses mainly on blue collars (about two thirds of the workers in our sample) and the older cohorts, namely those reaching the retirement age during the period covered by our data. These cohorts of workers remained relatively unaffected by the reforms of the 1990s, as most of the burden of the adjustment fell on the younger cohorts (Brugiavini 1999, Franco 2002). For example, the 1992 (Amato) reform explicitly distinguishes between workers with at least 15 years of contributions at the end of 1992 and all other workers. The old system (introduced in 1969) applies, with some changes, to the former, whereas the new system only applies to the latter. The adoption of different rules for older and younger workers is maintained in the subsequent 1995 (Dini) and 1997 (Prodi) reforms. In particular, with the exception of the new eligibility rules, very few changes apply to workers with 18 or more years of contributions at the end of 1995, beyond those already introduced in 1992.

2.1 Eligibility

Until 1995, eligibility could be based on either age or years of contribution. People could claim an old-age pension after a certain age (60 years for men and 55 years for women) or a seniority pension after contributing to the system for 35 years. From 1994, the minimum age for an old-age pension has gradually been raised, and will reach 65 years for men and 60 years for women in year 2002. From 1996, the minimum number of contributive years for a seniority pensions has also been raised, and will reach 40 years in 2008. In addition, from 1996, people who want to retire after 35 years of contribution must satisfy a minimum age requirement. The minimum age for retiring with 35 years of contributions was 52 years in 1996 and has gradually been raised until reaching 57 years in 2002.

During the 1995–1999 period, access to seniority pensions was further delayed through the use of the so-called "exit windows". Under these transitory rules, employees were forced to postpone their claim to a seniority pension for periods ranging between six and twelve months.

2.2 Pensionable earnings

Until 1995, the benefit formula was of the defined-benefits type, with benefits roughly proportional to pensionable earnings, the proportionality factor being the product of the number of years of contributions and a "rate of return" for each year of contribution. The 1995 (Dini) reform changed the benefit formula for new employees to defined-contributions. However, benefits of workers with at least 18 years of contributions in 1995 will still be based on the defined-benefits formula. The old formula will also be used to compute, at least partly, the benefits of workers with less than 18 years of contributions in 1995.

Pensionable earnings in the defined-benefits formula are equal to a weighted sum of past earnings. Until 1992, only the five most recent years were considered. From 1993, the number of years entering the calculation has gradually been increased to include, from 2001, the ten most recent years for workers with at least 15 years of contributions in 1992, and all contributive years for workers with less than 15 years of contributions in 1992.

Until 1992, past earnings were converted into real values using an appropriate index computed by the Italian National Statistical Institute (ISTAT). After 1993, the conversion is more generous, as a fixed 1 percent per year is added to price inflation.

Pensionable earnings were initially subject to a ceiling, that remained constant in nominal terms until 1980, despite a 2-digit inflation. After 1980, the ceiling was increased annually, but its real value kept falling until 1984, when it was increased substantially. In 1988, the ceiling on pensionable earnings was replaced by an inverse relationship between pensionable earnings and the "rate of return" from each year of contribution (see below).

2.3 Benefit computation

From 1969 to 1975, the "rate of return" was 1.85 percent of pensionable earnings for each year of contribution up to 40 years, corresponding to a maximum replacement rate (the ratio between pension benefits at retirement and pensionable earnings) of 74 percent with 40 years of contributions. In 1976, the "rate of return" was increased to 2 percent, corresponding to a maximum replacement rate of 80 percent with 40 years of contributions.

In 1988, the "rate of return" became a decreasing function of pensionable earnings. It was 2 percent if pensionable earnings did not exceed a reference level legislated annually, 1.50 percent if pensionable earnings were between the reference level and 1.33 times the reference level, 1.25 percent if they were between 1.33 and 1.66 times the reference level, and 1 percent if they exceeded 1.66 times the reference level. Starting with 1993, the number of income brackets increased from four to five, and the "rate of return" for the highest earnings bracket (now consisting of earnings exceeding 1.90 times the reference level) was lowered from 1 to .90 percent.

Between 1988 and 1997, the reference level for pensionable earnings increased steadily in nominal terms, but remained roughly constant in real terms to about $ 32 thousand per year at 1998 prices.

The defined-benefit formula is highly progressive for two reasons. First, benefits increase less than proportionally with average earnings (until 1986 because of the cap on pensionable earnings, after 1986 because of the negative relationship between the "rate of return" and pensionable earnings). Second, a "minimum pension" rule provides a lower bound on benefits for eligible workers. The nominal value of the minimum pension increased at a faster rate than price inflation until 1991, and at a slower rate in most of the subsequent years. Its current value is about $ 5 thousand per year at 1998 proces.

In the new defined-contributions formula introduced by the 1995 reform, benefits are simply proportional to the capitalized value of lifetime contributions and there is no "minimum pension" rule. The proportionality factor depends on the age at retirement and ranges between .04720 for retirement at age 57 and .05514 for retirement at 65 or later ages. Lifetime contributions are capitalized using a 5-year moving average of past GDP growth rates.

2.4 Indexation of benefits

Until 1993, pensions outstanding increased very rapidly in real terms because they were indexed to both price inflation and real earnings growth. From 1993, they are indexed to price inflation only. This change in the indexation rule is widely considered as one of the main reasons of the slowdown of pension expenditure growth in recent years.

Our modeling exercise assumes that indexation to price inflation is perfect. This is an approximation, because perfect indexation only holds for pensions that are near or below the mean. Pensions above a legislated threshold are indexed only partially.

2.5 Taxation of benefits

Pension benefits are treated as ordinary income. In Italy, the taxation of personal income is highly progressive, with several income brackets and rapidly increasing marginal tax rates. The marginal tax rate for the highest income bracket reached a peak of 56 percent in 1998. Since 1998, income tax rates have been slowly reduced, but this trend has been partly offset by a parallel increase of tax rates at the local level.

3 The data

The main novelty of this paper is the use of two new data sources. The first is a set of high quality microeconomic data from the administrative archives of the INPS, covering the period 1973-1997. The second are detailed mortality rates by age and sex, covering the period 1974-1994.

3.1 The INPS archive

This paper uses a new sample of administrative records from the archive that records all private-sector non-agricultural employees ensured with the INPS (O1M archive). Because the archive is used by the INPS to check the eligibility criteria for pension benefits and to compute the annual pension, its information is considered to be of high quality. The archive was introduced in 1973 and then modified in 1998. For this reason, consistent information is only available for the period 1973–97.

Our sample contains 20,000 workers (12,158 men and 7,842 women) entering the archive in any year between 1973 and 1997. The criterion for sample inclusion is being born on the first day of March or October. If births are approximately uniformly distributed during the year, then our data are approximately a random sample of private-sector non-agricultural employees.

Employment spells can last any number of years, and individuals can leave the sample and enter again in any subsequent year. The information on each employee is filed annually by the employer, typically before the end of March, on a standard form (the O1M form). It includes demographics (sex, year and place of birth), gross annual earnings, the number of days, weeks and months worked, the occupational category and the kind of job contract (full-time versus part-time). Each year, there may be more than one record per employee. This occurs when a person works for more than one employer at the same time, or she changes employer during the year, or she changes her occupational category, job contract or ensured risk while keeping the same employer. We refer to Ciccarelli (2002) for a more detailed discussion of the information contained in the archive.

The main advantage of these data is twofold. First, they represent a genuine longitudinal data set with a large cross-sectional dimension and spanning a fairly long time period. After dropping people aged less than 16 and older than 70, the sample contains 19,942 individuals (12,124 men and 7,818 women) for a total of 193,382 person-year observations. The average number of years in the sample is 10.3 for men and 8.7 for women, and for 27.3 percent of the men and 18.2 percent of the women we have available 15 years of data or more. Second, because the data form the basis for calculating social security benefits, the earnings information is supposedly very accurate.

There are also several disadvantages, due partly to the nature of the information originally collected in the O1M form, and partly to the anonymization criteria adopted by the INPS before releasing the data. First, the data only cover private-sector non-agricultural employees and, even in this case, coverage is not complete (for example, the data do not include managers insured by the INPDAI). Second, important personal characteristics (e.g. the total number of years of contribution to social security, the education level, spousal information and other family background variables) are not included. Third, no information is available regarding the employee. Fourth, the reason for leaving the O1M archive is not known. Fifth, there is no information on receipt of disability or other types of benefits.

Extensive comparisons with the Bank of Italy Survey of Household Income and Wealth (SHIW) show that the INPS data cover a decreasing fraction of the workforce. However, there is substantial agreement with the SHIW in the earnings data (Brugiavini and Peracchi 2001).

3.2 Mortality rates

To our knowledge, all available empirical analyses of the retirement decision in Italy use a single cross-sectional life table to compute survival probabilities, implicitly assuming stationarity of mortality rates and survival probabilities. This is a very strong assumption given the steady increase in survival at all ages, in particular at older ones, and the expectation that this trend will continue well into the future (see Caselli *et al.* 2002).

In this paper, we overcome the problem by using detailed mortality rates by sex and single year of age for each year between 1974 and 1994. The data come from the archive maintained by Professor Graziella Caselli at the University of Rome "La Sapienza". The availability of this relatively long sequence of repeated cross-sectional life tables enables us to explicitly model cohort variation in age- and sex-specific mortality through a synthetic cohort approach. We use the minimum chi-squared method to fit a simple model to the log-odds of mortality, separately for men and women. The fitted model includes a quartic age trend and a quadratic cohort trend.

Figure 1 presents the predicted mortality rates and the implied survival rates (conditional on survival at age 50) by sex and age for three birth cohorts: those born in 1920–24, those born in 1940–44 and those born in 1960–64. According to our estimates, men (women) born in 1940–44 may expect to have a conditional survival probability at age 70 that is 8 (4.6) percent higher than men (women) born in 1920–24. At age 90, the percentage difference between the two cohorts is expected to be 52.6 percent for men and 39.8 percent for women. If we instead compare those born in 1960–64 with those born in 1920–24, the percentage difference in expected survival probabilities at age 70 is 11.8 and 7.5 percent respectively for men and women. At age 90, the percentage difference is 84.4 and 71.4 percent respectively for men and women.

This dramatic increase in survival probabilities at all ages, and especially at older ones, has a strong positive impact on the value of any fixed annuity.

4 Calculation of SSW

This section describes the calculation of SSW. We also present a number of derived incentive measures which are meant to capture the financial incentives built into the social security system.

4.1 SSW and related incentive measures

We define the SSW of a worker of age a in case of retirement at age $h \geq a$ as

$$\mathrm{SSW}_h = \sum_{s=h+1}^{T} \rho(s) B_h(s),$$

where T 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 $\pi(s)$ at age s (conditional on being alive at age a), and $B_h(s)$ is the pension benefit expected at age s if the worker retires at age h.

Given the profile of SSW as a function of the age at retirement, we define two different incentive measures. The first is the *(one-year) social security accrual*

$$\mathrm{SSA}_a = \mathrm{SSW}_{a+1} - \mathrm{SSW}_a,$$

which is the difference in SSW if retirement is postponed by one year, from age a to age $a+1$. Notice that

$$\mathrm{SSA}_a = \sum_{s=a+2}^{T} \rho(s)[B_{a+1}(s) - B_a(s)] - \rho(a+1)B_a(a+1),$$

where $\sum_{s=h+2}^{T} \rho_s[B_{a+1}(s) - B_a(s)]$ is the present value of the expected increment in the flow of pension benefits and $\rho(a+1)B_a(a+1)$ is the present value of the pension benefits foregone. Clearly, 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 rescaled negative accrual $\tau_a = -\mathrm{SSA}_a / W(a+1)$, where $W(a+1)$ is the expectation of future earnings at age $a+1$, is called the implicit tax/subsidy of postponing retirement from age a to age $a+1$.

The second is the *peak value*

$$\mathrm{PV}_a = \max_h \{\mathrm{SSW}_h - \mathrm{SSW}_a\}, \qquad h = a+1, \ldots, R,$$

where R is the age of mandatory retirement. This is the maximum difference in SSW between retiring at some future age and retiring now. Although Italy does not have a mandatory retirement age, based on the available evidence we put $R = 70$. Notice that $\mathrm{PV}_a = \mathrm{SSA}_a$ if SSW declines monotonically with age.

In utility terms, the analog of the peak value is the *option value*

$$\mathrm{OV}_a = \max_h \{V_h - V_a\}, \qquad h = a+1, \ldots, R,$$

where $V_a = \sum_{s=a+1}^{S} \rho(s) U_1(B_a(s))$ is the intertemporal expected utility of retiring at age a and

$$V_h = \sum_{s=a+1}^{h} \rho(s) U_0(W(s)) + \sum_{s=h+1}^{T} \rho(s) U_1(B_h(s))$$

is the intertemporal expected utility of retiring at age $h > a$. The functions $U_0(x)$ and $U_1(x)$ represent the utility of income for a person who is working or retired, respectively. Notice that we are implicitly assuming no earnings after retirement. In the Italian case this is not quite true, for receipt of an old-age or seniority pension is incompatible with any form of dependent employment, but is not incompatible with self-employment.

Following Stock and Wise (1990), we parametrize the model by assuming $U_0(x) = x^\gamma$ and $U_1(x) = (kx)^\gamma$, and set $\gamma = 1$ and $k = 1.25$. Under these assumptions, $V_a = 1.25 \text{ SSW}_a$ and

$$V_h = \sum_{s=a+1}^{h} \rho(s) W(s) + 1.25 \text{ SSW}_h .$$

If expected future earnings are constant at $W(a)$ (as assumed in our earnings model), then

$$V_h - V_a = W(a) \sum_{a+1}^{h} \rho(s) + 1.25(\text{SSW}_h - \text{SSW}_a).$$

Calculation of SSW and related incentive measures depends crucially on two elements: (i) the process for individual earnings, and (ii) the social security system expected to prevail in the future. The latter determines eligibility for pension benefits, the way in which pension benefits are computed at retirement as a function of past earnings, and the pension indexation rules.

4.2 Modeling individual earnings

The specification of a model for the lifetime profile of earnings represents a key step in the estimation of SSW at the individual level. This is especially true in Italy, as the process of social security reform involves moving from a "final salary" type of benefit formula (pre-1993 system) to a lifetime earnings formula (1992 reform) and to a formula based on the value of lifetime contributions (1995 reform).

There are two issues here. The first is how to impute missing earnings information, both for the years before 1973–74 and for the periods when the worker is absent from the INPS archive. The second is how to forecast future earnings based on the information available in each period.

Although earnings are accurately measured in the INPS sample, the information available to model age-earnings profiles and to control for individual heterogeneity is not very rich. It basically consists of the sex, age and occupational category of a worker. We lack important personal information such as schooling attainments, marital status, labor market history outside the INPS archive, and we have no information at all on the characteristics of the employer.

We use the information on the initial occupational category to construct a proxy for schooling attainments. The imputed schooling level is then combined with cohort- and sex-specific information from the Bank of Italy SHIW to impute the age at which a worker started her contribution history. This starting age ranges between 16 and 18 for blue collars, between 19 and 20 for white collars, and between 23 and 25 for managers. For all schooling levels, women are characterized by a later age of entry into the labor force.

To impute missing earnings, we use a simple fixed effects model for the logarithm of earnings, with age and imputed years of contributions as predictors. Age enters as a cubic polynomial, while years of contributions enter linearly. The fixed effects are intended to capture time-invariant factors that affect earnings, such as unobserved individual ability and productivity differentials across cohorts. The model is fitted separately to men and women aged 20–65 using the subset of "stable" workers, namely those who remain in the sample for an uninterrupted period of at least five years and whose contributive history does not contain substantial gaps (that is, not more than 10 years of missing data). Earnings are expressed in Euros and converted to a common scale using the ISTAT consumer price index for families containing a dependent employee ("Famiglie di operai e impiegati") with base 1998 = 100.

Table 1 shows the estimated coefficients, separately for men and women, along with summary statistics of the fit, namely the sample size (N), the average number of observations per worker ($\bar{T}$), and the coefficient of determination (R^2). We present results for three different earnings measures. The first is annual earnings, defined as the sum of all earnings recorded in the O1M archive, the second is full-year earnings, defined as annual earnings excluded the first and last year in the sample, and the third is annualized monthly earnings, defined as annual earnings divided by the fraction of months a person worked during the year. The second and third measures provide alternative ways of controlling for the fact that people typically work only part of the year in their first and last year in the sample.

Figures 2 and 3 show on the log scale, for men and women respectively, the age-earnings profiles implied by the estimated model for a reference worker, namely one who started working at age 17 and whose fixed effect is equal to the average, whereas Figures 4 and 5 show, for men and women respecticely, the evolution across cohorts of the mean value of the estimated fixed effects for each earnings measure.

The estimated age-profile of annual earnings is strictly concave, with peaks at about age 45 for men and about age 50 for women, and earnings falling rapidly after the peak age. On the contrary, for both men and women, annualized monthly earnings increase monotonically with age. The implied growth rate of earnings initially declines with age, but becomes roughly constant after age 35. The age-profile of full-time earnings falls in-between those of the other two income measures, but appears to be quite sensitive to the inclusion of a cubic age term.

Turning to the second issue, computing SSW requires assuming a forecasting model for future earnings. After experimenting with various models for earnings dynamics, we assume that real age-earnings profiles are flat after the last year of observed earnings for individuals aged between 50 and 70. In other words, at each age between age 50 and 70, individuals assume that future earnings will be equal to current earnings. This corresponds to assuming that the individual earnings process follows a random walk without drift. To smooth out idiosyncratic noise, the "jump-off" point for the earnings projections is taken to be the average of the last 3 years of observed earnings.

4.3 Basic assumptions in the calculation of SSW

The INPS sample contains no information on the reasons for leaving the O1M archive. In fact, workers may leave because they retire, or move to a different archive within the INPS (e.g. they become self-employed), or take a job not covered by the INPS, or become unemployed, or die. In this paper we make the basic identifying assumption that all exits from the O1M archive between age 50 and age 70 are due to retirement. The available evidence shows that, for an Italian worker, the only relevant alternative escape route from the labor force is through a disability pension. After the legislated changes in 1984, however, the importance of this other escape route has greatly diminished. In the 50–70 age range (the range of ages at risk of retirement), the number of disability pensions is now negligible relative to old-age pensions, especially in the case of new awards (see Brugiavini and Peracchi 2002).

We assume that, at each age, workers revise their expectations about their future earnings and the rules of the social security system on the basis of the new information that they receive. This requires re-computing the SSW and the corresponding incentive measures for each year until retirement taking into account the new earnings forecasts, the changes in the legislation and their known future effects.

A crucial assumption maintained throughout in this paper is that pension reforms come as a surprise to workers. On the other hand, we assume that workers perfectly anticipate legislated changes that are known to take effect in the future. Thus, for example, the Amato reform is assumed to come as a complete surprise, whereas the progressive increases in the normal retirement age legislated in 1995 and 1997 are assumed to be fully known to the workers.

Calculations are carried out as follows.

1. We estimate SSW separately for men and women assuming a real discont factor of 3 percent.

2. 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, we only present calculations before income taxes. We also assume that a person who receives an old-age or a seniority pension does not earn self-employment income at the same time.

3. From the data, we are unable to tell whether a worker has a spouse. In the Italian legislation, the main difference between single and married workers is eligibility to survivors' pension (unlike the USA, there is no dependent-spouse benefit). Because most male workers are married to a woman who is 3–4 years younger and is expected to survive another 8 to 10 years after the spouse dies, modelling survivors' pensions is especially important for men. Thus we assume that all male workers are married to a woman who is 3-year younger. For women, we do not try to impute a spouse and we simply treat female workers as if they were single.

4. Disability benefits have not been taken into account because multiple exit routes from the labor force are not relevant in the Italian case. We experimented with adding this alternative exit route in an ad hoc fashion by using the observed disability probabilities, but this had no effect on the main findings.

5. We do not account for the benefit provided by the TFR ("Trattamento di fine rapporto"), a kind of job severance fund that represents a source of post-retirement income.

5 Estimation results

This section presents the results obtained by fitting various models to the observed exit rates into retirement. The range of ages considered goes from 50 to 69 years. The data used for estimation cover a period of 20 years from 1977 to 1997. We restrict the initial period relative to the available data because the system introduced with the 1969 reform became fully operational only in August 1976. We also exclude a very small number of records corresponding to categories with special rules, such as airline pilots and journalists. The resulting estimation sample consist of 20,100 person-year observations for men and 5,171 for women.

5.1 Exit into retirement

Figure 6 shows exit rates from the O1M archive by age, separately for men and women. We interpret these age-profiles as non-parametric estimates of the retirement hazards. Exit rates are higher for women than for men before age 60. After age 60, they are instead higher for men than for women. There is clear evidence of spikes at age 60 for men and age 55 for women, which are the minimum ages for an old-age pension under the pre-1992 rules.

Figure 7 shows the implied age-profiles of employment rates for those employed at age 50. Employment rates are higher for men than for women up to age 60, but they hardly differ by gender after that age. Notice that the estimated retirement rates imply that half of men employed at age 50 are already retired by age 58, whereas half of the women employed at age 50 are already retired by age 56.

5.2 Reduced-form probit model

Our first modeling exercise consists of a simple reduced-form probit model that only includes age, year of birth and occupation of employment as predictors. Age enters as a full set of age dummies (age51–age69), year of birth as a set of five dummies – born before 1925 (coh1), in 1930–34 (coh3), in 1935–39 (coh4), in 1940–44 (coh5), and after 1944 (coh6) – and occupation of employment as a set of three dummies – white collar (occ3), manager or supervisor (occ4), and homeworker or other non blue-collar (occ0). The model is fitted separately to men and women aged 50 to 69. Table 2 shows the estimated coefficients, their observed significance levels (p-values) and an overall measure of goodness of fit (R^2). The parametrization is such that the intercept corresponds to the retirement probability of a blue collar worker, aged 50, born between 1925 and 1929.

The reduced-form model provides a limited fit to the data, as indicated by a coefficient of determination (R^2) of 10.3 percent for men and only 4 percent for women. As a result of the large sample size, the model parameters are always estimated very precisely. The estimates show that, at each age, blue collars are more likely to retire than white collars or managers. For both men and women, we also observe strong cohort effects towards earlier and earlier retirement, the younger cohorts being much more likely to leave the labor force than the older ones.

5.3 Augmented probit models

We now present the results of augmenting the reduced-form probit model of Section 5.2 with a number of additional variables that reflect the earnings process and the features of the social security system. The set of additional variables consists of expected future earnings (Y), pensionable earnings (PY), social security wealth (SSW) and one of the three incentive measures introduced in Section 4.1, namely the accrual (accr), the peak value (peak) and the option value (ov). The various models differ depending on what incentive measure is considered and how the dependence of retirement rates on age is specified. Each model is fitted separately to men and women. The parametrization is such that the intercept always corresponds to the retirement probability of a blue collar worker, aged 50, born between 1925 and 1929, with expected future earnings, pensionable earnings, SSW and incentive measure all equal to their (gender-specific) average.

For each incentive measure, four basic specifications of the dependence on age are considered, for a total of twelve estimated models:

1. **Model M0**: It does not include age.

2. **Model M1**: It only includes a linear age term (age1).

3. **Model M2**: It includes a linear age term and dummies at ages 55 and 60.

4. **Model M3**: It includes a full set of age dummies, one for each year of age between 51 and 69.

Estimation results from models M1, M2 and M3 are presented separately for men and women. Tables 3 and 4 show the estimated coefficients, their observed significance levels and an overall measure of goodness of fit, whereas Figures 8 and 9 compare the age-profiles of the average retirement rates implied by the estimated models with the non-parametric estimates presented in Figure 6.

The introduction of the additional variables significantly improves the fit relative to the reduced-form probit model, as the coefficients of determination that now range between 16 and 19 percent for men, and between 13.1 and 15.6 percent for women. The fit is always better for men than for women.

The linear age term alone (model M1) does not capture the presence of spikes in the retirement hazard. At the other extreme, the use of a full set of age dummies (model M3) provides an age-profile that is fairly close to the raw hazard, but at the cost of saturating the model. Model M2 appears to provide the best compromize between goodness of fit and parsimony.

The effect of the cohort dummies is always very similar to the reduced-form probit models. The coefficient on the dummy variable for being a white collar retains its negative sign, while the coefficient on the dummy variable for managers becomes positive, partly offsetting the negative effect on retirement rates of higher than average expected future earnings for this group.

The effects of expected future earnings, pensionable earnings and SSW on retirement rates are always as expected, namely negative for future earnings and positive for pensionable earnings and social security wealth. Thus, keeping all other variables constant, workers with higher SSW or higher pensionable earnings are more likely to retire, whereas workers with higher future earnings are less likely to do so. At least for men, the observed significance levels of these variables are always small, partly because of the large sample sizes.

The effect of the incentive measures, however, does not conform to the expectations, as the estimated coefficients are always positive, although often not statistically significant. It is worth noticing that, in the case of model M0 (no age term), all incentive measures have instead the expected negative sign and are statistically significant.

6 Simulating retirement rates under alternative regimes

This section presents the results of using the models estimated in Section 5 to answer the counterfactual question of what would be the exit rates into retirement and the implied employment rates under alternative social security regimes. The simulations have been carried out for four regimes:

1. **Pre-1992**: The pre-1992 rules (it represents our reference case).

2. **Amato**: The rules introduced by the Amato reforms in 1992–93.

3. **Dini/Prodi**: The post-1997 rules in the steady state, once the Dini and Prodi reforms are fully phased in.

4. **Actuarial adjustment**: It features (i) an early retirement age of 60 and a normal retirement age of 65, (iii) pensionable earnings are equal to the average of the last five years of contribution, (iii) benefits replace 60 percent of pensionable earnings when retiring at age 65 with 40 years of contributions, and (iv) an actuarial reduction of 6 percent per year for early claiming and an actuarial increase of 6 percent per year for later claiming.

For each individual in the sample, we compute the value of SSW and the related incentive measures under the four regimes. The individual earnings profiles are assumed constant across regimes and are exactly the same as in Section 5.

6.1 Comparison of SSW and incentive measures across regimes

For each regime, we present summaries of the distribution of SSW and related incentive measures. Figures 10 and 11 compare across regimes, respectively for men and women, the age-profiles of four measures: SSW, social security accrual, peak value and option value.

Relative to the pre-1992 regime, all the other ones imply a substantial reduction of SSW over the 50–60 age range. The reduction is particularly strong under the last two regimes (Dini/Prodi and actuarial adjustment). These two regimes are also characterized by age-profiles of SSW that increase with age over the 50–65 age range, in sharp contrast with the hump-shaped profiles of the pre-1992 and the Amato regimes.

The age-profiles of the three incentive measures (social security accrual, peak value and option value) also differ considerably across regimes. At one extreme are the pre-1992 and the Amato regimes, with incentive measures that become negative as soon as a worker reaches 35 years of contribution and therefore becomes eligible for a seniority pension. For most male blue-collars, this occurs well before age 55. At the other extreme is the case of actuarial adjustment, with incentive measures (especially the peak value and the option value) that decline very smoothly with age and remain positive over most of the age range at risk of retirement. The Dini/Prodi regime is somewhat intermediate between these two extreme cases, as the incentive measures all tend to fall sharply after a worker reaches the early retirement age of 57.

6.2 Predicted exit rates into retirement

We now combine the estimates from Section 5 with the individual values of SSW and related incentive measures to obtain predicted age-profiles of the exit rates into retirement and the implied employment rates under each simulated regime.

The main problem with this kind of exercise is the fact that the estimated age coefficients cannot be interpreted as the pure effects of age, for they also reflect the impact on the retirement process of various features of the social security system that are not adequately captured by our incentive measures. Because the problem is likely to affect particularly the coefficients on the age dummies, we carry out our simulations using the model with a linear age trend (Model M1), although it is not our best fitting model. For simplicity, we only present the results obtained with social security accrual as the incentive measure. The results for the other incentive measures are very similar and are available from the Authors upon request.

The top panels of Figure 12 show, for men and women respectively, the age-profiles of the exit rates into retirement under each of the four regimes, whereas the bottom panels show the implied age-profiles of employment rates conditional on employment at age 50.

Compared to the pre-1992 regime, all the other ones imply a reduction of retirement rates over the whole 50–60 age range. The reduction is particularly strong under the last two regimes (Dini/Prodi and actuarial adjustment). At age 55, for example, male exit rates into retirement are 12.2 percent under the pre-1992 regime, 10.5 percent under the Amato regime, 6.6 percent under the Dini/Prodi regime, and 6.0 percent under the actuarial adjustment. The corresponding figures for women are 14.9 percent under the pre-1992 regime, 13.6 percent under the Amato regime, 11.6 percent under the Dini/Prodi regime, and 9.2 percent under the actuarial adjustment.

Interestingly, our estimates predict a substantial increase in retirement rates after age 60 under the Dini/Prodi reform, as a consequence of a rapidly rising level of SSW after that age. At age 65, for example, male exit rates into retirement are 40.3 percent under the pre-1992 regime, 39.1 percent under the Amato regime, 37.4 percent under the actuarial adjustment, and 59.9 percent under the Dini/Prodi regime. The corresponding figures for women are 29.0 percent under the pre-1992 regime, 30.0 percent under the Amato regime, 26.5 percent under the actuarial adjustment, and 58.3 percent under the Dini/Prodi regime.

As a result, relative to the pre-1992 regime, all the other ones imply an increase of employment rates over the 50–60 age range. The increase is particularly sizeable under the last two regimes. For example, at age 55, male employment rates (conditional on employment at age 50) are 65.7 percent under the pre-1992 regime, 71.2 percent under the Amato regime, 84.3 percent under the Dini/Prodi regime, and 83.9 percent under the actuarial adjustment. The corresponding figures for women are 53.8 percent under the pre-1992 regime, 60.0 percent under the Amato regime, 67.4 percent under the Dini/Prodi regime, and 71.1 percent under the actuarial adjustment.

After age 60, and especially after age 65, only the last regime appears to be able to generate a sizeable increase in employment rates compared to the pre-1992 regime. For example, at age 65, male employment rates (conditional on employment at age 50) are 4.9 percent under the pre-1992 regime, 6.5 percent under the Amato regime, 5.0 percent under the Dini/Prodi regime, and 13.0 percent for the actuarial adjustment. The corresponding figures for women are 6.2 percent under the pre-1992 regime, 7.4 percent under the Amato regime, 13.7 percent under the actuarial adjustment, but only 2.7 percent under the Dini/Prodi regime.

Our estimates imply that the median retirement age (defined as the age at which more than half of those employed at age 50 are retired) is 58 for men and 56 for women under the pre-1992, 58 and 57 under the Amato regime, 60 and 58 under the Dini/Prodi regime, and 61 and 59 under the actuarial adjustment.

7 Conclusions

This paper analyzes the retirement decisions of Italian private-sector non-agricultural employees during the period 1977–97 using microeconomic data from the administrative archives of social security. We first estimate simple quasi reduced-form probit models of exit into retirement, that include among the explanatory variables various measures of the financial incentives provided by the social security system. We then use the estimated models to predict retirement rates under alternative social security regimes characterized by different levels and age-profiles of SSW.

Overall, the estimated probit models fit the observed retirement rates reasonably well. Most of the key explanatory variables (expected earnings, pensionable earninsg and SSW) have the correct sign and are strongly statistically significant. The only exceptions are the variables that measure the slope of the age-profile of SSW (social security accrual, peak value and option value). These variables do not have the expected sign, but are often not statistically significant.

In our simulation exercise, we predict the retirement rates under the pre-1992 regime (the reference case) and three alternative regimes: the Amato regime (the 1992–93 reform), the Dini/Prodi regime (the 1995 and 1997 reforms), and a hypothetical regime characterized by an actuarial reduction of benefits of 6 percent per year for early retirement and an actuarial increase of 6 percent per year for delayed retirement.

Relative to the pre-1992 regime, all the others imply a reduction of retirement rates and therefore an increase of employment rates over the 50–60 age range. These effects are particularly strong under the Dini/Prodi regime and the actuarial adjustment. In particular, for both men and women, the median retirement age would increase by 2 years under the Dini/Prodi regime and by 3 years under the actuarial adjustment. After age 60, however, only the actuarial adjustment appears to be able to generate a sizeable increase in employment rates relative to the pre-1992 regime.

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Table 1: Estimated coefficients of fixed effects models for log earnings (** indicates an observed significance level below 5%, * indicates an observed significance level between 5 and 10%).

	Annual earnings		Full-time earnings		Annualized earnings	
	Men	Women	Men	Women	Men	Women
cons	2.90387 **	2.52511 **	2.97672 **	2.62778 **	3.07805 **	2.75958 **
age	.00131	-.00552	.02192	.02451 **	.00175	.00747 **
age^2	-.00115 **	-.00152 **	-.00033 **	-.00063 **	-.00022 **	-.00183 **
age^3	.00001 **	-.00002 **	.00004 **	-.00001 **	.00001 **	.00001 **
yrs. contr.	-.00697 **	-.00126	-.00964 **	-.01449 **	.01003 **	.00236 **
N	8,468	4,960	8,427	4,938	8,472	4,963
$\bar{T}$	12.9	11.4	11.3	9.8	13.6	12.2
R^2	.095	.030	.114	.033	.189	.065

Table 2: Estimated coefficients of reduced-form probit models for exit into retirement (** indicates an observed significance level below 5%, * indicates an observed significance level between 5 and 10%).

	Men	Women
cons	-1.853 **	-1.468 **
age51	.112 *	.106
age52	.170 **	.142
age53	.272 **	.163 *
age54	.363 **	.143
age55	.641 **	.764 **
age56	.624 **	.640 **
age57	.619 **	.523 **
age58	.797 **	.593 **
age59	.795 **	.496 **
age60	1.838 **	.704 **
age61	1.390 **	.756 **
age62	1.313 **	.721 **
age63	1.163 **	.566 **
age64	1.295 **	.750 **
age65	1.552 **	.738 **
age66	1.442 **	1.067 **
age67	1.767 **	1.012 **
age68	1.649 **	.059
age69	1.761 **	1.169 **
coh1	-.108 **	-.153 *
coh3	.107 **	.114 *
coh4	.291 **	.233 **
coh5	.566 **	.085
coh6	.786 **	.500 **
occ0	-.104	-.184
occ3	-.102 **	-.138 **
occ4	-.383 **	-.185
R^2	.103	.040

Table 3: Estimated coefficients of probit models for male exit into retirement (** indicates an observed significance level below 5%, * indicates an observed significance level between 5 and 10%).

	Accrual			Peak value			Option value		
cons	-2.076 **	-2.068 **	-2.020 **	-2.093 **	-2.085 **	-2.041 **	-2.169 **	-2.160 **	-2.129 **
age1	.110 **	.094 **		.115 **	.099 **		.133 **	.117 **	
age51			.081			.080			.104 *
age52			.143 **			.142 **			.190 **
age53			.211 **			.241 **			.314 **
age54			.267 **			.302 **			.392 **
age55		.132 **	.555 **		.143 **	.592 **		.145 **	.700 **
age56			.554 **			.591 **			.716 **
age57			.537 **			.576 **			.723 **
age58			.721 **			.762 **			.924 **
age59			.740 **			.782 **			.960 **
age60		.821 **	1.715 **		.817 **	1.759 **		.807 **	1.947 **
age61			1.248 **			1.296 **			1.503 **
age62			1.173 **			1.225 **			1.458 **
age63			1.043 **			1.099 **			1.358 **
age64			1.245 **			1.300 **			1.551 **
age65		.093	1.460 **		.088	1.524 **		.094	1.819 **
age66			1.227 **			1.294 **			1.617 **
age67			1.741 **			1.810 **			2.157 **
age68			1.555 **			1.622 **			1.952 **
age69			1.604 **			1.669 **			1.976 **
coh1	-.082 **	-.086 **	-.089 **	-.087 **	-.090 **	-.092 **	-.100 **	-.104 **	-.105 **
coh3	.098 **	.097 **	.094 **	.098 **	.098 **	.095 **	.098 **	.098 **	.096 **
coh4	.261 **	.280 **	.284 **	.264 **	.283 **	.286 **	.278 **	.297 **	.300 **
coh5	.620 **	.630 **	.627 **	.598 **	.610 **	.611 **	.622 **	.634 **	.634 **
coh6	1.114 **	1.093 **	1.054 **	.938 **	.923 **	.904 **	.918 **	.905 **	.886 **
occ0	-.158	-.118	-.127	-.157	-.117	-.128	-.143	-.103	-.114
occ3	.079 **	.099 **	.099 **	.055 *	.076 **	.078 **	.026	.048	.049
occ4	.642 **	.640 **	.639 **	.639 **	.635 **	.634 **	.490 **	.495 **	.497 **
Y	-.076 **	-.075 **	-.075 **	-.077 **	-.076 **	-.075 **	-.085 **	-.084 **	-.083 **
PY	.038 **	.038 **	.038 **	.035 **	.035 **	.035 **	.006 *	.007 **	.007 **
ssw	.002 **	.002 **	.002 **	.002 **	.002 **	.002 **	.005 **	.004 **	.004 **
accr	.002 **	.002 **	.002 **						
peak				.003 **	.002 **	.002 **			
ov							.004 **	.003 **	.003 **
R^2	.160	.178	.180	.160	.179	.181	.170	.188	.190

Table 4: Estimated coefficients of probit models for female exit into retirement (** indicates an observed significance level below 5%, * indicates an observed significance level between 5 and 10%).

	Accrual			Peak value			Option value		
cons	-1.671 **	-1.740 **	-1.776 **	-1.641 **	-1.704 **	-1.748 **	-1.699 **	-1.772 **	-1.859 **
age1	.038 **	.044 **		.046 **	.052 **		.062 **	.067 **	
age51			.077			.089			.133
age52			.078			.089			.164
age53			.071			.135			.257 **
age54			.140			.201 *			.278 **
age55		.449 **	.720 **		.468 **	.786 **		.465 **	.886 **
age56			.613 **			.675 **			.790 **
age57			.486 **			.550 **			.690 **
age58			.478 **			.541 **			.689 **
age59			.344 **			.415 **			.596 **
age60		-.034	.464 **		-.038	.537 **		-.042	.709 **
age61			.478 **			.563 **			.763 **
age62			.581 **			.674 **			.900 **
age63			.382			.481 **			.684 **
age64			.415 *			.522 **			.740 **
age65		-.526 **	.183		-.522 **	.303		-.532 **	.538 **
age66			.893 **			1.006 **			1.240 **
age67			.828 **			.949 **			1.187 **
age68			-.264			-.148			.054
age69			1.159 **			1.281 **			1.525 **
coh1	-.044	-.037	-.019	-.055	-.052	-.032	-.069	-.062	-.035
coh3	.121 *	.116	.116	.127 *	.124 *	.128 *	.111	.106	.108
coh4	.239 **	.224 **	.216 **	.242 **	.231 **	.227 **	.212 **	.199 **	.193 **
coh5	.028	-.008	-.012	-.019	-.061	-.064	-.022	-.046	-.042
coh6	.675 **	.664 **	.657 **	.468 **	.393 **	.347 *	.485 **	.453 **	.452 **
occ0	-.186	-.208	-.226 *	-.180	-.203	-.224 *	-.173	-.199	-.223 *
occ3	-.013	-.004	-.002	-.012	-.004	-.001	-.061	-.056	-.055
occ4	.667 **	.680 **	.698 **	.672 **	.686 **	.697 **	.346	.341	.326
Y	-.126 **	-.127 **	-.129 **	-.126 **	-.128 **	-.129 **	-.136 **	-.138 **	-.140 **
PY	.079 **	.086 **	.089 **	.061 **	.065 **	.068 **	.024 *	.029 **	.032 **
ssw	.002 **	.002 *	.002 *	.004 **	.003 **	.003 **	.006 **	.006 **	.005 **
accr	.005	.008	.012 **						
peak				.008 **	.011 **	.012 **			
ov							.006 **	.006 **	.006 **
R^2	.131	.141	.148	.133	.144	.150	.138	.149	.156

Figure 1: Mortality rates and implied survival rates conditional on survival at age 50 by sex, age and cohort.

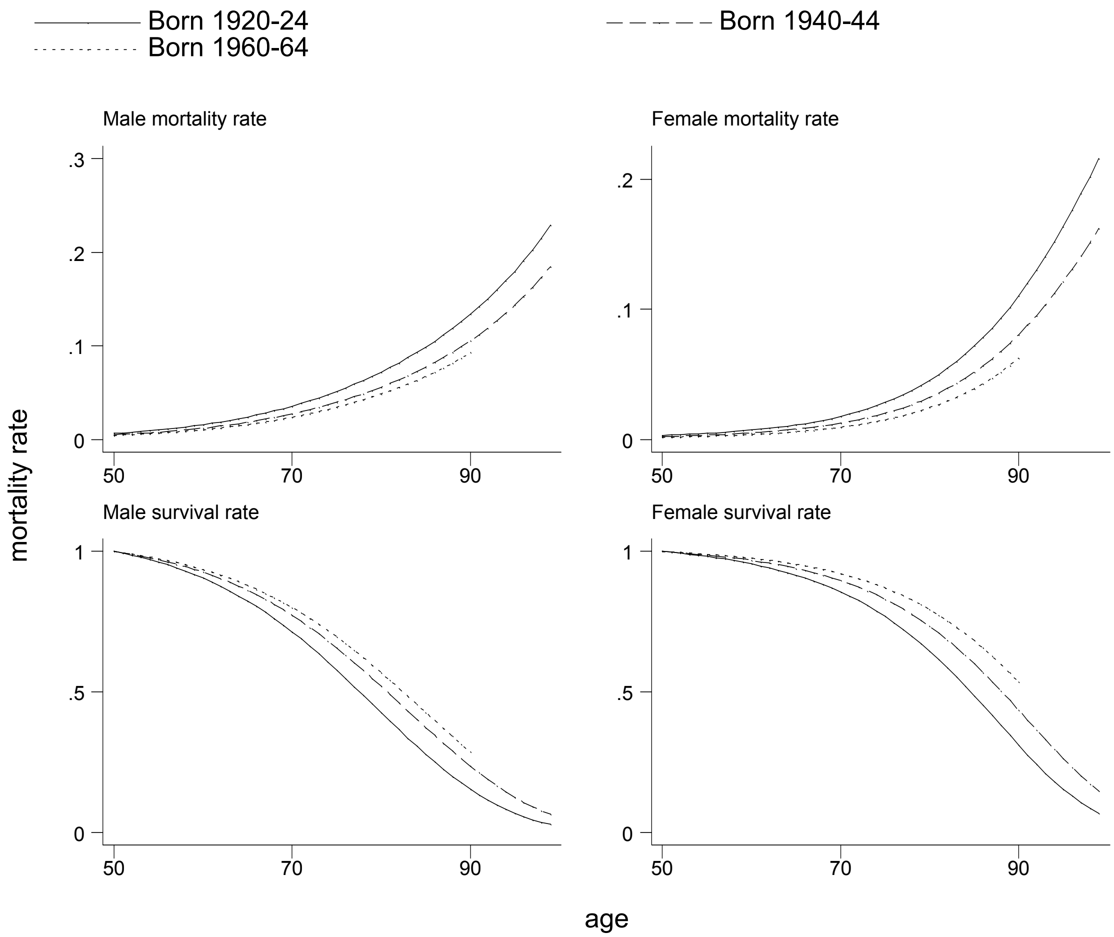

Figure 2: Estimated male age-earnings profiles.

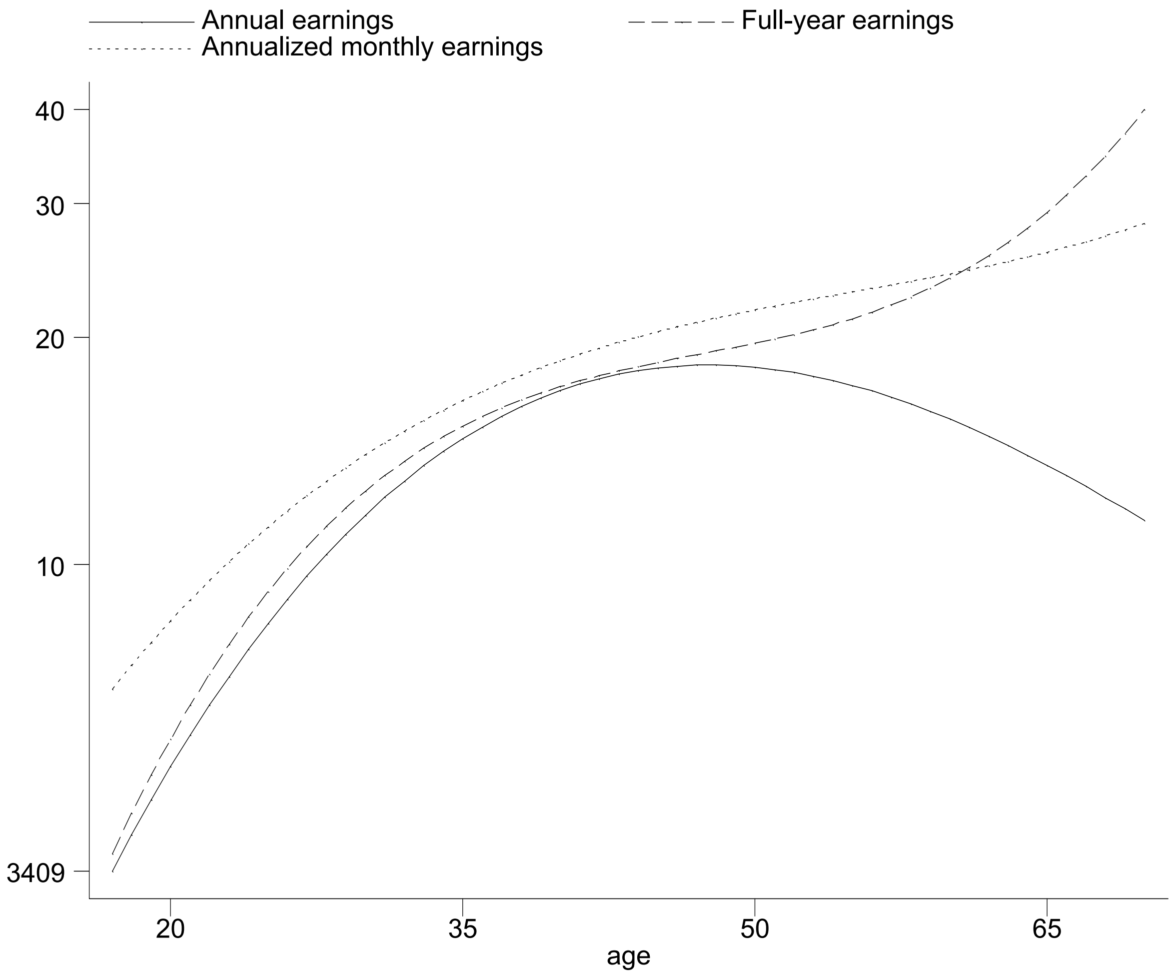

Figure 3: Estimated female age-earnings profiles.

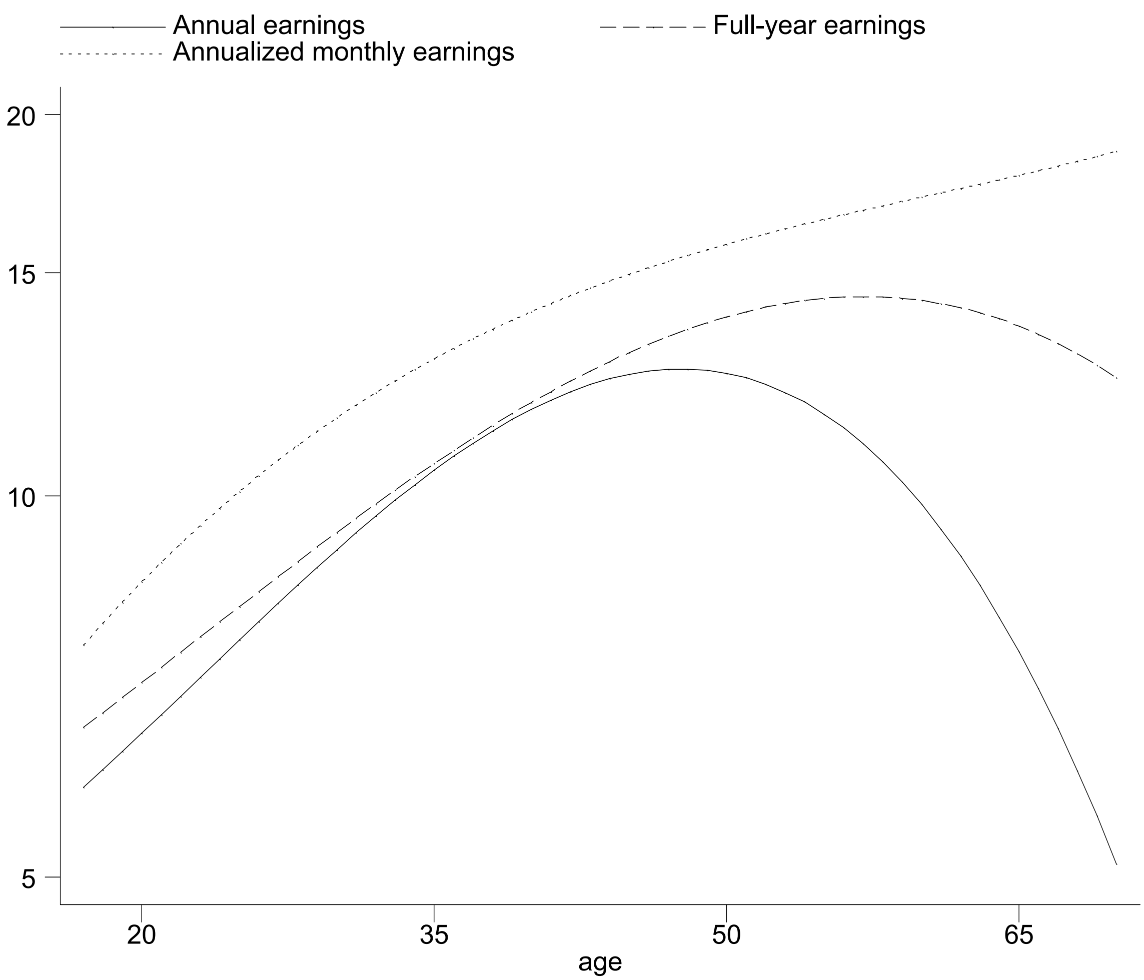

Figure 4: Estimated male earnings fixed effects: Averages by birth cohort.

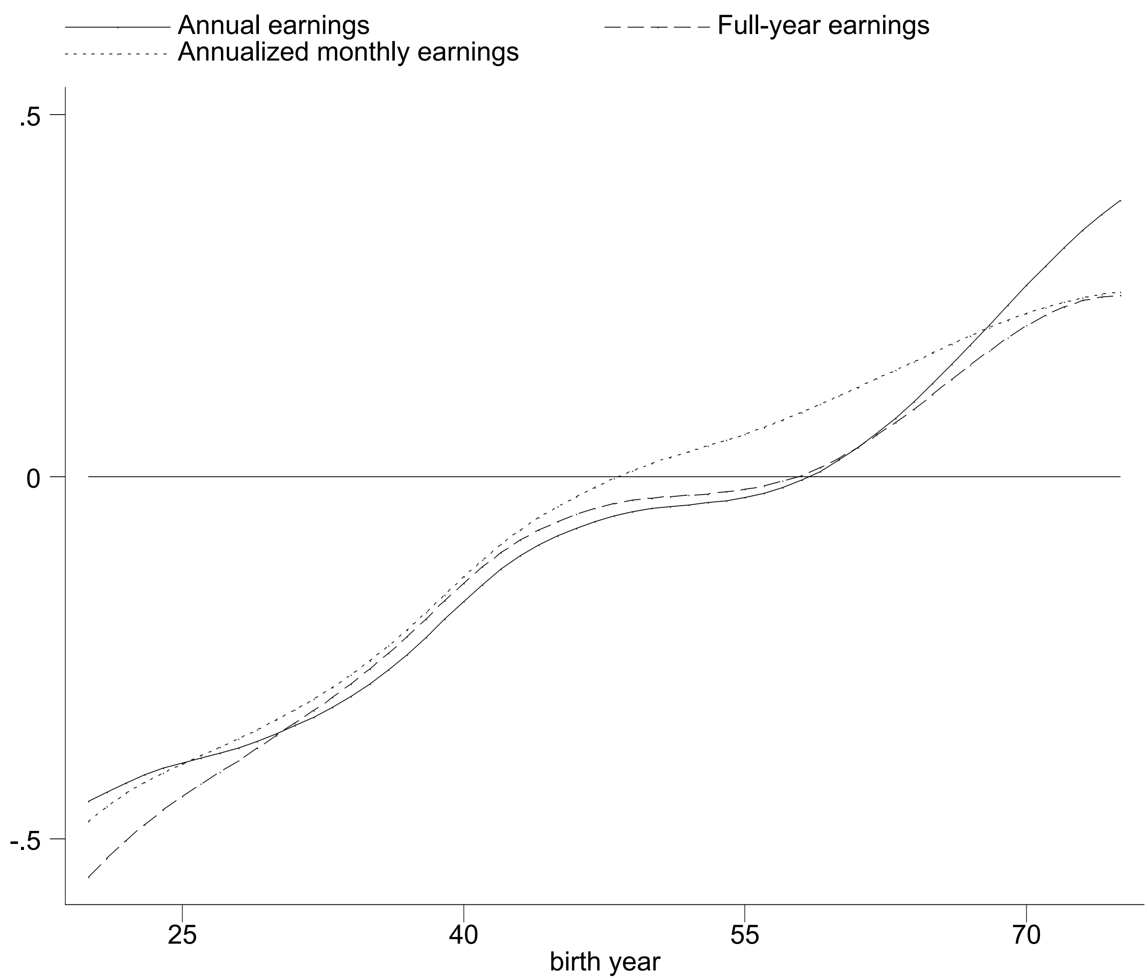

Figure 5: Estimated female earnings fixed effects: Averages by birth cohort.

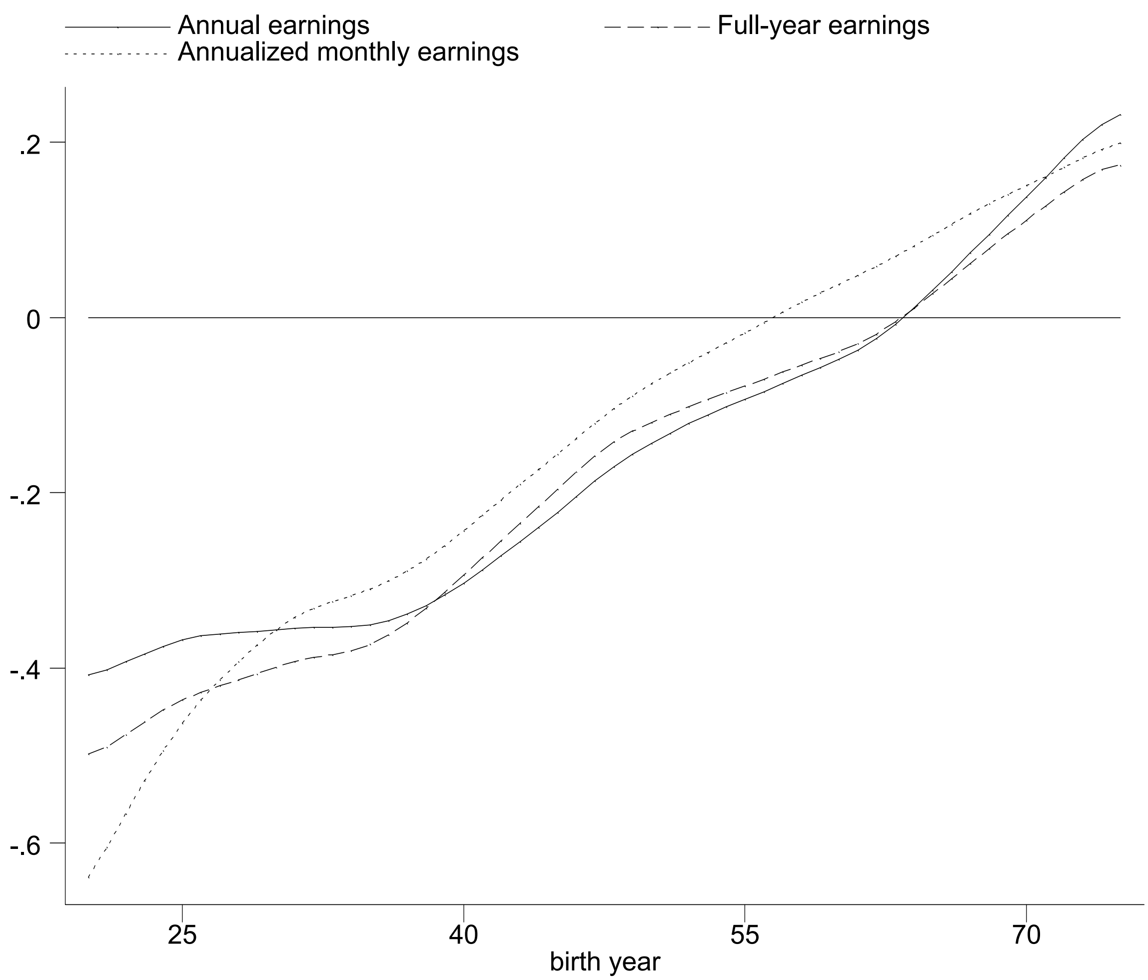

Figure 6: Retirement rates by sex and age.

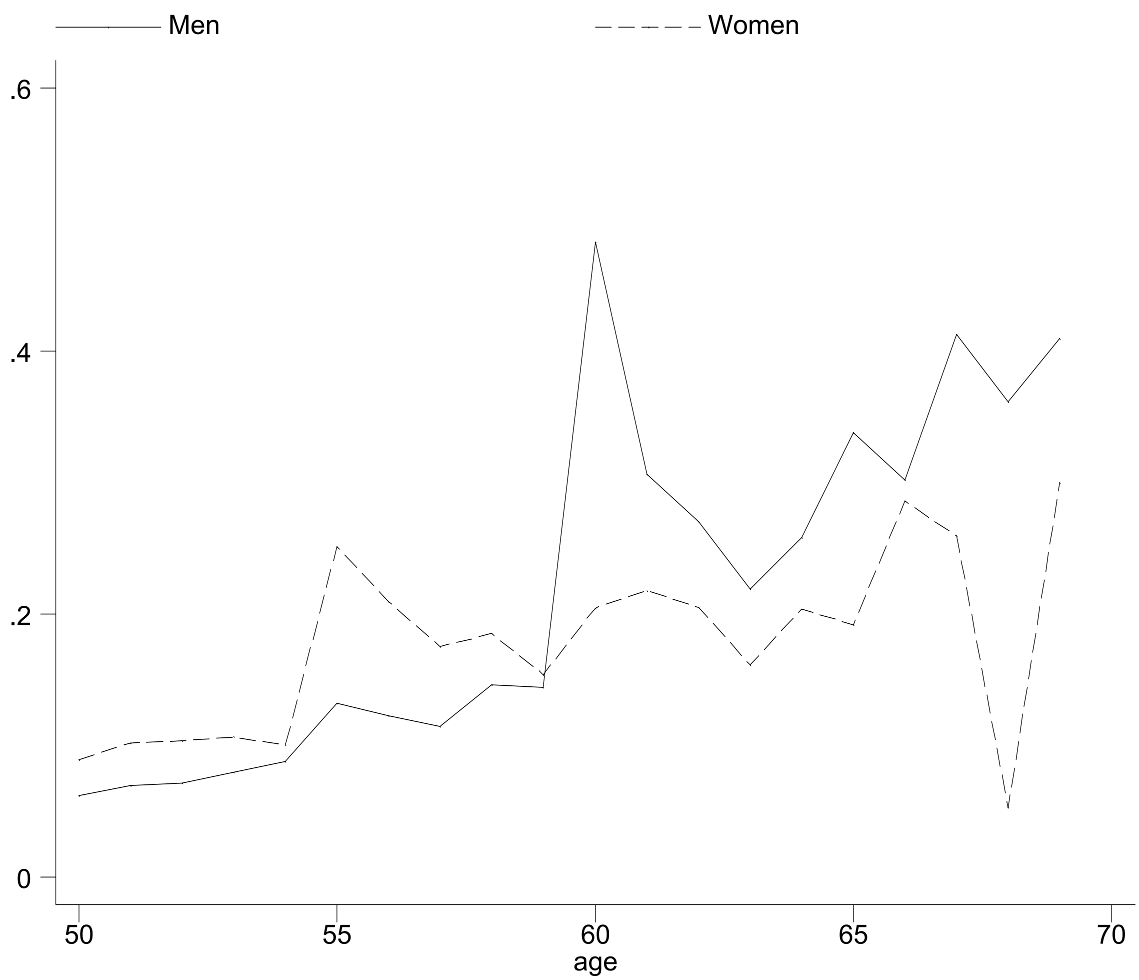

Figure 7: Age-profile of employment rates by sex conditional on employment at age 50.

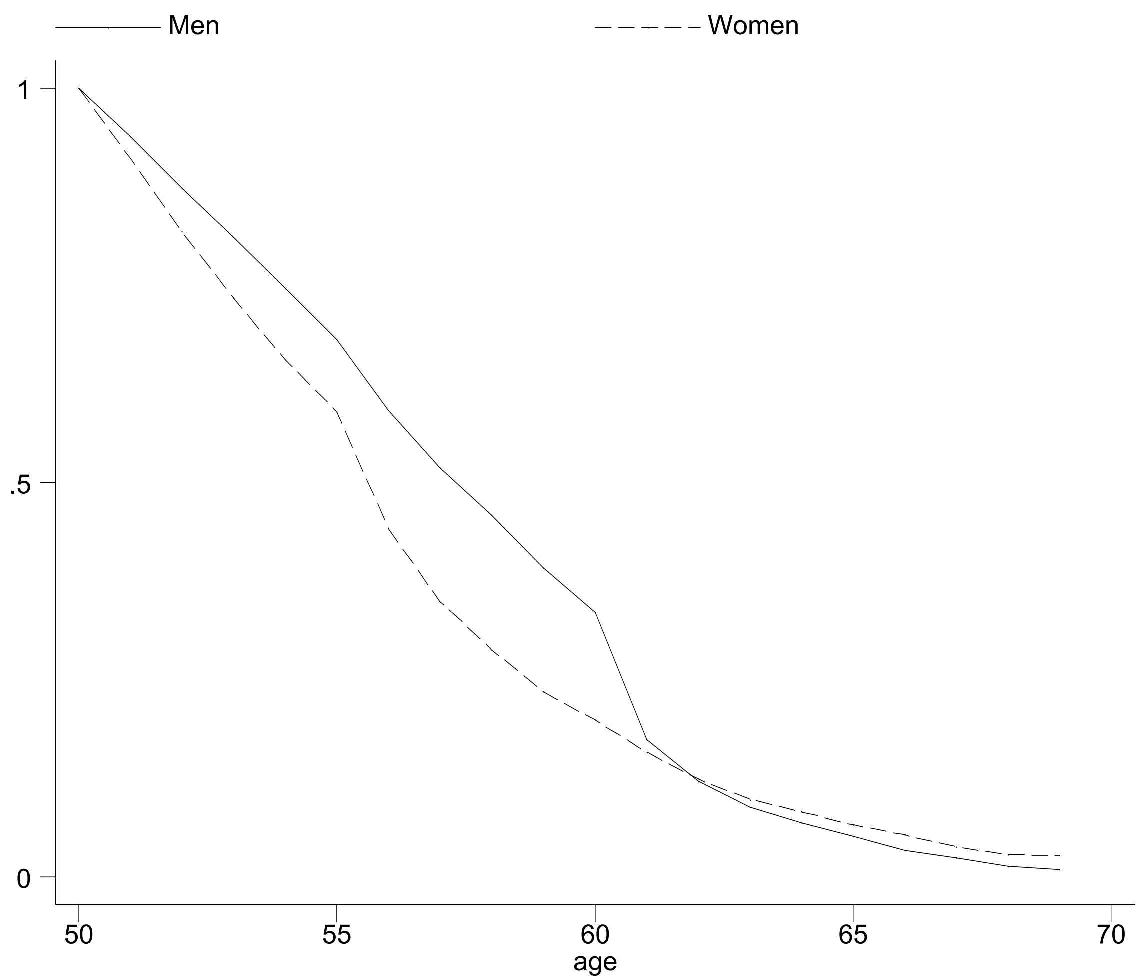

Figure 8: Age-profiles of average male retirement rates implied by the estimated models.

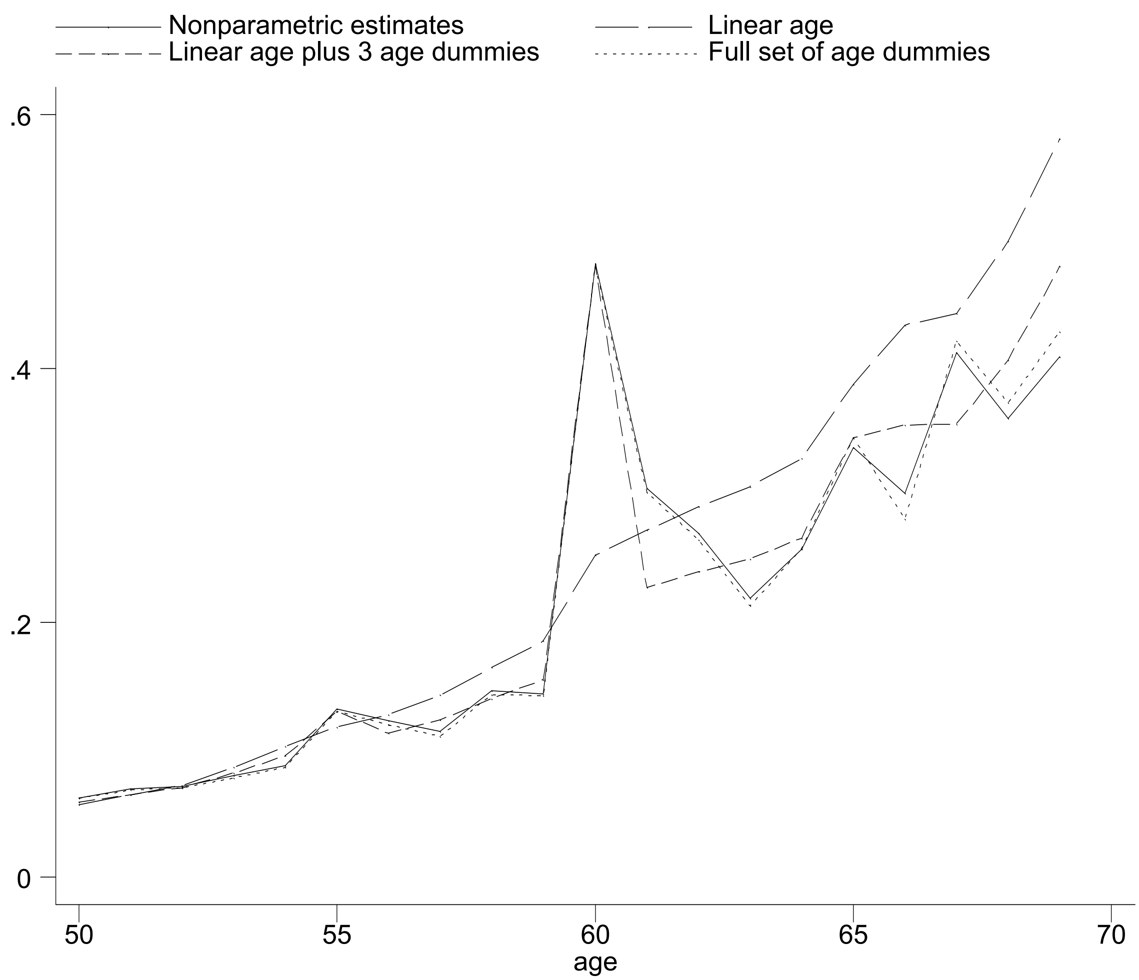

Figure 9: Age-profiles of average female retirement rates implied by the estimated models.

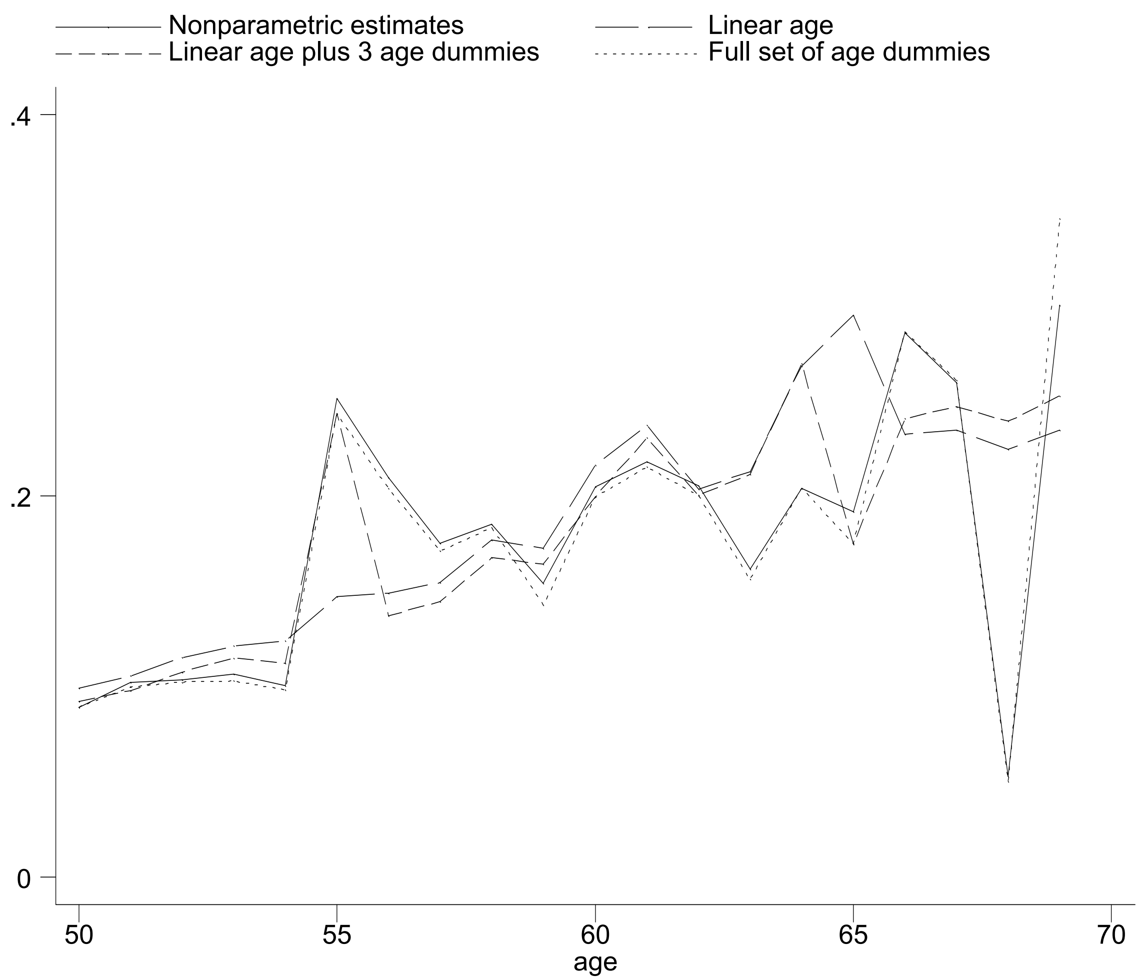

Figure 10: Age-profiles of the median values of SSW, 1-year accrual, peak value and option value by regime. Men.

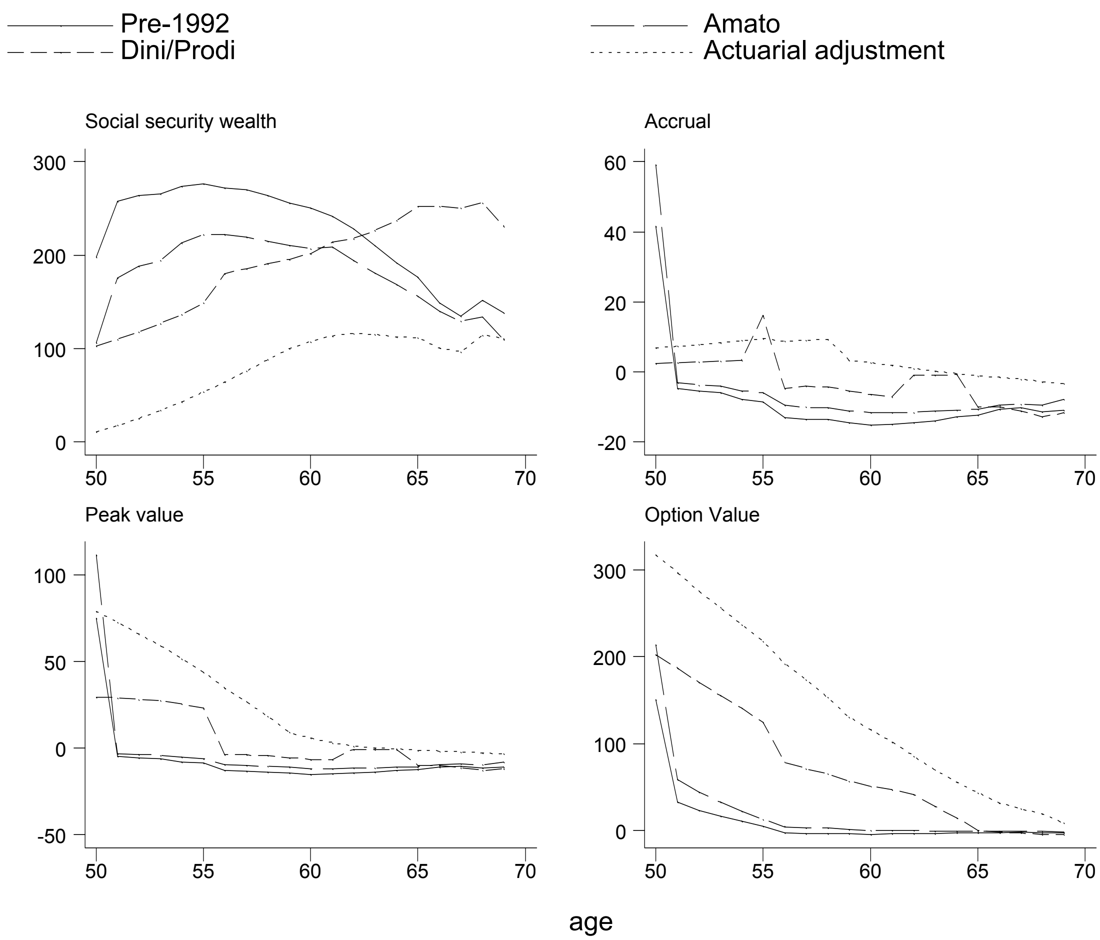

Figure 11: Age-profiles of the median values of SSW, 1-year accrual, peak value and option value by regime. Women.

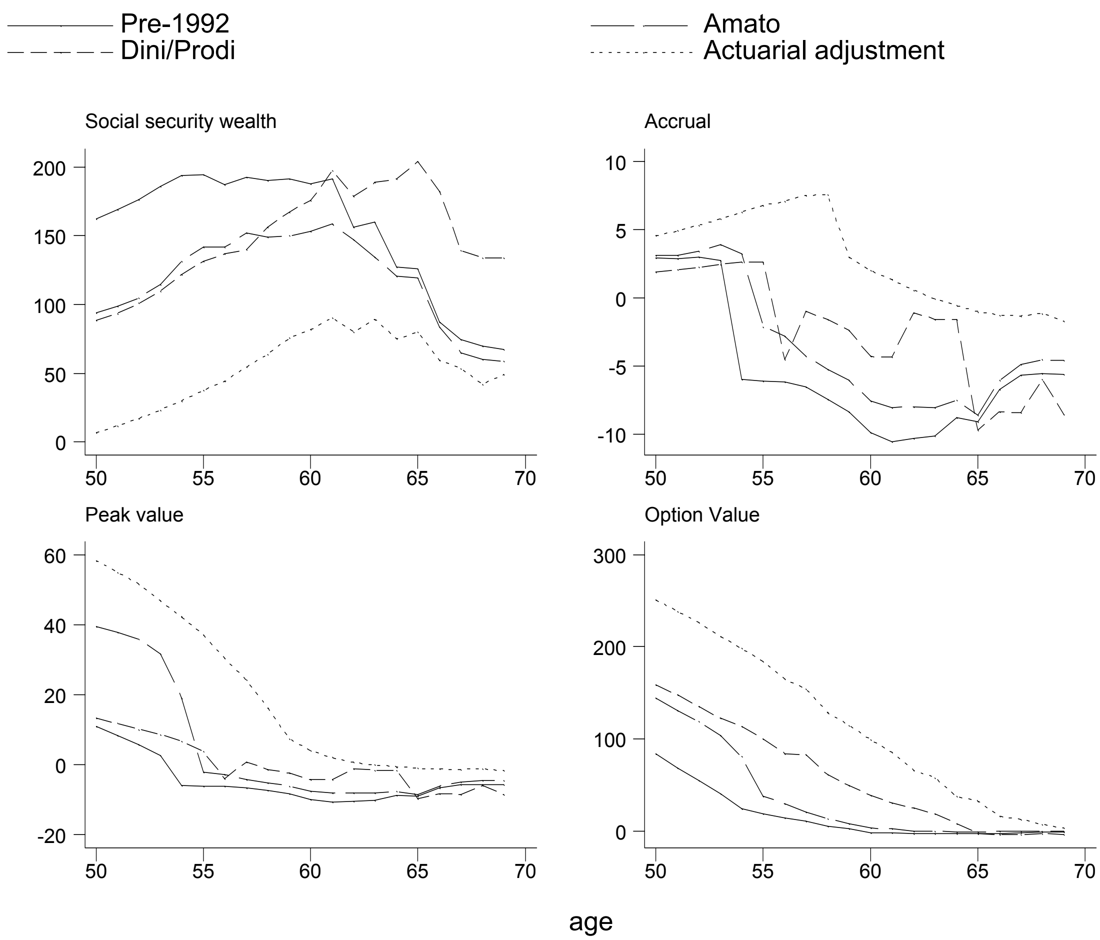

Figure 12: Predicted age-profiles of exit rates into retirement by regime and implied employment rates conditional on employment at age 50.