Micro Modeling of Retirement Behavior in Italy

by

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1. Introduction

This paper presents an empirical analysis of the retirement decisions of Italian workers. We emphasize the role played by dynamic incentives, built in the social security system, which encourage (or discourage) retirement. The basic idea is that, at any given age and based on the available information, workers compare the expected present value of two alternatives, retiring today and working one more year, and then choose the one which is best. A key role in this kind of comparisons is played by social security wealth, whose level and whose changes on a year-to-year basis and over the worker's residual life reflect 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. These incentive measures are relevant in explaining retirement decisions as, according to the prevailing legislation, there are substantial gains or losses from retiring at particular ages. Notice, however, that our model does not pretend to be a structural representation of the retirement process, as a worker's decision is modeled here following a simple reduced form approach, where the incentive measures enter as predictors of a worker's binary choice, in addition to standard variables such as sex, age and other background variables.

We use a longitudinal sample of Italian workers drawn from the social security archive containing the information on private sector employees. We have available twenty years of data and can follow workers from the moment they start an employment spell in the private sector until they permanently leave the archive. Hence, we can model age-earnings profiles for all workers in the sample. This enables us to project their earnings forward and compute social security wealth in order to carry out the empirical analysis described above. Results from the estimated binary choice model are then used to predict retirement probabilities under alternative policy arrangements. A basic feature of the simulated policies is to make retirement (particularly early retirement) more costly or to make eligibility requirements more stringent. Because changes in policy imply changes in the incentive measures, we expect to observe an impact on retirement probabilities.

Our results suggest that incentives are important in explaining retirement decisions, although the interaction of age and dynamic incentives is rather complex. In some of our policy simulations we observe a shift in the age hazard into retirement toward older ages, and also (but this is less frequent) an increase of the mean retirement age in response to the policy change.

The remainder of the paper is organized as follows. Section 2 reviews the recent situation of the Italian social security system in terms of expenditure trends and financial viability. It also describes recent institutional changes and labor market trends. Section 3 provides a description of the available data and discusses the methodology and the results of estimating age-earnings profiles. Section 4 looks at the definitions of the incentive variables and highlights some of the methodological issues involved in computing these measures in our sample. Finally, Section 5 presents the results of the econometric exercise, as well as the results of the simulations.

2. Recent situation and institutional details

In this section, we briefly describe the current situation of the Italian social security system. After summarizing the institutional details of the system before the beginning of the reform process in 1992, we look at the steady-state characteristics of the system introduced with the 1995 reform. For the scope of this study, the transitional arrangements are also important. Finally, we discuss recent trends in retirement patterns and review the results of the available empirical literature.

2.1 Recent expenditure trends

Figure 2.1 shows the historical trends in the number of pensions (top-left panel), average pension amounts (top-right panel), total pension expenditure (bottom-left panel) and the ratio of pension expenditure to GDP (bottom-right panel) as measured by the National Institute of Statistics (ISTAT, 1999). We only consider expenditure on old-age, disability and survivor pensions, thus excluding non-contributive pensions. In 25 years, from 1975 to 1999, the number of pensions outstanding grew by more than 40 percent, from 12.4 to 17.8 millions, and the average pension amount more than doubled in real terms, from 7.1 to 16.1 million It.L. at 1998 prices. Therefore, total expenditures increased by more than three times and the ratio of pension expenditure to GDP rose by more than 5 percentage points, from 8.4 to 13.6 percent. No other country in the European Union experienced such a dramatic growth.

The increase in the number of pensions outstanding reflects both the progressive aging of the Italian population and the steady reduction of the average retirement age, largely due to people taking advantage of the possibility of retiring with a seniority pension (*pensione di anzianita`*) after 35 years of contributions to the system (or even less for public sector employees) without any actuarial reduction. On the other hand, the rise of average pensions is due to the sharp increase of lifetime earnings of successive cohorts of workers, a number of legislated changes which made the system progressively more generous, and the fact that until 1992 outstanding pensions were linked to productivity growth.

Notice that, after increasing very fast during the 1970s, pension expenditure slowed down during the first half of the 1980s. Expenditure resumed growing very rapidly from the mid-1980s to the early 1990s when two major reforms, in 1992 and 1995 (known respectively as the "Amato reform" and the "Dini reform" from the names of the Prime Ministers then in charge), apparently succeeded in stabilizing the ratio of pension expenditure to GDP. The next subsections discuss in more detail the rules prevailing before 1993 and the reforms of the 1990s.

2.2 The rules prevailing before 1993

The Italian social security system is based on a variety of institutions administering public pension programs. About two thirds of the workforce is insured with the National Institute of Social Security (*Istituto Nazionale della Previdenza Sociale* or INPS)[1]. This is responsible for a number of separate funds, of which the most important covers the private sector employees (*Fondo Pensioni Lavoratori Dipendenti* or FPLD).

In this section, we describe the main rules prevailing before 1993. In 1992, a major reform was introduced, followed by another major reform in 1995, and further changes in 1997. These reforms are

[1] It covers the vast majority of the private sector employees and the self-employed. Public sector employees are covered by a completely separate administration (INPDAP).

discussed in Section 2.3. We focus on the FPLD fund, because our empirical exercise uses data on private sector employees. This description is incomplete, however, as important differences exist between the rules for private and public sector employees. Further, the self-employed are characterized by a separate fund and enjoy a particularly favorable treatment in terms of both contributions and benefit calculation.

Payroll social security taxes

The resources to the system come mainly from the employers' and employees' contributions. Outlays exceed revenue, however, and the resulting deficit is financed by the Central Government that has come under increasing pressure to pay for pensions.

The payroll tax is unevenly shared between the employer and the employee. For the FPLD, the total payroll tax was 24.51% of gross earnings until 1992, of which 7.15% falling on the employee. This grew to 27.17% in 1992 (of which the worker paid 8.34%) and 33% in 1998 (of which the worker pays 8.89%). Social security taxes for public sector employees have been lower in the past but are now in line with those in the private sector. [2]

Employees contribute a further 7.41% to a "severance pay fund" known as TFR[3]. These contributions are retained by the employer and build up in a fund that offers a legislated rate of return (1.5% plus 75% of the annual inflation rate) and provides a lump sum benefit when the employee leaves the firm.

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[2] While 33% is the level of the payroll tax used in the benefit-calculation formula, the actual amount paid is 32.7%. In contrast to employees, social security taxes for the self-employed remain considerably lower, the tax rate is notionally set at 20%, but the effective payroll tax rate is 15%.

[3] TFR stands for *Trattamento di Fine Rapporto*.

Eligibility

Before 1993, eligibility requirements were met when a male worker reached age 60 (a female worker age 55) after contributing for at least 15 years. However, the existence of an early retirement option made the age-requirement largely irrelevant for private sector workers with uninterrupted work careers, because they could claim early retirement benefits at any age after completing 35 years of contributions[4].

A feature that is important when discussing labor supply incentives provided by the system is the retirement earnings-test. Italian workers can draw a pension and earn income at the same time, but there are earnings-cutoffs that tend to discourage this choice. The cutoffs changed over time and have been affected by the reforms. Prior to 1993, private sector employees could receive an old-age pension along with earnings only if earnings did not exceed the minimum pension benefit. Early retirement benefits could not be received along with earnings[5].

Eligibility criteria and the rules for benefits calculations were responsible for the highly redistributive nature of the pension program. Most importantly, they affected retirement decisions and the choice between dependent employment and self-employment in a non-trivial fashion. In particular, there was a clear incentive to early retirement as no actuarial penalty applied to early retirees. For example, a private sector employee who started working at age 16 could retire at age 51 with a full pension. This helps to explain why

[4] For a male public sector employee, only 20 years of contributions were required (15 years for a married woman).

[5] Note that the self-employed could claim early retirement without restrictions on earnings. Also cutoff points on earnings did not apply to this group of workers when claiming old age benefits. Only in 1998 early retirement benefits are reduced for a working self-employed.

exit from the labor force increased significantly over time for the age group 50-59.

Benefit computation

Pensionable earnings for private sector employees (covered by the FPLD) were computed by averaging the earnings of the last five years before retirement[6]. Earnings were taken before tax and converted into real amounts using a consumer price index. Pension benefits were then obtained as the product of three terms: pensionable earnings, the number of years of contribution (up to a maximum of 40), and a 2% factor per year of contribution (referred to as the "rate of return"). Hence, a worker could get at most 80% of his pensionable earnings. If retirement was postponed, additional years of work beyond 40 did not count for benefit computation, although they were included in pensionable earnings as they replaced earnings of earlier years. As discussed in Section 4 below, this has important implications for the age profiles of social security wealth.

The system was highly progressive (and it still is) because of both capping on earnings and a minimum benefit level. Earnings entering the benefit computation were capped. Between 1969 and 1988, only earnings up to a legislated limit would contribute to pensionable earnings, while after 1988 different “rates of return” would be applied to different pensionable-earnings brackets[7].

[6] It is worth recalling that public-sector employees had their benefit level based on final salary rather than average earnings of the last five years of work.

[7] For example, in 1985 pensionable earnings in excess of 32 million Lit (1.6 times the average earnings of that year) would not be included in benefit calculations. After 1988 the constraint became less stringent but a lower "rate of return" was applied to pensionable earnings in excess of the legislated limit. In 1995, a 2% rate applied to the first 57 million It.L. (again 1.6 times the average earnings), a 1.5% rate to pensionable earnings between 57 and 76 million It.L. (2.2 times the average earnings), and a 1.25% rate to pensionable earnings between 76 and 95 million It.L.

Contributions were not subject to income taxes but social security benefits were taxed at the normal income tax rates[8]. For all funds, benefits were indexed both to consumer price inflation and real earnings growth[9]. The former was measured by the consumer price index, but was implemented in a slightly staggered fashion (e.g. if the pension amount is more than three times the "minimum benefit", then indexing is based only on 75% of the price change). The measure of earnings growth took into account changes in real wages in both the private and the public sector.

Minimum benefit

This provision of the Italian system is important for at least two reasons. First, the number of retirees involved is non-negligible (see Table 2.4). Second, the minimum benefit is often used as a benchmark for income transfers from other assistance programs. In practice, if the benefit formula results in a benefit level below a legislated threshold, then the benefit itself is increased up to the threshold. Until 1983, this provision could be applied to more than one pension for the same retiree. Now, it only applies to one pension, leaving the other benefits at their original level. Minimum benefits are means-tested. Until 1992, the test was based only on the claimant's income, excluding the income of the spouse. For example, in 1985, the means-test had a cutoff at twice the minimum level

(2.7 times the average earnings). Finally, a 1% rate of return applied to the top earnings bracket. The generosity of the system towards low-income workers was further increased by the *minimum benefit* provision, i.e. a floor on the benefit level.

[8] The principle of taxing pension benefits but not taxing contributions remains valid after the reforms..

[9] These growth rates were combined in a specific index computed by the INPS administration (*coefficiente di perequazione*). The frequency was: every four months between 1983 and 1986, every six months between 1986 and 1992 and annually after the 1992 reform.

(roughly 4.7 million It.L. of that year, corresponding to 17% of mean household income of the same year). A limit on individual income still applies to singles. For married couples what matters now is instead the sum of incomes of both spouses, which must be less than 4 times the minimum level (approximately 8 million Lit in 1995, corresponding to 18% of mean household income).

2.3 The reforms of the 1990s

Some of the issues emerging from the above description of the pre-1993 system have been tackled by the recent reforms. A first reform (the so-called "Amato reform") was passed by Parliament in 1992 and took effect in 1993. It raised the normal retirement age and the minimum number of years of contribution by five years, lengthened the reference period for calculating pensionable earning, restricted the special eligibility conditions applying to public sector employees, eliminated pension indexation to real wage growth by indexing pensions only to price inflation, and increased social security contributions.

The 1992 reform was the first signal of a coherent attempt at redesigning the social security system and reducing pension expenditures. However, it left the rules governing early retirement almost untouched and, overall, it did not produce the much needed short-term savings in the social security budget[10]. This partly justified the need of a second reform in 1995 (the so-called "Dini reform"), which totally changed the basic rules for granting benefits to future retirees and tried to harmonize the actuarial rates of return for early and late retirees.

The 1995 reform goes under the heading of "virtual" funding, as public pensions are still financed through a pay-as-you-go scheme

[10] The next section 2.4 analyzes some of the effects of the 1992 reform and of the 1995 reform.

but each worker holds a claim based on a fund that remains only "virtual". The new system is similar to the one recently adopted by Sweden[11]. Crucial elements of the reform are: (i) how the accrued value of the "virtual" fund is computed, (ii) how it is then converted into an annuity at the time of retirement, and (iii) the indexation rule adopted for the pensions outstanding. Lifetime tax payments are capitalized at an annual rate equal to a (5-year) moving average of past GDP growth rates. The level of benefits (the annuity) no longer depends on final earnings, as in the previous system, but is instead proportional to the value of accrued social security tax payments. The proportionality factor increases more than proportionally with the retirement age up to age 65, and then flattens out. Its current age profile implies an actuarial reduction of 23 percent in pension benefits for retirement at age 57 relative to retirement at age 65, and has been legislated keeping two key elements into account: the average residual life expectancy at retirement based on the 1990 life tables and a fixed real rate of return of 1.5% which reflects long-run forecasts of annual GDP growth. Finally, outstanding pensions are going to be indexed to price inflation only, and not to real wage growth.

The 1995 reform changed eligibility rules by allowing people to retire at any age after reaching age 57 provided that they meet two conditions: (a) they must have contributed to the system for at least 5 years, and (b) the value of their pension must be at least 1.2 times the non-contributive pension which is paid to those aged 65+ who have no other income source ("social" pension). Besides changing the benefit formula and the eligibility rules, the 1995 reform also took a number of steps in the direction of unifying the rules of the many schemes in which the Italian social security system is organized.

[11] This system of recording contributions without actually building up a fund is also referred to as "notional funding".

Once phased in, the 1995 reform will imply a more transparent and actuarially fair pension system. The reason is twofold. First, benefits are more clearly linked to contributions than it was the case with the previous “final salary" type formulae, thus reducing negative incentive effects on labor supply. Second, the whole workforce is now covered by essentially the same system, thus reducing “accidental” incentive effects in favor of certain types of employment (public sector employees and the self-employed). The system is not completely neutral, however, and a number of provisions still exist that tend to favor the self-employed[12].

Table 2.1 summarizes the key features of three regimes: the one prevailing before the 1992 reform (denoted as pre-1993 regime), the one prevailing at the steady state after the 1992 reform and the ones after the 1995 reform. In practice, both the 1992 and the 1995 reforms are characterized by a very long transitional period. For workers with less than 15 years of contributions at the end of 1992, the provisions for the transitional period establish eligibility and benefit computation criteria on a pro-rata basis. This method allows the rules of the old regime to hold for the fraction of years in employment under that regime, while the remaining fraction is regulated by the new rules. For these workers, eligibility and social security benefits are therefore computed taking into account three different systems of legislation. For workers with at least 15 years of contribution at the end of 1992, the rules of the pre-1992 regime apply with only small changes. Therefore, people will retire under the pre-1993 system until about the year 2015. During the following 15-

[12] For example the self-employed still enjoy lower contribution rates (see also footnote 2). Furthermore not all funds are affected by the reform, for example a number of special funds for “professional” self-employed (such as Lawyers, Architects and Building Engineers, Accountants) still work according to their own rules, although attempts at harmonizing these rules with those of the employees fund are taking place.

20 more years, an increasing fraction of a retiree's pension will be computed on the basis of the new system. It will only be around 2030 that a significant number of workers will start retiring fully under the 1995 rules.

In our paper, the only relevant transitional phase is the one introduced by the 1992 reform. According to these rules, the normal retirement age for a private sector employee gradually increases to reach 65 for men and 60 for women in year 2000. It should be mentioned that between 1992 and 1997 there have been spells (typically lasting between 6 months and 1 year) in which many employees were not allowed to take early retirement[13]. During the transitional phase, the benefit calculation distinguishes workers depending on their seniority and deals differently with contributions paid before and after the reform as detailed in Table 2.2. It is clear that the transitional rules mainly affect younger workers.

2.4 Future prospects

So far, the effects of the 1995 reform on pension expenditure have been only minor. After 1995, pension expenditure resumed growing at rates that, although lower than in the past, have nevertheless been higher than GDP growth rates (Figure 2.1). Further, the slowdown of expenditure growth is largely the result of decisions taken in 1992, namely the switch from double-indexing of pensions (to price inflation and productivity growth) to price-inflation indexing, the introduction of limitations to early retirement, and the gradual increase of the normal retirement age. However, as we discuss below, the changes in eligibility for old age and early retirement benefits brought about by the reforms have not been particularly effective: the

[13] The 1995 reform has gradually removed these constraints. In the transitional phase starting in 1996 public sector employees who claimed early retirement benefits suffered minor reductions on the basis of actuarial adjustment factors.

elimination of the double-indexation has been by far the most important change.

In order to evaluate the future prospects of the Italian public pension system, we need to start from the available demographic projections. Indeed, the ones produced by ISTAT for the period 1996-2050 have attracted considerable attention in the public policy debate. They portray a rather worrisome picture as the elderly dependency ratio, that is, the ratio between the elderly population (people aged 60+) and the working age population (people aged 20-59), is expected to grow from 40% in 1996 to 83% in 2050. These projections have been criticized for being too optimistic, because they rule out further declines in mortality. On the other hand, they appear to underestimate migration, which could play an offsetting role.

Besides demographics, the other crucial variable for judging the future viability of the social security system is labor market trends. Past trends in labor force participation, described in Brugiavini (1999), show a progressive detachment of older workers from the labor force. Here we look at more recent evidence on the labor market behavior of older workers.

Figure 2.2 shows the time series of labor force participation rates (top panels) and employment rates (bottom panels) by age group for the period from October 1992 to April 2000, separately for men and women. The data have been computed from the micro-files of the quarterly labor force survey and have been normalized by taking indices with base October 1992 = 100. For men, a relatively stable labor force participation rate (and employment rate) is observed after 1998 in all age groups. This occurs after a period of marked decline in participation. It is interesting to note that, after 1996, labor force participation is slowly starting to increase for the age group 50-54, while it remains at a low level for the other two age groups. Women aged 50-54 and 55-59 also show increasing participation after the beginning of 1995, whereas men and women aged 60-64 show a very similar negative trend.

The interpretation of these findings is that the recent reforms have affected retirement behavior in two ways. Initially, reforms had mainly an "announcement" effect and workers – particularly younger retirees - claimed retirement as soon as they could in order to avoid losing the option of leaving the labor market in subsequent years. After 1997, however, the eligibility rules built into the new system start to become binding (see Table 2.3) and workers, particularly the younger cohorts of potential retirees, were forced to delay retirement[14]. Overall, there is some evidence that the recent reforms of the Italian social security system begin to have an impact on the retirement behavior of older workers, although this is unlikely to revert the pension expenditure trends of the recent past and to counteract the aging process of the Italian population.

2.5 Literature review

To our knowledge, only three studies are currently available in Italy that try to explain the individual decisions to retire from the labor force, in particular the choice of the retirement age and the specific pathway of exit. The problem, however, is of great importance. Take for example the dramatic decline in labor force participation of men aged 50-59 following the start of the lengthy process of social security reforms in 1992. This decline has been missed entirely by the reduced form model used by the actuaries of the main social security funds, which are based on simple extrapolation of the trends prevailing up to the early 1990s (see for example INPS, 1995).

The first study, by Miniaci (1998), analyses the effects of socio-economic and demographic characteristics on the choice of

[14] See also Franco, 2000, for similar arguments in an appraisal of the recent Italian reforms.

labor force status using the 1995 Survey of Household Income and Wealth (SHIW) carried out by the Bank of Italy. The sample consists of heads of households and their partners who were in the labor force at the age of 45 (if women) or 50 (if men). The retirement age is obtained from the retrospective questions asked in the survey about the time when pension benefits started being received. The basic model is a multinomial logit specification with three states: working, receiving an old age or seniority pension, and receiving other pensions (invalidity, survivor or "social" pensions). The paper also estimates a Cox proportional hazard model for the duration of stay in employment and separate pathways of exit (old-age or seniority pension, and invalidity or other), with and without the inclusion of the predicted value of the replacement rate among the covariates. The main findings show the presence of strong cohort effects towards earlier retirement, later retirement ages among the better educated workers, lower replacement rates and later retirement ages among the self-employed, no evidence that public employees retire earlier, no evidence of a differential role of invalidity and other pensions between the North and the South, and little evidence of an effect of the replacement rate on the expected retirement age.

The second and third study, respectively by Spataro (2000) and Colombino (2000), take a more structural approach. The paper by Spataro estimates an option value model using a subset of the panel component of the SHIW for the years 1991 and 1993 (namely men aged 45-65 who are full-time employees at the end of 1990). The estimation methods is pseudo maximum likelihood based on the normality assumption. He compares the empirical results with reduced form probit specifications and the original results in Stock and Wise (1990). In particular he shows that, relative to US workers, Italian workers value their leisure more highly, are more risk averse, and have a lower intertemporal discount rate. He also shows that the option value model is unable to capture the peak in the retirement hazard at age 60.

Finally, Colombino (2000) extends the probit model estimated by Zweimüller et al. (1996) for Austria, providing a structural interpretation in terms of utility comparisons between two mutually exclusive states (employed and retired). This interpretation is based on specific assumptions about the time profiles of the instantaneous utility of being employed and retired. The model is estimated using the 1993 SHIW for those aged 40 and older. The empirical implementation of the model relies crucially on the imputation of potential earnings for those who are currently retired and of potential pension benefits for those who are currently employed. One of the main findings is that women are more sensitive than men to the rules and incentives of the system. The paper also contains an extension to the joint decision of a couple. This extension leads to a bivariate probit model whose parameters are subject to constraints and admit a structural interpretation. The model is used to simulate the effects of various policies (cut of pension benefits, elimination of seniority pensions, complete phasing in of the 1992 and 1995 reforms), distinguishing between the effects due to the changes in the way pension benefits are computed, the changes in the criteria for pension eligibility and the behavioral response to both changes. The main finding here is that behavioral effects are small, but not negligible.

3. Data description and earnings model

3.1 The data

Unlike the papers reviewed in Section 2.5, all based on the Bank of Italy's SHIW, we use a random sample of administrative records from one of the INPS archives[15]. The sample is drawn from the so-called INPS Workers-Archive (Archive O1M), which contains records on all private sector employees ensured with INPS. The information on each employee is filed in by the employer on a standard form containing a small number of entries. We have a random sample of these employees in the form of a panel covering a period of about 20 years from 1973 to 1994. The sample contains 10,000 workers entering the archive at any time during the period considered. Employment spells can last any number of years, and individuals can leave the sample and enter again in any subsequent year. The panel is therefore highly unbalanced.

The main advantages of using these data are that they span a fairly long time period and contain information on gross earnings (as opposed to net earnings as in the SHIW), which form the basis for the

[15] This is a sub-sample (one out of one hundred) workers borne either on March 1st or on October 1st of any possible year contained in the Archive. We carried out a parallel analysis of retirement decisions using the Bank of Italy –SHIW data. The SHIW is a cross-sectional sample and contains a full set of demographic variables (both on members of the household and on the household), plus labour market variables. However, the panel component of SHIW is characterized by a very small sample size and very short time span: very few transitions into retirement are actually observed. Also questions in the SHIW survey are retrospective and the survey is carried out, for the relevant period, every two years. Therefore we decided to restrict the attention to the INPS sample.

calculation of social security benefits. However, there are several shortcomings.

(1) The data set only covers private sector employees, leaving out public sector employees and the self-employed. Even for private sector employees, however, coverage is not full and a small fraction of them is not included.

(2) The reason for a worker dropping off the archive is not known: in addition to retiring, workers could die, become self-employed or public sector employees, or simply stop working.

(3) Important covariates (e.g. education level, spousal information and other family background variables) are missing: hence we have very few demographic controls available, we do not know about marital status, and cannot say much about differential mortality.

(4) There is no information on receipt of disability or other types of benefits.

The initial sample selection, carried out in order to estimate suitable earnings histories, is as follows. We focus on workers between 18 and 70 years of age. We drop observations for which one important indicator (such as age) is missing and individuals who work less than 26 days a year. We also exclude from the analysis workers belonging to special INPS funds (nursery school teachers, local authorities employees, etc.)[16]. In order to estimate earnings profiles and eventually measure social security wealth, we further select the sample by including only workers who are present in the sample for an uninterrupted period of at least five years (workers often appear for one year and then disappear from the sample for a

[16] We could include these observations to add variability across funds, but these workers represent only a small number (less than 100 observations) and tend to exhibit many gaps in their careers.

long spell). The 5-year minimum requirement is motivated by the fact that this corresponds to the minimum contributive period under the 1995 reform. We only keep workers who do not have substantial gaps (more than 10 years missing) in their records. This is because we cannot say whether in that time span they were engaged in other labor market or non-labor market activities (such as maternity leaves, or undertaking further education). The choice of a 10-year interval is arbitrary and is based on a preliminary inspection of the data[17].

In order to check the quality of our data, we carried out an extensive comparison between the basic variables in the INPS sample and those in the Bank of Italy's SHIW, using the whole sequence of SHIW cross sections for all available years between 1978 and 1995. Here we only report some of our results.

We first look at changes in the composition of the workforce. Table 3.1 measures the relative importance of private sector employees on total employment and shows a clear trend towards a reduced importance of employment in the private sector and a corresponding increase in the importance of self-employment and

[17] It should be noted that, in order to gain variability in social security benefits, we did experiment with a larger sample including almost all workers, regardless of the existence of gaps in their careers. However, this did not add valuable information as the majority of workers with substantial spells out of the private sector would end up qualifying for minimum benefits (the level of which is fixed by legislation each year) or for an old age income guarantee (*pensione sociale*). Hence there would be very little correlation between earnings histories and pension benefits for these individuals, and the effects of potential reforms in changing the incentives to retire would be negligible (these workers would basically qualify for the minimum benefit under all regimes). Therefore these cases would end up blurring the results rather than adding variability to be exploited. Finally, our choice of the ten years threshold and the requirement of a minimum of five years presence in the archive give us an estimated sample percentage of minimum benefit recipients which is not too far from what observed in the universe of pension awards as recorded by the INPS Administration (see Table 2.4).

employment in the public sector. Hence, a drawback of the INPS data is that an increasingly important section of the workforce is not covered.

Turning to earnings of private sector employees, notice that the SHIW only collects information on net earnings while the INPS data provide gross earnings figures (as earnings are recorded by the social security administration before any tax due). To carry out the comparison, the SHIW data were "grossed-up" using a procedure based on the information available at both the individual and the household level. Table 3.2 shows little differences in average gross earnings between the two samples. A more careful comparison was carried out by controlling for age and cohort effects. In particular, we estimated a simple model of gross earnings as a function of age and birth cohort, with synthetic cohorts defined according to the year of birth of each worker[18]. This analysis confirmed a substantial agreement in the earnings data for the two samples.

3.2 Earnings projection

The information available in order to model age-earnings profiles in the INPS sample consists of age, gender, occupation, sector of employment and region of working activity[19].

The specification of a model for the age-earnings profile represents an essential step in the estimation of social security wealth at the individual level. This is especially important in Italy, as the process of social security reform involves moving from a "final

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[18] Year-of-birth cohorts were defined in the same way in both surveys. For example the oldest cohort was born between 1918 and 1926, the next cohort between 1927 and 1936, and so on.

[19] This is actually the region where the firm is located. Hence a comparison with the SHIW and national accounts data reveals that there seems to be a higher number of workers located in the North-West, where many large firms have their headquarters.

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).[20] Below we describe two additional hypothetical reforms, which also involve extending the benefit calculation period. It turns out that results are very sensitive to the way earnings projections, in particular backward projections, are carried out. For example, what may seem a negligible overestimation of real earnings in the early years can have marked effects on benefit calculations in the 1995 reform, where the whole earnings history matters and revaluation of past earnings is based on a 5-years moving average of past GDP growth rates.

Three alternative earnings-modeling strategies were considered. In the first strategy, individual real age-earnings profiles are assumed to be completely flat after the last year of observed earnings. This corresponds to the assumption that, at the individual level, the real earnings process is a random walk with no drift. In practice, the "jump-off" point for the earnings projections is taken to be the average of the last three years of observed earnings. This jump-off point pins down the level of the age-earnings profile for each individual.[21] Note that this might seem to underestimate future earnings growth, particularly for younger cohorts, but since our "sample at risk" (as defined below) consists mainly of older cohorts, the problem may not be too severe[22]. Furthermore, for ages above 50, earnings are lower on average and very noisy, possibly because of part-time work or the coexistence of early retirement benefits and

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[20] In this and in the following sections we only describe results for the 1995 reform, results for the other cases are available on request from the authors.
[21] When going backward, the jump-off point corresponds to the average of the first three observations available for each individual.
[22] The cohorts at risk are defined according to year of birth: for the oldest cohort these are between 1918 and 1926, for the next cohort 1927-1936 and for the youngest cohort 1937-1944.

working activities. When going backward, using a flat earnings profile would grossly overestimate the level of earnings at earlier ages and grossly underestimate real earnings growth. To avoid this problem, individual earnings were assumed to grow at the annual growth rate of aggregate earnings, for the years when this information is available, and at a constant real rate of 1.5% otherwise.[23]

In the second strategy, real earnings are projected into the future using group-specific growth rates obtained from the available sample, with groups defined by sex, age, birth cohort and occupation. We did not really pursue this route, as some major drawbacks became soon apparent. Because group-specific growth rates are obtained using the sample information, we face the problem that individual-specific growth rates may differ dramatically from those estimated for the relevant group but, at the same time, group-specific growth rates may differ substantially from the macroeconomic growth rate. In addition, for younger cohorts we would often get very high growth rates going backward and very low growth rates going forward. Finally, notice that our first data point is in 1973, while we need to go back to the 1930's for some of our workers in order to complete their working history. Hence, we would be forced to use a hybrid procedure which makes use of aggregate growth rates when projecting backwards into the distant past, while using group-specific growth rates for the recent past.

In the third strategy, real earning projections are obtained using an AR(1) specification. This estimation procedure did not give satisfactory results in terms of forecasting future earnings. For all these reasons, we opted for the first solution, which seems to be the

[23] Aggregate earnings are equal to the earnings series put together by Rossi, Sorgato and Toniolo (1993) for the years before 1970 and to national account statistics for subsequent years up to 1999.

safest. Notice that, in projecting earnings forward, individuals are assumed to form expectations by "using the model". In other words, for each age we only use actual earnings up to that age, and project earnings from that age forward according to the forecasting model.

3.5 Transitions into retirement

The INPS sample contains no information on the reasons for leaving the archive. Thus, in order to use these data we have to make the strong assumption that every exit from the archive is due to retirement. In fact, rather than retiring, a worker could have died, or moved from private sector employment to public sector employment or to self-employment. Our identifying assumption is that, for the range of ages that we consider (from age 50 to 65), exit from the INPS archive is due to retirement and not to other reasons.

This assumption is backed up from what we observe in the SHIW sample, where we have available the full set of information concerning the occupational status in each year [24]. Table 3.3 shows the transitions observed in the panel component of the SHIW sample for the years 1989, 1991, 1993 and 1995. Each entry of the table gives the proportion of transitions as a percentage of the observations in that age group starting from the sample of workers in 1989. First, it is apparent that, after age 54, the transitions into retirement are substantial. Furthermore, the overwhelming majority of transitions are from work to retirement, very few cases of transitions from work to disability are observed and only some cases from disability to

[24] In the SHIW sample different definitions of pensioner are available, based on self-reported occupational status, on earnings and on benefits receipts. However no marked difference in the distribution of retired people by age emerged from adopting different definitions.

retirement.[25] We do not report transitions from retirement back into the labor force as these are basically non-existent and we can safely assume that retirement is an absorbing state.

This evidence suggests that for Italian workers, the only relevant alternative escape route from the labor force is via disability. Many other "soft landing" or bridging plans exist, but they would all fall in the category of "pre-retirement" or "early-retirement" and, in our data, they would effectively correspond to retirement[26]. As far as disability benefits are concerned, after the changes legislated in 1984, their importance as an escape route has greatly diminished[27]. This is shown quite clearly in Figure 3.1, which presents the number of new pension awards in 1997 (flow data) and the number of outstanding pensions at the end of 1997 (stock data). The data, kindly provided by ISTAT, are tabulations based on the INPS Pensions-Archive and are broken down by sex and age of the beneficiary and by type of pension (old age and early retirement, survivors, and disability)[28]. In the age range that we consider (50 to 70), the number of disability pensions is clearly negligible relative to old age pensions, especially in the case of new awards (flow data). Disability becomes important relative to old age pensions only if we consider the stock of pensions at ages above 65, which reflects the very generous policy followed until the mid-1980s, a period that we do not model in this paper.

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[25] A disability pension is automatically converted into an old age pension when the recipient reaches the age of eligibility.

[26] For example, in the SHIW sample we do know about disability insurance, but early retirement and pre-retirement are recorded as retirement.

[27] The fall in disability benefits out of total benefits occurring after 1984 is documented in Brugiavini (1999).

[28] The INPS-pensions archive contains all outstanding pensions paid out by the INPS fund and by the other public funds, including the public sector employees fund and the local authorities employees fund. This archive contains the universe of all public pension benefits.

Finally, Figure 3.2 presents two descriptions of the retirement hazard based on the INPS sample. The first is a non-parametric estimate based on the raw data, which shows sharp peaks at age 60 and age 65 and substantial exit already at age 50. The second is a semi-parametric estimate of the baseline hazard in a proportional hazard model with a number of basic demographic variables introduced as covariates that proportionally shift the baseline hazard. For men there is an important spike at age 60, but a lot of action also at other ages, whereas for women there are several important ages at which the conditional probability of leaving the labor force peaks.

1. *Social security wealth and incentive measures*

Section 4.1 reminds the reader of the definition of social security wealth and the related incentive measures used in the econometric application. Section 4.2 lists our basic assumptions in the calculation of social security wealth, whereas Section 4.3 describes the social security regimes modeled in the simulations.

4.1 Definition of social security wealth and incentive measures

For a worker of age a, we define social security wealth (SSW) in case of retirement at age h ³ a as the expected present value of future pension benefits

$$SSW_h = \sum_{s=h+1}^{S} r_s B_s(h) \quad ,$$

where S is the age of certain death, $r_s = b^{s-a} p_s$ is a discount factor that depends on the rate of time discount ß and the survival probability p_s at age s conditional on being alive at age h, and $B(h)$

is the pension benefit expected at age $s \geq h+1$ in case of retirement at age *h*. Pension benefits are net of income taxes. Given the SSW, we define three incentive measures for a worker of age *a*.

1. Social security accrual (SSA) is the difference in SSW from postponing retirement from age *a* to age *a*+1

$$SSA_a = SSW_{a+1} - SSW_a = \sum_{s=a+2}^{S} r_s \left[B_s(a+1) - B_s(a)\right] - r_{a+1} B_{a+1}(a)$$

.

The SSA is negative if the expected present value of pension benefits foregone by postponing retirement by one year is greater than $\sum_{s=a+2}^{S} r_s \left[B_s(a+1) - B_s(a)\right]$, the expected present value of the increment in the flow of pension benefits. The rescaled negative accrual $t_a = -SSA_a / W_{a+1}$, where W_{a+1} are expected net earnings at age *a*+1 based on the information available up to age *a*, is called the implicit tax/subsidy of postponing retirement from age *a* to age *a*+1.

2. Peak value: $PV_a = \max_h \left(SSW_h - SSW_a\right), h = a+1,..,R$, where *R* is the mandatory retirement age (the latter does not exist in Italy, but given the retirement evidence we find it reasonable to put *R* = 70). Thus, the peak value is the maximum difference in SSW between retiring at future ages and retiring at the current age.

3. Option value: $OV_a = \max_h (V_h - V_a)$, $h = a+1,\ldots, R$, where

$$V_a = \sum_{s=a+1}^{S} r_s \left[kB_s(h)\right]^g$$

is the intertemporal expected utility of retiring at age *a,* while

$$V_h = \sum_{s=a+1}^{h} r_s W_s^{g} + \sum_{s=h+1}^{S} r_s \left[kB_s(h)\right]^{g}$$

is the intertemporal utility of retiring at age $h > a$. Thus the option value is the maximum utility difference between retiring at future ages and retiring at age *a*. We parameterize the model by

γ = 1 and k = 1.25. Under these assumptions, $V_a = 1.25SSW_a$ and

$$V_h = \sum_{s=a+1}^{h} r_s W_s^{g} + 1.25SSW_h .$$

If expected earnings are constant at W_a (as assumed in our earnings model), then

$$V_h - V_a = W_a \sum_{s=a+1}^{h} r_s + 1.25(SSW_h - SSW_a)$$

That is, the peak value and the option value are proportional to each other except for the effect due to the term $\sum_{s=a+1}^{h} r_s$.

These three incentive measures are consistent with the view that, in deciding whether or not to retire, a worker compares the expected gain from each of the two alternatives. Note that, in computing the incentive measures, we used the assumption that workers revise their expectations at each age. Hence for each given age, a worker projects the path of observed earnings according to the model and then computes her SSW and the incentive variables taking into account the information currently available. This requires re-computing SSW and the corresponding incentive measures for each year until retirement. Reforms are assumed to come as a surprise to workers.

As it is clear from the above formula, the social security accrual depends crucially on the expected present value $r_s\left[B_s(a+1)-B_s(a)\right]$ of the increment in pension benefits at age s resulting from postponing retirement by one year. Let t denote the number of years of contributions for a worker of age a, and assume that pension benefits remain constant in real terms. Under the pre-1993 regime (but also during the transitional period which we assume as the baseline regime), if $t < 40$ then

$$B_s(a+1)-B_s(a) = 0.02\,t\left[\overline{W}(a+1)-\overline{W}(a)\right] + 0.02\,\overline{W}(a+1),$$

where $\overline{W}(a)$ denotes pensionable earnings in case of retirement at age a; whereas if $t \geq 40$, then

$$B_s(a+1)-B_s(a) = 0.8\left[\overline{W}(a+1)-\overline{W}(a)\right].$$

In the special case when $\overline{W}(a+1)=\overline{W}(a)=\overline{W}$ we obtain

$$B_s(a+1)-B_s(a) = \begin{cases} 0.02\overline{W}, & t<40 \\ 0, & \text{otherwise} \end{cases}$$

Under the 1995 reform, we instead have

$$B_s(a+1)-B_s(a) = g(a+1)M(a+1)-g(a)M(a),$$

where $g(a)$ represents the legislated conversion factor used to transform the worker's "notional account" into a pension annuity and *M(a)* denotes the value of such notional fund in case of retirement at age a. If the 5-years moving average of GDP growth rates (used to capitalize past earnings) is positive, then the difference $\left[B_s(a+1)-B_s(a)\right]$ is always positive because $M(a+1) > M(a)$ and $g(a+1) \geq g(a)$ (with equality for $a > 65$).

Note that, for many ages and under most regimes, SSW is a monotonically decreasing function of age. In all these cases, the maximum value of SSW over current and future years is attained at the current age. Therefore, once the eligibility criteria are met, the age-profile of the peak value looks very similar to the age-profile of the accrual. This explains why the pictures portraying the age profile of the peak value and the accrual look often similar (see Section 4.2). We do have cases, however, of bcal maxima (e.g. under the 1995 reform).

4.2 Basic assumptions and calculation of social security wealth

In the actual calculation of SSW we assume a real discount factor of 1.5 percent (β = .985). Benefits are defined in real terms and the indexation rules prevailing under each legislation are implemented (e.g. before the 1992 reform we apply indexation to both price inflation and real wages). We also assume that real earnings growth after 1994 (the last year of the INPS sample), is constant at 1.5%. We carry out calculations as follows.

(1) Estimate SSW for men and women separately.
(2) Unlike most other countries in this project, we assume that workers are single. In fact, from the data we are unable to tell whether a worker has a spouse. In the Italian legislation, the only major difference between a single worker and a married worker is eligibility to survivors' pension (there is no dependent-spouse benefit[29]). We did not attempt an imputation procedure to assign workers a spouse[30].

[29] There is a difference in the rebates on income tax and in the calculation of "minimum benefit", particular in the way means-testing is carried out.

[30] We could readily generalize our calculations to include pensions to a surviving spouse. E.g. we could randomly assign to men a wife who is three years younger (say). However, this imputation would not produce extra variability in social security wealth because pension wealth of survivors depends on the characteristics of the deceased and on the survivor's age. Hence, in order to have an impact on the variability of the age-social security wealth profile we should also assign randomly

(3) Disability benefits have not been taken into account because multiple exit routes 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.
(4) We do not account for the lump sum benefit represented by the TFR, as we know from the paper by Brugiavini (1999) that this lump sum benefit does not alter dynamic incentives.
(5) We assume variation in mortality only by sex and age.
(6) We look at all individuals "at risk" (i.e. aged 50 to 70).

Note that, in our sample, the first worker who becomes eligible for retirement under the baseline regime is aged 50 and the econometric application makes use of the full range of ages between 50 and 70. However, since there are very few exits until age 52 and very few individuals working after age 65, in some tabulations (e.g. Table A at the end of the paper) we present results starting at age 53 and group in a single age interval all workers aged 65 and over.

In estimating the model, we also had to deal with the fact that the actual age of entry into the labor market is not always known. We used the information on the initial occupational level to get a reasonable proxy for educational attainments. This was then used to impute an initial age for the worker's contributive history.

Eligibility rules and benefit computation rules prevailing under each regime are rather complex (see Section 2), and some shortcuts were made. Finally, we computed social security wealth net

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the age of the imputed wife, which may produce a considerable amount of noise for a little gain.

of income tax, by subtracting from gross pension benefits income taxes as due.

4.3 Social security regimes modeled in the simulation

We estimate social security wealth and incentive variables under five alternative regimes[31]:

1 The rules prevailing before 1993.
2. The rules actually prevailing during the transitional phase which starts in 1993. This case represents our **baseline**.
3. The rules prevailing in the steady state, once the 1995 reform is fully phased in.
4. Policy simulation-1. Starting from the current system (the baseline case), we raise the normal retirement age by three years while holding constant all other features.
5. Policy simulation-2. This simulation entails a different pension program altogether, which features an early retirement age of 60 and a normal retirement age of 65. It provides a retiree with a benefit, which replaces 60% of her projected earnings when she turns 65. It applies an actuarial reduction of 6% per year for early claiming and an actuarial increase of 6% per year for later claiming. It essentially makes early retirement costly and introduces age-neutrality in retirement choices.

To simplify the presentation, we only report the results obtained for the baseline, the 1995 reform and the two policy simulations.

[31] We actually simulated also the rules prevailing after 1992 in the steady state, once the Amato reform is fully phased in. But, since this case is only of theoretical interest, because the 1992 reform will never reach its steady state values as subsequent changes took place in 1995 and 1997, we did not report results for this case.

Table A at the end of the paper presents descriptive statistics (mean, standard deviation and selected percentiles) for the three incentive measures. In the baseline case, eligibility is reached very early and SSW tends to decrease monotonically after the eligibility age. By comparing the two initial panels of Table A one can have a first impression of the effects of the 1995 reform: under the post 1995-regime SSW becomes positive only late in life and median SSW is lower. A clearer picture of this comparison is provided in Figure 4.1 and is discussed below. We also report descriptive statistics for the implicit tax on work, an incentive measure that was used extensively in Gruber and Wise (1999). On average, the estimated implicit tax in our sample is fairly close to the one obtained for a reference individual in the Gruber and Wise study[32]. In particular, taking the comparable case of a single male worker, under the pre-1993 legislation, the average implicit tax of the sample is in line with the one computed in Brugiavini (1999), but it differs substantially at the two crucial ages of 60 and 65.

Figures 4.1 through to 4.5 complement this information by presenting non-parametric estimates of the density for each incentive measure and for SSW. This is done first under different policy regimes separately for men and women (Figures 4.1 and 4.2), and then at selected ages for men only (Figures 4.3 to 4.5). These estimates have been computed by the kernel method using only the observations with a positive value of the SSW. The effects of the reform on the density of the relevant variables produced by the policy simulation-1 (3 years delay) are negligible and we do not report them in these graphs. The 1995 reform and the policy simulation-2 (actuarial adjustment) have a more marked impact. For men, both reforms imply a shift to the left of the distribution of SSW (see Figure

[32] In the Gruber and Wise study (see Brugiavini, 1999 for Italy) the reference individual is basically a worker characterized by the median earnings of his cohort.

4.1), hence a lower mean and no substantial change in dispersion. However accrual and peak value show a substantial change in the level of concentration around the mean as a result of the reforms, while the option value exhibits an interesting bimodal shape. For women, as a result of the reforms, there are more important changes in the location and dispersion of all variables, including SSW. For men, we also look at the distribution of SSW and all incentive measures for a few selected ages. These distributions are much more sensitive to age under the baseline than under the reforms. This confirms the point that the pre-1993 legislation (essentially the baseline) was highly non-neutral with respect to age.

5. Modeling retirement choices

In this section we present the results of modeling exit into retirement using probit models that include, in addition to a standard set of covariates (such as age, occupation and sector), the incentive measures discussed in the previous section. Table 5.1 provides mean values and standard deviations of the relevant variables.

5.1 Probability of retirement

We present two tables of probit estimates, one for men (Table 5.2) and one for women (Table 5.3). In either case, the response variable is a binary indicator, representing exit from the INPS sample between the year t and the year t +1. As discussed in Section 4 we assume that exit from the INPS sample corresponds to retirement. The population at risk consists of workers aged between 50 and 70 in any of the relevant years. The sample used for estimation includes all pairs of years from 1980-1981 through to 1993-1994. Because in some cases we have to model earnings profiles going back fifty years, given the existing limitations on aggregate wage data, we restrict the analysis to individuals at risk after 1980. In this way, our oldest worker is aged 70 in 1980 and we only need to back-cast earnings to the year 1930[33].

For each incentive measure, two basic specifications are considered, for a total of six estimated models. The first column of each table corresponds to the use of the accrual as the incentive measure and shows the results obtained for a general specification which includes, in addition to accrual and social security wealth, a set of sectoral and regional indicators, a linear age term and a set of earnings measures relevant for the retirement choice, i.e. a quadratic polynomial in expected earnings and a quadratic polynomial in pensionable earnings. It should be noted that, for all ages, expected earnings in the next period are computed based on the projection model and the information available to the worker at that age. We refer to this as **model M1**. The second column shows the results for a specification where the effect of age is modeled through a set of age dummies rather than a linear age term while the rest of the specification is unchanged, we refer to this as **model M2**. The same pattern is repeated for the other columns: columns 3 and 4 correspond to the use of the peak value with, respectively, a linear age trend (model M1) and a set of age dummies (model M2), while columns 5 and 6 correspond to the use of the option value. Since coefficients from a probit analysis do not have an immediate interpretation, we also provide the probability effect of the relevant variables. These are shown underneath the coefficient estimated for social security wealth and for each incentive variable. Since the scale of each of these variables differs, we measure the probability effect, for the reference

[33] Retirement is not mandatory. Given that we assume an individual at risk up to age 70, and given that we cannot exclude that she started working at age 20, we cannot rule out the possibility that this individual worked for fifty years.

individual, by increasing the variable of interest from the mean level to the level of the mean plus one standard deviation, holding the other variables constant.

In our baseline specification, social security wealth and all incentive measures are computed according to the transitional rules introduced after 1992. This represents the relevant regime for the workers in our sample. Overall, using instead the pre-1993 rules leads to negligible differences in terms of social security wealth and eligibility for our sample of workers. This is because, as already mentioned, the rights of workers near retirement were changed only marginally by the reforms of the 1990s.

All the specifications are satisfactory in terms of explaining variability in the data, as indicated by pseudo *R*-squares ranging between 32 and 34 percent. The use of age dummies increases the fit relative to the model with a linear age term, but only marginally. This suggests that age is an important determinant of retirement decisions but, despite the presence of impressive spikes in the hazard, we get only marginal gains by making use of a fully parameterized model. Hence, these spikes may be less important than it first appears in explaining the age-retirement process, as most of the action comes from the exits taking place between age 50 and age 60. For men, the accrual is the only incentive variable that is statistically significant and has the expected negative sign. For women, instead, the incentive variables have the expected sign and are significant, at least for the specifications with age dummies. For the estimates based on the accrual, we also find a non-negligible probability effect of the incentive variable (a one-percent increase in the accrual decreases the retirement probability by 24%). Social security wealth has in some cases a negative effect on retirement. This is somewhat surprising as it suggests that workers with higher levels of social security wealth tend to postpone retirement (i.e. have a taste for work) even after controlling for the type of job and the occupational sector. However, the negative coefficient is hardly ever significant.

A better grasp of the importance of the age effects can be gained by looking at Figure 5.1. In the top part, we present results for the general model with age dummies (M2). We plot the raw hazard computed in the estimation sample versus the projected hazards both for men (left panel) and women (right panel). The projected hazards are obtained, on the basis of the general model M2 and for the baseline case, by setting the incentive variables and all continuous variables to their mean value and setting to zero all dummies, except the age dummies. The different lines drawn for the projected hazards on the same graph correspond to the different incentive measures.

Figure 5.2 compares the hazard function and the cumulative distribution function (CDF) of the raw data with those implied by our estimates of model M2 (the baseline). The raw hazard and the raw CDF have a number of interesting features. In particular, while the hazard shows significant spikes at age 55 and 60 for men (more spikes for women), it is clear from the CDF that half of the sample has already retired by age 57 for men and by age 55 for women. The results obtained for the two models described above (models M1 and M2) suggest that the linear age term does not capture the important spikes in the data, but the use of a full set of age dummies provides an age-profile for the hazard which is fairly close to the raw hazard, at the cost of saturating the model.

In order to separate the effect of age on retirement due to preferences from the age effect related to incentives and to provide a parsimonious representation of the age effects, we carry out an additional probit analysis where we replace the linear age term by a combination of a cubic function of age plus three dummies at ages 55, 60 and 65[34]. This model, which we call **model M3**, tries to

[34] For women only two age dummies at 55 and 60 are added.

capture the fact that the raw hazard tends to increase smoothly with age, except for the presence of three important spikes at ages 55, 60 and 65. We interpret the estimated cubic-age trend as the "pure" effect of preferences on retirement. The results of the probit analysis are not presented for brevity. We simply note that the main results obtained for model M2 remain valid for model M3 and the age effects are overall significant. We use this specification M3 in two ways: (i) directly, to make projections on the basis of an "intermediate" specification in simulating retirement decisions, and (ii) indirectly, to impose the estimated age effect on the results of specification M2 in order to "purge" the general model M2 from the effect of age-preferences[35]. Results are described in Figure 5.1 (bottom panels), where the age effects implied by model M3, along with the raw hazard, are graphed against age for both men and women. This specification fits closely the age pattern observed in the data, particularly for men.

5.2. Simulating retirement choices

We carry out simulations separately for men and women. This is done on a simulation sample, where earnings are projected forward as well as backward to cover the necessary time span, regardless of actual

[35] By "intermediate" specification we mean one which models age in a satisfactory way without saturating the model. In view of the 1995 reform, which tries to implement an actuarially fair system, it would be reasonable to remove the three dummies and to allow the cubic specification in age to capture taste for retirement. However, in our sample, which does not cover the *post* reforms years, we have a basic identification problem on the interpretation of the spikes occurring at particular ages, as these may be mostly due to legislation, but could also emerge as a result of habits and peer-effects in retirement choices.

retirement or actual entry into the sample[36]. In all cases, we maintain the assumption that policy changes are not anticipated. We perform six types of simulations based on three policy variants to be contrasted with the baseline. The first policy variant envisages a forward shift of three years in the retirement ages. The second policy variant (referred to as the "common reform") consists of an actuarial adjustment of benefits of 6 percent per year and is designed to make early retirement costly to individuals. The last variant is the actual 1995 reform of the Italian social security system.

Simulation S1 (Model M1)

Starting from the model which only includes a linear age trend (model M1), we project the estimated hazard on the simulation sample by changing the social security wealth and the incentive variables according to the chosen reform. Results for men are shown in Figure 5.3 (accrual and peak value) and the left panels of Figure 5.4 (option value). The effect of a policy change is significant only in the case of the accrual. The largest effect is under the "common reform". Results are not much different for women (left panels of Figure 5.8).

Simulation S2 (Model M2)

Starting from the model with age dummies (model M2), we project the estimated hazard by changing the incentive variables according to the chosen reform while leaving all the other variables (including the age dummies) unchanged. Since the model is saturated, and the age dummies are very important in explaining variability in retirement probabilities, this case leaves little room for the effects of

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[36] This is different from the estimation sample, which is based on actual data (and backward projections), where workers drop from the sample as they retire. In other words no forward projections are used.

policies. Results are shown for men in Figure 5.4 (right panels) and Figure.5.5. The only case where the effect of a policy change is non-negligible is for the accrual (Figure 5.4 M2-S2 for men and Figure 5.8 for women).

Simulation S3 (Model M2)

Starting from the model with age dummies (model M2), we project the estimated hazard by changing all the relevant variables (incentive variables and age dummies) according to the policy change. In this experiment we want to measure the impact of policies going through the incentives and through a direct effect of age, hence it is important to net out the effect that age has on retirement due to individual preferences. To this end, in accordance with the policy regime, the age dummies are adapted ex post. For the policy entailing a three years shift in retirement age, this feature is modeled in the incentive variables and subsequently imposed on the age dummies (effectively shifting the hazard to the right by three years). In the case where the reform entails an actuarial adjustment by age, age-dummies coefficients are adjusted by assuming that the underlying hazard should be smoother than the observed one. In order to impose this behavior we make use of the information obtained in model M3 and adjust the age dummies according to a cubic function in age. The final effect of using model M3 is to preserve the important breaking points while making the rest of the simulated hazard smoother.

Results for men are presented in Figure 5.6 (accrual and peak value) and Figure 5.7 (option value). The effects of policies are more marked than in the previous cases. In particular, both policies imply a tendency to delay retirement, as it is clearly documented by the CDF. The "common reform" has a stronger impact than the 3-years shift. It is also interesting to note that under the "common reform", the ex-post adjustment of the age dummies smoothes out most spikes, leaving only one important spike at age 60.

Simulation S4 (Model M2)

In this simulation, we consider the effects of the 1995 (Dini) reform described in Section 2. This reform is in many respects similar to the "common reform", as it computes benefits at each age according to an actuarial adjustment factor and restricts retirement ages to a window. For this simulation, we contrast the estimated hazard with the baseline by looking at model M2 and M3 only. The results presented in Figure 5.7 (right panels) suggest that the incentive measures do not have a strong impact in this case.

Simulation S5 (Model M3)

We look at the results obtained for the intermediate model M3 by contrasting the baseline and the policy changes. The assumption here is that the age polynomial should capture only preferences. Results for men are shown in Figure 5.10 and Figure 5.11. In particular, Figure 5.10 and the left panel of Figure 5.11 present the two hypothetical reforms, while the right panels of Figure 5.11 are for the actual 1995 reform. When incentives are measured by the accrual, there is a non-negligible effect towards delayed retirement for both the "common reform" and the 1995 reform.

Finally, in Figure 5.12 we carry out an experiment (only by making use of the accrual) which simulates on the basis of model M3 the relevant policy changes. This is done by applying the incentive variables of the "three-years-adjustment" and the "common reform" on the basis of coefficients estimated under specification M3. At the same time we shift forward the three important spikes (age 55, 60 and 65) by three years, while leaving the cubic polynomial in age in its original form. Figure 5.12 presents the results, it suggests that, not only for the "common reform" we obtain a significant changes in the hazard, but also an impact on the CDF, leading to a non-negligible increase in mean retirement age (see Table 5.4).

6. Conclusions

This paper analyzes retirement behavior of Italian workers by first estimating probit models and then making use of the econometric model to simulate exits from the labor force.

Results are mixed. The probit analysis provides, overall, a good fit for the estimated retirement hazards and the correct sign for the incentive variables, i.e. when the dynamic incentives increase workers tend to delay retirement. When comparing the models with actual behavior one sees that, despite the adequate fit, all models tend to underestimate actual retirement, as measured by mean retirement age (see Table 5.4 for men). However, in this paper, the important comparison is between the baseline scenario and the simulated reforms. The reforms are implemented in two steps: by first allowing only for a change in the incentives (social security wealth as well as dynamic incentives) and then by looking at the full impact of the reforms through eligibility. However, while the effects of the reforms, as captured by the incentive variables, are clearly seen on the hazard, these are not of a significant magnitude. Of the incentive variables the most effective is the accrual and, in some cases (e.g. model M2 simulation S3), we can see a substantial change in the hazard caused by the policy change. In particular, both the hypothetical "common reform" (based on an actuarially fair scheme) and the actual 1995-Italian-reform show a clear move toward an age-neutral system as opposed to the baseline scenario. However, this is not always sufficient to produce significant changes in mean retirement age and in the unconditional retirement probabilities as described by the CDF.

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FIGURES and TABLES

Table 2.1: Key features of the pre-1993 regime, and the 1992 and 1995 reforms (at the steady-state).

	Pre-1993 regime	1992 reform	1995 reform
Normal retirement age	60 (men) 55(women)	65 (men) 60(women)	Any age after 56 (for both men and women)
Transitional period		Until about 2032	Until about 2035
Pensionable earnings	Average of last 5 years real earnings (converted to real values through price index)	Career average earnings (converted to real values through price index + 1%)	Career contributions (capitalized using a 5-year moving average of GDP growth rate)
Pension benefit	2%*(pensionable earnings)*(t), where t is years of tax payments (at most 40)	2%*(pensionable earnings)*(t), where t is years of tax payments (at most 40)	Proportional to capitalized value of career contributions, the proportionality factor increasing with age at retirement (from .04720 at age 57 to .06136 at age 65)
Pension indexation	Cost of living plus real earnings growth	Cost of living	Cost of living
Pension to survivor	60% to spouse 20% to each child 40% to each child (if no spouse)	Same	Same
Years of contributions for eligibility	15	20	5
Early retirement provision	Any age if contributed to SS for 35 years or more, no actuarial adjustment	Any age if contributed to SS for 35 years or more, no actuarial adjustment	No early retirement provision
Total Payroll tax	24.5% of gross earnings	27.17% of gross earnings	32.7% of gross earnings

Table 2.2:
Rules for benefit computation prevailing during the transitional period after the 1992 reform.

	Pensionable Earnings Computation
Case A1: Private Sector – Senior[1] For the years before 1993	average of last 5 years' real earnings
Case A2: Private Sector – Senior For the years after 1993	average of last 6.5 years' earnings, to gradually become last 10 years' earnings after 2002
Case B1: Private Sector – Junior For the years before 1993	same as group A1
Case B2: Private Sector – Junior For the years after 1993	average of last 8 years' earnings, to gradually become last 15 years' earnings after 2002 and further increasing thereafter
Case C1: Public Sector – Senior For the years before 1993	last month's real earnings
Case C2: Public Sector – Senior For the years after 1993	average of last 1.5 years' earnings, to gradually become last 10 years' earnings after 2012
Case D1: Public Sector – Junior For the years before 1993	same as group C1
Case D2: Public Sector – Junior For the years after 1993	average of last 3 years' earnings, to gradually become last 10 years' earnings after 2012 and further increasing thereafter

1. Seniors: at least than 15 years in the system at the end of 1992. Years "before" 1993 are the years of valid tax payments to the social security administration completed before 1993.

Table 2.2 focuses on employees, but similar rules apply to the self-employed. Consider, for example, a "case-A" worker with at least 15 years of seniority at the end of 1992. His pension depends on a weighted average of pensionable earnings computed under case A1 and pensionable earnings computed under case A2, with weights determined by the number of years in the system before and after 1993 respectively

Table 2.3: Eligibility criteria for retirement and early retirement (at the steady state).

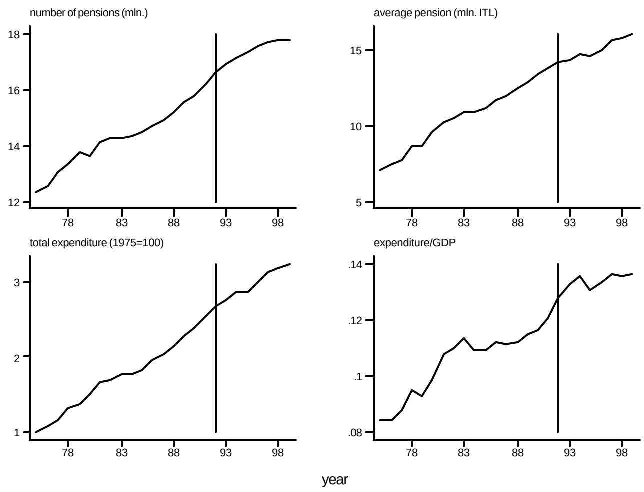
	Private Sector		Public Sector		Self-employed	
Pre-1993 regime	**M**	**F**	**M**	**F**	**M**	**F**
Old age benefit (age)	60	55	65	65	65	60
Early retirement (years of tax payments)	35	35	20	15	35	35
1992 reform						
Old age benefit (age)	65	60	65	65	65	60
Early retirement (years of tax payments)	35	35	35	35	35	35
1995 reform						
			All			
Old age benefit (age)			57 to 65			

Table 2.4: Fraction of minimum benefit awards over total awards by sex and type of benefits.
End of 1999

	Old age and early retirement		Disability		Survivors	
Age	**male**	**female**	**male**	**female**	**male**	**female**
<=50	0.000	0.000	0.153	0.250	0.390	0.325
51	0.000	0.000	0.169	0.310	0.326	0.308
52	0.004	0.008	0.175	0.308	0.326	0.306
53	0.007	0.020	0.174	0.325	0.298	0.297
54	0.011	0.034	0.182	0.328	0.309	0.304
55	0.011	0.044	0.191	0.341	0.293	0.309
56	0.012	0.056	0.188	0.345	0.290	0.300
57	0.012	0.063	0.191	0.345	0.283	0.300
58	0.016	0.086	0.198	0.359	0.268	0.301
59	0.018	0.252	0.203	0.417	0.263	0.284
60	0.019	0.328	0.207	0.520	0.265	0.259
61	0.021	0.408	0.215	0.565	0.263	0.254
62	0.024	0.433	0.220	0.589	0.265	0.247
63	0.028	0.453	0.225	0.602	0.283	0.247
64	0.050	0.464	0.263	0.610	0.265	0.242
65	0.080	0.382	0.338	0.616	0.250	0.259
66	0.092	0.382	0.387	0.622	0.251	0.256
67	0.100	0.390	0.389	0.620	0.254	0.245
68	0.111	0.402	0.402	0.629	0.255	0.238
69	0.121	0.406	0.400	0.630	0.246	0.231
70	0.101	0.400	0.410	0.639	0.268	0.227
71	0.103	0.385	0.418	0.647	0.260	0.226
72	0.116	0.380	0.433	0.655	0.258	0.219
73	0.128	0.374	0.439	0.659	0.253	0.214
74	0.133	0.372	0.448	0.661	0.256	0.208
>=75	0.136	0.327	0.535	0.684	0.212	0.193

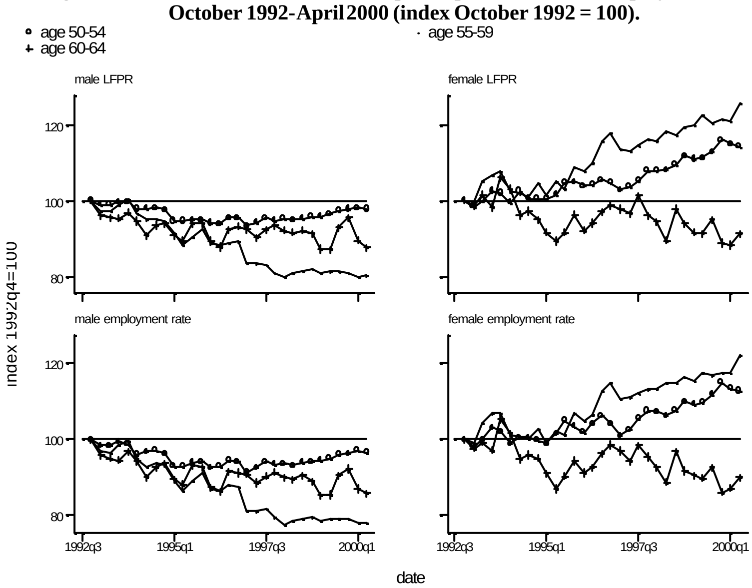
Note: own calculations based on the INPS -Archive of outstanding pension benefits. This contains the universe of public pension benefits.

Figure 2.1: Number of pensions, pension expenditure, average pension and expenditure/GDP ratio, 1975-98. Old-age, disability and survivor pensions.



Source: *ISTAT, I Trattamenti Pensionistic, several years.*

Figure 2.2: Recent trends in labor force participation rates and employment rates, October 1992-April 2000 (index October 1992 = 100).



Source: own calculations based on the micro-files of the Labor Force Survey - 1992-2000.

Table 3.1: Distribution by labor force status in the SHIW.

Year	Private Setor Employees	Public Sector Employees	Self-employed	Pensioners	Other
1978	44.41	12.96	15.42	25.76	1.46
1979	41.23	15.07	15.45	26.36	1.88
1980	39.42	15.22	15.09	28.44	1.83
1981	43.56	14.21	14.55	26.24	1.44
1982	42.44	15.29	17.42	23.53	1.31
1983	39.64	15.21	15.01	28.76	1.38
1984	36.85	16.56	15.17	29.37	2.05
1986	37.15	15.46	14.61	31.34	1.45
1987	45.79	6.95	7.27	28.87	11.12
1989	40.37	10.50	16.63	30.89	1.61
1991	35.02	13.16	13.23	34.69	3.91
1993	26.72	16.50	12.70	37.48	6.60
1995	26.64	15.36	13.54	37.21	7.25
Total	**37.00**	**13.69**	**13.80**	**31.39**	**4.12**

Private sector employee = active workers in private sector; Public sector employee = active worker in public sector;
Self-employed = this is a wide category of active workers working as entrepreneurs, professionals and self-employed proper. Pension= self-reported pensioner

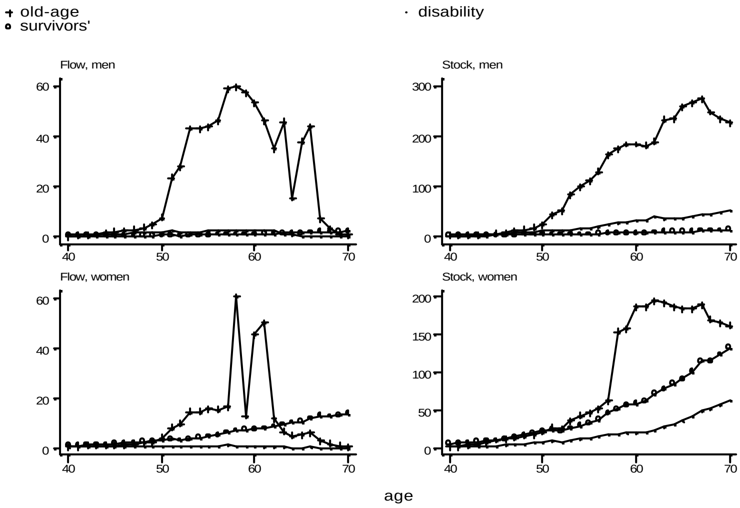
**Table 3.2: Average gross earnings for private sector employees in the Bank of Italy (SHIW)
and the INPS sample by year (thousands of 1994 It.L.).**

Year	SHIW – Male earnings	INPS - Male earnings	SHIW – Female earnings	INPS – Female eamings
1974		20344		13759
1975		23575		15579
1976		22806		15462
1977		25085		18123
1978	25765	26340	15941	18690
1979	25431	26362	16073	19528
1980	25986	26326	17802	19649
1981	25764	27289	15216	19495
1982	27544	27113	18391	19681
1983	26608	26993	17665	19772
1984	28005	26778	17635	19985
1985		26964		19637
1986	28405	27148	18496	19898
1987	33360	27422	24062	20656
1988		27524		20251
1989	33107	27322	25634	20771
1990		27747		20540
1991	32160	28890	24725	21810
1992		29194		21984
1993	31963	29546	20771	22504
1994		30171		22362
1995	31902		20708	

Table 3.3: Transitions observed in the SHIW panel sample, by age.

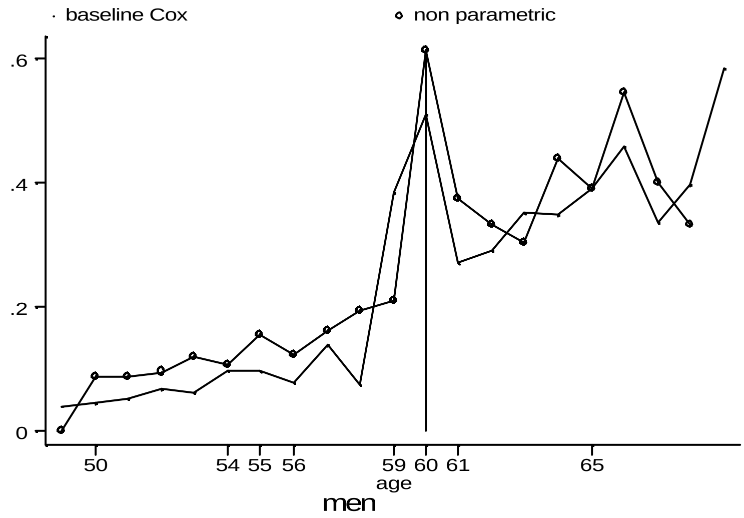
Age	From work to retirement	From work to disability	From disability to retirement
50	6,11%	0.27%	0.27%
51	11.79%	0.00%	2.85%
52	10.12%	0.77%	0.00%
53	9.03%	0.28%	0.00%
54	22.22%	0.56%	0.85%
55	15.03%	1.12%	0.56%
56	17.46%	1.04%	0.78%
57	20.16%	0.25%	1.03%
58	32.65%	0.53%	1.59%
59	22.07%	0.00%	1.91%
60	18.51	0.28%	1.41%
61	15.78%	0.50%	2.79%
62	36.66%	0.00%	2.08%
63	40.74%	0.00%	1.51%
64	76.47%	0.22%	1.83%

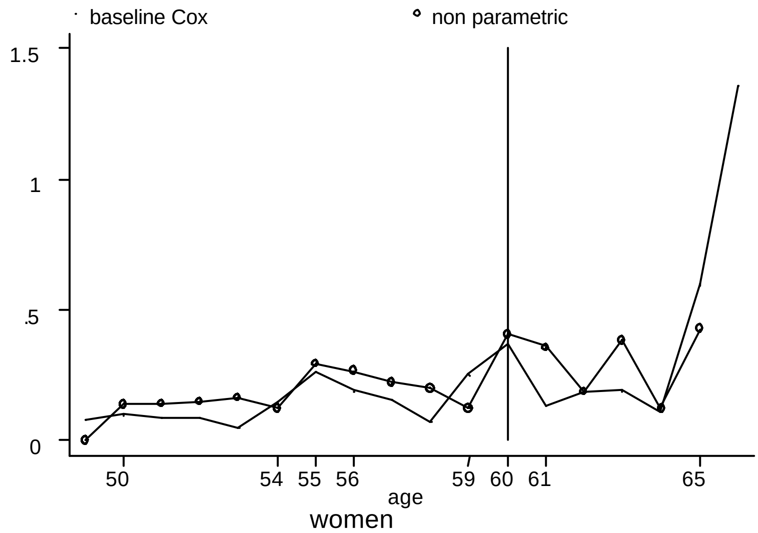
Figure 3.1: Flow of new pensions in 1997 and stock of existing pensions at the end of 1997 (in thousands)
by sex and age of the beneficiary and type of pension.



Note: Figures are based on the INPS-Archive of outstanding pension benefits. This contains the universe of public pension benefits.

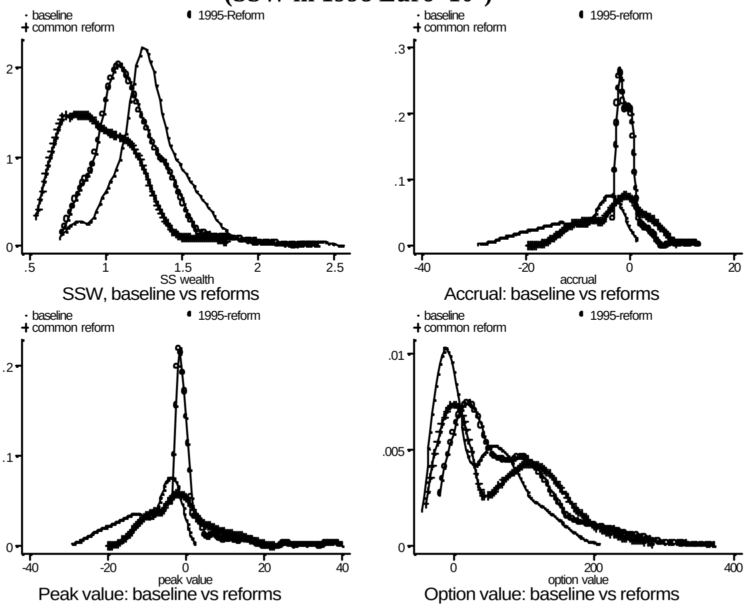
Figure 3.2: Hazard functions.





Note: Each picture shows two hazard functions. The non -parametric hazard is the one obtained from the raw hazard by simply relating the flow into retirement at each age to the stock of workers of that age. The baseline Cox hazard is obtained by using Cox proportional hazard model with age as the only explanatory variable.

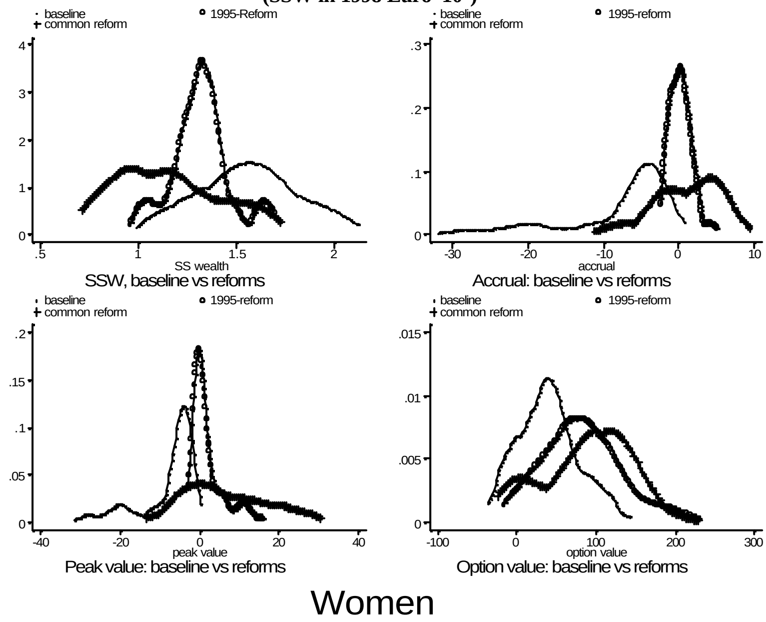
Figure 4.1: Kernel Estimated Density of Social Security Wealth and Incentives (SSW in 1998 Euro*10^8)



Men

Note: we do not show the results for the reform labeled “plus three years” as these almost entirely overlap with the baseline densities.

Figure 4.2: Kernel Estimated Density of Social Security Wealth and Incentives (SSW in 1998 Euro*10^8)



Note: we do not show the results for the reform labeled "plus three years" as these almost entirely overlap with the baseline densities.

Figure 4.3. Kernel-estimated densities, social security wealth and incentives. Selected ages.

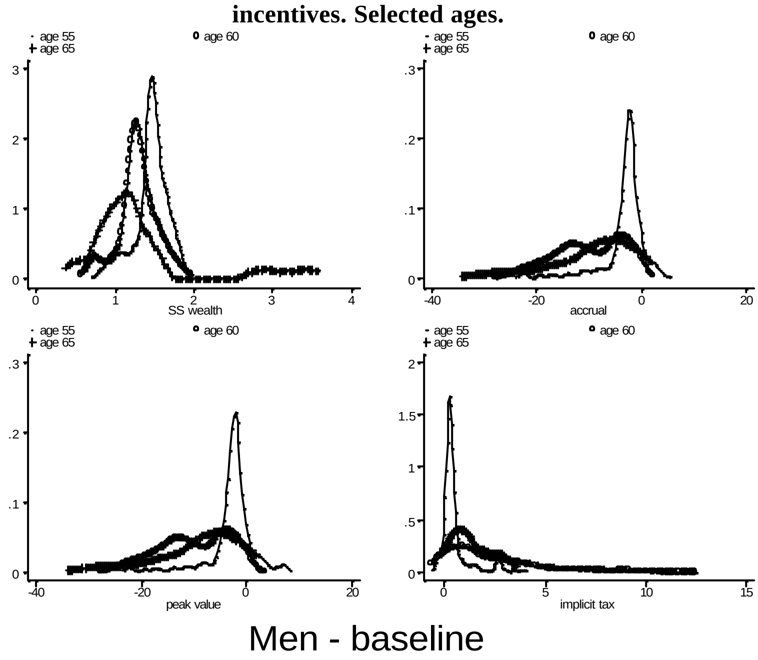
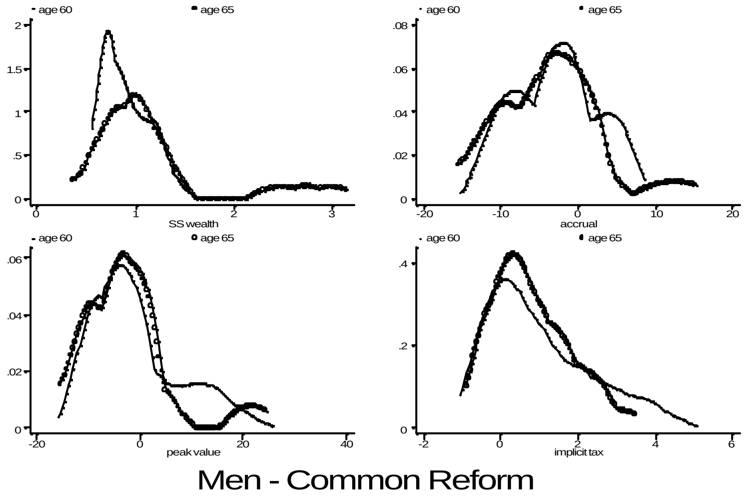
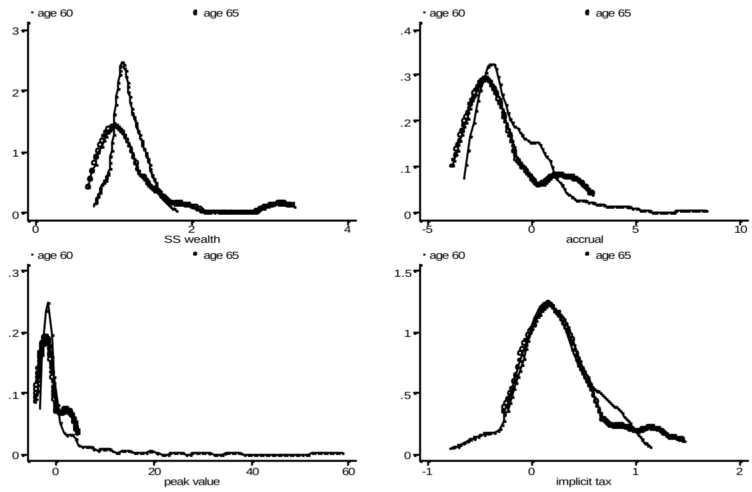


Figure 4.4. Kernel-estimated densities, social security wealth and incentives. Selected ages.





Men - 1995 Reform

Table 5.1. Summary statistics of variables used in the Probit Analysis

Variable	Women		Men	
	Mean	**S.d.**	**Mean**	**S.d**
Year	87.74	4.07	87.14	4.17
Age	53.06	3.51	53.80	3.62
No. Jobs held	0.58	1.11	0.91	1.58
Industry dummy	0.47	0.49	0.50	0.49
Agriculture d.	0	0	0.01	0.10
Building d.	0.00	0.08	0.11	0.31
Trade d.	0.14	0.35	0.08	0.27
Transport d.	0.02	0.15	0.09	0.29
Financial d.	0.03	0.17	0.04	0.20
Other sect. D.	0.30	0.46	0.14	0.35
Earnings	13736.26	52.88	18953.01	14495.15
Years contribution	32.44	3.93	33.12	4.43
SSW-baseline	0.52	0.79	0.53	0.73
SSW-1995-ref	0.17	0.45	0.27	0.56
SSW-sim1	0.22	0.56	0.25	0.55
SSW-sim2	0.07	0.28	0.07	0.29
Option V-base	236.93	179.69	269.36	240.63
Option V-ref	312.23	176.62	343.64	260.39
Option V-sim1	290.92	173.39	313.94	239.15
Option V-sim2	306.90	162.65	335.34	232.58
Peak V-baseline	101.84	86.03	87.60	82.20
Peak V-1995-ref	118.09	63.71	106.36	78.42
Peak V-sim1	137.40	72.49	115.64	74.77
Peak V-sim2	113.16	43.15	98.40	48.71
Accrual-baseline -	2.00	7.27	-2.02	6.32
Accrual-1995-ref	0.27	1.36	0.34	2.51
Accrual-sim1	-0.72	3.87	-1.11	4.32
Accrual-sim2	- 0.01	1.75	-0.15	2.85
Retirement D.	0.12	0.33	0.11	0.31
North-W	0.45	0.49	0.38	0.48
North-E	0.21	0.41	0.22	0.41
Center	0.27	0.44	0.21	0.41
South	0.04	0.19	0.11	0.32
Islands	0.01	0.12	0.05	0.22
Blue collar	0.62	0.48	0.73	0.44
White collar	0.32	0.46	0.23	0.42
Manager	0.00	0.07	0.03	0.17
Other levels	0.04	0.20	0.00	0.04

Note: earnings are in thousand 1998 Δ, social security wealth is in 1998Euro*(10^8). Social security wealth and incentive variables are distinguished according to the baseline case, the 1995 reform and the two hypothetical reforms.

Table 5.2: Male retirement probit analysis. INPS sample 1980-1993, population at risk aged 50-70.

	(1) M1: Accrual	(2) M2:Accrual	(3) M1-Peak V	(4) M2-Peak V.	(5) M1- Option V.	(6) M2- Option V.
Incentive	-0.023* (0.004)	-0.024* (0.004)	0.0005 (0.013)	-0.001 (0.013)	0.0008 (0.0005)	-0.0005 (0.0006)
	-0.244	-0.079	0.075	-0.314	0.504	-0.185
Social Security Wealth	-0.128* (0.048)	-0.071 (0.053)	0.006 (0.125)	-0.095 (0.130)	0.091 (0.096)	0.088 (0.107)
	-0.161	-0.022	0.088	-0.030	0.141	0.028
Earnings(T+1)	-0.150* (0.006)	-0.147* (0.006)	-0.161* (0.007)	-0.159* (0.007)	-0.176* (0.008)	-0.168* (0.009)
Earnings(T+1) sq.	0.105* (0.008)	0.102* (0.008)	0.109* (0.008)	0.106* (0.008)	0.105* (0.008)	0.104* (0.009)
Pensionable Earn.	0.117* (0.008)	0.114* (0.009)	0.131* (0.008)	0.132* (0.009)	0.127* (0.009)	0.127* (0.009)
Pensionable Earn sq.	-0.070* (0.011)	-0.068* (0.011)	-0.075* (0.011)	-0.073* (0.011)	-0.070* (0.012)	-0.070* (0.012)
Age	0.093* (0.008)		0.101* (0.009)		0.104* (0.009)	
Age 50		1.34 * (0.259)		1.35 * (0.259)		1.34 * (0.259)
Age 51		1.33 * (0.259)		1.35 * (0.259)		1.33 * (0.259)
Age 52		1.43 * (0.258)		1.42 * (0.258)		1.43 * (0.258)
Age 53		1.53 * (0.258)		1.56 * (0.258)		1.53 * (0.258)
Age 54		1.49 * (0.262)		1.54 * (0.262)		1.49 * (0.262)
Age 55		1.75 * (0.261)		1.79 * (0.261)		1.75 * (0.261)
Age 56		1.48 * (0.266)		1.54 * (0.266)		1.48 * (0.266)
Age 57		1.61 * (0.267)		1.68 * (0.267)		1.61 * (0.267)
Age 58		1.70 * (0.268)		1.76 * (0.268)		1.70 * (0.268)
Age 59		1.81 * (0.269)		1.86 * (0.269)		1.81 * (0.269)
Age 60		2.51 * (0.267)		2.59 * (0.267)		2.51 * (0267)
Age 61		1.88 * (0.296)		1.88 * (0.296)		1.88 * (0.296)
Age 62		1.99 * (0.315)		1.99 * (0.315)		1.99 * (0.315)
Age 63		2.10 * (0.340)		2.10 * (0.340)		2.10 * (0.340)
Age 64		2.55 * (0.356)		2.55 * (0.356)		2.55 * (0.356)
Age 65		1.95 * (0.435)		1.95 * (0.435)		1.95 * (0.435)
Age 66 and above		2.25 * (0.516)		2.25 * (0.516)		2.25 * (0.516)
Constant	-1.353 (0.094)	-2.456 (0.101)	-1.435 (0.129)	-1.345 (0.138)	-1.497 (0.105)	-2.518 (0.114)
N	7446	7446	7446	7446	7446	7446
Pseudo R2	0.322	0.342	0.316	0.335	0.316	0.334
Log-likelihood	-1765	-1716	-1782	-1734	-1781	-1734

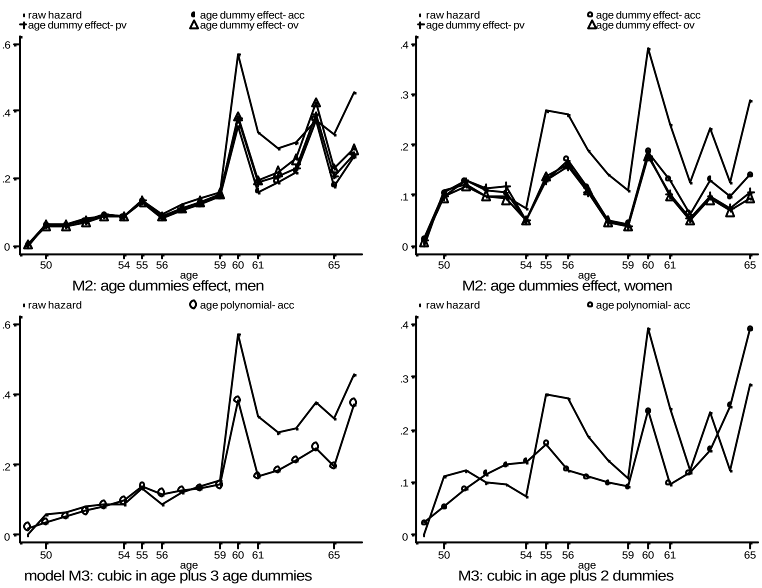
Note: Dependent variable is a dummy for being retired. Standard errors in parentheses. The number under the coefficient indicates the probability effect measured by the percentage change in the probability. The difference in probabilities is obtained by first generating a projected probability for the reference individual (mean value of continuous variables and zero for the dummy variables) at the mean, and then generating a projected probability at the mean plus one standard deviation of the relevant variable (other things equal). Hence the change in the independent variable depends on the scale of the variable itself. For example in the case of social security wealth, we start from a mean of 538 thousand Euro and reach a value of 1271 thousand Euro (mean plus one standard deviation). A star indicates a coefficient that is statistically significant at the 5% level. The reference category for the age dummies is aged 49. All specifications include region, sector of employment and number of jobs held.

Table 5.3: Female retirement probit analysis. INPS sample 1980-1993, population at risk aged 50-70.

	(1) M1: Accrual	(2) M2:Accrual	(3) M1-Peak V	(4) M2-Peak V.	(5) M1- Option V.	(6) M2- Option V.
Incentive	-0.020* (0.006)	-0.021* (0.007)	-0.004 (0.002)	-0.007* (0.002)	-0.0007 (0.001)	-0.004* (0.002)
	-0.240	-0.056	-0.522	-0.907	-0.231	-0.685
Social Security Wealth	-0.014 (0.094)	0.143 (0.159)	0.321 (0.248)	-0.476 (0.291)	0.030 (0.251)	-0.359 (0.310)
	-0.015	0.024	-0.345	-0.094	-0.002	-0.064
Earnings(T+1)	-0.240* (0.025)	-0.241* (0.025)	-0.241* (0.028)	-0.229* (0.028)	-0.249* (0.034)	-0.213* (0.035)
Earnings(T+1) sq.	0.260* (0.089)	0.288* (0.088)	0.282* (0.092)	0.282* (0.091)	0.299* (0.090)	0.327* (0.089)
	0.199* (0.034)	0.187* (0.034)	0.229* (0.034)	0.238* (0.035)	0.216* (0.035)	0.232* (0.035)
Pensionable Earn.	-0.219* (0.115)	-0.260* (0.115)	-0.292* (0.118)	-0.315* (0.117)	-0.272* (0.118)	-0.318* (0.118)
Pensionable Earn sq.	0.062* (0.018)		0.059* (0.019)		0.061* (0.021)	
		0.97 * (0.266)		1.04 * (0.282)		1.05 * (0.288)
Age		1.09 * (0.268)		1.21 * (0.185)		1.18 * (0.289)
		1.00 * (0.273)		1.14 * (0.291)		1.07 * (0.292)
Age 50		0.97 * (0.282)		1.16 * (0.303)		1.03 * (0.301)
Age 51		0.57 * (0.332)		0.71 * (0.345)		0.71 * (0.345)
Age 52		1.10 * (0.338)		1.21 * (0.345)		1.27 * (0.350)
Age 53		1.28 * (0.348)		1.34 * (0.355)		1.37 * (0.357)
Age 54		1.02 * (0.369)		1.09 * (0.373)		1.13 * (0.374)
Age 55		0.59 (0.406)		0.67 (0.402)		0.70 (0.401)
Age 56		0.50 (0.431)		0.57 (0.430)		0.58 (0.428)
Age 57		1.33 * (0.383)		1.43 * (0.383)		1.44 * (0.382)
Age 58		1.10 * (0.441)		1.08 * (0.442)		1.06 * (0.440)
Age 59		0.69 (0.565)		0.73 (0.558)		0.71 (0.556)
Age 60		1.10 * (0.531)		1.06 * (0.529)		1.03 * (0.529)
Age 61		0.92 (0.674)		0.91 (0.665)		0.87 (0.659)
Age 62		1.15 * (0.680)		1.10 * (0.654)		1.05 * (0.656)
Age 63						
Age 64	-1.069 (0.229)	-1.750 (0.201)	-0.795 (0.275)	-1.363 (0.283)	-1.032 (0.246)	-1.556 (0.271)
Age 65 and over						
	1770	1770	1770	1770	1770	1770
Constant	0.319	0.343	0.314	0.342	0.313	0.339
	-458	-443	-461	-443	-463	-445
N						
Pseudo R2						
Log-Likelihood						

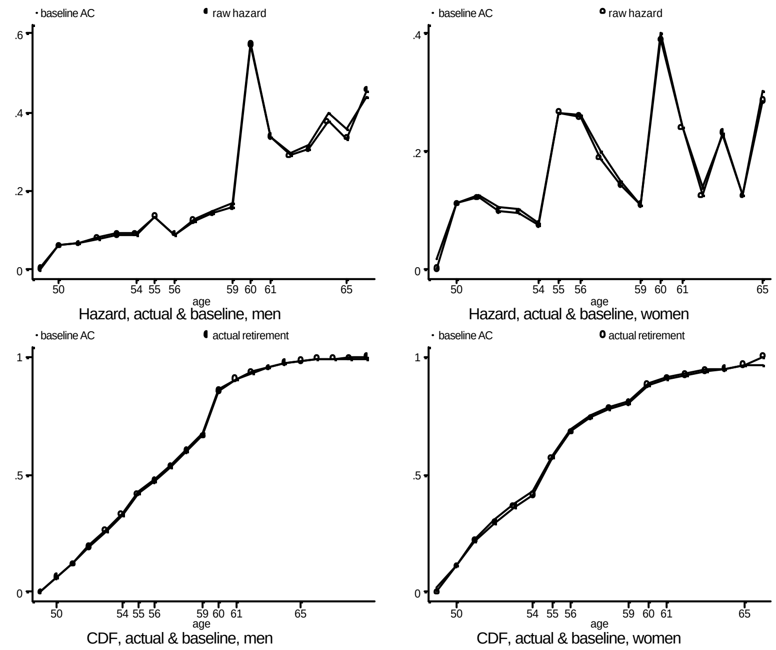
Note: Dependent variable is a dummy for being retired. Standard errors in parentheses. The number under the coefficient indicates the probability effect measured by the percentage change in the probability. The difference in probabilities is obtained by first generating a projected probability for the reference individual (mean value of continuous variables and zero for the dummy variables) at the mean, and then generating a projected probability at the mean plus one standard deviation of the relevant variable (other things equal). Hence the change in the independent variable depends on the scale of the variable itself. For example in the case of social security wealth, we start from a mean of 548 thousand Euro and reach a value of 1345 thousand Euro (mean plus one standard deviation). A star indicates a coefficient that is statistically significant at the 5% level. The reference category for the age dummies is aged 49. All specifications include region, sector of employment and number of jobs held, however, because of sample size, the specification of dummy variables for women changes slightly from the one used for men.

Figure 5.1. Age effects in model M2 and model M3.



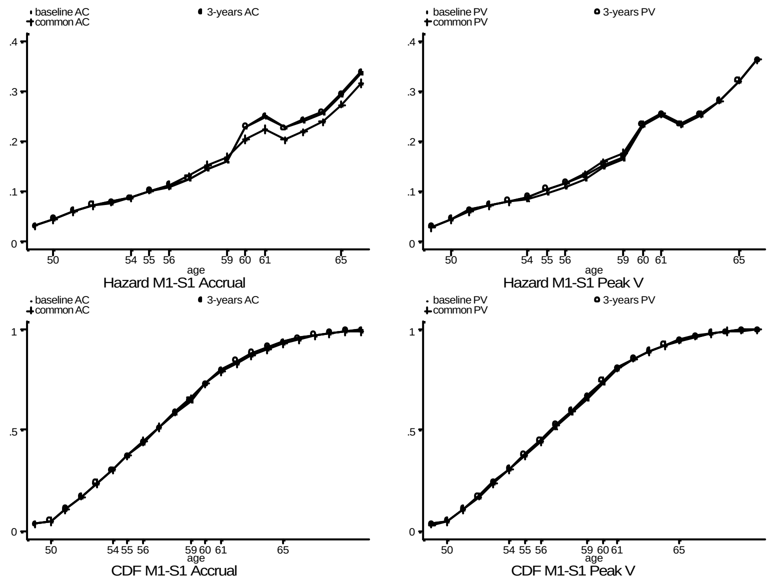
Note: The left panels are for men and the right panels for women. The continuous line is the raw hazard. The estimated hazards are based (1) on the complete model M2 for each of the incentive variable (top panels) and (2) on the parsim onious representation based on a cubic in age plus the relevant dummies M3 (bottom panels). We convert in probability space the age effects for a representative worker. This is a worker characterized by the mean values of continuos variables and zero for all the dummy variables (apart from age and age dummies). Based on estimation sample.

Figure 5.2: Hazard and CDF. Raw data versus baseline estimates in Model M2.



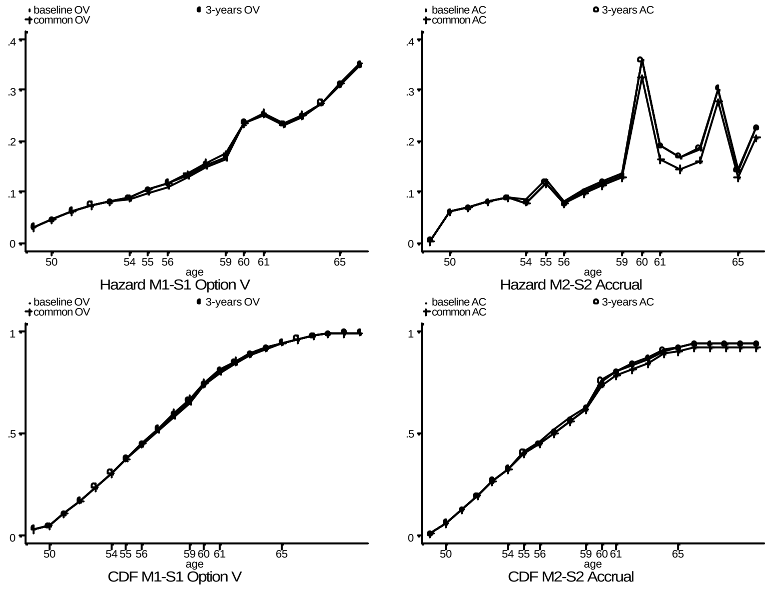
Note: The top panels present the hazard functions while the bottom panels present the corresponding CDF. The results for the baseline are obtained from the general model M2. These graphs are based on the estimation sample (7446 observations for men and 1770 observations for women) where individuals drop from the sample at the age of actual retirement. The picture looks much different for the simulation sample, where individuals are assumed to be at risk up to a maximum age of 70.

Figure 5.3: Simulation M1 -S1 for accrual and peak value. Men.



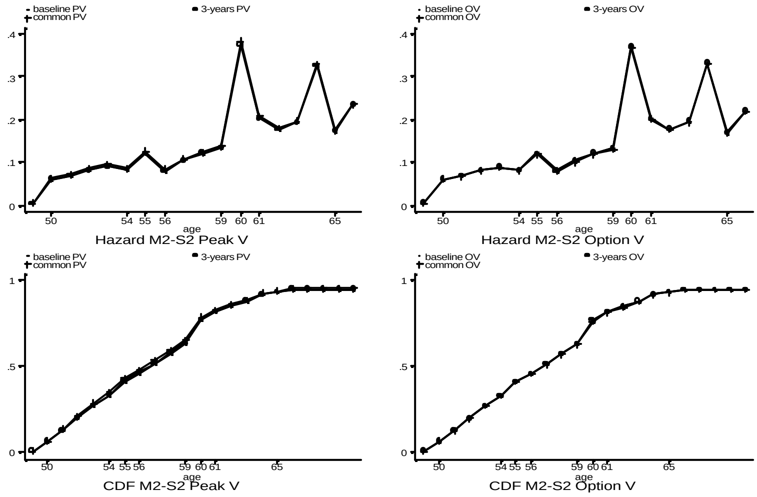
Note: The top panels show the hazards and the bottom panels the corresponding CDF. Results are obtained by using the coefficients from the baseline M1 estimated on the estimation sample (7446 men-years) and projecting both the baseline and the policy on the simulation sample (25330 men-years)

Figure 5.4: Simulations M1 -S1 for option value and M2 -S2 for accrual. Men.



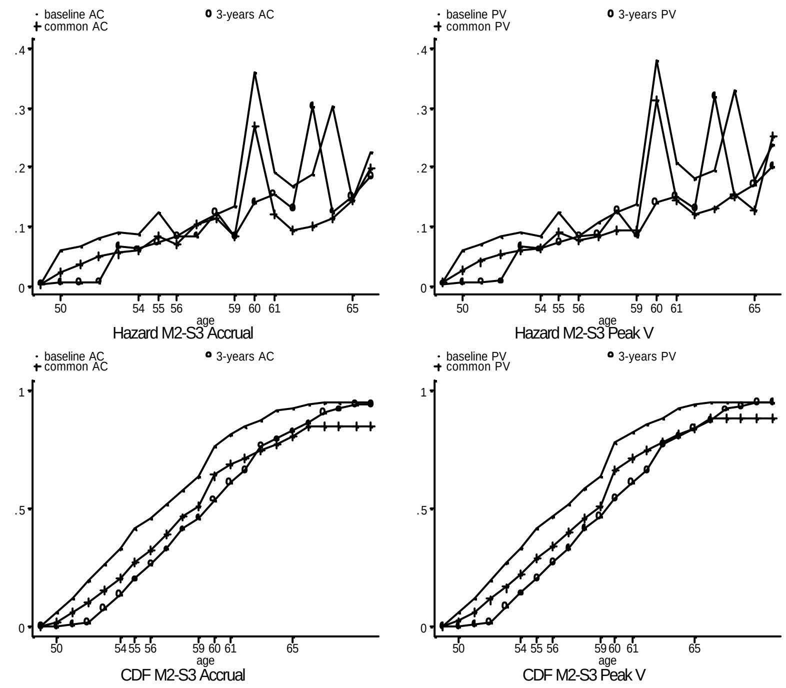
Note: The top panels show the hazards and the bottom panels the corresponding CDF. Results are obtained by using the coefficients from the baseline M1 estimated on the estimation sample (7446 men-years) and projecting both the baseline and the policy on the simulation sample (25330 men-years)

Figure 5.5: Simulations M2-S2 for peak value and option value. Men.



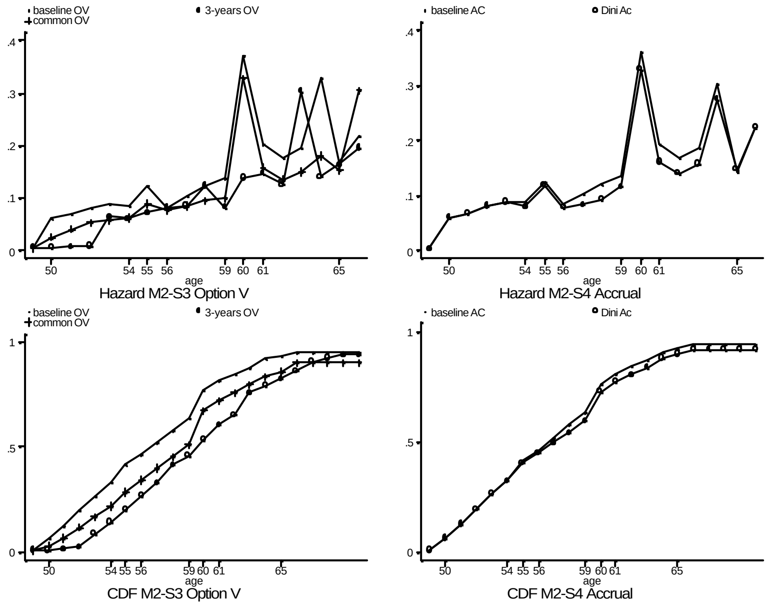
Note: The top panels show the hazards and the bottom panels the corresponding CDF. Results are obtained by using the coefficients from the baseline M1 estimated on the estimation sample (7446 men-years) and projecting both the baseline and the policy on the simulation sample (25330 men-years)

Figure 5.6: Simulations M2 -S3 for accrual and peak value. Men.



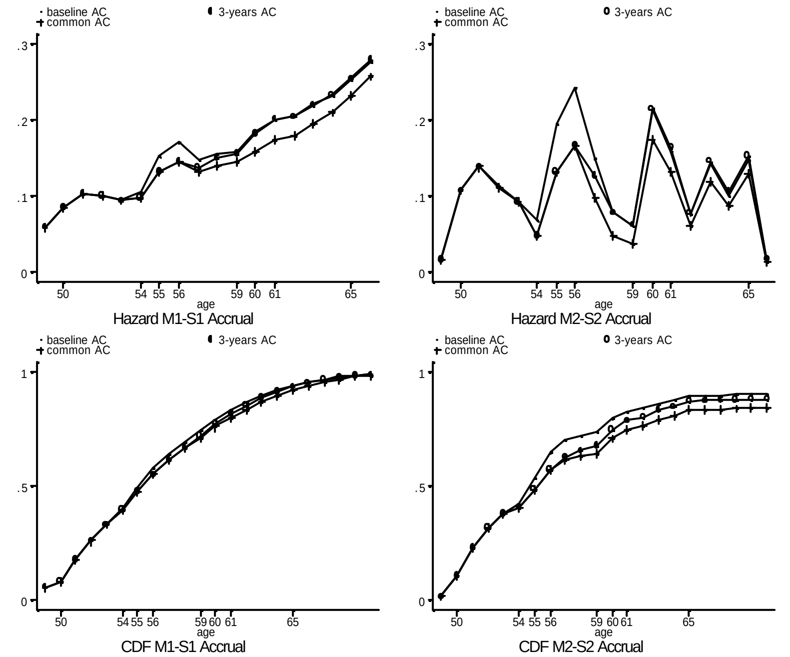
Note: The top panels show the hazards and the bottom panels the corresponding CDF. Results are obtained by using the coefficients from the baseline M1 estimated on the estimation sample (7446 men-years) and projecting both the baseline and the policy on the simulation sample (25330 men-years)

Figure 5.7: Simulations M2 -S3 for option value and simulation M2 -S4 based on the legislation of the 1995 reform. Men.



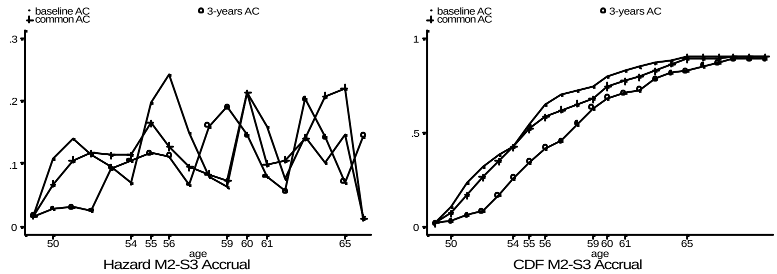
Note: The top panels show the hazards and the bottom panels the corresponding CDF. Results are obtained by using the coefficients from the baseline M2 estimated on the estimation sample (7446 men-years) and projecting both the baseline and the policy on the simulation sample (25330 men-years). The right panels refer to the reform enacted in Italy in 1995, known as the "Dini Reform"

Figure 5.8: Simulations M1-S1 and M2-S2 for accrual. Women.



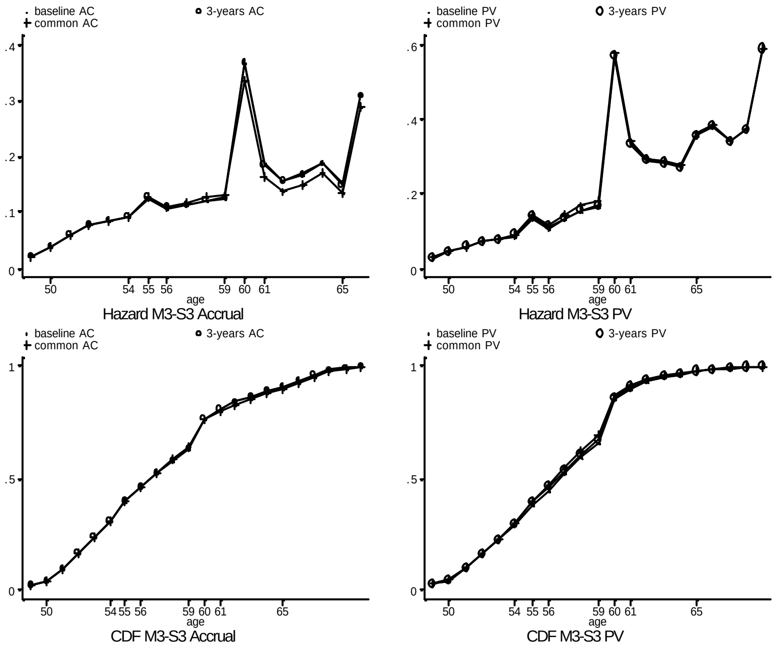
Note: The top panels show the hazards and the bottom panels the corresponding CDF. Results are obtained by using the coefficients from the baseline M1 and then M2 estimated on the estimation sample (1770 women-years) and projecting both the baseline and the policy on the simulation sample (6954 women-years)

Figure 5.9: Simulations M2-S3 for accrual. Women.



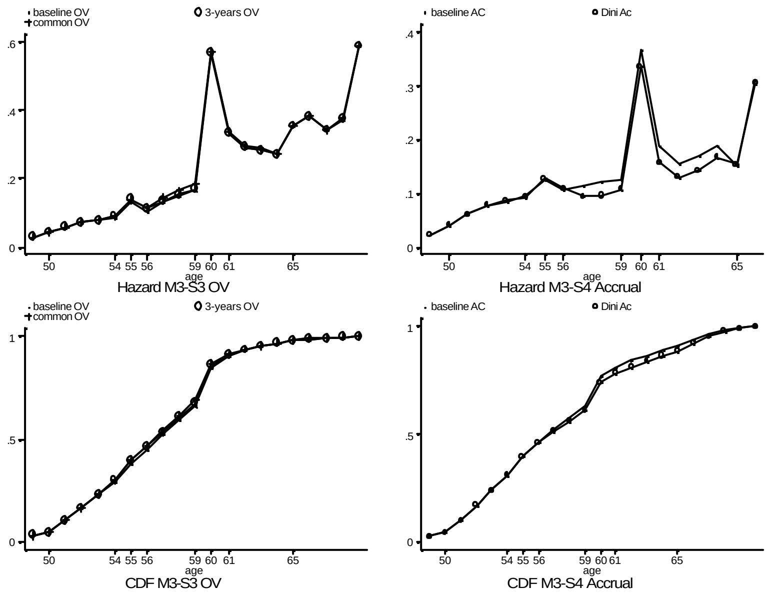
Note: The left panel shows the hazards and the right panel the corresponding CDF. Results are obtained by using the coefficients from the baseline M2 estimated on the estimation sample (1770 women-years) and projecting both the baseline and the policy on the simulation sample (6954 women-years)

Figure 5.10: Simulation M3 based on a flexible specification of the age effects. Men.



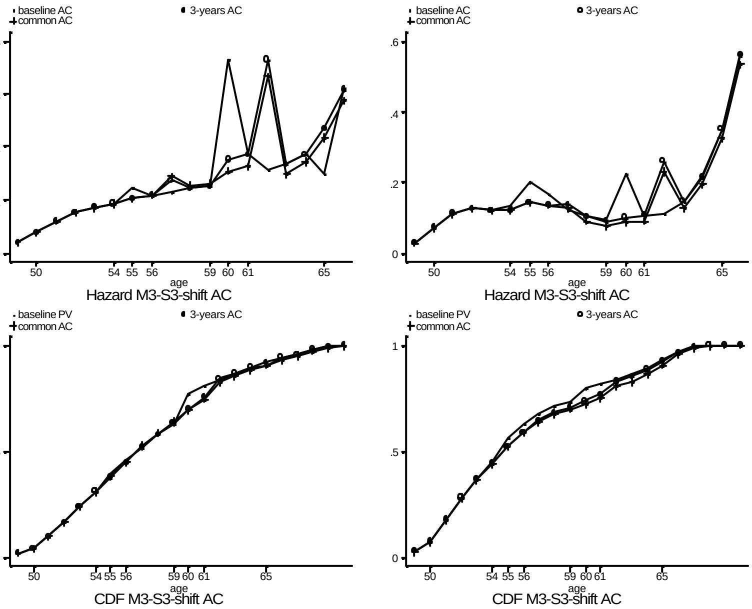
Note: Results for the simulated hazards are obtained by using the coefficients from the baseline M3 estimated on the estimation sample (7664 men-years). The left panel makes use of the accrual and the right panels of the peak value for the baseline and for the policy changes.

Figure 5.11: Simulation M3 based on a flexible specification of the age effects. Men.



Note: Results for the simulated hazards are obtained by using the coefficients from the baseline M3 estimated on the estimation sample (7664 men-years). The left panel makes use of the option value for the standard reforms and the right panels make us of the accrual for the 1995 reform.

Figure 5.12: Simulation M3 based on flexible specification of the age effects.



Note: The Left panels are for men and the right panels for women. Results for the simulated hazards are obtained by using the coefficients from the baseline M3 estimated on the estimation sample (7664 men-years) then simulating on the simulation sample. Note that in this case we shift the three important dummies by three years in order to impose an age effect due to the policy change.

Table 5.4: Estimated mean retirement age. Men.

Estimation sample (N=7664)

	Baseline	**3-years**	**Common**	**"1995 reform"**
Sample mean retirement age			**56.63**	
M1-S1-ACC	55.23	55.23	55.24	55.43
M1-S1- Peak V	55.26	55.19	55.25	55.19
M1-S1- OV	55.28	55.18	55.16	54.95
M2-S2 – ACC	55.97	56.01	55.81	55.71
M2-S2-Peak V	55.92	55.93	55.80	55.92
M2-S2-OV	55.93	55.97	55.94	55.81
M2-S3-ACC	58.35	58.45	58.41	58.58
M2-S3-Peak V.	58.40	58.42	58.32	58.43
M2-S3-OV	58.43	58.45	58.66	58.38
M3-ACC	55.71	55.70	55.74	55.90
M3-S5-ACC		55.84	55.88	

Simulation sample (N= 25330)

	Baseline	**3-years**	**Common**	**"1995 reform"**
M1-S1-ACC	55.73	55.71	55.66	55.85
M1-S1- Peak V	55.84	55.74	55.81	55.75
M1-S1- OV	55.78	55.67	55.65	55.41
M2-S2 – ACC	53.21	53.15	53.21	53.30
M2-S2-Peak V	53.73	53.64	53.73	53.64
M2-S2-OV	53.56	53.39	54.01	53.66
M2-S3-ACC	55.61	55.61	54.06	54.97
M2-S3-Peak V.	56.28	56.22	53.80	56.15
M2-S3-OV	55.72	55.79	51.76	55.90

Table A: Summaries of the distribution of social security wealth and of the incentive measures.

BASELINE (TRANSITION) CASE -MEN

AGE	MEDIAN SSW	MEDIAN ACCRUAL	10% ACCRUAL	90% ACCRUAL	STD ACCRUAL	MEDIAN TAX/SUBSIDY	**From volume**	Observations
53	0	0	0	0	1.20	0		712
54	112.48	0	-4.60	.051	6.40	0		641
55	129.96	-1.00	-7.68	0	6.50	.102	**.282**	600
56	135.52	-1.25	-7.69	.082	7.04	.124	**.301**	516
57	142.30	-2.61	-16.78	.867	8.48	.287	**.326**	466
58	137.97	-2.66	-16.19	.666	8.48	.298	**.356**	405
59	134.32	-3.69	-13.40	0	7.10	.403	**.378**	333
60	129.30	-9.76	-21.44	-1.86	11.075	1.634	**.623**	279
61	128.73	-4.42	-23.55	-.111	13.54	.528	**.632**	110
62	126.19	-4.87	-23.23	0.983	11.82	.591	**.633**	69
63	124.46	-4.96	-23.037	-1.00	10.80	.628	**.638**	46
64	120.36	-4.49	-20.233	1.63	17.15	.487	**.648**	32
65	101.24	-4.91	-20.94	-1.99	13.32	0.923	**.651**	39

Post- 1995 (DINI) CASE -MEN

AGE	MEDIAN SSW	MEDIAN ACCRUAL	10% ACCRUAL	90% ACCRUAL	STD ACCRUAL	MEDIAN TAX/SUBSIDY	Observations
53	0	0	0	0	0	0	712
54	0	0	0	0	0	0	641
55	0	0	0	0	0	0	600
56	0	0	0	0	0	0	516
57	116.62	0.33	-1.065	4.43	3.41	-.034	466
58	115.51	1.42	-1.195	7.23	5.19	-.111	405
59	114.48	-.59	-2.00	2.90	4.06	.063	333
60	112.90	-1.23	-2.59	2.24	4.62	.154	279
61	117.25	-.775	-2.69	6.64	6.60	.123	110
62	114.98	.084	-1.08	13.94	7.13	.009	69
63	111.96	.065	-.93	24	8.29	-.006	46
64	117.41	.132	-.94	15.49	8.19	-.015	32
65	95.36	-2.18	-3.14	1.09	1.56	.256	39

SIMULATION (3 years increment) -MEN

AGE	MEDIAN SSW	MEDIAN ACCRUAL	10% ACCRUAL	90% ACCRUAL	STD ACCRUAL	MEDIAN TAX/SUBSIDY	0bservations
53	0	0	0	0	0	0	712
54	0	0	0	0	0	0	641
55	0	0	0	0	1.44	0	600
56	0	0	0	0	1.80	0	516
57	129.25	-.504	-5.69	0	5.53	.057	466
58	128.65	-1.37	-6.94	0	5.71	.136	405
59	126.59	-2.72	-8.25	0	5.57	.338	333
60	126.83	-8.41	-19.72	0	8.71	1.21	279
61	127.18	-4.27	-21.99	0	10.45	.496	110
62	120.34	-4.6	-23.23	0	8.36	.591	69
63	124.46	-4.18	-21.29	-1.00	9.67	.496	46
64	120.85	-4.49	-20.23	1.64	14.59	.500	32
65	102.4	-4.91	-20.94	-1.99	13.32	.659	39

COMMON REFORM (Act. Adjustment) -MEN

AGE	MEDIAN SSW	MEDIAN ACCRUAL	10% ACCRUAL	90% ACCRUAL	STD ACCRUAL	MEDIAN TAX/SUBSIDY	observations
53	0	0	0	0	0	0	712
54	0	0	0	0	0	0	641
55	0	0	0	0	0	0	600
56	0	0	0	0	0	0	516
57	0	0	0	0	0	0	466
58	0	0	0	0	0	0	405
59	0	0	0	0	0	0	333
60	83.88	-2.18	-11.30	5.69	6.94	.652	279
61	94.64	-.356	-18.93	7.44	11.51	.035	110
62	100.14	-.623	-10.53	6.18	13.27	.064	69
63	105.87	-.602	-8.97	24.11	12.52	.063	46
64	105.12	-1.259	-11.06	3.79	13.80	.119	32
65	89.84	-2.02	-13.71	6.80	10.41	.352	39

BASELINE (TRANSITION) CASE- MEN

AGE	MEDIAN PEAK	10% PEAK	90% PEAK	STD PEAK	MEDIAN OPTION V	10% OPTION V	90% OPTION V	STD OPTION V
53	147.90	69.35	187.01	54.86	301.17	114.81	531.27	219.23
54	3.27	-4.61	174.19	83.58	143.20	48.06	477.51	234.33
55	-.659	-7.15	176.58	85.00	123.77	11.68	474.82	231.79
56	-1.17	-7.69	178.90	81.57	112.70	20.86	450.28	206.05
57	-2.58	-15.44	64.90	47.49	99.78	12.75	248.62	140.10
58	-2.66	-16.11	41.13	44.33	89.48	-1.29	246.70	145.95
59	-3.56	-13.40	14.46	45.34	79.33	-2.53	221.00	154.66
60	-9.76	-21.44	-1.76	15.61	-0.825	-22.6	143.92	125.00
61	-4.42	-23.55	2.49	18.97	53.27	-25.63	254.06	164.45
62	-4.68	-23.23	1.83	14.49	51.99	-20.24	366.24	165.17
63	-4.96	-23.04	-1.00	14.00	45.16	-24.30	428.20	171.61
64	-4.49	-20.23	-2.85	18.72	45.20	-6.4	136.25	125.76
65	-5.24	-23.47	-1.99	14.54	10.01	-25.09	81.99	54.87

1995 REFORM CASE - MEN

AGE	MEDIAN PEAK	10% PEAK	90% PEAK	STD PEAK	MEDIAN OPTION V	10% OPTION V	90% OPTION V	STD OPTION V
53	123.39	92.12	182.56	63.2	334.11	171.18	598.8	248.99
54	121.76	88.57	177.31	61.52	325.63	156.24	567.08	235.53
55	120.33	88.40	173.22	65.30	309.88	153.79	549.60	231.53
56	119.27	85.38	169.36	66.59	300.34	159.76	538.11	213.15
57	5.72	-.94	58.08	34.45	157.37	47.52	322.79	154.98
58	4.53	-1.17	57.38	5.715	142.32	38.39	298.18	164.90
59	-.485	-1.96	60.29	31.86	128.35	28.38	255.88	163.95
60	-1.14	-2.56	52.94	31.08	51.42	3.70	230.24	160.40
61	-.246	-2.70	60.33	34.84	95.46	-1.91	373.90	205.02
62	.425	-1.08	56.27	29.00	94.09	3.04	551.25	206.55
63	.161	-.938	56.48	24.06	81.32	6.90	601.55	208.60
64	.132	-.94	35.13	14.40	68.84	16.25	397.06	161.15
65	-2.18	-3.14	2.52	2.17	33.55	-3.00	110.98	78.62

SIMULATION 1 CASE -MEN

AGE	MEDIAN PEAK	10% PEAK	90% PEAK	STD PEAK	MEDIAN OPTION V	10% OPTION V	90% OPTION V	STD OPTION V
53	143.40	69.39	179.69	51.07	316.72	119.70	545.38	219.99
54	143.95	69.42	179.13	50.78	311.10	106.85	516.38	208.64
55	140.52	56.24	176.99	62.86	290.96	94.64	496.41	211.96
56	139.49	13.07	176.49	61.70	279.56	96.34	491.54	187.54
57	-.285	-5.69	167.40	79.23	123.54	39.37	450.03	191.51
58	-1.24	-6.91	169.64	83.48	107.79	16.20	425.61	204.80
59	-2.72	-8.25	168.42	85.68	92.74	.328	396.20	210.26
60	-8.42	-19.72	56.06	58.54	3.36	-21.58	205.77	174.40
61	-4.27	-21.99	35.56	82.81	59.44	-25.22	346.32	243.86
62	-4.60	-23.23	192.40	100.64	64.56	-20.51	553.95	270.40
63	-4.18	-21.29	-1.00	12.94	52.15	-10.81	462.73	176.74
64	-4.06	-20.23	2.06	16.36	53.09	-6.40	157.65	139.04
65	-4.91	-20.94	-1.99	14.19	19.99	-20.61	88.68	56.24

SIMULATION 2 CASE - MEN

AGE	MEDIAN PEAK	10% PEAK	90% PEAK	STD PEAK	MEDIAN OPTION V	10% OPTION V	90% OPTION V	STD OPTION V
53	102.58	62.73	135.40	42.61	315.54	119.56	544.01	228.55
54	103.13	62.69	133.10	42.12	309.91	102.55	514.72	216.92
55	102.07	62.69	133.14	43.55	295.40	105.73	494.77	212.44
56	102.87	62.73	135.32	37.43	288.26	111.34	490.25	183.38
57	101.34	62.69	133.16	35.60	272.98	102.65	455.71	167.42
58	100.84	62.69	134.74	40.62	260.22	98.26	440.76	181.99
59	101.02	62.73	131.10	45.08	248.52	89.50	398.04	189.26
60	-2.18	-11.30	15.22	25.95	17.88	-9.96	202.95	161.45
61	-.116	-18.93	19.35	39.72	103.99	-21.86	332.89	216.70
62	-.624	-10.53	61.64	42.41	96.24	-4.60	566.63	224.92
63	-.371	-8.95	85.52	44.06	82.96	-1.88	653.44	233.20
64	-.91	-11.06	31.29	29.24	74.46	-1.30	283.30	171.98
65	-2.02	-13.71	6.80	12.80	25.13	-15.89	105.05	75.21