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Author: Arnaud Dellis, Raphaël Desmet, Alain Jousten, Sergio Perelman

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Micro-Modeling of Retirement in Belgium

Arnaud Dellis, Raphaël Desmet, Alain Jousten, and Sergio Perelman

1.1 Introduction

The Belgian social security systems face an uncertain future. One major reason is the financial burden imposed by the aging of the population. For the systems to survive this demographic process, higher contribution levels, lower benefits, or both will have to be introduced, given the pay-as-you-go (PAYG) nature of these systems. Indeed, a straight increase in the public debt to finance this demographic transition is not an option as it would mean pushing the already high ratio of public debt to gross domestic product (GDP) to even further astronomical heights. Most recently however, the successive Belgian governments have successfully brought down the debt-GDP ratio to close to 115 percent from a level of 130 percent by means of strict budgetary policy. The government has even achieved a small budget surplus in 2001 and has reached the same goal in 2002 even in the presence of an economic slowdown. This fiscal rigor will no doubt increase the margin of maneuverability of the federal government in its attempts to cope with the demographic aging process.

Another factor of uncertainty pertains to the consequences of increased labor mobility on the way the social security systems are organized. First

Arnaud Dellis is a Ph.D. candidate at Cornell University. Raphaël Desmet is a researcher at the University of Liège. Alain Jousten is professor of economics at the University of Liège. Sergio Perelman is professor of labor economics at the University of Liège.

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of all, increased mobility between jobs in the public sector, in the private sector, and in self-employment may induce large changes in the way the three corresponding social security systems work. Recent reform proposals by the Belgian federal government to improve the way the public sector works also has to be seen in this light. Mobility between sectors will most likely increase once people's behavior is determined by similar factors measuring achievement and productivity in both the public and the private sectors. In those circumstances, a review and harmonization of the corresponding public retirement-income systems seems warranted. Second, the question of international job mobility is becoming more and more important, particularly for a small open economy in the heart of Europe like Belgium. Jousten and Pestieau (2002) study the implications of an expected increase in labor mobility from a European perspective, and the authors pay particular attention to the degree of redistribution inherent to the different systems. They argue that both levels of intra- and intergenerational redistribution will be widely affected, even if we replace the assumption of perfect labor mobility between member countries with a more restrictive and plausible one of mobility limited to individuals belonging to particular income groups.

However, even leaving these two challenges aside, the Belgian social security system needs reform. The widespread use of a variety of early retirement programs makes Belgium the country with the lowest average retirement age in the Western world, which is approximately fifty-seven years old for men.[1] This chapter studies the incentives pushing people toward retiring early. We explicitly model the incentive structure built into the various public retirement and early retirement systems. First, we compute indicators of benefit entitlement, such as social security wealth. Then, we define several different incentive measures based on the notion of social security wealth. In a third step, we perform an empirical estimation of microeconometric probit and option value models. From our exceptionally rich and broad database, we are able to compute a rather accurate measure of all individuals' pension wealth, as well as of the implicit tax rates the elderly workers face in case of delayed retirement.

The structure of the paper is as follows: Section 1.2 describes the essential features of the various public retirement and early retirement systems. In section 1.3, we explain the different, mostly administrative components of our large data set. The following section touches on the problem of the earnings process used in the simulations and estimations. Section 1.5 explains the process and logic underlying the construction of the different incentive measures used, while section 1.6 contains regression results ob-

1. The average retirement age of 57.6 years for men was estimated by Blöndal and Scarpetta (1998) on the basis of the *Labor Force Surveys.* In this study we estimated an average retirement age of 58.4 years for men and 57.4 years for women.

tained using these latter incentive measures. Section 1.7 delivers two policy simulations using the previously estimated coefficients. The first simulation consists of an increase by three years of the eligibility age in the various retirement systems, and the second consists of a policy in which early retirement would be possible at age sixty at the earliest, while normal retirement age would be sixty-five. Section 1.8 is devoted to the conclusions.

1.2 Social Security Schemes

The Belgian retirement income system rests upon three very unequal pillars. First of all, there are the public social security programs that represent the largest part of pension income for a wide majority in the population. The second pillar consists of company pension schemes, which only play a minor role as a source of income for the average Belgian worker. Essentially, they are currently confined to the higher-income individuals in the private sector and to the self-employed, a finding that is at least in part due to their tax treatment. A third type of retirement income comes from individual retirement savings. These take multiple forms: there are tax-favored individual-pension savings accounts with a maximum annual contribution of €580 per person (approximately U.S.$615),[2] or there are more traditional savings vehicles, such as the tax-favored savings accounts, investments in trust funds, life insurance, and so forth. The dominance of the first pillar can also be represented in numbers: Whereas the first pillar represents pension entitlements of more than 250 percent of GDP, assets in private-pension funds only amount to 10 percent of GDP.[3]

The first pillar, public retirement programs, essentially consists of four components. There are three large sectoral social security programs; one for the public sector, one for the private-sector wage earners, and one for the self-employed. Some special categories of workers, such as coalmine workers and military personnel, have special retirement systems that we will not analyze in the present paper. A fourth large category of public retirement income consists of the guaranteed-minimum-pension system that operates on a means-tested basis.

Aside from these pure retirement programs, the Belgian government has introduced early retirement provisions that either operate under the name of early retirement scheme, or alternatively as a form of old age unemployment. Table 1.1 gives a brief outline of the importance of the different categories of social security programs for the year 1995.

2. In this paper, we apply an exchange rate of €0.942 per $1, which approximately corresponds to the exchange rate in place on 31 December 1999.

3. See the Organization for Economic Cooperation and Development (OECD; 1994), Bouillot and Perelman (1995), and the European Economic Community (EEC; 1994) on the subject.

Table 1.1 Categories of Social Security Schemes in 1995

	Benefits as % of GDP	Number of Pensioners[a]	Average Amount of Benefits in Relative Terms (%)
Wage earners	5.72	1,347	87.3
Self-employed	0.71	246	59.1
Public-sector workers	3.38	405	170.7
Mandatory early retirement	0.64	128	103.8
Minimum old age pensioners	0.14	50	56.7
All schemes	10.59	2,175	100.0

Source: Bouillot and Perelman (1995).

[a]The number of pensioners is reported in thousands and also includes surviving spouses. A possibility of double counting exists.

1.2.1 Wage Earners' Scheme

The wage earners' scheme is the largest program, according to the number of people affiliated with the program. The program allows for retirement between the ages of sixty and sixty-five, with the choice of the retirement age not inducing any actuarial adjustment.[4] The system worked according to a different logic till the early 1990s. Until 1992, the wage earners' scheme had an actuarial adjustment factor of 5 percent per year of early retirement before the age of sixty-five.

However, in the case of most workers, the choice of the retirement age is not completely neutral with respect to the benefit amount, as most men still accrue extra pension rights by working additional years between the ages of sixty and sixty-five. This is so because a full earnings history consists of forty-five years of work for men, a condition that many people do not satisfy at the age of sixty. For those having more than forty-five working years, a dropout-year provision replaces low-income years with higher ones. The situation so far has been slightly different for women. Indeed, until very recently, women only needed forty years of earnings to have a complete earnings history. In reaction to successive court rulings on the illegality of this sex discrimination, the Belgian government introduced a reform a few years ago that aims at progressively increasing the complete career condition to forty-five working years for women over the time period 1997–2009. However, for most women included in our data set, a full career still consists of forty years of work.

Benefits are computed based on earnings during periods of affiliation. The benefit formula can be represented as follows:

4. Notice that, from a legal point of view, age sixty-five does not represent a compulsory retirement age, but rather an age at which a worker loses the social protection associated with his job.

$$\text{Benefit} = \frac{n}{N} \cdot \text{average wage} \cdot k,$$

where n represents the number of years of affiliation with the wage earner's scheme, N the number of years required for a full career (in our case either forty or forty-five), and k is a replacement rate, which takes on the value of 0.60 or 0.75 depending on whether the social security recipient claims benefits as a single person or as a household. The variable average wage corresponds to indexed average wages over the period of affiliation, with indexation on the price index combined with additional discretionary adjustments for the evolution of growth. A peculiar feature of the Belgian wage earners' scheme is that periods of the life spent on replacement income (e.g., unemployment benefits, disability benefits, workers compensation, and the like) fully count as years worked in the computation of the average wage, and hence of the social security benefit. For any such periods, fictive wages are inserted into the average wage computation. In line with the general philosophy of the Belgian social insurance system that any such spell on a replacement-income system is purely involuntary, imputed wages are set equal in real terms to those that the workers earned before entering these replacement-income programs.

An additional category of linked benefits is payable to surviving spouses or, more generally, to surviving dependents of deceased wage earners. All the different types of benefits provided for under the wage earners' social security system are covered against erosion by the means of inflation through an automatic consumer price index (CPI) adjustment.

The system works both with floors and ceilings, which are either indexed to the evolution of prices or to average wages. The minimum household pension represents a floor for workers that have contributed during their entire working life to the systems. It is approximately equal to 56 percent of average net wages. At the opposite extreme, a ceiling operates on pensionable but not on taxable earnings. The earnings entering the above pension formula are strictly limited to a maximum of 120 percent of average gross wages. Wage earners' pensions are also subject to an earnings test. Currently, the earnings limit is approximately €7,450, or $7,900, per year. For earnings above this limit, pension entitlement is suspended.

The wage earners' system is essentially based on the PAYG principle and financed through payroll taxes that are levied both on the side of the employers and of the employees with a combined contribution rate of 16.36 percent. The system also receives a subsidy from the Belgian federal government that is approximately equal to 11 percent of overall benefits.

Next to the official wage earners' scheme, several forms of early retirement programs have developed over the last few years, some officially carrying that name and others that do not (e.g., unemployment, preretirement, and so forth). Those schemes can be broadly subdivided into two

groups: collective mandatory retirement and individual early retirement. During the 1980s and the 1990s, an arsenal of mandatory early retirement schemes was put in place. All of these arrangements were and are based on collective agreements, which are negotiated with the active involvement of employees and employers, sometimes at the sectoral level or sometimes at the level of an individual company or production site. For some companies in a difficult economic position, mandatory retirement ages as low as fifty were introduced. The federal government did not necessarily object to such arrangements, as it considered early retirement as a good tool in the fight against youth unemployment. Indeed, some of these early retirement schemes required the employers to rehire young workers. Lately however, these early retirement schemes have undergone some scrutiny. Not surprisingly, the beneficial labor market effects have been rather modest, if not completely absent. Recent discussions and decisions at the government level clearly move in the direction of lifting the effective early retirement age and hence also the sector-specific mandatory retirement ages.

This has to be seen in contrast to the massive costs these programs induce for the federal budget, as well as for the society as a whole. First of all, the effect of these waves of early retirement on the federal budget operates both through missing contributions during the period spanning from early retirement to the normal retirement age as well as through additional costs. Thus, the federal government pays a large fraction of early retirement compensation.[5] On the other hand, an individual's pension rights in the wage earners' pension schemes are essentially unaffected by the decision to retire early or not. This is due to the previously discussed feature of the Belgian social security system that days spent on replacement income count as working periods in the computation of average pensionable earnings and of periods of activity. Hence, retiring early does not induce any loss of income during retirement.

Individual early retirement differentiates itself from its collective counterpart by the fact that it is based on an individual's decision to retire from work. The most prevalent way is to pass through the unemployment system in which the unemployed aged fifty or older are considered "aged unemployed," and thus neither subject to controls on availability to work, nor to benefit cuts due to long-term unemployment. Therefore, people unwilling to continue to work can ask their employer to lay them off. The latter has no incentive not to lay the worker off, unless the employer considers the employee to be a crucial wheel in the working of the company. Laying the worker off allows the employer to replace an expensive old worker by a cheaper young one. Furthermore, the employer's behavior does not add any costs to his unemployment contributions, as the system is not experience rated.

5. Depending on the early retirement scheme, the employer pays part of the income to the worker from the early to the normal retirement age.

Next to the unemployment path, some people also attempt to proceed to retirement through the disability-insurance scheme. However, in the Belgian context, we think that disability is not a very prominent means of departure, at least not for private-sector employees. Incentives to claim disability benefits are rather limited: Medical screening is relatively severe, and benefits are not significantly more interesting than early retirement provisions.

1.2.2 Public-Sector Employees

The social security scheme for public servants is the oldest one of the three, dating back to as early as 1844. Public pensions are paid out of the general federal budget. Officially, the public sector pensions are considered as deferred income rather than old age insurance. The only official insurance aspects are the 7.5 percent payroll taxes that the public-sector employees have to pay to finance survivor benefits. Benefits are essentially individualized, that is, there are no additional spousal benefits available for no- or low-income spouses.

Civil servants' pensions are compulsory as of age sixty-five for both men and women. However, as for the private sector, there is a multitude of ways of retiring earlier than this normal age of sixty-five. It is possible to opt for an incomplete career and retire at sixty. For some particular categories of workers, the normal retirement age is lower than sixty-five, and early retirement provisions are sometimes extremely generous. This is particularly the case for military personnel and for teachers, who have always enjoyed a much more favorable treatment. For example, secondary-school teachers in the French-speaking community can either retire at age fifty-five if they have sufficient years of service, or alternatively take a less demanding route in terms of career requirements and retire at the age of about fifty-eight.

Public-sector pensions are based on the income earned by an individual during the last five years before retirement. Benefits are computed according to a rather complicated formula, but can never exceed 75 percent of the average wages over the last five years. The benefit formula can be represented as follows:

$$\text{Benefit} = \text{average wage over last five years} \cdot \min(\text{fract}; 0.75),$$

where fract is a fraction with a numerator consisting of the number of years the person worked in the public service, and the denominator is a benefit accrual factor. This latter benefit accrual factor, also called *tantième*, depends on the rank the person occupied in the hierarchy. This denominator ranges from 30 to 60, taking the value of 30 for the highest-ranking civil servants (university professors and so forth) and 60 for the lowest ranks.

In addition to the aforementioned limit on pensions of 75 percent of the average gross wage, there is also an absolute limit to the amount of a public-sector pension, which corresponds to about three times average

gross wages in the economy. Furthermore, minimum pensions are also available to aged civil servants, which corresponds to 56 percent of average wages for a single individual and 70 percent for a one-earner couple.[6] Notice the rather marked difference of these floors and ceilings with those applicable to the private-sector employees. A major conclusion we can already draw at this stage is that higher-income civil servants get a much better deal than their private-sector counterparts. This finding is even reinforced once we introduce another aspect, namely the indexation rules. As opposed to the private-sector social security system that only indexes benefits to the CPI, public pensions are indexed to average wages (*péréquation*). Civil servants therefore enjoy the benefits of productivity increases in the economy even beyond the moment when they actively contribute to them as workers.

Aside from this official route to retirement, civil servants have another alternative to quit work early through disability protection. This route seems a much more plausible route to early retirement for public-sector employees than for private-sector wage earners as the screening seems to be much less severe.

1.2.3 Self-Employed

The self-employed retirement scheme is the latest one to have been introduced as it has only existed since 1956. It is also the least generous of the three big social security systems. For a very long time, pensions have been independent of earnings levels. However, since 1984, the system has been progressively transformed to allow for a stronger link between contributions and benefits. Additional earnings past 1984 enter the pension computation formula at their correct value, instead of some fictive amount. Given the period of analysis we will be looking at in our econometric analysis, pensions of the self-employed are still essentially independent of their earnings histories and contributions.

Full benefits are available at age sixty-five for men with a complete earnings history of forty-five years. However, early retirement is possible as early as age sixty with a reduction of 5 percent per year of anticipation. Women are currently in a transitory system that progressively increases their normal retirement age from sixty to sixty-five and the complete career requirement from forty years of work to forty-five in line with the reform of the wage earners' scheme. Again, most women in our data set are still subject to a normal retirement age of sixty and a full career condition of forty years of work.

The social security system of the self-employed is financed through two broad categories of income. First, there are direct social insurance contri-

6. The latter feature is the only instance in which the family structure matters for the amount of civil service pension.

butions levied under the form of a 16.7 percent tax on the first €46,035 ($47,368) of income and 12.27 percent on the income in the bracket between €46,035 and €67,352 ($89,302). Income above the latter threshold is not subject to social-insurance taxation. More than 75 percent of the contributions raised using this social-insurance taxation are used for the pension system of the self-employed, the remainder serves to cover health care and other social-insurance benefits for the self-employed. Second, the federal government pays a large subsidy to the system that corresponds to approximately 37 percent of benefits.

Self-employed do not have access to the unemployment-insurance system, and no other special regime has been put in place to allow them to retire early. A public disability system exists, but in our opinion, it cannot be seen as an early retirement vehicle, as it is based on criteria even more stringent than those of the wage earners' scheme. Hence, if the self-employed desire to retire early, they generally have to transit through some private retirement-income arrangement, be it a formal pension plan or simple savings.

1.2.4 Guaranteed Minimum Income

The guaranteed-minimum-income pensions are fully paid for by general government revenue, and are means tested. This type of pension is only available after the legal retirement age.

1.2.5 Labor Market and Benefit-Program Participation

Labor market participation rates start to decline at a rather early age. Table 1.2 illustrates the picture for men between the ages of fifty and sixty-nine. Notice the very rapid decline in the labor force participation for men in their late fifties. Part-time work plays a totally marginal role in the Belgian retirement landscape. However, the Belgian government currently plans to introduce bigger incentives for people to retire progressively through a period of part-time work and part-time retirement. The corresponding panel for women shows that early retirement schemes are much less important for female workers than for males. The reasons for this finding are at least two. First, women sometimes do not fulfill some career length requirements for access to these early retirement schemes. Second, women tend to work in somewhat different jobs. Many mandatory early retirement schemes were set up in male-dominated vocations involving structural difficulties, such as heavy industry and mining.

1.2.6 Pathways to Retirement

Pathways to retirement vary somewhat according to the social security system the worker is subject to. Table 1.3 summarizes the differences for the case of the wage earners and the self-employed. Unfortunately, we have been unable to separate out the different pathways for the civil servants.

Table 1.2 **Labor Market and Benefit Program Participation (%)**

	50–54	55–59	60–64	65–69	Total
		Men			
Working full time	24.71	15.39	6.64	1.59	48.33
Working part time	1.53	0.93	0.45	0.19	3.10
No benefit receipt	0.73	1.10	0.74	0.03	2.60
Unemployment benefits	0.63	0.62	0.52	0.01	1.78
Disability benefits	0.82	1.23	1.57	0.02	3.64
Early retirement benefits	0.45	3.94	6.63	1.41	12.43
Public retirement benefits	0.55	1.80	7.93	17.84	28.12
Total	29.42	25.01	24.48	21.09	100.00
		Women			
Working full time	9.58	5.02	1.66	0.29	16.55
Working part time	3.65	1.70	0.42	0.09	5.86
No benefit receipt	11.22	12.12	6.83	5.46	35.62
Unemployment benefits	1.55	1.15	0.04	0.00	2.74
Disability benefits	0.93	1.01	0.04	0.00	1.99
Early retirement benefits	0.22	1.11	0.28	0.00	1.60
Public retirement benefits	1.50	2.84	16.34	14.95	35.64
Total	28.65	24.95	25.60	20.80	100.00

Source: Authors' calculations.

Table 1.3 **Pathways to Retirement (%)**

	Wage Earners	Public-Sector Employees	Self-Employed
	Men		
Directly to SS	34.85	94.97	90.02
Early retirement then SS	46.97	5.03	0.00
Disability then SS	8.21	0.00	9.98
Unemployment then SS	9.97	0.00	0.00
Total	100.00	100.00	100.00
	Women		
Directly to SS	54.85	93.82	98.18
Early retirement then SS	20.02	6.18	0.00
Disability then SS	5.25	0.00	1.82
Unemployment then SS	19.88	0.00	0.00
Total	100.00	100.00	100.00

Source: Authors' calculations.

Note: Impossible to separate the disability path for public-sector employees because of missing data.

The reason for this rather disappointing fact is that our data source for the corresponding information is the income tax returns, which do not separate the type of pension income for public-sector employees. Focusing on the wage earners, we see the importance of the early retirement provisions. Furthermore, we also see the important role of the unemployment system

that absorbs some of the mandatory early retirees, but also some of the voluntary early retirees.

1.3 Data Overview

Our data set stems from five sources, which are mostly administrative databases. We were able to match all of these using an individual national identification number. Our merged data set has the big advantage of being extremely rich, as it includes data from multiple sources for a very large fraction of the Belgian population. In the following, we briefly present the various data sources, as well as their major advantages and disadvantages.

1.3.1 Statistiques Fiscales des Revenus (SFR)

The data used for the SFR are originally collected by Finance Ministry. The INS (National Statistical Office) then processes the raw information to produce the SFR. Starting in 1989, the SFR data include the national identification number, thereby making 1989 the first year for which we can merge the different data sets needed. In our analysis, we focus on the years ranging from 1989 to 1996. The INS records all information relevant for the computation of individual's tax liabilities. Variables available include wage income and income from other professional activities, household size and type, number of dependents in the household, age and income of spouse and any other dependent, social-insurance transfers and private-pension receipt, house ownership status (owner or renter), taxable real estate income, contributions to second and third pillar pensions, and so forth.

1.3.2 Comptes Individuels de Pension (CIP)

The CIP is collected by the wage earners' pension administration (ONP) since the mid-1950s. It includes all career information relevant for the wage earners' pension computation: gross wages, days of work, days on social insurance programs, and the like.

1.3.3 Institut National d'Assurance Sociale des Travailleurs Indépendants (INASTI)

The INASTI dataset includes good information on periods of affiliation as a self-employed worker. There is however no information on earnings levels, other than those available for last years from the SFR dataset. As a result, we decided to apply the fictive earnings amounts that are used by the social security administration in the benefit computation for a large part of the self-employed.

1.3.4 Finance Ministry, Department of Pensions

This segment of our database contains the information on the periods of affiliation as a civil servant, as well as some information on wages during

the last year of work. Again, information on periods of affiliation allows us to complete the wage data using the SFR file for the period 1989–1996.

1.3.5 The 1991 Census

We only use a very limited amount of information available in the census. Essentially, we focus on education levels that are classified according to nine categories. Doing so, we are able to match education-specific life tables to all the individuals in the database. Furthermore, we use industry indicators from the census that give information on the activity sector to which each individual belongs.

The major disadvantages of our merged data set are the slightly incomplete earnings information for the self-employed and public servants, as well as the sparse information on occupational and individual private-pension arrangements.

In our analysis, we analyze men and women separately. Our sample selection procedure operates in four steps departing from the original SFR file. First, we select households with at least one member in the fifty to sixty-four age range. Then, we draw a 2.5 percent random sample out of this group, which gives us a total household number of 21,818. In a third step, we match all the information from the other data sources. Finally, we eliminate all inactive people using the following definition of retirement: The retired are all those who have either pension or early retirement income and have income from work smaller than a threshold of €7,450 ($7,895), or who have unemployment or disability income and no income from work. Table 1.4 summarizes all the relevant information for our sample. The total number of observations, 23,238 and 9,707 for men and women, respectively, corresponds to three successive years—1993, 1994, and 1995—on which we focus our analysis.

1.4 Earnings Histories and Projections

Our data set contains very different earnings information for periods of affiliation with the different systems. The CIP data allows us to reconstruct the complete earnings histories for wage earners. For public-sector workers, however, we only have wage information for the years from 1989 until 1996. Given the requirement that we need five years of earnings to compute public-sector pension entitlements, we do a backward projection in case there is a missing observation for one of the last five years of earnings. For the self-employed, we have very insufficient earnings information to compute wage-dependent pension entitlements. Fortunately, the social security system of the self-employed has heavily relied on fictive income figures for past years of earnings, which we use for pension computation.

As for forward projections, we decided to apply wage increases so as to keep real wages constant (price-inflation adjustment) after some experi-

Table 1.4 Summary Statistics

	Total		SD	
	Men	Women	Men	Women
No. of observations	23,238	9,707		
Retired (%)	8.6	9.9		
Age mean	54.9	54.2	3.7	3.5
Married (%)	80.6	66.1		
Inactive spouse (%)	66.4	30.7		
Age difference mean	2.7	–1.9	4.0	3.9
Earnings mean	24,017	15,252	19,758	11,901
Spouse's earnings mean	6,163	19,865	9,990	14,004
Life earnings (wage earners)	33,207	18,610	12,540	9,238

	Number		Retiring Within the Next Year (%)	
	Men	Women	Men	Women
Age structure				
50–54	11,938	5,664	3.1	5.3
55–59	8,200	3,149	9.8	9.0
60–65	3,100	894	26.3	41.3
Social security program				
Wage earner	13,135	5,242	9.6	11.0
Self-employed	3,984	1,080	5.0	7.5
Civil servant	6,119	3,385	8.6	8.8
Region				
Brussels	1,850	1,330	9.1	8.7
Flanders	14,715	5,197	8.6	10.4
Wallonia	6,673	3,180	8.4	9.4

Note: Observations correspond to person-year cells. SD = standard deviation. Blank cells indicate that data is not applicable (i.e., SD does not apply).

mentation with other wage regression models. In particular, it has the advantage of allowing for reasonable projections for people belonging to multiple systems.

1.5 Construction of Incentive Measures

To measure the impact of the social security systems' incentives we use several different indicators. A first one is the concept of social security wealth (SSW), which is the present discounted value of all future benefit flows from a given social security system. Discounting is done allowing both for time preference and mortality adjustments. Mortality adjustments are based on education-specific life tables, as computed by Deboosere and Gadeyne (2000) based on the 1991 Census and population registers. Depending on the household situation and the system, SSW also

includes an element that is a function of dependent or survivor benefits. Furthermore, SSW also has to allow for the possibility of people being subject to different retirement-income systems. In the Belgian context, private pensions are not integrated as they only play a minor role in the pension landscape. However, the case of people having pension entitlements in two or even three of the public social security programs is not rare. We apply the official rules that exist for cumulating benefits from the three main public systems.

We compute this SSW measure for every pathway toward retirement that is accessible to the individual. After the construction of these SSW –figures, we then proceed in a second step to the computation of weighted SSW indicator, which sums the previously derived path-specific components. We attach age-specific weights to the different retirement paths, as described in table 1.5. The weights on the early retirement and the unemployment and disability routes correspond to the sum of observed frequencies of these routes among all people of any given age up to age sixty-five, and the public retirement system takes the residual weight. For wage earners, we add the unemployment-insurance and disability-insurance paths as the two systems produce very similar benefit structures. Doing so, we give an upper bound on incentives for people to retire, as we render all of disability voluntary. Given the lack of information for the public sector, we consider as early retirees all people retiring before the age of sixty.

As for the self-employed, we only allow for one path in our computation as the disability system provides quite low levels of benefits with very strict conditions. Furthermore, it would be very difficult for us to compute any reasonable amount of disability benefits due to the lack of good earnings information that we mentioned earlier.

A last important remark relates to retirement benefits of two-worker couples. It sometimes happens that the dependent benefit of a spouse is larger than the benefits based on the individual's own work history. In that case, we apply the official rule of supplementing the pension based on the personal earnings history by the difference between the potential dependent benefits of the spouse and the pension for work. Furthermore, the SSW measure that will be used hereafter includes both the worker's and the spouse's potential SSW, independent of whether or not the individual continues to work.[7]

Based on this weighted SSW, we then compute different secondary incentive measures. A first one is the concept of accrual, which simply represents the variation in SSW that is obtained by retiring next year rather than

7. We assume that the spouse retires on a standard retirement path (using the previously defined weights) as soon as the spouse is entitled to access any one of the three main public retirement programs.

Table 1.5 Weight of the Different Pathways to Retirement (by age)

	Wage Earners			Civil Servants	
Age	Public Retirement	Early Retirement	Unemployment/ Disability	Public Retirement	Early Retirement
			Men		
50	0.335	0.479	0.186	0.948	0.052
51	0.351	0.483	0.166	0.948	0.052
52	0.362	0.485	0.153	0.949	0.051
53	0.382	0.479	0.138	0.953	0.047
54	0.401	0.473	0.126	0.952	0.048
55	0.417	0.472	0.111	0.956	0.044
56	0.456	0.442	0.102	0.963	0.037
57	0.502	0.415	0.083	0.968	0.032
58	0.605	0.331	0.064	0.977	0.023
59	0.757	0.185	0.058	0.982	0.018
60	0.807	0.145	0.048	0.990	0.010
61	0.844	0.112	0.044	1.000	0.000
62	0.903	0.065	0.032	1.000	0.000
63	0.970	0.018	0.012	1.000	0.000
64	1.000	0.000	0.000	1.000	0.000
65	1.000	0.000	0.000	1.000	0.000
			Women		
50	0.526	0.210	0.264	0.937	0.063
51	0.570	0.214	0.216	0.947	0.053
52	0.586	0.219	0.195	0.950	0.050
53	0.623	0.201	0.176	0.961	0.039
54	0.658	0.176	0.166	0.965	0.035
55	0.700	0.169	0.131	0.973	0.027
56	0.756	0.143	0.101	0.984	0.016
57	0.835	0.122	0.043	0.991	0.009
58	0.924	0.048	0.028	1.000	0.000
59	0.995	0.000	0.005	1.000	0.000
60	1.000	0.000	0.000	1.000	0.000
61	1.000	0.000	0.000	1.000	0.000
62	1.000	0.000	0.000	1.000	0.000
63	1.000	0.000	0.000	1.000	0.000
64	1.000	0.000	0.000	1.000	0.000
65	1.000	0.000	0.000	1.000	0.000

the present. Table 1.6 gives the summary statistics we obtain by applying this first incentive measure to the entire sample of individuals belonging to the different social security systems.

At all ages from fifty to sixty, we find that the value of the SSW median is always higher than $200,000. For accruals, notice the large spread between the values we obtain for people at the tenth and the ninetieth percentile of the distribution. Another feature that our tabulation reveals is that once men and women attain age sixty, more than 90 percent of them

Table 1.6 **Social Security Wealth and Accrual**

			Accrual			
Age	Obs.	SSW Median	10th %	Median	90th %	SD
			Men			
50	2,821	248,352	–10,441	–5,722	4,905	8,517
51	2,586	250,816	–9,579	–4,878	5,021	8,006
52	2,305	250,300	–10,465	–5,232	4,925	7,746
53	2,150	250,413	–9,944	–5,005	5,404	7,600
54	2,076	251,578	–9,285	–1,052	6,722	8,213
55	2,045	255,997	–12,164	–4,990	5,168	8,481
56	1,894	255,076	–10,868	–4,163	4,745	7,665
57	1,701	258,560	–14,785	–3,917	4,954	8,363
58	1,409	255,560	–13,758	–4,228	5,155	7,726
59	1,151	258,025	–6,919	–658	5,864	6,050
60	1,027	259,078	–18,113	–9,673	–167	6,868
61	694	240,421	–18,405	–8,995	–187	7,083
62	473	207,874	–18,895	–8,382	–205	7,577
63	375	199,347	–18,148	–7,660	–301	7,101
64	302	199,683	–17,999	–8,051	–374	7,421
65	229	203,135	–20,918	–12,376	–6,596	6,318
			Women			
50	1,464	227,610	–9,380	–2,775	4,418	5,889
51	1,273	231,872	–5,528	–1,028	5,231	5,533
52	1,118	232,794	–7,348	–1,824	4,768	5,560
53	940	233,461	–6,706	–1,354	5,403	5,455
54	869	229,748	–6,223	–1,268	5,228	5,112
55	824	229,591	–7,276	–1,707	5,000	5,261
56	747	230,956	–8,408	–1,855	4,846	5,461
57	621	231,328	–9,494	–1,789	5,235	6,201
58	514	234,003	–8,755	–989	5,512	5,760
59	443	232,094	–9,027	–514	6,109	6,089
60	391	232,243	–18,179	–11,053	–6,473	5,616
61	227	217,335	–17,306	–10,448	–6,213	4,896
62	97	207,054	–17,430	–10,319	–5,928	6,694
63	78	197,000	–17,753	–9,778	–5,361	5,242
64	57	172,528	–14,555	–8,455	–4,992	4,553
65	44	143,350	–15,120	–8,899	–3,434	4,259

Note: Obs. = observations; SD = standard deviation.

face negative accruals. These results are essentially due to the fact that, under the rules outlined in section 1.2, workers are hardly penalized for retirement at age sixty rather than sixty-five. Also, notice the effect of the early retirement systems that are made generally available to workers at key ages, such as fifty-two, fifty-five, and fifty-eight. For men, we observe quite substantial negative accruals at very early ages because of the availability of very generous early retirement provisions. For women, the situation is slightly different. First of all, the value of the accrual for women is much

Table 1.7 SSW, Accrual, and Tax or Subsidy for Male Wage Earners

		SSW		Accrual			Tax or Subsidy	
Age	Obs.	Median	10th %	Median	90th %	SD	Median	Pestieau-Stijns
50	1,708	269,845	–15,009	–8,064	–4,204	7,967	0.362	n.a.
51	1,552	269,298	–13,339	–7,262	–3,310	7,642	0.321	n.a.
52	1,397	267,181	–13,443	–7,665	–2,852	7,070	0.354	n.a.
53	1,318	266,273	–13,969	–7,248	–2,678	6,754	0.337	n.a.
54	1,253	265,461	–12,251	–6,182	8,467	9,206	0.279	n.a.
55	1,212	268,248	–17,706	–8,559	–3,449	7,823	0.410	0.821
56	1,083	266,265	–15,479	–8,061	–2,659	6,976	0.396	0.809
57	953	268,312	–17,663	–9,486	–1,939	7,382	0.474	0.789
58	750	265,781	–15,762	–10,026	–3,985	5,209	0.489	0.771
59	562	266,845	–8,237	–2,660	241	5,737	0.126	0.811
60	464	271,955	–17,832	–10,776	–6,018	5,402	0.498	0.496
61	336	269,417	–18,631	–11,061	–6,225	5,812	0.556	0.497
62	193	257,141	–19,053	–10,660	–4,070	6,073	0.523	0.491
63	143	247,500	–18,069	–11,256	–5,596	5,372	0.526	0.489
64	116	232,136	–18,236	–9,750	–5,057	5,738	0.499	0.473
65	95	224,505	–19,964	–12,425	–7,979	5,134	0.585	0.529

Source: Pestieau and Stijns (1999, table 1.9) and authors' calculations.
Note: Obs. = observations; n.a. = not available.

less negative for ages up to fifty-nine than the values observed for men. Women usually have shorter periods of affiliation with the social security systems and thus have more limited access to these early retirement schemes. Furthermore, the change in accruals is much more pronounced at the ninetieth percentile for women than for men. We see two broad reasons for this finding. First of all, for single women with a rather complete earnings history, the same logic applies as the one we already saw for men. For married women however, the husband's earnings history plays an important role in the determination of the value of the wife's accrual. To illustrate this point, it is easiest to use a simple example. Consider a couple in which the husband is still working when the wife turns sixty. Suppose, rather plausibly, that the wife has an incomplete and low-income earnings history. This woman will face a large negative accrual, as she knows that when her husband retires, she will give up her own pension entitlement to claim spousal benefits based on her husband's earnings history. Therefore, an additional year of work implies a net loss both in terms of pension income (based on her earnings record) and in terms of further social security contributions that will in the end not affect her pension entitlement.

The findings are very similar once we restrict our attention to the wage earners' scheme, as table 1.7 indicates. Approximately 90 percent of the population face negative accruals starting at age fifty. Under the rules of the unemployment or early retirement systems for wage earners, fictive

income is imputed to the earnings histories of workers on these types of replacement income. This way, the pensions payable to a large number of low- and medium-income workers under the wage earners' scheme are almost immune to a decision to retire early.

The same finding can also be represented using a different incentive measure, namely the implicit tax or subsidy rate imposed by the social security system. This tax or subsidy rate is defined as being the negative of the accrual divided by the potential income during the next year.[8] To allow a comparison with the results of the previous study by Pestieau and Stijns (1999), we restrict our attention to the subsample of male wage earners. The simulated numbers of these authors match up pretty nicely with the ones we derive for our sample from age sixty upward. At earlier ages, the difference is rather substantial. This result is due to the different weighting of the pathways into retirement as we use a weight on the early retirement route that is smaller than the 100 percent used by these authors.

The next two incentive measures are forward-looking measures. "Peak value" represents the difference between SSW at its peak and SSW at present. It thus differentiates itself from the accrual measure by the fact that it takes into account the entire SSW process, not only the variation from the present to the next period.[9] The second forward-looking measure is the concept of "option value" as defined by Stock and Wise (1990), which is based on a utility-maximization framework. The utility function V_t underlying the computation of the option value process can be summarized by the following mathematical expression:

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} Y_s^{\gamma} + \sum_{s=r}^{S} \beta^{s-t} [kB_s(r)]^{\gamma},$$

where the first expression on the right-hand side represents the utility derived from labor income Y, and the second expression represents utility derived from retirement income $B_s(r)$;[10] β is the time-preference rate for which we assume a discount rate of 3 percent, which corresponds to a value of β of approximately .97. The variable γ corresponds to a parameter of risk aversion and is set to $\gamma = 0.75$. Finally, $k = 1.5$ expresses the relative weight of utility of retirement income as compared to wage income.

The concept of option value $G_t(r^*)$ is then defined as the difference in utility terms between retiring at the best point in the future (r^*) and now (t).

$$G_t(r^*) = V_t(r^*) - V_t(t)$$

8. In line with the Belgian social insurance legislation, we apply a somewhat different projection mechanism for this income figure than for the one used in the pension computation formula that we discussed in section 1.4.

9. Peak value is equal to accrual if the peak of the SSW process is attained with immediate retirement.

10. The value of the benefit corresponds to the weighted sum of retirement income using the weights of table 1.5.

Summary statistics for both of these forward-looking measures are given in table 1.8. The peak value numbers of table 1.8 for men and women older than fifty-nine strongly resemble those we discussed for the accrual definition in table 1.6. Even at lower ages, we find that these concepts only differ at the top of the distribution. The cause for this finding is the pressure built into the Belgian retirement systems to retire as early as possible. The peak of the SSW variable is often attained by retiring as soon as possible, hence bringing the two incentive measures to equality. For a nonnegligible frac-

Table 1.8 **Peak Values and Option Values**

		Peak Value				Option Value			
Age	Obs.	10th %	Median	90th %	SD	10th %	Median	90th %	SD
					Men				
50	2,821	–10,408	–5,677	19,975	14,717	2,256	9,917	22,959	12,014
51	2,586	–9,576	–4,749	19,790	14,299	2,192	9,291	21,681	10,801
52	2,305	–10,433	–4,911	18,842	13,869	1,903	8,186	19,915	10,498
53	2,150	–9,817	–3,186	18,515	13,388	1,701	7,065	17,602	9,539
54	2,076	–9,218	–499	17,802	12,301	1,463	6,053	15,650	8,976
55	2,045	–12,164	–4,761	15,790	12,676	975	5,117	13,535	9,318
56	1,894	–10,868	–4,017	13,694	11,331	919	4,478	12,954	9,002
57	1,701	–14,785	–3,890	12,698	11,596	674	3,722	11,466	9,048
58	1,409	–13,757	–4,204	10,144	10,066	654	3,106	10,805	7,905
59	1,151	–6,919	–646	6,054	6,357	710	2,191	9,597	7,692
60	1,027	–18,113	–9,633	–167	7,293	–812	644	8,608	8,371
61	694	–18,405	–8,995	–170	7,243	–929	656	10,096	9,755
62	473	–18,816	–8,348	–205	7,527	–913	759	13,011	8,360
63	375	–18,148	–7,660	–301	7,120	–872	847	12,927	7,528
64	302	–17,999	–8,051	–374	7,421	–912	483	8,583	5,918
65	229	–20,918	–12,376	–6,596	6,318	–1,037	–215	7,253	5,748
					Women				
50	1,464	–9,327	3,836	26,321	15,449	1,459	8,730	17,333	7,267
51	1,273	–5,500	4,956	25,590	14,209	1,453	8,154	16,145	6,336
52	1,118	–7,324	3,557	25,138	13,817	989	7,389	14,897	5,789
53	940	–6,641	3,720	24,703	13,216	956	6,746	13,437	5,499
54	869	–6,219	3,062	22,974	12,542	805	6,077	12,279	5,268
55	824	–7,276	2,009	20,097	11,917	500	5,430	10,739	5,507
56	747	–8,408	1,592	17,510	11,269	233	4,661	9,198	4,968
57	621	–9,494	1,175	14,502	10,349	–137	3,764	7,460	4,236
58	514	–8,755	1,132	12,123	8,716	–222	2,959	5,530	3,359
59	443	–9,027	–12	6,383	7,883	–324	1,959	4,016	3,536
60	391	–18,179	–10,890	–6,294	6,453	–1,532	284	2,120	2,886
61	227	–17,306	–10,217	–6,213	5,754	–1,466	507	1,920	4,920
62	97	–17,430	–10,315	–5,928	6,700	–1,264	1,125	2,998	5,422
63	78	–17,753	–9,753	–5,361	5,293	–1,126	761	2,851	2,762
64	57	–14,555	–8,455	–4,922	4,553	–681	1,323	4,152	3,826
65	44	–15,120	–8,899	–3,434	4,259	–728	1,561	4,167	5,418

Note: Obs. = observations; SD = standard deviation.

tion of the population younger than sixty, there are quite large possible gains from continuing to work. Hence, we find rather large standard deviations in the peak value indicator.

As for the option value statistics, it is important to recognize the major role played by the utility term that is based on wage income during any additional period of work. As a result, most values are positive. The same qualitative results still hold true if we do some sensitivity analysis by replacing either the value of k by 1, the value of γ by 1, or both.

1.6 Regression Results

The present section summarizes the regression results we obtained while performing probit estimations with three of the above incentive measures—namely accrual, peak value, and option value. The dependent variable is retirement; it equals one in the case that the individual retires within the year of observation, and zero otherwise. As indicated in section 1.3, we define retired persons as those who have either a pension or early retirement income and have income from work smaller than the threshold, or who have unemployment or disability income and no income from work.

All estimations include an intercept term, as well as a differing series of controls. The controls include demographic variables (marital status, a dummy for an active spouse, a dummy variable for dependent children, and the age difference between the individual and the partner). Furthermore, age is inserted for some specifications in the form of a dummy variable for each age, and for other specifications in the form of a linear age variable. Earnings appear in three ways: individual projected annual earnings and average lifetime income (only available for wage earners); projected potential spousal annual earnings (all these variables are in dollars, converted at the exchange rate on 31 December 1999), and lastly, system variables are also used in all the specifications.

Furthermore, all of these models contain controls for activity sector (ten dummies), level of schooling (eight dummies), squared earnings and lifetime earnings, an occupational pension dummy, a private retirement savings dummy, a home ownership dummy, real estate income, regions (Brussels, Flanders, or Wallonia), and dummies for the year of the observation (1993, 1994, or 1995). The estimates of them are not reported in the tables for space reasons.[11]

Tables 1.9 and 1.10 summarize our regression results and are organized as follows: We estimated a total of six probit models, separate for men and women. The six models are the combination of our three dynamic incentive measures with two different specifications of the age variable. The first column for every incentive measure reports the results of a probit model

11. Complete results can be obtained from the authors upon request.

Table 1.9 **Retirement Probits for Men**

	Accrual				Peak Value				Option Value			
	Age		Age Dummies		Age		Age Dummies		Age		Age Dummies	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	–7.9660	0.2675	–2.5199	0.1690	–7.5957	0.2698	–2.4346	0.1690	–7.5110	0.3387	–2.2976	0.1709
Incentive measures												
SSW (1000s)	–0.0007	0.0003	–0.0008	0.0003	–0.0008	0.0003	–0.0008	0.0003	–0.0001	0.0003	–0.0001	0.0003
	(–0.0069)		(–0.0076)		(–0.0079)		(–0.0082)		(–0.0008)		(0.0001)	
AC, PV, OV (1000s)	–0.0442	0.0018	–0.0428	0.0019	–0.0380	0.0016	–0.0364	0.0017	–0.0392	0.0054	–0.0327	0.0054
	(–0.4590)		(–0.4307)		(–0.3769)		(–0.3505)		(–0.4111)		(–0.3383)	
Demographic variables												
Age	0.1105	0.0039		0.1049	0.0039		0.1050	0.0053				
Married	0.0870	0.0498	0.0886	0.0503	0.1027	0.0499	0.1026	0.0505	0.0294	0.0488	0.0342	0.0495
Active spouse	–0.0525	0.0393	–0.0530	0.0397	–0.0501	0.0394	–0.0515	0.0399	–0.0857	0.0383	–0.0839	0.0388
Age difference	0.0002	0.0039	0.0005	0.0039	–0.0003	0.0039	–0.0001	0.0039	–0.0009	0.0038	–0.0015	0.0039
Dependent	–0.0964	0.0360	–0.0873	0.0364	–0.0999	0.0361	–0.0911	0.0364	–0.0729	0.0352	–0.0754	0.0355
Income earnings variables												
Life cycle earnings	0.0129	0.0066	0.0143	0.0068	0.0138	0.0066	0.0151	0.0068	0.0155	0.0066	0.0180	0.0068
Earnings (1000s)	–0.0085	0.0012	–0.0085	0.0012	–0.0084	0.0012	–0.0084	0.0012	0.0014	0.0018	–0.0002	0.0018
Spouse earnings (1000s)	0.0036	0.0024	0.0039	0.0024	0.0043	0.0024	0.0044	0.0024	0.0037	0.0024	0.0031	0.0024

(*continued*)

Table 1.9 (continued)

	Accrual				Peak Value				Option Value			
	Age		Age Dummies		Age		Age Dummies		Age		Age Dummies	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Age and schemes dummies												
51	—	—	0.0619	0.0826	—	—	0.0523	0.0827	—	—	0.0134	0.0808
52	—	—	0.2851	0.0778	—	—	0.2779	0.0779	—	—	0.2289	0.0763
53	—	—	0.3115	0.0787	—	—	0.3191	0.0788	—	—	0.2087	0.0773
54	—	—	0.4730	0.0773	—	—	0.4516	0.0773	—	—	0.2871	0.0760
55	—	—	0.6921	0.0720	—	—	0.6751	0.0720	—	—	0.5664	0.0718
56	—	—	0.6771	0.0741	—	—	0.6429	0.0740	—	—	0.5003	0.0745
57	—	—	0.8893	0.0724	—	—	0.8546	0.0723	—	—	0.7359	0.0738
58	—	—	1.0551	0.0735	—	—	1.0048	0.0734	—	—	0.8659	0.0760
59	—	—	0.8427	0.0838	—	—	0.7310	0.0833	—	—	0.4475	0.0869
60	—	—	1.5016	0.0743	—	—	1.4439	0.0745	—	—	1.4456	0.0816
61	—	—	1.4963	0.0804	—	—	1.4396	0.0806	—	—	1.4302	0.0876
62	—	—	1.0288	0.0956	—	—	0.9767	0.0958	—	—	0.9868	0.1028
63	—	—	1.0927	0.1021	—	—	1.0380	0.1023	—	—	1.0364	0.1097
64	—	—	0.9724	0.1126	—	—	0.9208	0.1129	—	—	0.9320	0.1198
65	—	—	1.9490	0.1081	—	—	1.9180	0.1083	—	—	1.9801	0.1191
Civil servant	0.5489	0.1251	0.5399	0.1270	0.6314	0.1258	0.6177	0.1277	0.3850	0.1254	0.3858	0.1281
Self-employed	0.0023	0.1237	0.0164	0.1255	–0.0328	0.1235	–0.0216	0.1254	–0.0408	0.1244	–0.0396	0.1271
Pseudo R^2		0.1913		0.2076		0.1901		0.2067		0.1512		0.1741

Notes: Coef. = coefficient; SE = standard error. Dashes indicate variables not included in the model. The probability effect, which appears in parentheses below the coefficient, is the expected change in the probability of retirement corresponding to an infinitesimal change in the selected independent variable.

Table 1.10 **Retirement Probits for Women**

	Accrual				Peak Value				Option Value			
	Age		Age Dummies		Age		Age Dummies		Age		Age Dummies	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Intercept	–6.3141	0.4077	–1.9632	0.2505	–6.2897	0.4100	–1.8504	0.2497	–4.7976	0.5161	–1.5951	0.2554
Incentive measures												
SSW (1000s)	–0.0005	0.0003	–0.0002	0.0004	–0.0003	0.0003	–0.0001	0.0004	–0.0007	0.0004	–0.0004	0.0004
	(–0.0068)		(–0.0021)		(–0.0042)		(–0.0001)		(–0.0089)		(–0.0048)	
AC, PV, OV (1000s)	–0.0540	0.0034	–0.0409	0.0039	–0.0307	0.0023	–0.0222	0.0024	–0.0793	0.0089	–0.0651	0.0091
	(–0.7109)		(–0.5345)		(–0.3940)		(–0.2868)		(–1.0341)		(–0.8434)	
Demographic variables												
Age	0.0877	0.0059			0.0887	0.0060		0.0641	0.0080			
Married	0.1994	0.0714	0.1854	0.0727	0.2222	0.0708	0.2030	0.0725	0.2269	0.0709	0.2079	0.0729
Active spouse	0.0174	0.0559	–0.0154	0.0572	–0.0367	0.0552	–0.0606	0.0566	–0.0784	0.0544	–0.0920	0.0560
Age difference	0.0202	0.0063	0.0146	0.0064	0.0206	0.0063	0.0145	0.0064	0.0288	0.0066	0.0226	0.0068
Dependent	–0.1540	0.0585	–0.1627	0.0589	–0.1539	0.0586	–0.1687	0.0590	–0.1346	0.0580	–0.1575	0.0587
Income earnings variables												
Life cycle earnings	0.0077	0.0106	0.0056	0.0107	0.0081	0.0104	0.0062	0.0106	0.0069	0.0106	0.0053	0.0107
Earnings (1000s)	–0.0098	0.0027	–0.0088	0.0027	–0.0090	0.0027	–0.0083	0.0027	0.0125	0.0038	0.0102	0.0039
Spouse earnings (1000s)	–0.0027	0.0021	–0.0021	0.0021	–0.0021	0.0020	–0.0017	0.0020	–0.0011	0.0020	–0.0010	0.0021

(*continued*)

Table 1.10 (continued)

	Accrual				Peak Value				Option Value			
	Age		Age Dummies		Age		Age Dummies		Age		Age Dummies	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Age and schemes dummies												
51	—	—	0.0512	0.0924	—	—	0.0094	0.0923	—	—	–0.0462	0.0922
52	—	—	0.2775	0.0877	—	—	0.2391	0.0877	—	—	0.1767	0.0876
53	—	—	0.3783	0.0898	—	—	0.3247	0.0897	—	—	0.2195	0.0899
54	—	—	0.2818	0.0955	—	—	0.2192	0.0951	—	—	0.0871	0.0955
55	—	—	0.5650	0.0890	—	—	0.4942	0.0888	—	—	0.3306	0.0906
56	—	—	0.4214	0.0944	—	—	0.3489	0.0942	—	—	0.1500	0.0973
57	—	—	0.5806	0.0955	—	—	0.5099	0.0951	—	—	0.2681	0.1001
58	—	—	0.4396	0.1066	—	—	0.3334	0.1060	—	—	0.0456	0.1128
59	—	—	0.3560	0.1175	—	—	0.2208	0.1161	—	—	–0.1246	0.1261
60	—	—	1.4321	0.0973	—	—	1.4579	0.0973	—	—	1.2533	0.1123
61	—	—	1.6353	0.1129	—	—	1.6646	0.1124	—	—	1.4447	0.1243
62	—	—	0.4892	0.1813	—	—	0.5275	0.1795	—	—	0.2841	0.1881
63	—	—	0.4537	0.1993	—	—	0.4805	0.1976	—	—	0.2177	0.2072
64	—	—	1.0051	0.1992	—	—	0.9965	0.1988	—	—	0.6746	0.2108
65	—	—	1.3046	0.2113	—	—	1.3057	0.2116	—	—	1.0055	0.2218
Civil servant	0.2478	0.1228	0.1748	0.1247	0.2851	0.1224	0.2128	0.1248	0.1541	0.1228	0.1287	0.1252
Self-employed	–0.1986	0.1306	–0.2326	0.1327	–0.2508	0.1292	–0.2766	0.1319	–0.2041	0.1300	–0.2281	0.1330
Pseudo R^2		0.1644		0.1948		0.1536		0.1918		0.1365		0.1860

Notes: See table 1.9.

with a linear age trend. The second column then reports the results of a model in which we replace the linear age trend by age dummies. The motivation for this change is to allow for nonlinearities in the systems that our incentive measures do not fully capture.

Inspection of the different columns of table 1.9 reveals that the incentive measures are significant when taken individually. Comparing the estimates from the different specifications, we see that this result is pretty robust as these estimates do not depend on the precise functional form of the specification. The SSW has a small negative effect on the probability of retirement. The numbers reported in parentheses indicate the change in the underlying probability function as a result of a small change in the incentive variable. The three dynamic incentive variables, accrual (AC), peak value (PV), and option value (OV), have a strong negative effect on the probability of retiring, as reported in parentheses below the parameter estimates. Also notice the positive effect of the civil-servant-system dummy, which contrasts with a generally insignificant self-employment dummy.

Table 1.10 reveals that the dynamic incentive variables (AC, PV, and OV) also display a large degree of significance for women and an even stronger probability effect than for men. However, our estimates seem to indicate that the level of SSW does not have a lot of explanatory power in women's retirement decisions. Furthermore, the significance of the system dummies is very different from the findings for men. The civil servants dummy is never significant at any conventional level, and the self-employment dummy is always negative, but rarely with a high degree of significance. This seems to indicate that self-employed women represent a somewhat special group that is more reluctant to retire, or alternatively, this finding may be due to the fact that we do not fully capture all the characteristics of the system.

As expected, age variables have a strong effect on retirement probabilities, either in the form of continuous or dummy variables. However, age dummies at ages smaller than sixty seem to be much stronger for men than for women, particularly so at the key early retirement ages (fifty-two, fifty-five, and fifty-eight years old). Women—given their generally incomplete earnings histories—are often simply not eligible for some or all of the early retirement benefits. Alternatively, it may reflect the fact that women's incomes generally represent a smaller fraction of household resources and hence that women's behavior is strongly influenced by the decisions that their husbands make.

Looking at the pseudo R^2 of the different probit models, we notice that those models that include age dummies uniformly perform better than those simply integrating a linear age trend. However, regarding the question of which dynamic incentive variable has the highest explanatory power, we find that the accrual measure performs best for both men and women.

At this stage, it is important to check whether our incentive measures (SSW, AC, PV, and OV) capture the entire impact of the numerous benefit provisions in the different retirement income systems available in Belgium. Particularly, and somewhat surprisingly, the replacement of the linear age trend by a dummy-variable model does not seem to have a major impact on the sign, the value, or the significance of the estimates of the incentive variables SSW, AC, PV, and OV for men. The story is slightly different for females as we can observe in table 1.10 where the probability effect of the accrual variables changes slightly more. We interpret these findings as rather comforting as they tend to indicate that our SSW and dynamic incentive variables have a rather stable explanatory power and hence, they capture some of the nonlinearities of the retirement income systems in Belgium.

Coming back to the other results presented in tables 1.9 and 1.10, a finding common to all estimations for men and women is that the presence of an active spouse does not have a significant impact on the retirement probability. However, the presence of any additional dependent in the family has a significant negative impact on retirement decisions. Being married also has a positive effect on the probability of retirement, with a particularly high level of significance for women. A similar strongly positive effect is observable with respect to the age difference between spouses, but again only for women.[12]

The effect of the earnings variables is rather similar for men and women. First of all, average life-cycle earnings (a variable only available for wage earners) positively influence the retirement decision, but the coefficients are not statistically significant in the case of women. On the contrary, projected earnings have, as expected, a negative and significant influence upon retirement when the dynamic incentive variables are AC and PV. In the OV models, however, this effect vanishes naturally, as projected earnings enter directly in the calculation of the incentive measure. Finally, the projected spouse earnings appear to have no impact on individual decisions for either men or women.

Figures 1.1 and 1.2 plot the observed hazard rate of departures into retirement by sex and by age on the same scale as the departure probabilities implied by age effects of the age-dummy regression models. One important result is that the dummy effects follow the changes in the empirical hazards very closely. This tends to indicate that our incentive models only explain a fraction of the retirement process and that the dummies are a good complementary tool for capturing some of the nonlinearities that our general SSW computation cannot absorb. One plausible explanation for this finding is that many of the retirement decisions taken in the Belgian companies and public administrations can be seen as mandatory for individuals, while

12. As indicated in table 1.4, the average age difference between women and men within couples is –1.9 years.

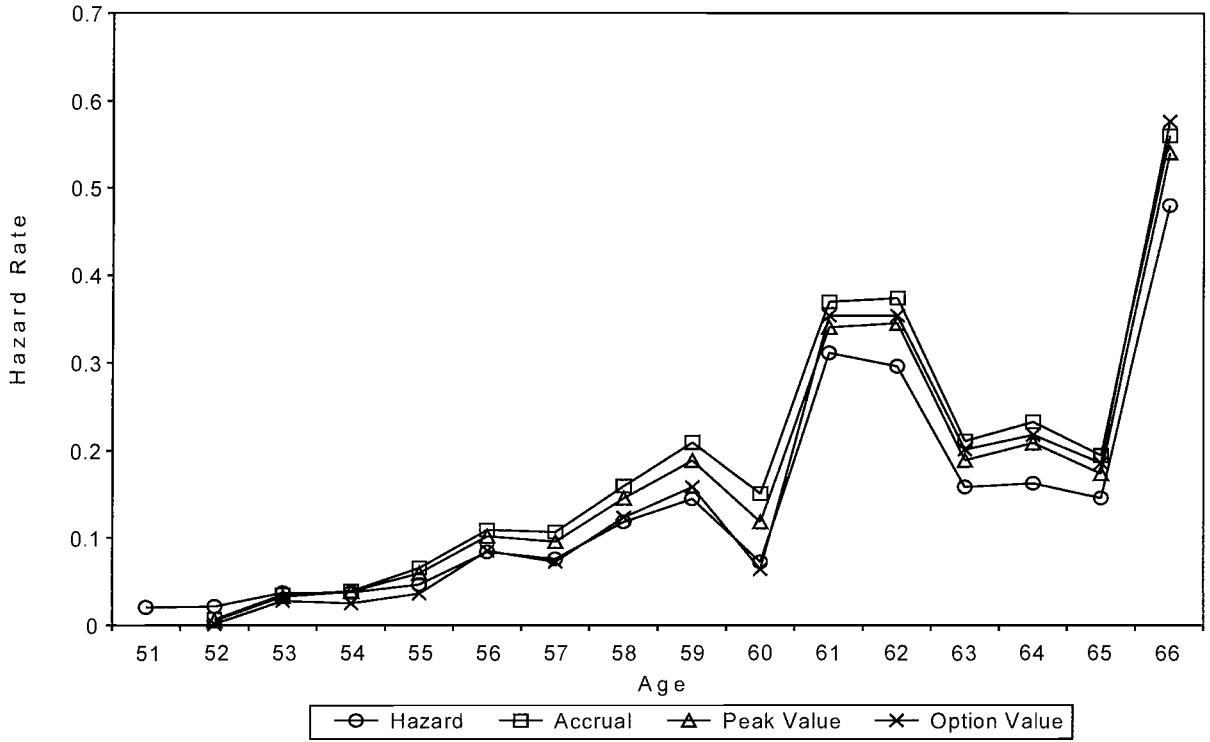


Fig. 1.1 The retirement hazard and age dummies for men

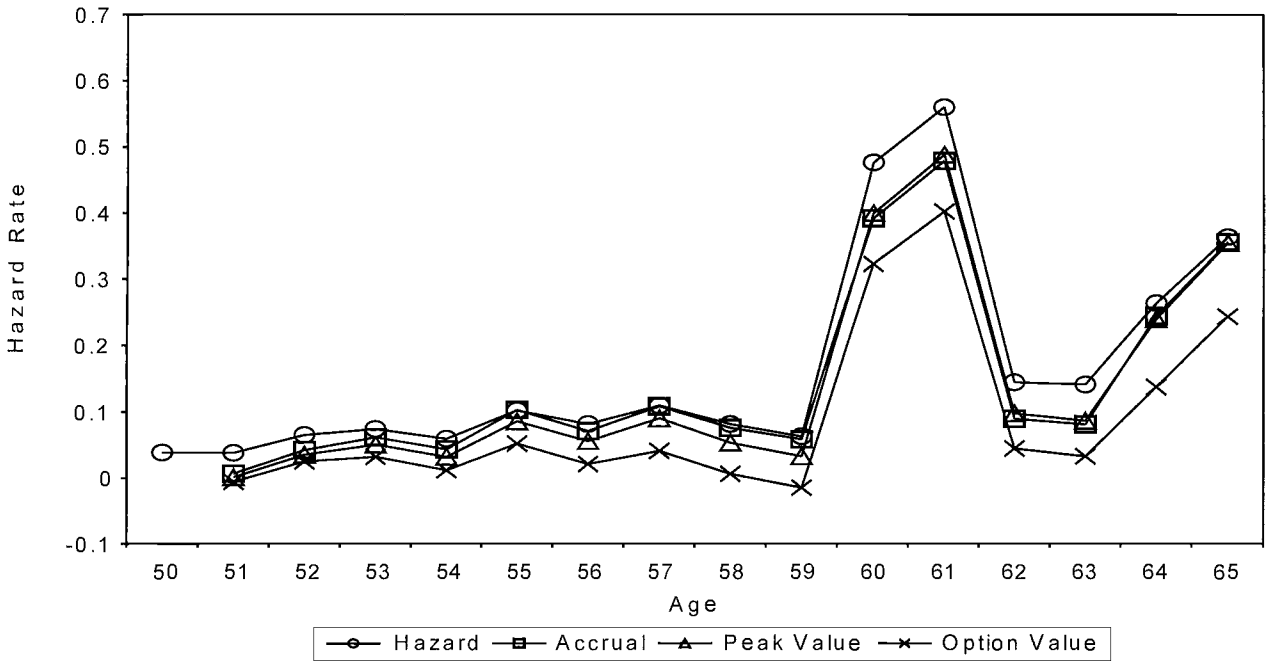


Fig. 1.2 The retirement hazard and age dummies for women

they can be seen as collectively voluntary, as trade unions intervene in the negotiations relating to many early retirement schemes. Therefore, incentive measures have only a very limited role to play in the decision on when to stop working. Our findings also back the previously discussed result that the explanatory power of the accrual model is highest for men, while option value does best for women.

1.7 Simulations

We present the results of some simulation exercises to better understand the results we found in the preceding section. We focus our attention on two hypothetical policy reforms. The first one consists of an increase by three years of all the key ages in the various retirement and early retirement systems. Even though there is no clear eligibility age for unemployment, sickness, or disability insurance, we suppose that these programs become available three years later than we supposed in the original setup. The second reform consists of a policy that would harmonize the retirement-income systems in all the countries covered in the present collection. This latter "common reform" replaces the myriad of current retirement and early retirement systems by a uniform and unique retirement system. Early retirement would be possible at age sixty at the earliest, while the normal retirement age would be sixty-five. At age sixty-five, every individual would be entitled to retirement income that corresponds to a replacement rate of 60 percent of the pension with respect to the average income over the five years of income between ages fifty-five and fifty-nine. For retirement prior to age sixty-five, a 6 percent actuarial reduction is applied to the amount of benefit entitlement on a lifetime basis. Similarly, late retirement (i.e., after age sixty-five) is rewarded by a lifetime increase in benefits of 6 percent per year of delay. For this second policy simulation, we suppose that there is no unemployment, sickness, or disability retirement pathways available to the individual.

For each of these two policy changes, we use three different methodologies and apply those to the three model specifications (AC, PV, and OV) that we derived in the previous section. Hence, we perform a total of eighteen simulations both for men and for women. The first simulation approach, S1, uses the estimates from the models with a linear age trend. Given that our incentive measures SSW and AC, PV, and OV are all derived using age-specific weights, we apply the weights of section 1.5 on age a to the incentive measures at age $a + 3$. Hence, expressed a little differently, we suppose that the age-specific probabilities of replacement-income receipt are shifted up by three years. This change in the weighting will also have implications on retirement through the incentive-variable coefficients. Notice that this change in weighting only matters for the first policy change, as by definition, we impose the absence of any other pathway to retirement in the second policy. In summary, S1 simply consists of a recom-

putation of SSW at every age under these new rules and a prediction of retirement rates by the application of the new SSW and AC values to our estimated coefficients.

The second simulation approach, S2, is the same as the first, except that it uses the model with age dummies included. The impact of this change in the modeling of age does not have a major impact on the coefficients of the incentive variables. However, the age-dummy effects are far from linear, and hence it is possible that these dummies better pick up the nonlinearities in the various retirement and early retirement systems, or alternatively that tastes for leisure are not a linear function of age. Also, as we already mentioned in a preceding section, it is possible that a nonnegligible fraction of retirees are facing compulsory retirement at a given age. However, a comforting finding is that the incentive effects seem to be pretty robust to the change in the modeling of age. This seems to indicate that the dummies do not simply take away explanatory power from the incentive variables, but rather contribute new information of their own to the analysis of the variance. This second simulation approach implicitly privileges the explanation of different leisure tastes over the explanation that the SSW and the related incentive variables do not fully capture the nonlinearities in the system.

A third and last simulation approach is labeled "S3." For policy 1, it uses the model with age dummies, but on top of incrementing the incentive and SSW measures and the eligibility probabilities, it also increments the age dummies by three years. We do not only recompute the values of our SSW measures arising from the change, but we also recompute the value of the age dummies themselves, so that the age-fifty-three dummy takes on the estimated value of the age-fifty dummy, the age-sixty-eight dummy takes on the estimated value of the age-sixty-five dummy, and so forth. This approach takes a view rather opposed to S2 as it implicitly imputes the entire effect on the age dummies to the social security incentives. Clearly, the truth will be between these two extremes.

For policy 2 and S3, we proceed in a similar way, but the impact of age dummies are modified in a different way. On the one hand, given that in this policy simulation alternative retirement pathways are assumed out, we apply the age-fifty-one dummy for both men and women to all ages up to age fifty-nine, just prior to the early retirement age.[13] On the other hand,

13. The method applied differs from the one used in the other articles of the volume. In those papers, the effects of age dummies before age sixty are imputed following the trend of estimated dummies from age fifty to fifty-four (the age at which the path first breaks in the dummies) whenever this trend is positive. However, this would lead us to unrealistic results. The observed age trend in dummies between the ages of fifty and fifty-four—and hence the extrapolation thereof till the age of fifty-nine—would be highly progressive and extremely powerful, it would occur in a situation in which we have assumed away all early retirement schemes. The reason for this extreme finding is that even people in the lowest age bracket considered face high exit rates from the labor force because of the characteristics of the Belgian retirement income landscape.

Table 1.11 Average Retirement Age

Model	Simulation	Simulated Reform: Policy 1	Simulated Reform: Policy 2
	Men		
Base retirement rate		58.38	58.38
AC	S1	59.49	59.22
	S2	58.78	59.08
	S3	61.18	59.11
PV	S1	59.72	59.15
	S2	59.01	59.05
	S3	61.34	59.05
OV	S1	59.89	59.14
	S2	59.18	59.06
	S3	61.47	59.34
	Women		
Base retirement rate		57.43	57.43
AC	S1	58.59	57.33
	S2	58.18	57.36
	S3	59.99	57.51

we keep the effect of age-sixty and -sixty-five dummies unchanged, assuming that policy 2 will not affect individual behavior at these particular ages. Finally, using these two dummy values, we imputed the values of the intermediary dummies, from age sixty-one to age sixty-four assuming a smooth path trend.

We present the results of these simulations in three broad ways. First of all table 1.11 summarizes the effect on the average retirement age of the three models (AC, PV, and OV) and the three simulations (S1, S2, and S3) for the two policy changes discussed (policy 1 and policy 2). In an attempt not to overcrowd the paper with tables and figures, only the results corresponding to the accrual model for women are reported.[14] Second, figures 1.3 to 1.14, panels A, illustrate the hazard rates of departure into retirement under the different specifications as compared to the baseline observed hazard using the underlying specification. The first nine of these graphs summarize the results of the nine simulations for men. The last three figures (figures 1.12, 1.13, and 1.14) are the results of the simulations done for women using the accrual model. Third, figures 1.3 to 1.14, panels B, present the cumulative distribution function (CDF) of departures into retirement.

14. From table 1.10, it appears that the estimation of the accrual model gives the best pseudo R^2.

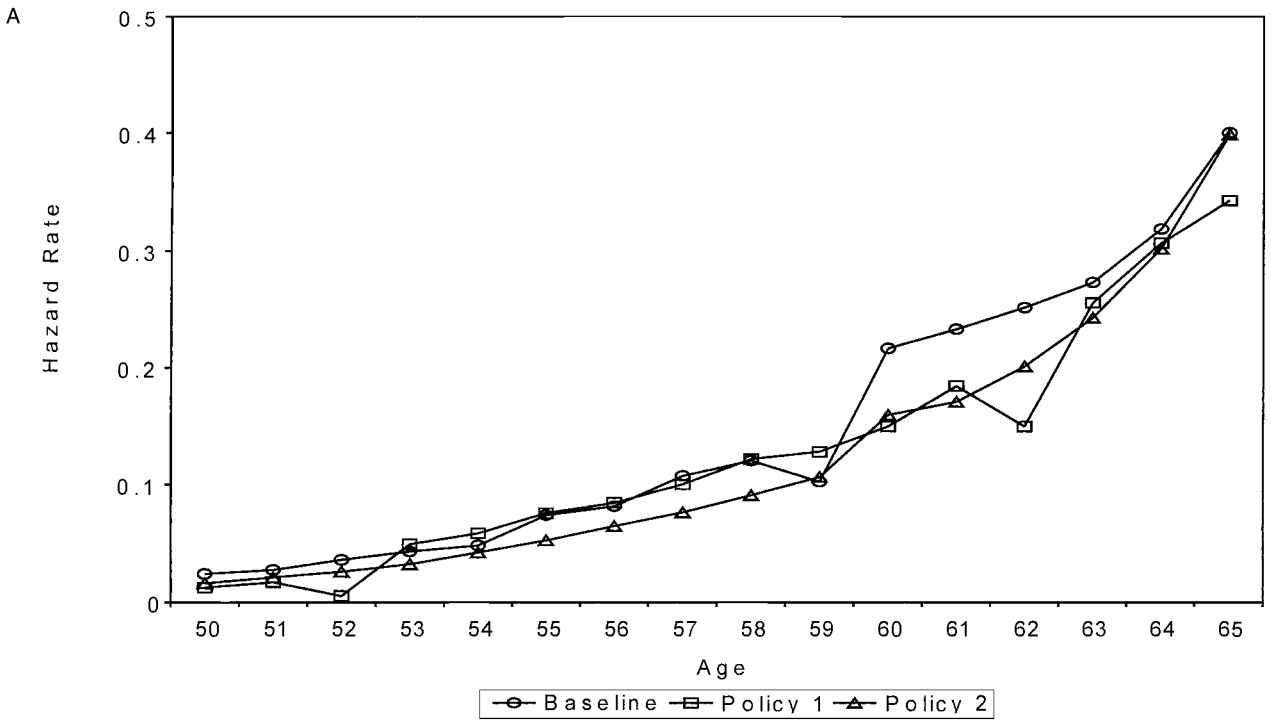


Fig. 1.3 AC, S1: *A*, Hazard rates for men; *B*, CDF for men

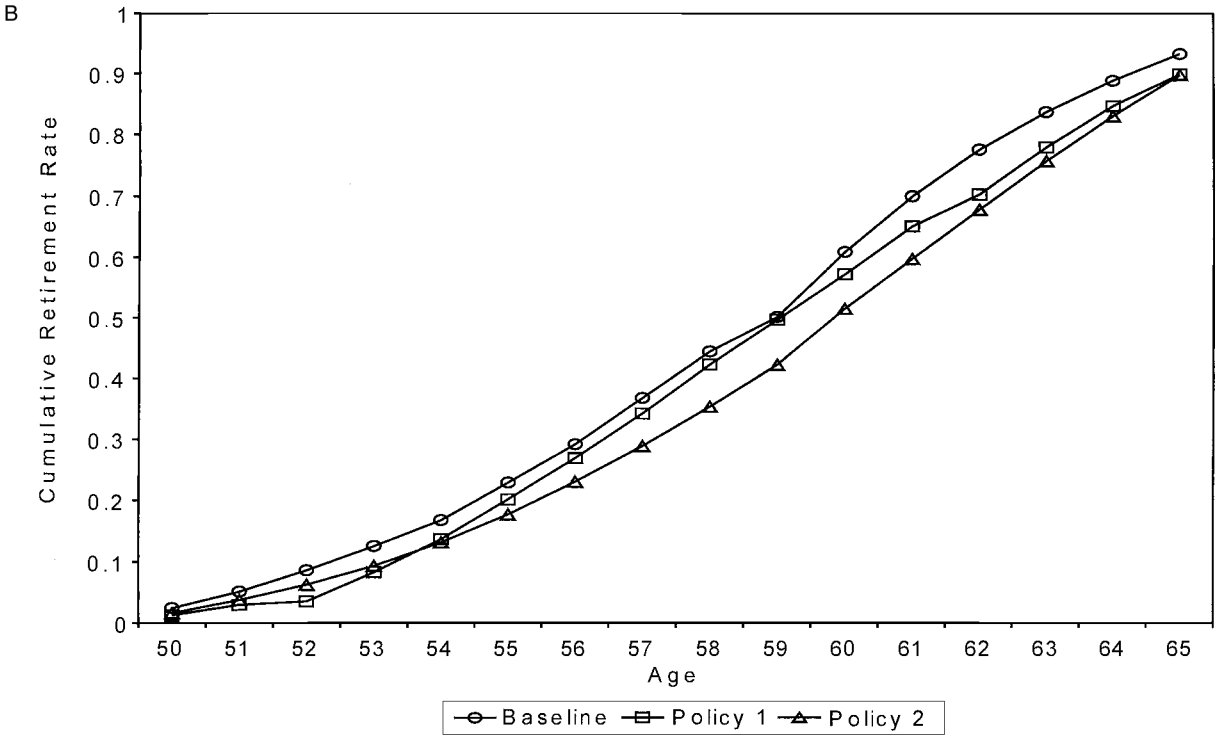

B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.3 (cont.)

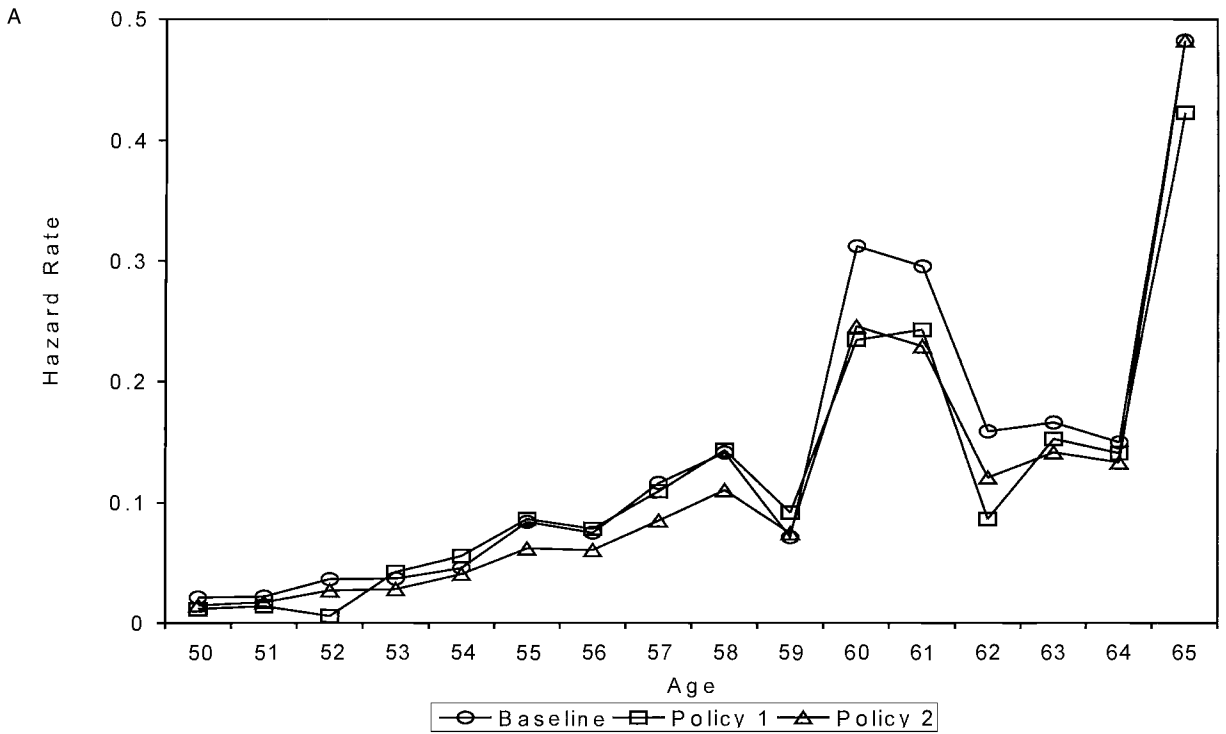


Fig. 1.4 AC, S2: *A*, hazard rates for men; *B*, CDF for men

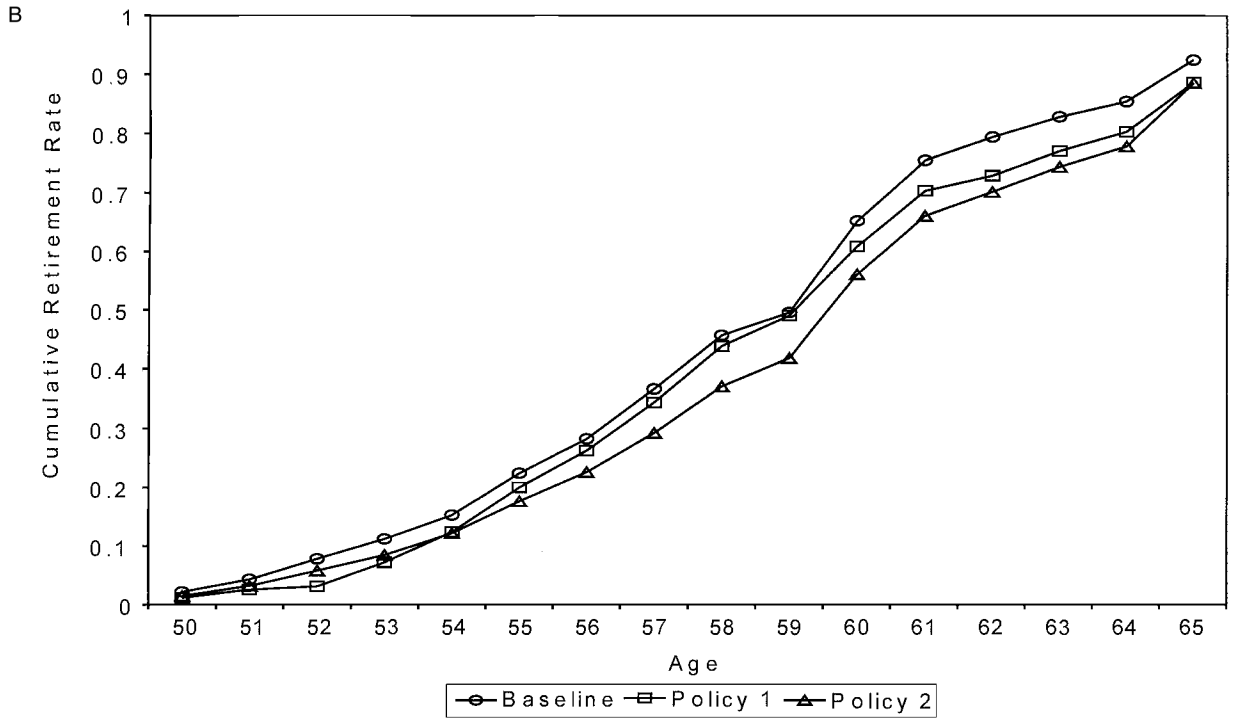

B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.4 (cont.)

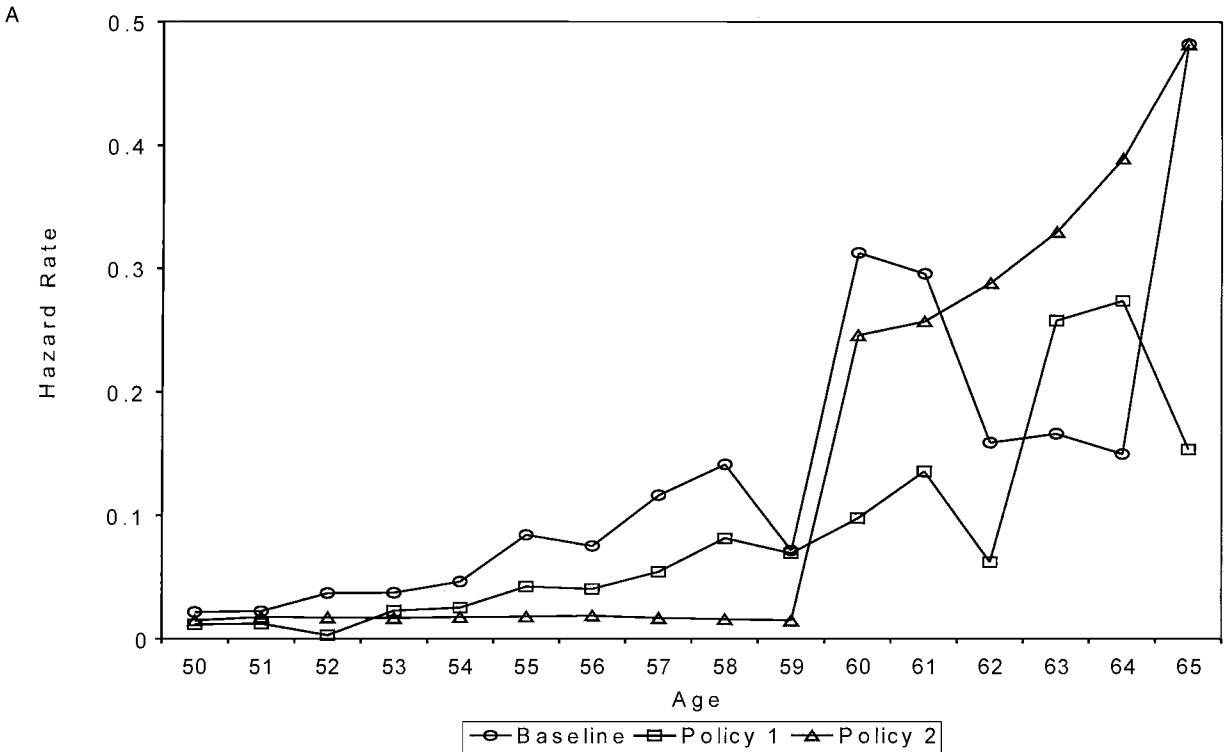
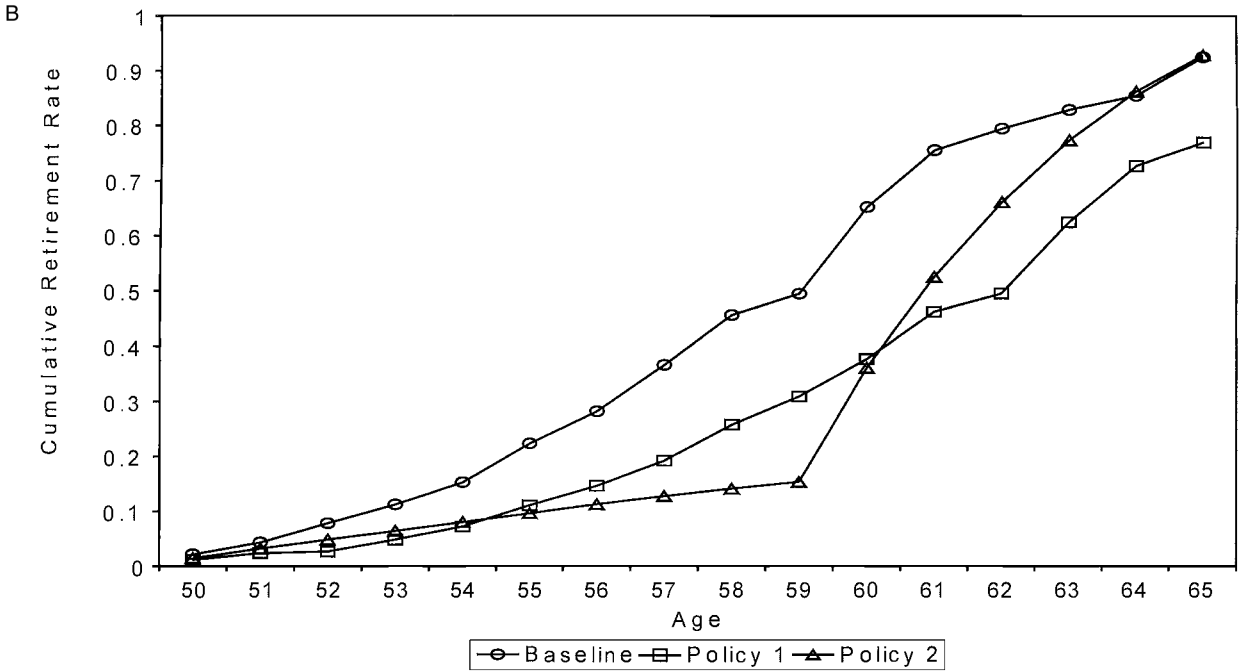


Fig. 1.5 AC, S3: *A*, Hazard rates for men; *B*, CDF for men


B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
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57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.5 (cont.)

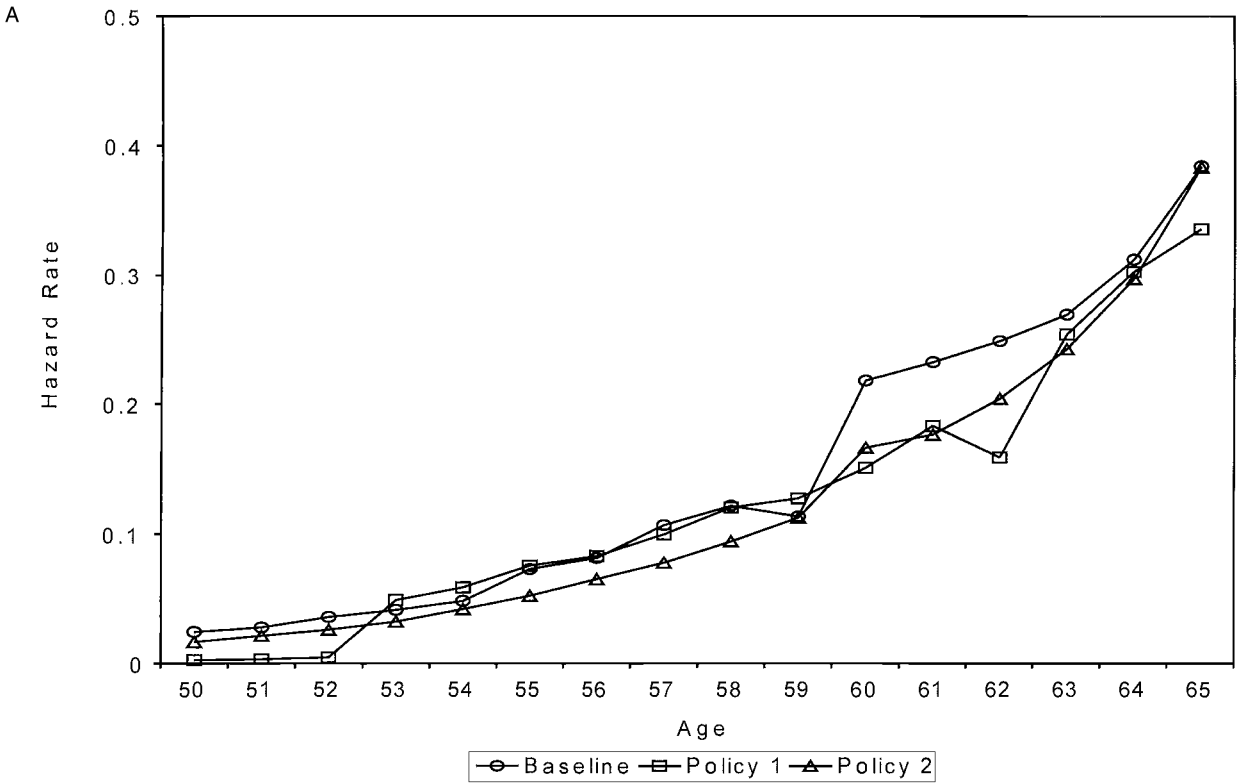
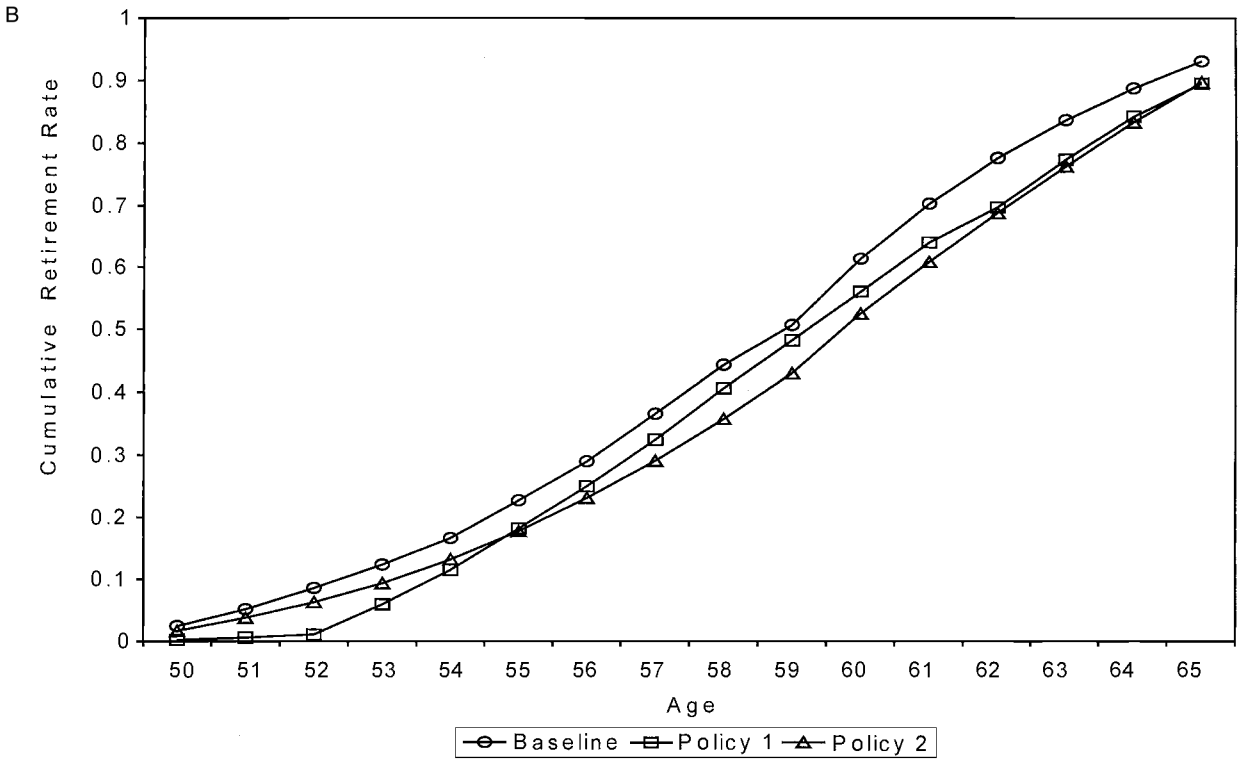


Fig. 1.6 PV, S1: *A,* Hazard rates for men; *B,* CDF for men


B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
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57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.6 (cont.)

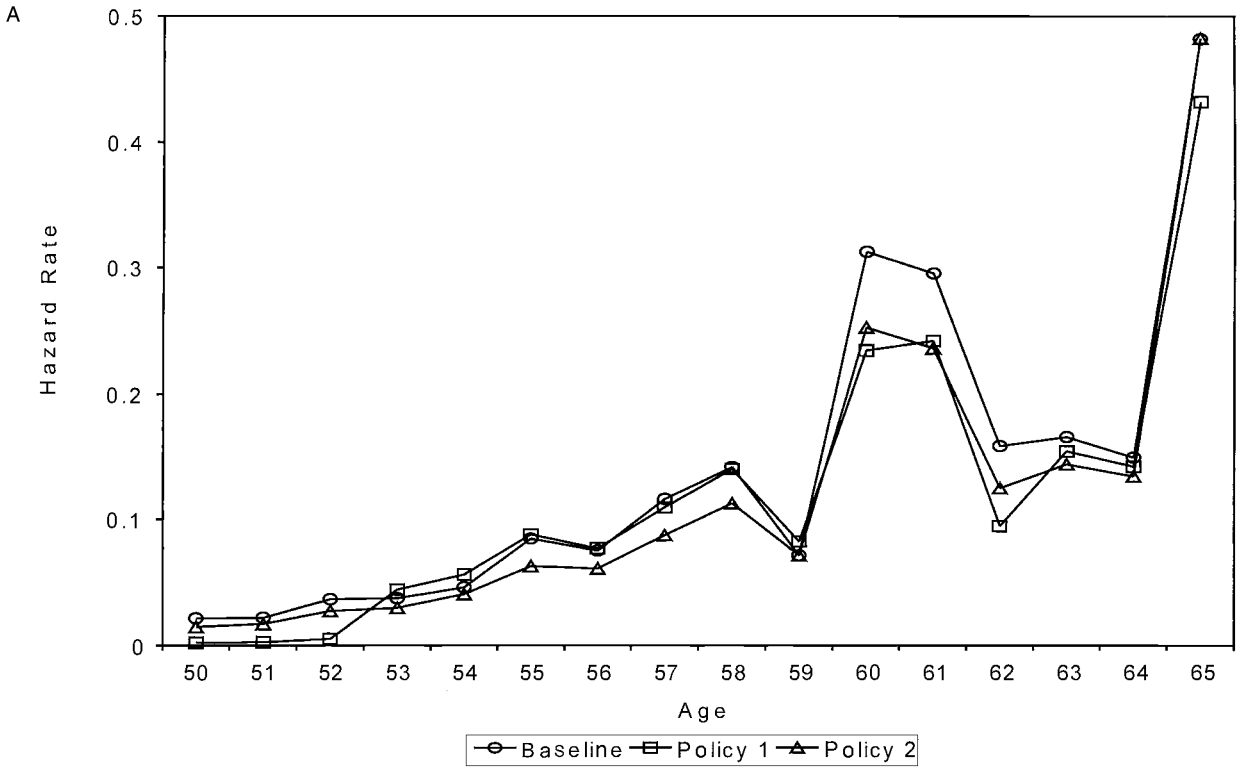
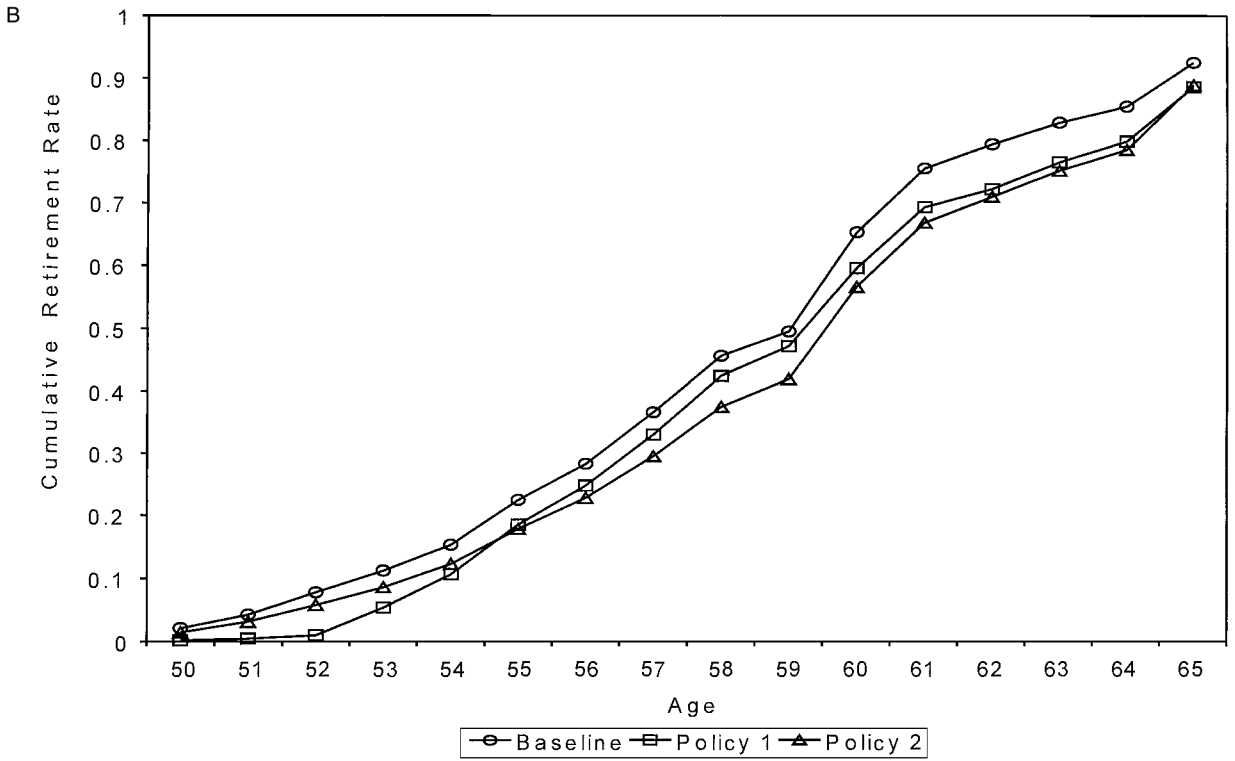


Fig. 1.7 PV, S2: *A*, Hazard rates for men; *B*, CDF for men


B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
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57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.7 (cont.)

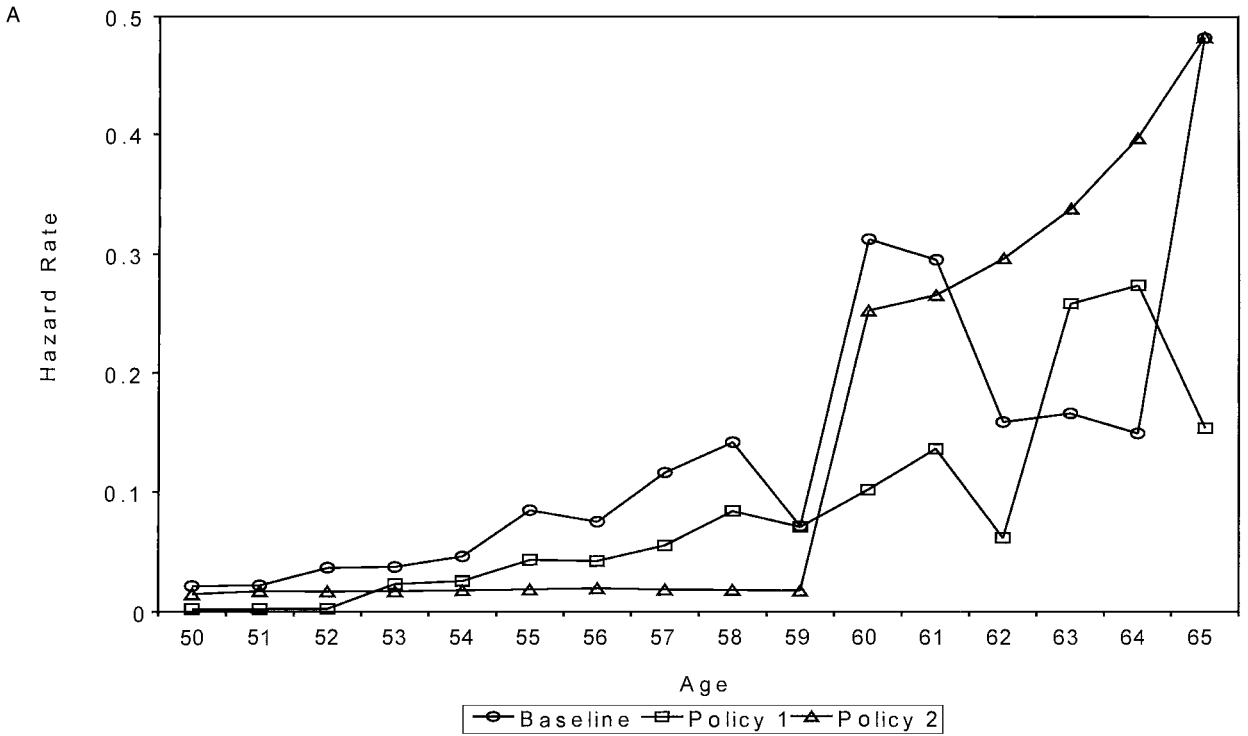

Fig. 1.8 PV, S3: *A,* Hazard rates for men; *B,* CDF for men

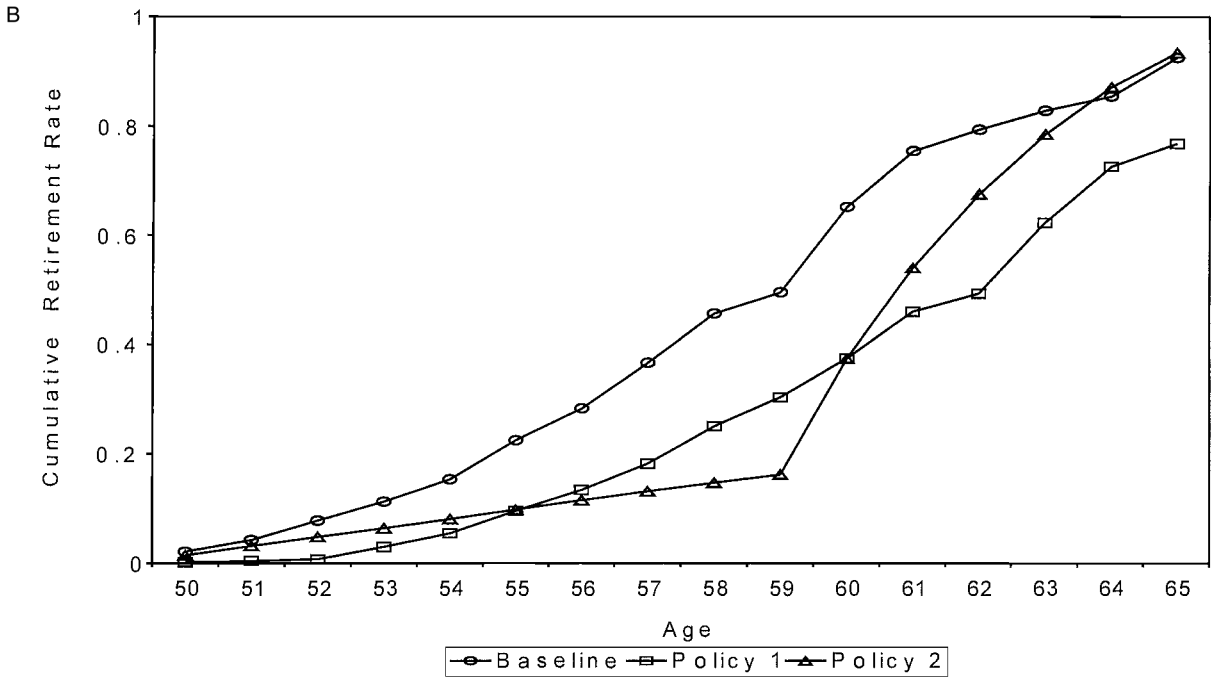
B
Cumulative Retirement Rate
1
0.8
0.6
0.4
0.2
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.8 (cont.)

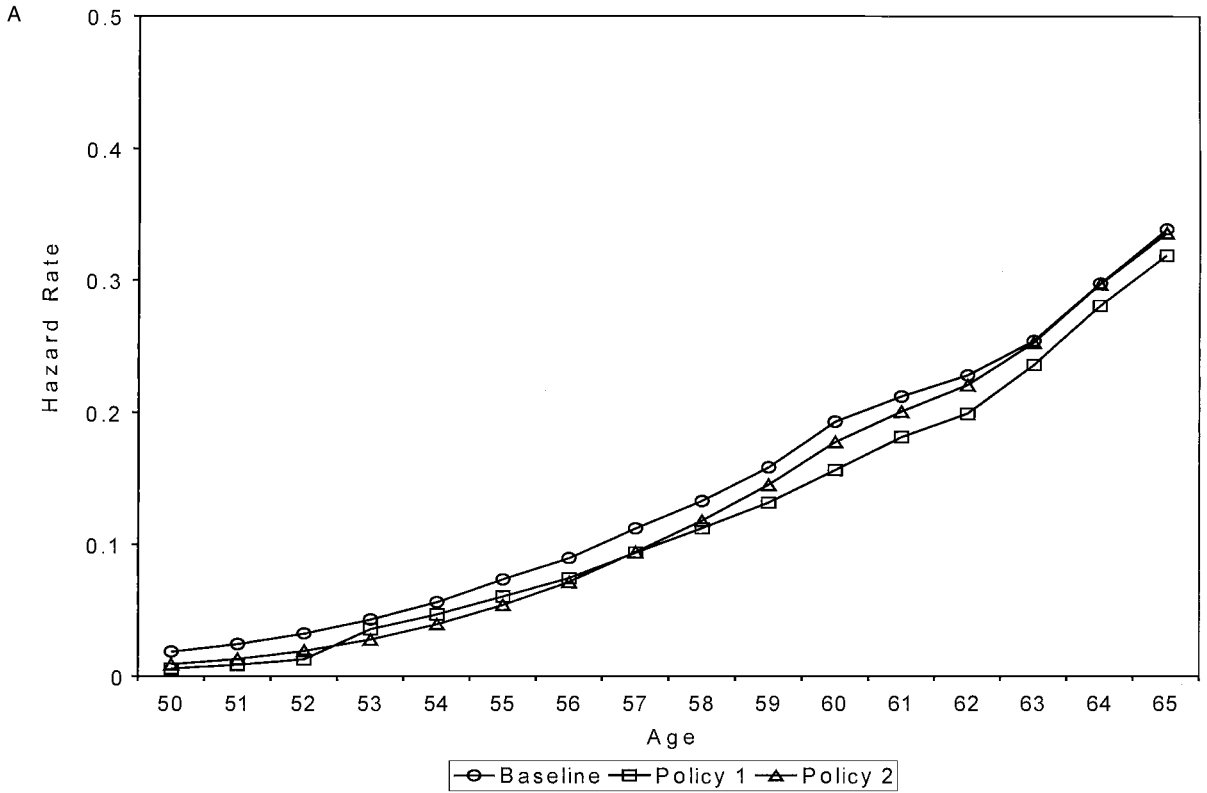

Fig. 1.9 OV, S1: *A*, Hazard rates for men; *B*, CDF for men

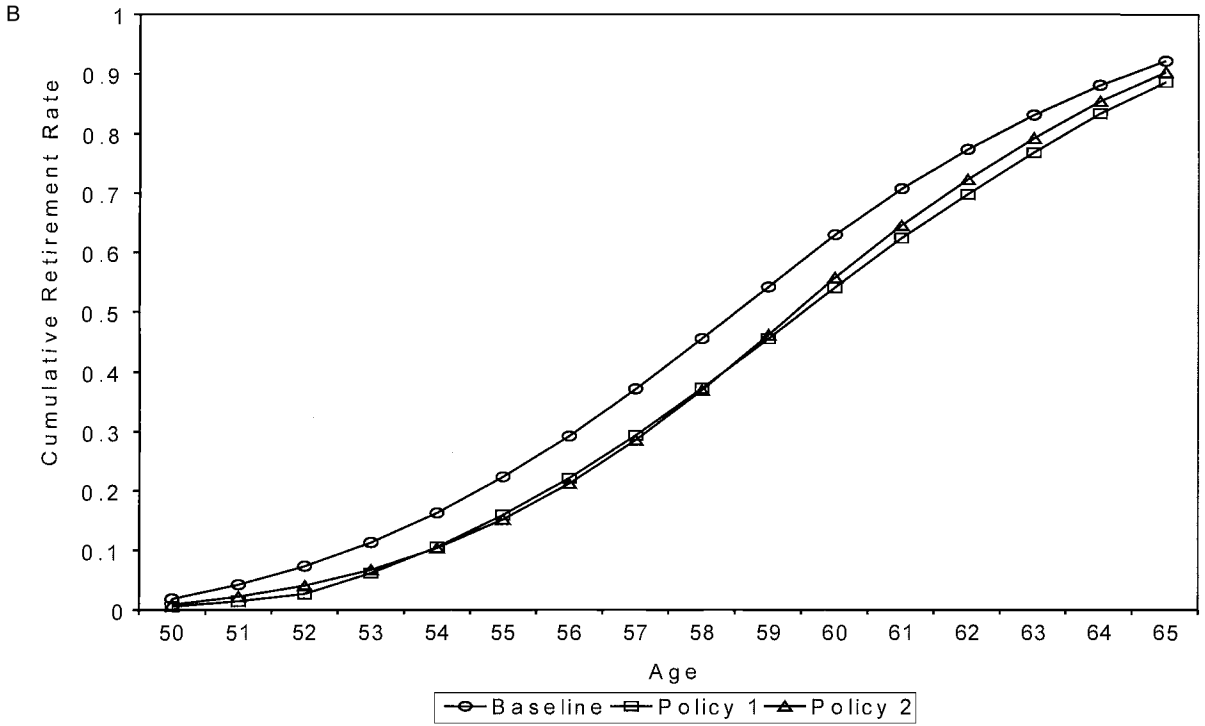
B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.9 (cont.)

Fig. 1.10 OV, S2: *A*, Hazard rates for men; *B*, CDF for men

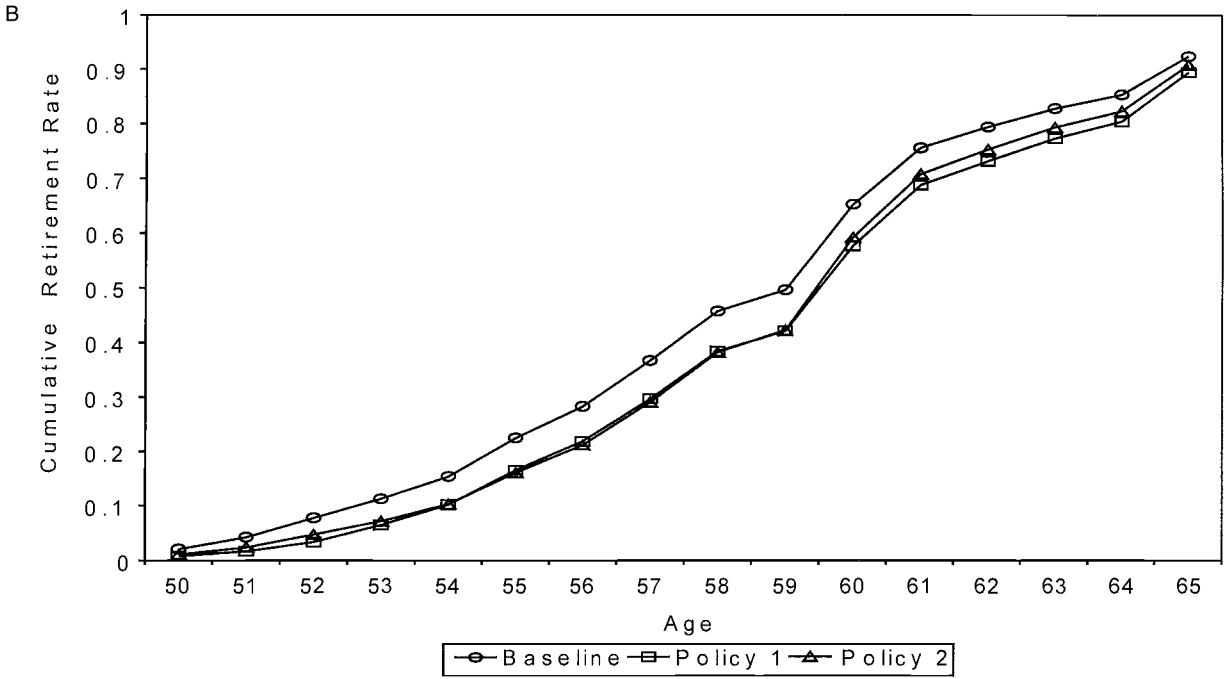
B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.10 (cont.)

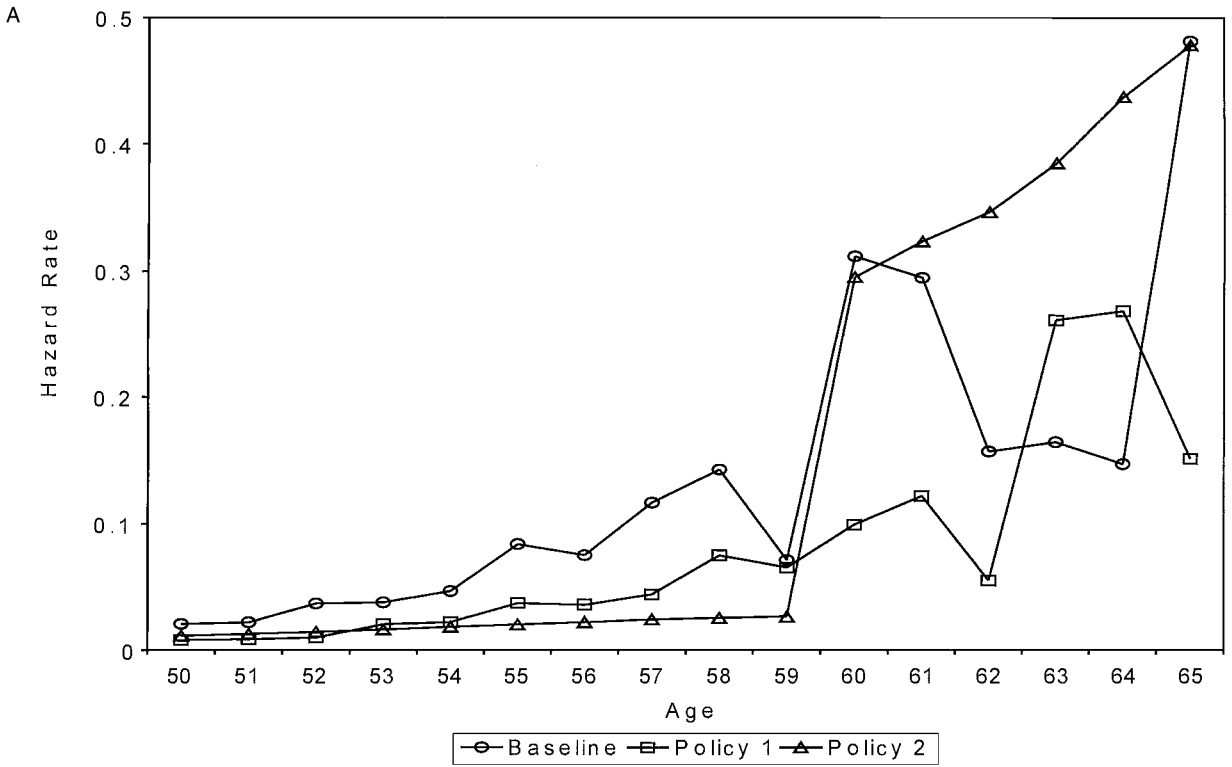

Fig. 1.11 OV, S3: *A*, Hazard rates for men; *B*, CDF for men

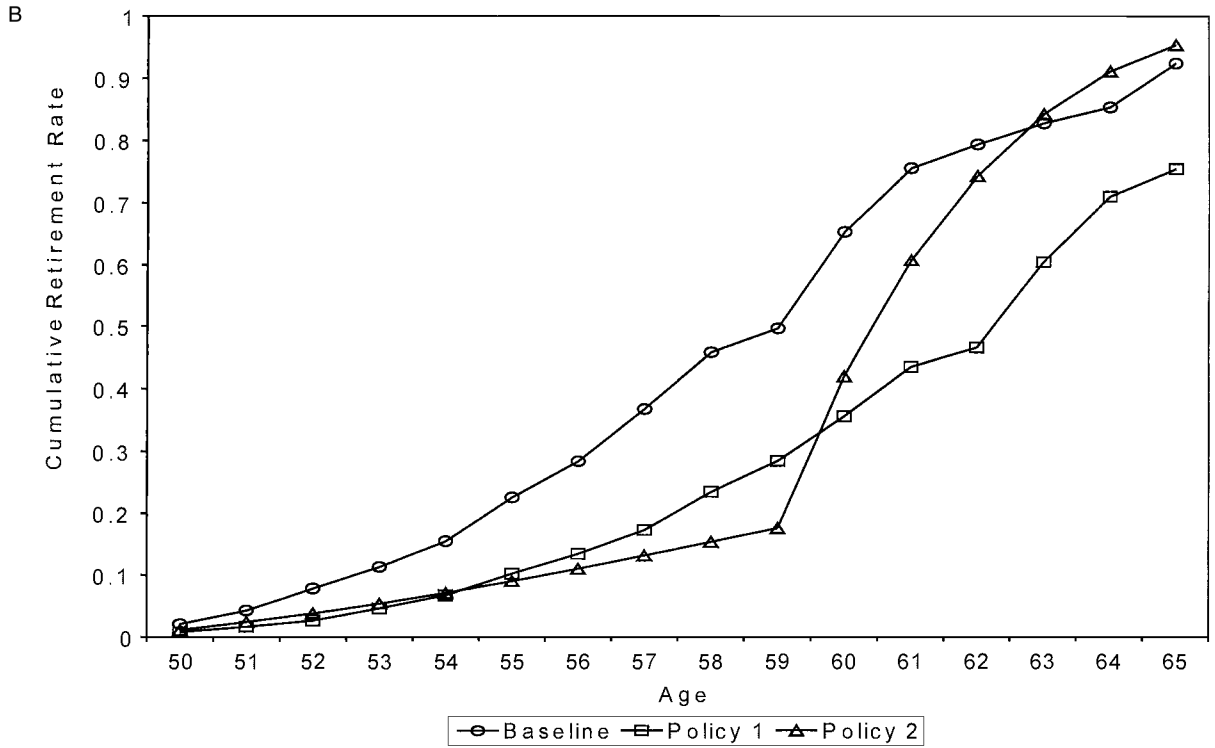
B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.11 (cont.)

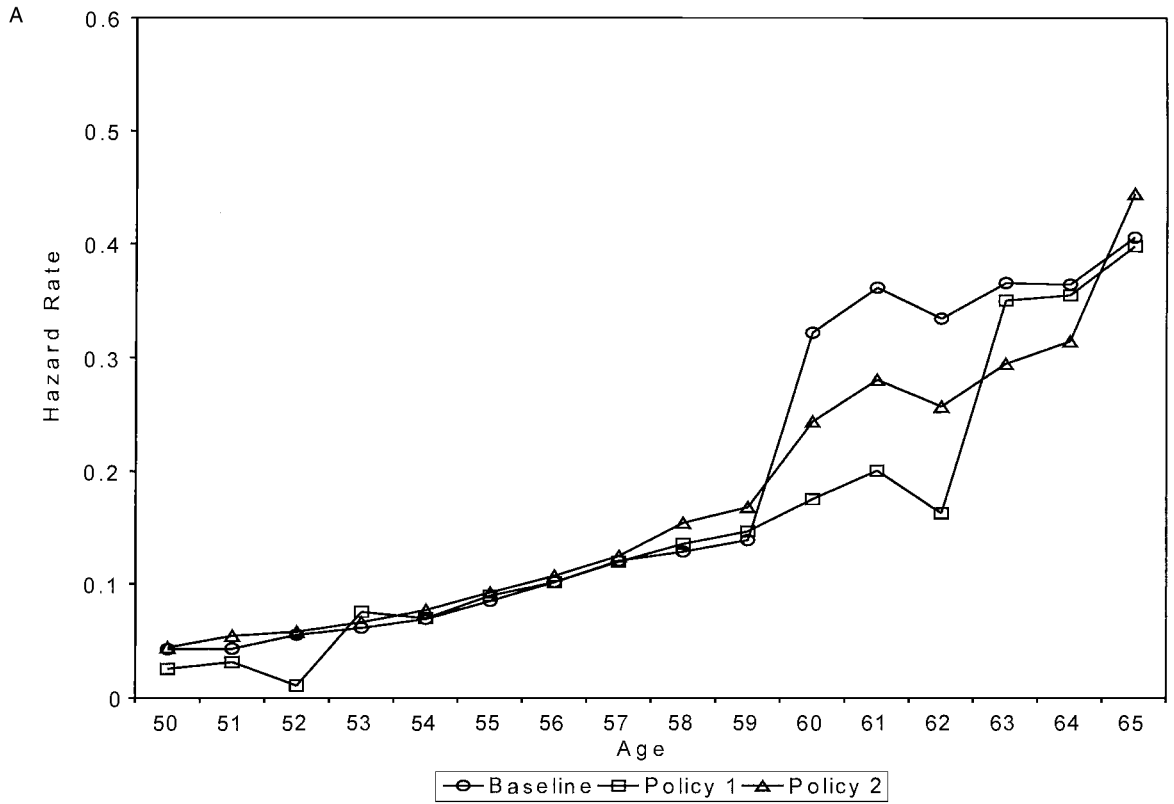

Fig. 1.12 AC, S1: *A*, Hazard rates for women; *B*, CDF for men

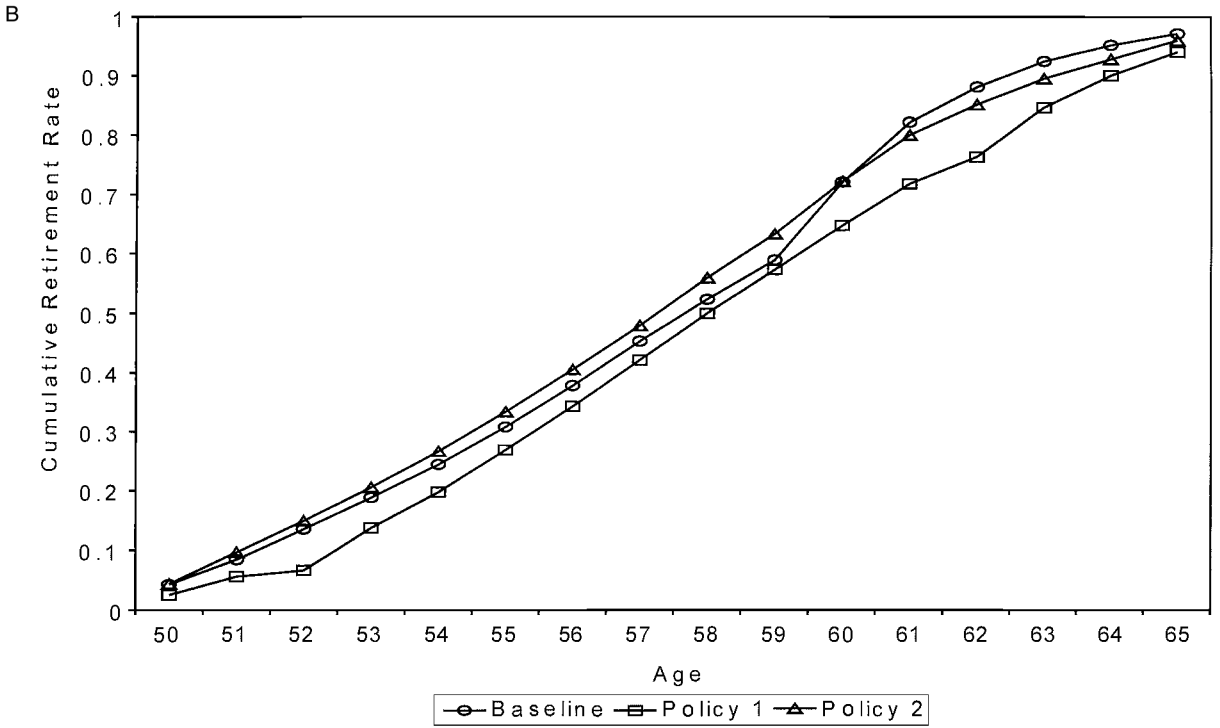
B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.12 (cont.)

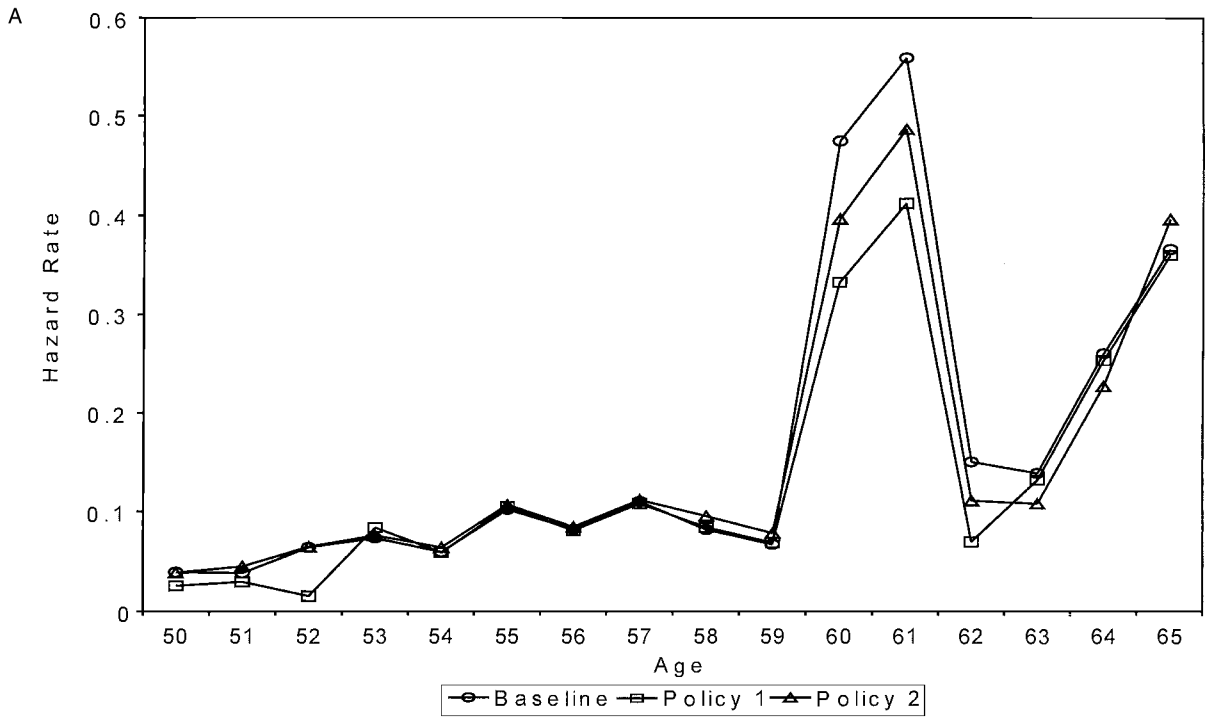

Fig. 1.13 AC, S2: *A,* Hazard rates for women; *B,* CDF for men

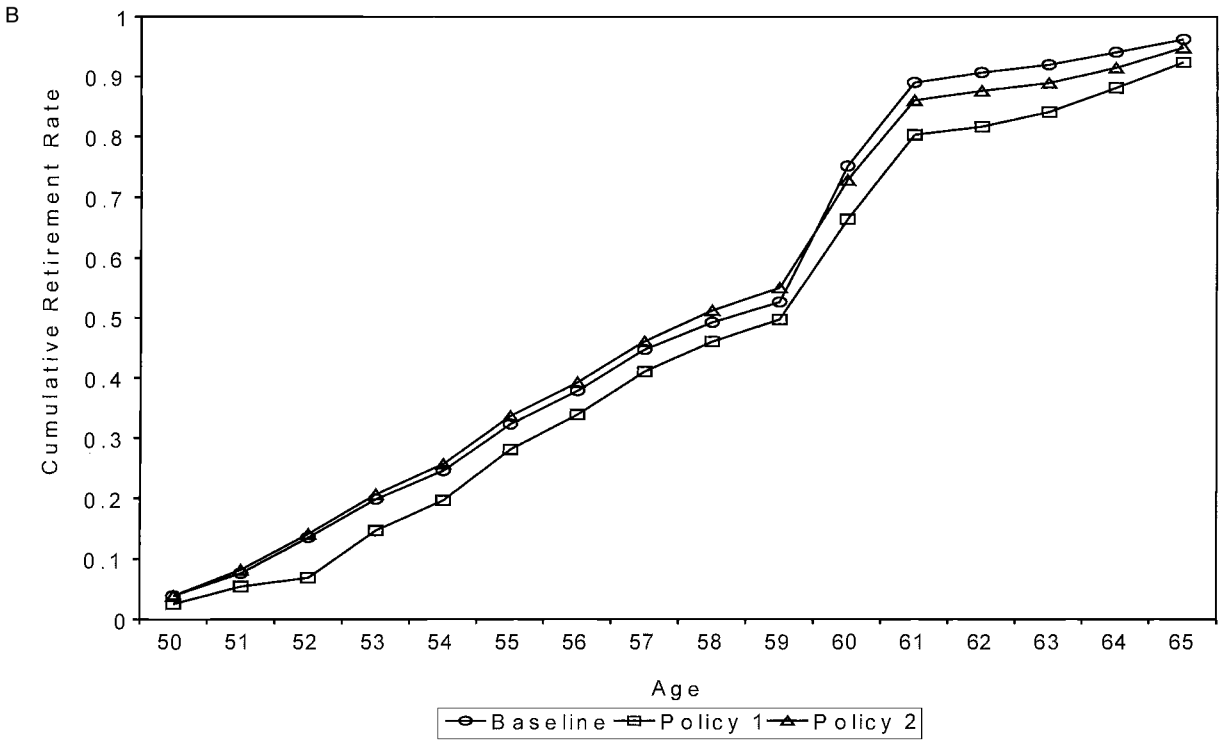
B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.13 (cont.)

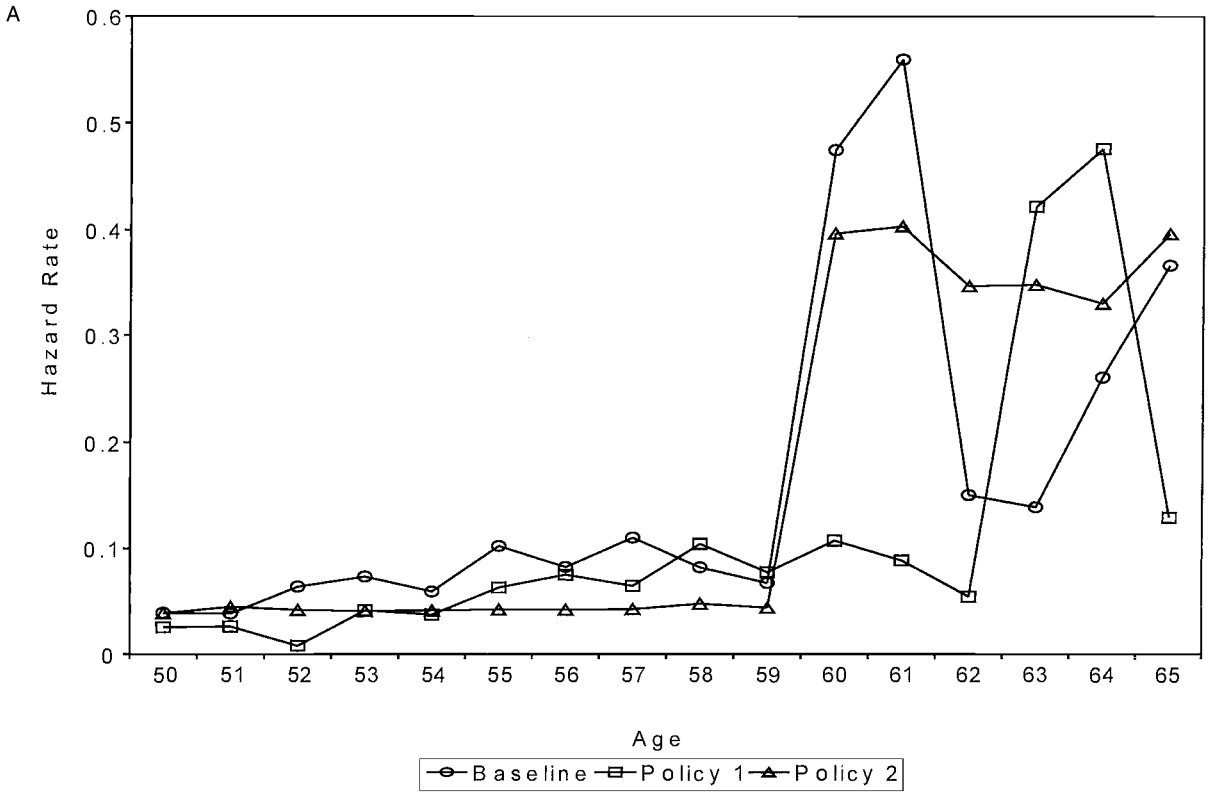

Fig. 1.14 AC, S3: *A*, Hazard rates for women; *B*, CDF for men

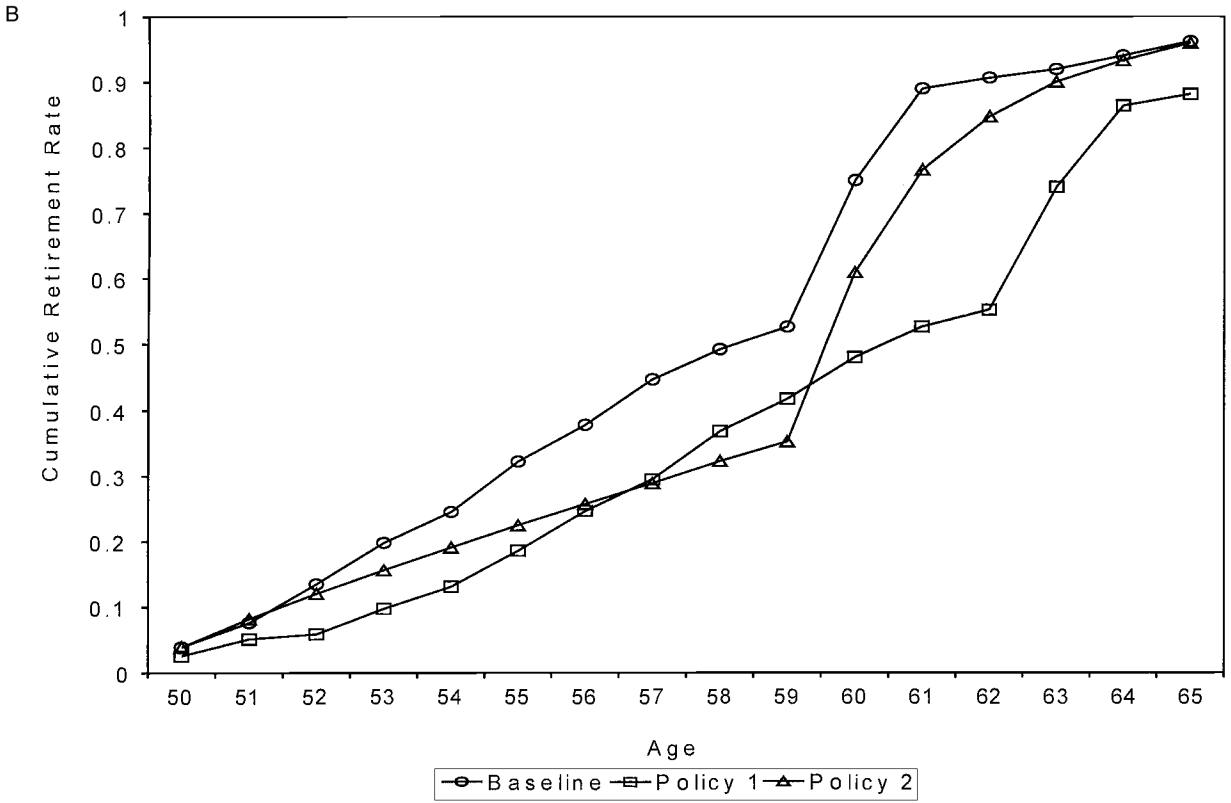
B
Cumulative Retirement Rate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
Age
Baseline
Policy 1
Policy 2

Fig. 1.14 (cont.)

Our findings tend to indicate that the proposed reforms would have a rather significant impact on the retirement behavior of older Belgians, especially for policy 1. This is not really surprising since the hypothetical changes represent massive shake-ups of the system. Indeed, in a country such as Belgium where the current average observed departure out of the labor force lies well below the early retirement age of the official pension system (sixty for most individuals aside from teachers and similarly privileged occupations), the elimination of all these early exit routes from the labor force has to be seen as an earthquake. This is particularly true if we consider simulations of the S3 type. No matter which incentive variable we use (AC, PV, or OV), we see strong effects on the hazard rate of departures and, as a consequence, strong effects on the cumulative distribution function.

The figures clearly display the wide disparity between the hazard functions and the cumulative distribution functions depending on which simulation method (S1, S2, or S3) serves as a basis for the simulation. There is, however, a large degree of similarity between the results we obtain using one of the three simulation methods while changing between any of the three different incentive variables (AC, PV, or OV). Summary measures such as the average retirement age, although useful in their own way, are clearly insufficient for understanding the total change in the retirement patterns. Very similar average retirement ages can be derived from very different hazard processes.

The findings also comfort the intuitive idea that the changes in the hazard rate implied by policy 1 should be clearest in S1 and S3, where the jumps at ages sixty are simply shifted up by three years. Of the three methods, S1 is the most conservative in terms of the changes in the hazard rate, which should also not surprise the reader because of the underlying linear age trend that is involved. Not surprisingly, the effect of policies 1 and 2 are the most divergent in S3, where their specificities fully come to bear on the hazard rates. This clearly illustrates the importance of the question of whether we should (S3) or should not (S2) also change the weights on the age dummies in the dummy model.

1.8 Conclusions

The rapid aging of the Belgian population creates major problems for the financing of the public retirement and early retirement systems. This is even more so, given the rather impressive decline of labor force participation that we have witnessed in Belgium over the last several decades, which has made the country one of the world leaders in putting its people into retirement at very early ages. Because of the varying departure patterns from the labor force in the different systems, these challenges will also have a very different impact on their viability.

The present paper sets a new standard in analyzing the retirement decisions of Belgian workers because it models and analyzes the impact of incentive variables, such as the present-discounted value of social security entitlements and the change that occurs in the latter when people change their age of retirement. Our paper finds strong evidence that social security accruals are strongly negative for most people aged sixty and above. More strikingly, more than 50 percent of workers face negative accruals as early as age fifty-eight. We find a similar picture using more forward-looking incentive measures that take into account the entire future path of benefit dynamics. Even more importantly, we find a strong and very significant negative impact of these dynamic incentive variables, such as AC and OV, on the decision to work. Hence, we find that workers with smaller rewards or even penalties on continued work do indeed retire earlier from the labor force.

These findings are of a crucial importance in the light of reforms to one, several, or all of the Belgian retirement systems. Governments and policymakers cannot simply assume that retirement decisions are static, but rather have to take into account the impact of the SSW and the dynamic incentive measures. We illustrate this logic by applying two rather distinct hypothetical policy proposals for reforming the Belgian retirement landscape, which have in common a reduction of benefit entitlements to improve the chances of survival of the public retirement-income systems. Our simulations show that such reforms have the potential to induce major changes in observed retirement patterns.

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