DISCUSSION PAPER SERIES

No. 2795

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PUBLIC POLICY

Centre for Economic Policy Research

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ISSN 0265-8003

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Discussion Paper No. 2795
May 2001

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CEPR Discussion Paper No. 2795

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ABSTRACT

Micro-Modelling of Retirement in Belgium*

The present Paper studies the retirement incentives for elderly people in Belgium. We model the incentive structure built into the various public early retirement and retirement systems. First, we compute indicators of benefit entitlement such as social security wealth. Then, we use three 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 an accurate measure of all individuals' pension wealth, as well as of the implicit tax rates the elderly workers face in case of delayed retirement. We find strong evidence of social security-based financial incentives inducing most workers to retire at the earliest possible stage. Finally, we use the derived parameter estimates from the probit models to simulate the responses to various policy changes.

JEL Classification: H55, J26
Keywords: ageing, retirement, social security, Belgium

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* We are indebted to the Belgian Institut National de Statistiques (INS) and in particular to Frans Desmedt, Paul Everaerts and Jean-Marc Sobrie for their outstanding contributions in building the database used in this study. Also we want to thank Ron Lesthaeghe, from the Vrije Universiteit Brussel, for accepting to perform the estimation of life tables by educational group. We thank Raphael Desmet for excellent research assistance and Pierre Pestieau and the participants at the NBER meetings in Paris and Sienna for helpful discussions. Financial support from the Communauté Française de Belgique (PAC 98/03-221) and from SSTC (PAI-94/32) is also acknowledged. All remaining errors are entirely our own. Comments welcome at ajousten@ulg.ac.be.

Submitted 07 March 2001

NON-TECHNICAL SUMMARY

The Belgian social security systems face an uncertain future. One major reason is the financial burden imposed by the ageing of the population. For the systems to survive this demographic process, higher contribution levels and/or lower benefits will have to be introduced given the pay-as-you-go (PAYG) nature of these systems. The fiscal rigor of the successive Belgian governments has no doubt increased the margin of manoeuvre of the federal government in its attempts to cope with the demographic ageing process. Another factor of uncertainty pertains to the consequences of increased labour mobility on the way the social security systems are organized. First, increased mobility between jobs in the public sector, 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 have to be seen in this light. Mobility between sectors will most likely increase once people's behaviour 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. Even leaving these two challenges aside, however, the Belgian social security system is in need of reform. The widespread use of a variety of early retirement programmes makes Belgium the country in the OECD area with the lowest average retirement age, which is approximately 57 for men.

The present Paper studies the incentives pushing people towards retiring early. We explicitly model the incentive structure built into the various early retirement and retirement systems by integrating entitlements to a wide variety of programmes. We restrict our attention to the public retirement income systems, as they represent the bulk of pensions income for a wide majority of workers. Our analysis proceeds in several steps. First, we compute an indicator of total benefit entitlement that is the present discounted value of future expected benefit pay-outs. This value, called 'social security wealth' is computed using both survival and interest rate discounting. It puts a single monetary value on the outstanding claims an individual has in all of the different systems. Then, we define several different incentive measures based on the notion of social security wealth. These measures are designed to capture the change in total benefit entitlements an individual is exposed to upon altering their retirement age. In a first case, we use a measure valuing the financial incentive to retire in one year's time rather than today, in the other two cases we use more dynamic forward-looking concepts that take a much longer-run perspective. In a third step, we then bring in microdata from a new and extraordinarily rich database that was assembled for the present

project. Our data set stems from five sources, which are mostly administrative databases (fiscal statistics, pension records, etc.) but there are also some survey-based elements included. We were able to match all of these using an individual national identification number that every Belgian has. The resulting data set has the major advantage of being extremely rich, as it includes data from multiple sources for a very large fraction of the Belgian population. For our estimation, we limit ourselves to data on the people between the ages of 50 and 69, and our data dates back to the years 1989–96. Using this data, we are able to compute accurate measure of all individuals' pension wealth, as well as of the – sometimes punitive – implicit tax rates the elderly workers face in case of delayed retirement. We then perform an empirical estimation of microeconometric probit and option value models integrating the concept of social security wealth. We also successively use the three different dynamic incentive measures in the regressions to check the robustness of the specification. We find that the estimates of the incentive measures are all significant when taken individually. Comparing the estimates from the different specifications, we see that this result is quite robust as they do not depend on the precise functional form of the specification. The social security wealth has a small positive effect on the probability of retirement. There is also strong evidence that the dynamic incentive variables have a powerful negative effect on the probability of retiring. These findings show that there is a need for a reform of the rather generous early retirement programmes, as they have to be seen as one of the main culprits for pushing people out of the labour force.

Micro-modeling of retirement in Belgium

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January 22, 2001

Abstract

The present paper studies the retirement incentives for elderly people in Belgium. We model the incentive structure built into the various public early retirement and retirement systems. First, we compute indicators of benefit entitlement such as the social security wealth. Then, we use three different incentive measures based on the notion of social security wealth. In a third step, we perform an empirical estimation of micro-econometric probit and option value models. From our exceptionally rich and broad database, we are able to compute 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. We find strong evidence of social security based financial incentives inducing most workers to retire at the earliest possible stage. Finally, we use the derived parameter estimates from the probit models to simulate the responses to various policy changes.

JEL codes : H55, J26
Keywords : retirement, aging, social security, Belgium

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 and/or lower benefits 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 high ratio of public debt to GDP even further to astronomous heights. Most recently however, the successive Belgian governments have successfully brought down the debt-GDP ratio to close to 105 percent from a level of 130 percent by means of strict budgetary policy. The government is even expected to run a budget surplus in 2001. This fiscal rigor

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will no doubt increase the margin of maneuver 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 of all, increased mobility between jobs in the public sector, 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. Secondly, 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 (2000) 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, and this even if we replace the assumption of perfect labor mobility between member countries by a more restrictive and plausible one of mobility limited to individuals belonging to some income groups.

However, even leaving these two challenges aside, the Belgian social security system is in need for reform. The widespread use of a variety of early retirement programs makes Belgium the country in the OECD area with the lowest average retirement age, which is of approximately 57 for men according to Blöndal and Scarpetta (1998).[1] The present paper studies the incentives pushing people towards retiring early. We explicitly model the incentive structure built into the various public early retirement and retirement systems. First, we compute indicators of benefit entitlement such as the 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 micro-econometric probit and option value models. From our exceptionally rich and broad database, we are able to compute 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 2 describes the essential features of the various public retirement and early retirement systems. In section 3 we explain the different mostly administrative components of our large dataset. The following section touches on the problem of the earnings process used in the simulations and estimations. Section 5 explains the process and logic underlying the construction of the different incentive measures used, while section 6 contains regression results obtained using these latter incentive measures. Section 7 delivers two policy simulations using the coefficients estimated in the preceding section: the first consists of an increase by three years of the eligibility ages in the various retirement systems, and the second consists of a policy in which early retirement would be possible at age 60 at the earliest, while the normal retirement age would be 65. Section 8 is devoted to the conclusions.

2. Social security schemes in Belgium

The Belgian retirement income system relies on 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. A 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 which 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: First, there are tax-favored individual pension savings accounts with a maximum annual contribution of BEF 22.000 per person (approximately US$ 579),[2] or under the form

[1] The average retirement age of 57 for men was estimated on the basis of Labor Force Surveys.
[2] In this paper, we apply a BEF/US$ exchange rate of 38 BEF per US$, which approximately corresponds to the exchange rate in place on 31/12/1999.

of more traditional savings vehicles such as the tax-favored savings accounts, investments in trust funds, life insurance, etc. The dominance of the first pillar can also be represented in numbers: whereas the first pillar represents pension entitlements of more than 250% of GDP, assets in private pension funds only amount to 10% 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 coal-mine 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, Belgian governments have 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 gives a brief outline of the importance of the different categories of social security programs for the year 1995.

2.1. Wage-earner's scheme

The wage-earner's scheme is the largest one according to the number of people affiliated with the program. The program allows for retirement between the ages of 60 and 65, with the choice of the retirement age not inducing any actuarial adjustment.[4] The system worked according to a different logic till the early 1990's. Until 1992, the wage earner's scheme had an actuarial adjustment factor of 5 percent per year of early retirement before the age of 65.

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 additional pension rights by working additional years between the ages of 60 and 65. This is so because a full earnings history consists of 45 years of work for men, a condition that many people do not satisfy at the age of 60. For those having more than 45 working years, a drop-out year provision operates replacing low income years by higher ones as they arrive. The situation has so far been slightly different for women. Indeed, till very recently, women only needed 40 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 which aims at progressively increasing the complete career condition to 45 for women. However for most women included in our dataset, a full career still consists of 40 years of work.
Benefits are computed based on earnings during periods of affiliation. The benefit formula can be represented as follows:

Benefit =min[n/(40 or 45), 1] * average wage * k

Where n represents the number of years of affiliation with the wage-earner's scheme, and k is a replacement rate, which takes on the value of 0.6 and 0.75 depending on whether the social security recipient claims benefits as a single 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 (unemployment benefits, disability benefits, workers compensation,…) 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.

[3] See OECD (1994), Dellis and Perelman (1999) and EEC (1994) on the subject.
[4] Notice that from a legal point of view, age 65 does not represent a compulsory retirement age, but rather an age at which a worker loses the social protection associated with his job.

An additional category of linked benefits is payable to surviving spouses, or more generally 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 BEF 300,000 or US$ 7,895 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-earner scheme, several forms of early retirement programs have developed over the last few years, some officially carrying the name of "early retirment", others not doing so (unemployment, disability, sickness, …). Those schemes can broadly be subdivided into two groups, mandatory collective retirement, and individual early retirement. During the 1980's and the 1990's, 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 sector level, 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 50 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 costs have been rather modest, if not completely absent. Recent discussions and decisions at the government level clearly move into 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 through additional costs. For example, a large fraction of early retirement compensation is paid by the federal government.[5] On the other hand, individual's pension rights in the wage-earner 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 as well as they are not entitled to pay social security contributions.

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 people aged fifty or more are considered 'aged unemployed' not required to actively look for work. 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

[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.

considers the employee as a crucial wheel in the working of the company. Laying the worker off allows him to replace to expensive old worker by a cheaper young one. Further, the employer's behavior does not add any costs to his unemployment contributions as the system is not experience rated. Next to the unemployment path, some people also attempt to proceed to retirement through the disability insurance scheme.

In the Belgian context, we think that disability is however 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.

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. This is the reason they are commonly considered as deferred income rather than old-age insurance. The only official insurance aspect are the payroll taxes of 7.5 percent the public sector employees have to pay to finance survivor benefits. Benefits are essentially individualized, i.e. there are no additional spousal benefits available for no or low income spouses.

Civil servants' pensions are compulsory as of age 65 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 65. It is possible to opt for an incomplete career and retire at 60. For some particular categories of workers, the normal retirement age is lower than 65, 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 55 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 58.[6]

Public sector pensions are based on the income earned by an individual during the last 5 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:

Benefit = average wage over last five years * min [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 being a benefit accrual factor. This latter benefit accrual factor, also called "tantième", depends on the rank the person occupied in the hierarchy. For example, the denominator is equal to 30 for university professors and high ranking magistrates. At the opposite extreme, most civil servants have a denominator of 60.

In addition to the above-mentioned 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. Further, 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.[7] Notice the rather marked difference of these floors and ceilings with the ones applicable to the private sector employees. A major conclusion we can already draw at this stage is that higher income public servants get a much better deal than their private sector counterparts. This finding is even reinforced once we introduce another aspect, namely the rules on indexation. As opposed to the private sector social security system which only indexes benefits to the CPI, public pensions are

[6] There are three jurisdictions in Belgium, called communities, defined on the basis of citizens' languages (Dutch, French and German). Communities have jurisdiction over the education policy.
[7] The latter feature is the only instance where the family structure matters for the amount of civil service pension.

indexed to average wages ("péréquation"). Public 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, public 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 is much less severe.

2.3. Self-employed

The self-employed retirement scheme is the latest one to have been introduced, as it only exists since 1956. It is also the least generous of the three major social security systems. For a very long time, pensions have been independent of earnings levels. However, since 1984, the system is progressively being 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 65 for men with a complete earnings history of 45 years. However, early retirement is possible as early as age 60 with a reduction of 5 percent per year of anticipation. Women are currently in a transitory system, which progressively increases their normal retirement age from 60 to 65 and the complete career requirement from 40 years of work to 45. Again, most women in our dataset are still subject to a normal retirement age of 60 and a full career condition of 40 years of work.

The social security system of the self-employed is financed through two broad categories of income. First, there are direct contributions levied under the form of a tax of 16.7 percent on the first BEF 1,800,000 (US$ 47,368) of income, and 12.27 percent for all income above this threshold. 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-earner's 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.

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.

2.5. Labor-market and benefit program participation

Labor market participation rates start to decline at a rather early age. Table 2.1a illustrates the picture for men. 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 table for women (table 2.1b) 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 industries in structural difficulties, such as heavy industry and mining.

2.6. Pathways to retirement

Pathways into retirement vary somewhat according to the social security system the worker is subject to. Table 2.2a and 2.2b summarize 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. The reason for this rather disappointing fact is that our datasource for the corresponding information are 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. Further, 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.

3. Data overview

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

3.1. SFR (Statistiques Fiscales des Revenus)

The data used for the SFR are originally collected by Finance Ministry. The National Statistical Office (INS) then processes the raw information to produce the SFR. Starting in 1989, the SFR data includes the national identification number, hence making 1989 the first year for which we can merge the different datasets 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, renter), taxable real estate income, contributions to second and third pillar pensions…

3.2. CIP (Comptes Individuels de Pension)

The CIP is collected by the wage-earners pension administration (ONP) since the mid 50's. It includes all career information relevant for the wage-earner pension computation: gross wages, days of work, days on social insurance programs, days worked abroad, …

3.3. INASTI (Institut National d'Assurance Sociale des Travailleurs Independants)

The INASTI dataset includes good information on periods of affiliation as a self-employed. There is however no information on earnings levels, other than those available for last years from the SFR dataser. 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.

3.4. Finance Ministry, Department of Pensions

This segment of our database contains the information on the periods of affiliation as a public 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.

3.5. Population Survey (1991)

We only use a very limited amount of information available in the population survey. Essentially, we focus on education levels that are classified according to 9 categories. Doing so, we are able to match education-specific life tables to all the individuals in the database. Further, we use industry indicators from the population survey that gives information on the activity sector that each individual belongs to in order to create dummy variables for the regressions of section 6.

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

In our study, we use data from three successive years (1993, 1994 and 1995) and 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 50-64 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. Are retired all those who have either pension or early retirement income and have income from work smaller than a threshold of BEF 300,000 (US$ 7,895), or who have unemployment or disability income and no income from work. Table 3 summarizes all the relevant information for our sample. The total number of observations is of 32,954, 23,261 and 9,693 for men and women respectively.

4. Earnings histories and projections

Our dataset 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 till 1996. Given the requirement that we need 5 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 experimentation with other wage regression models. In particular, it has the advantage of allowing for reasonable projections for people belonging to multiple systems.

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 Population Survey 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. Further, 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 towards 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, such as described in tables 5.1a and 5.1b. The weights on the early retirement and the unemployment/disability routes correspond to the observed frequencies of these routes among all people of any given age, 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. For the public sector, we decided to apply weights based on those observed for the private sector. More specifically, we added the weights attached to unemployment, disability and early retirement to create an early retirement option for public sector employees which is available as of the age of 50.

As for the self-employed, we only allow for one path in our computation, as the disability system only provides for really low levels of benefits and this only under very strict conditions. Further, 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 already 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 his or her own work history. In that case, we apply the official rule of supplementing the pension based on the own 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 individual and the potential partner SSW, independent if she/he continuous to work, but assuming a normal retirement path.

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 today. Tables 5.2 give the summary statistics we obtain while applying this first incentive measure to the entire sample of individuals belonging to the different social security systems.

Table 5.2a: SSW and accrual for Men

Age	Obs.	SSW	Accrual			
		Median	10^{th} %	Median	90^{th} %	Std Dev
50	2834	185143	-3596	-227	5619	5759
51	2592	189625	-243	4457	9839	5525
52	2311	197759	-1261	2062	7693	5170
53	2156	204255	-1427	1841	7205	4996
54	2077	212052	-131	5082	10071	5172
55	2048	223428	-1764	1758	6750	4529
56	1889	228379	-494	3960	8408	4642
57	1700	238550	-2981	1167	6356	4918
58	1408	240909	-5447	-305	5131	4955
59	1147	250608	-3290	2293	7754	5907
60	1026	253974	-16693	-8355	-176	6798
61	693	235956	-16996	-7466	-83	6998
62	474	207610	-17454	-7286	-205	7386
63	375	198460	-17995	-7439	-263	7333
64	302	198794	-17999	-7600	-374	7491
65	229	202825	-20431	-11791	-4046	7305

Table 5.2b: SSW and accrual for Women

Age	Obs	SSW	Accrual			
		Median	10^{th} %	Median	90^{th} %	Std Dev
50	1475	203856	-7959	-2176	4313	5337
51	1262	205774	-50	5174	11772	5237
52	1121	213020	-1241	2932	8723	4960
53	936	218406	-1776	2685	8434	5078
54	869	217281	-1706	2774	8730	5447
55	823	220059	-4138	1831	7806	5686
56	741	224722	-5666	1305	7430	5631
57	618	227735	-8051	-11	6926	7387
58	512	232510	-8391	-125	6634	6398
59	444	231763	-9421	-336	6503	6617
60	390	232365	-18233	-10958	-5270	5958
61	226	216830	-17336	-10161	-4393	5257
62	97	207545	-17430	-10301	-5183	6833
63	78	196502	-17753	-9674	-4642	5413
64	57	172312	-14555	-8392	-4703	4634
65	44	143359	-15120	-8909	-3434	4243

Notice the large spread between the values we obtain for people at the 10^{th} and the 90^{th} percentile of the distribution. Another feature that our tabulation reveals is that once men attain age 60, more than 90% of them face negative accruals. These results are essentially due to the fact that under the rules outlined in section 2, workers are hardly penalized for retirement at age 60 rather than 65. Also notice the effect of early retirement systems, that are generally made available to workers at some key ages such as 52, 55 and 58, where we observe a drop in accruals, and this at all points in the distribution of accruals. The reason for this finding is the rather large fluctuation of departure rates via the three different systems such as displayed in table 5.1a. For women, the situation is slightly different. First of all, there is no such dip at the usual early retirement ages. As women usually have shorter periods of affiliation with the social security systems, and thus have more limited access to these early retirement schemes. Further, the change in accruals is much more pronounced at the 90^{th} 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 is playing 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 where the husband is still working at the time the wife turns 60. 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 the day 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 5.3 shows us. 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-earner's scheme are almost immune to a decision to retire early.

Table 5.3 : SSW , accrual and tax/subsidy for male wage-earners

Age	Obs	SSW	Accrual				Tax/Subsidy	
		Median	10^{th} %	Median	90^{th} %	Std Dev	Median	Pestieau-Stijns
50	1725	188307	-4373	-1083	3170	5524	0.011	.
51	1562	192729	227	4612	8268	4689	-0.197	.
52	1406	200728	-1749	2088	5592	4996	-0.096	.

53	1325	207429	-1809	1840	5614	4642	-0.092	.
54	1257	213468	1106	5277	9058	4198	-0.241	.
55	1216	224514	-2080	1737	5074	4016	-0.081	-0.129
56	1084	230203	-323	4244	7651	3864	-0.181	-0.134
57	952	241872	-3018	1331	5372	4495	-0.048	-0.145
58	750	247769	-6287	-1290	2439	4202	0.016	-0.148
59	558	256160	-2933	2885	6593	5520	-0.094	-0.157
60	463	265461	-15830	-8927	-3414	5393	0.383	0.496
61	335	261693	-16478	-9089	-2762	6220	0.367	0.497
62	194	255484	-17303	-8812	-2127	6338	0.361	0.491
63	143	247160	-17603	-9993	-2655	5778	0.377	0.489
64	116	231707	-18236	-9574	-4490	5807	0.415	0.473
65	95	219025	-19565	-11733	-5368	6073	0.564	0.529

Source : Pestieau and Stijns (1999) table 1.9 and authors own calculations

The same finding can also be represented using a different incentive measure, namely the implicit tax/subsidy rate imposed by the social security system. This tax/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. The only difference, around 0.10, comes from a slight difference in calculations given that SSW figures used here are gross of pension payroll taxes.[9]

The next two incentive measures are forward-looking measures. "Peak value" represents the difference between SSW at its peak and SSW today. It thus differentiates itself from the accrual measure by the fact that it takes into account the entire SSW process, and not only the variation from the present to the next period.[10] The second forward-looking measure is the concept of "option value" such 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:

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

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 $B_s(r)$; β is the time preference rate which we assume to be β=0.97. γ corresponds to a parameter of risk-aversion and is set to γ=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 now (t) and retiring at the best point in the future (r^*).

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

Aside from the above assumption on the parameter values of k and gamma, we also perform some sensitivity analysis using other values.

[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 4.

[9] We also simulated tax/subsidy rates using the same departure rates for the different systems for all ages considered and found very stable tax-subsidy rates in line with those found by Pestieau and Stijns(1999).

[10] "Peak value" is equal to "accrual" if the peak of the SSW process is attained with immediate retirement.

Summary statistics for both of these forward-looking measures are given in tables 5.4. The peak value numbers of table 5.4a and 5.4b for men and women older than 59 strongly resemble those we discussed for the accrual definition of table 5.2a. 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 substantial fraction of the population younger than 60, there is quite large possible gain from continuing to work. Again, heterogeneity in the female population is quite large, and 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 the values of k by 1 and/or the value of γ by 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 in our model is retirement, it equals one in the case the individual retires within the year of observation, and zero otherwise. As indicated in section 3, are retired those people who have either a pension or early retirement income and have income from work smaller than a 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). Further, age is inserted, for some specifications under the form of a dummy variable for each age, for other specifications under the form of a linear age variable. Earnings appear in three ways: individual projected annual earnings, average lifetime income (only available for wage-earners), and projected potential annual earnings of the spouse (all these variable are in dollars, converted at the exchange rate of the 31/12/1999). Lastly, system variables are also used in all the specifications.

Furthermore, all of these models contain controls for activity sector (11 dummies), level of schooling (8 dummies), and squared earnings and life-time earnings, an occupational pension dummy, a private retirement savings dummy, a home ownership dummy, real estate income, region (Brussels, Flanders or Wallonia) and dummies for the year of the observation (1993, 1994 or 1995). The estimates of these variables are not reported to avoid overcrowding the tables with the results.[11]

Tables 6.1 and 6.2 which summarize our regression results are organized as follows. We estimated a total of six probit models, separately 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 with a linear age trend. The second column then reports the results of a model were we replace the linear age trend by age dummies. The motivation for this change is to allow for non-linearities in the systems that our incentive measures do not fully capture.

Inspection of the different columns of table 6.1 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 Social Security Wealth (SSW) has a small positive effect on the probability of retirement. The numbers reported in bold indicate the change in the underlying probability function as a result of a small change

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

in a dependent variable. The three dynamic incentive variables accrual (AC), peak value (PV) and option value (OV) have a strong negative effects on the probability of retiring, as reported in bold below the parameter estimates. Also notice the positive effect of the civil-servant-system dummy which contrasts with a generally negative and insignificant self-employment dummy.

Table 6.2 reveals that the dynamic incentive variables (AC, PV, OV) also display a large degree of significance for women, and that they even have a 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 decision. Further, the significance of the system dummies is reversed, while their signs are identical to the ones we have found for men. This seems to indicate that self-employed women represent a somewhat special group who 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, and this independently of the specification. However, age dummies at ages smaller than 60 seem to be much stronger for men than for women, and this particularly at the key early retirement ages (52, 55 and 58 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 also be the reflection of 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 take.

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 on the question of which dynamic incentive variable has the highest explanatory power, we find a somewhat mixed answer. Whereas for men, accrual models have the highest level of the pseudo-R^2, this is not so for the female sample where the prospective option value model performs better.

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 and 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 6.2, where the probability effect of the accrual variables changes slightly more. We interpret these findings as rather comforting as they would tend to indicate that our SSW and dynamic incentive variables have a rather stable explanatory power, and hence that they capture some of the non-linearities of the retirement income systems in Belgium.

Coming back to the other results presented in tables 6.1 and 6.2, a common finding to all estimations for men and women is that the presence of an active spouse or of any additional dependent in the family has a significant negative impact on the decision to retire, and this particularly for women. Also in the case of women only, to be married has a strong positive and significant effect towards early retirement, but this effect declines significantly following the age difference among partners.[12]

The effect of the earnings variables is rather similar for men and women. First of all, average lifecycle earnings, which are only available for wage-earners, influence positively 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 accruals (AC) and peak values (PV). In the option value (OV) models however this effect vanishes, as projected earnings enter directly in the calculation of the incentive measure. Finally, the projected earnings of the spouse appear to have no impact on individual decisions, neither for men nor for women.

[12] As indicated in table 3, the average age difference between men and women within couples is of 1.9 years.

Figures 6.1 and 6.2 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 would tend 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 non-linearities 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 they can be seen as collectively voluntary, as trade-unions intervene in the negotiations relating to many early retirement schemes. Hence, incentive measures have only a very limited role to play in the decision on when people stop to work. We also find back the previously discussed result that the explanatory power of the accrual model is highest for men, while option value does best for women.

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 insurance, 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 unique retirement system. Early retirement would be possible at age 60 at the earliest, while the normal retirement age would be 65. At age 65, 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 55 and 59. For retirement prior to age 65, a 6 percent actuarial reduction is applied to the amount of benefit entitlement, and this on a lifetime basis. Similarly, late retirement, i.e. after age 65 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 benefit 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) we derived in the previous section. Hence we perform a total of eighteen simulations both for men and for women. The first simulation approach labeled "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 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 thus also have implications on retirement through the incentive variable coefficients. Notice that this change in weighting only matters for the first policy change, as we do by definition impose the absence of any other pathway to retirement in the second policy. Summarizing, S1 simply consists of a re-computation of SSW at every age under these new rules and a prediction of retirement rates by the application of the new SSW and accrual values to our estimated coefficients.

The second simulation approach labeled "S2" is the same as the first, however 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 non-linearities 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 non-negligible fraction of retirees are facing compulsory retirement at a given age. A comforting finding is however 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 by different leisure tastes over the explanation by the non-linearities in the system that the SSW and the related incentive variables do not fully capture.

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 53 dummy takes on the estimated value of the age 50 dummy, the age 68 dummy takes on the estimated value of the age 65 dummy, etc. This approach takes a rather opposed view to S2 as it implicitly imputes all the effect on the age dummies to the social security incentives. Clearly, the truth will be between these two extremes.

For Policy 2 and simulation S3 we proceed in a similar way, but the impact of age dummies are modify in a different way. On the one hand, given that in this policy simulation alternative retirement pathways are assumed out, the effect of age dummies before age 60 are imputed following the trend of estimated dummies from age 50 up to the age before the first path-break increase in dummies was observed. From the results reported in tables 6.1 and 6.2, we considered that this path-break corresponds to the age of 55, when pre-retirement plan's eligibility seems to have a first huge impact on individual retirement. On the other hand, we keep the effect of age 60 and 65 dummies unchanged assuming that Policy 2 will not affect individual behavior at these particular ages. Finally, using these two dummy values we inputted the values of the intermediary dummies, from age 61 to age 64, assuming a smooth path trend.

We present the results of these simulations in three broad ways. First of all table 7 summarizes the effect on the average retirement age of the 3 models (AV, PV and OV) and the 3 simulations (S1, S2 and S3) for the 2 policy changes discussed (Policy 1 and Policy 2). In an attempt not to overcrowd the paper with tables and figures, we only report the results corresponding to the option value model for women.[13] Secondly, we present graphs (figures 7.1a to 7.12a) that 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 7.10a, 7.11a and 7.12a) are the results of the simulations done for women using the option value model. Thirdly, figures 7.1b to 7.12b present the cumulative distribution function (CDF) of departures into retirement.

Our findings would tend to indicate that the proposed reforms would have a rather significant impact on the retirement behavior of older Belgians, particularly for Policy 1. This is not a really surprising finding as the hypothetical changes represent massive shakeups 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 (60 for most individuals aside from teachers…), the elimination of all these early exit routes from the labor force have to be seen as an earthquake. This is particularly true of we consider simulations of the type S3. No matter which incentive variable (AC, PV or OV) we use, 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, though 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.

[13] From Table 6.2, it appears that the estimation of the option value model gives the best Pseudo R^2.

The findings also comfort the intuitive idea that the changes in the hazard rate implied by Policy 1 should be clearest in simulations S1 and S3, where the jumps at ages 60 are simply shifted up by three years. Simulation method S1 is the one that 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 simulations 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.

8. Conclusions

The rapid aging of the Belgian population induces 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 we have witnessed in Belgium over the last several decades which have 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 the analysis of the retirement decisions of Belgian workers as it models and analyzes the impact of incentive variables such as the present discounted value of social security entitlements and the change 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 60 and above. More strikingly, more than 50 percent of workers face negative accruals as early as age 58. We find a similar picture using more forward-looking incentive measures taking 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 accrual and option value 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 static retirement decisions, but rather have to take the impact of the social security wealth and the dynamic incentive measures into account. 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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Table 1: Categories of Social Security schemes in 1995

	Benefits as % of GDP	Number of Pensioners (1,000) [a,b]	Average Amount 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

Source: Bouillot and Perelman (1995)

Notes: a. number of pensioners also includes surviving spouses.
b. Possibility of double-counting.

Table 2.1a : Labor market and benefit program participation for men (%)

	50-54	55-59	60-64	65-69	Total
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
Not working	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

Note: Authors' calculations

Table 2.1b : Labor market and benefit program participation for women (%)

	50-54	55-59	60-64	65-69	Total
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
Not working	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

Note: Authors' calculations

Table 2.2a : Pathways to retirement for men (%)

	wage-earners	Public sector employees	self-employed
Directly to SS	34.85	100.00	90.02
Early retirement then SS	46.97	0.00	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

Note: Authors' calculations
Impossible to separate the paths for civil servants because of missing data.

Table 2.2b : Pathways to retirement for women (%)

	wage-earners	public sector employees	self-employed
Directly to SS	54.85	100.00	98.18
Early retirement then SS	20.02	0.00	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

Note: Authors' calculations
Impossible to separate the paths for civil servants because of missing data

Table 3: Summary Statistics

	Males		Females	
		Std		Std
Summary Statistics				
Observations Number	23261		9693	
Retired (%)	8.6		9.9	
Age Mean	54.9	3.7	54.2	3.5
Married (%)	80.6		65.9	
Inactive Spouse (%)	76.5		31.0	
Age Difference Mean	2.7	4.0	-1.9	-3.9
Earnings Mean	24004	19703	15251	11906
Spouse's Earnings Mean	6131	9969	19827	24040
Life Earnings (Wage-Earners)	33216	12560	18585	9210
	Number	Retiring within the next year (%)	Number	Retiring within the next year (%)
Age Structure				
50-54	11970	3.1	5663	5.4
55-59	8192	9.8	3138	9.0
60-65	3099	26.3	892	41.3
Social Security Program				
Wage-Earner	13181	9.6	5258	11.0
Self-Employed	3970	5.0	1066	7.6
Civil Servant	6110	8.6	3369	8.9
Region				
Brussels	1855	9.2	1330	8.7
Flanders	14730	8.6	5187	10.4
Wallonia	6676	8.4	3176	9.5

Note: Observations correspond to person-year cells.

Table 5.1a: Weight of the different pathways to retirement (by age) for wage-earners men

Age	Public retirement	Early retirement	Unemployment/disability
50	0.942	0.027	0.031
51	0.971	0.013	0.016
52	0.950	0.029	0.021
53	0.955	0.028	0.017
54	0.961	0.022	0.017
55	0.924	0.060	0.016
56	0.932	0.050	0.018
57	0.895	0.087	0.018
58	0.901	0.091	0.008
59	0.973	0.021	0.006
60	0.967	0.026	0.007
61	0.983	0.013	0.004
62	0.987	0.009	0.004
63	0.995	0.003	0.002
64	1.000	0.000	0.000
65	1.000	0.000	0.000

Table 5.1b: Weight of the different pathways to retirement (by age) for wage-earners women

Age	Public retirement	Early retirement	Unemployment/disability
50	0.892	0.028	0.080
51	0.966	0.007	0.027
52	0.943	0.029	0.028
53	0.949	0.031	0.020
54	0.954	0.015	0.031
55	0.950	0.025	0.025
56	0.949	0.018	0.033
57	0.953	0.038	0.009
58	0.970	0.020	0.010
59	0.998	0.000	0.002
60	1.000	0.000	0.000
61	1.000	0.000	0.000
62	1.000	0.000	0.000
63	1.000	0.000	0.000
64	1.000	0.000	0.000
65	1.000	0.000	0.000

Table 5.4a: Peak Values and Option Values for Men

Age		Peak Value				Option Value			
	Obs	10th %	Median	90th %	Std Dev	10th %	Median	90th %	Std Dev
50	2834	-100	11999	38457	16509	10313	15807	27418	10586
51	2592	-83	14598	39601	15785	9595	14849	25569	9606
52	2311	-129	11574	36296	15189	8351	12991	23510	9285
53	2156	-72	11163	31950	13882	7519	11596	21396	8703
54	2077	-68	10219	28479	12250	6369	9945	18680	8224
55	2048	-303	6551	22439	10670	5152	8236	16037	8670
56	1889	-319	5527	18559	9485	4022	6795	15191	8562
57	1700	-2676	2197	15494	9239	2890	5259	13097	8758
58	1408	-5248	1000	11468	8080	1778	3959	11310	7805
59	1147	-3261	2459	8368	6489	1065	2710	10342	7721
60	1026	-16693	-8271	-158	7580	-713	988	9254	8416
61	693	-16996	-7466	-73	7361	-801	1061	10197	9765
62	474	-17336	-7265	-195	7557	-732	1197	12759	8351
63	375	-17995	-7415	-259	7367	-831	1105	12927	7577
64	302	-17999	-7600	-374	7511	-909	613	8583	5961
65	229	-20431	-11791	-4046	7305	-1037	9	7336	5863

Table 5.4b: Peak Values and Option Values for Women

Age		Peak Value				Option Value			
	Obs	10th %	Median	90th %	Std Dev	10th %	Median	90th %	Std Dev
50	1475	-5279	15689	38996	17523	4117	11172	18021	6677
51	1262	266	19431	43056	16817	3933	10851	17580	6060
52	1121	-777	15186	35777	15621	2945	9437	16047	5557
53	936	-1046	13630	32618	15093	2343	8409	14435	5424
54	869	-854	11793	29060	14291	1930	7479	13164	5203
55	823	-4005	9039	25606	13465	1110	6448	11274	5452
56	741	-5530	7076	21550	12385	564	5373	9656	4971
57	618	-8051	3899	17418	12020	-79	4086	7961	4268
58	512	-8391	2325	13366	9530	-157	3107	5719	3399
59	444	-9421	165	7074	8283	-328	2002	4145	3540
60	390	-18233	-10795	-5147	6752	-1552	308	2220	2899
61	226	-17336	-9932	-4323	6043	-1473	548	1920	4928
62	97	-17430	-10223	-5183	6956	-1264	1150	2998	5426
63	78	-17753	-9522	-4642	5813	-1126	807	2851	2766
64	57	-14555	-8125	-4703	5383	-744	1365	4152	3824
65	44	-15120	-8909	-3434	4243	-728	1560	4167	5418

Figure 6.1 : The Retirement Hazard and Age Dummies for Males

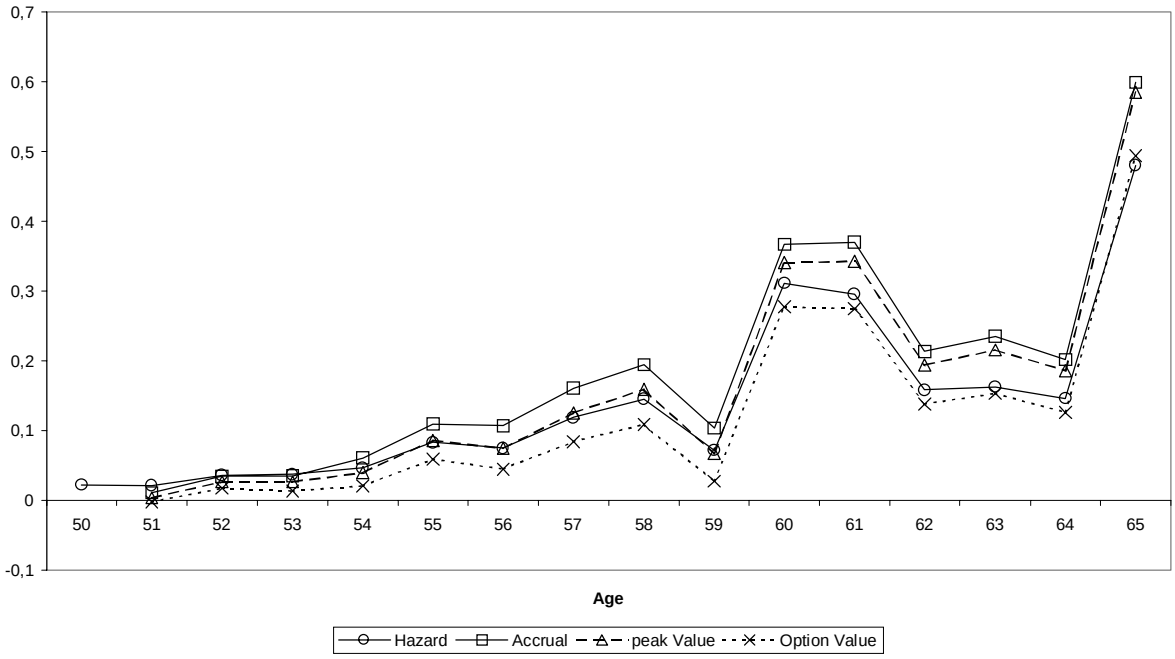

Figure 6.2 : The Retirement Hazard and Age Dummies for Females

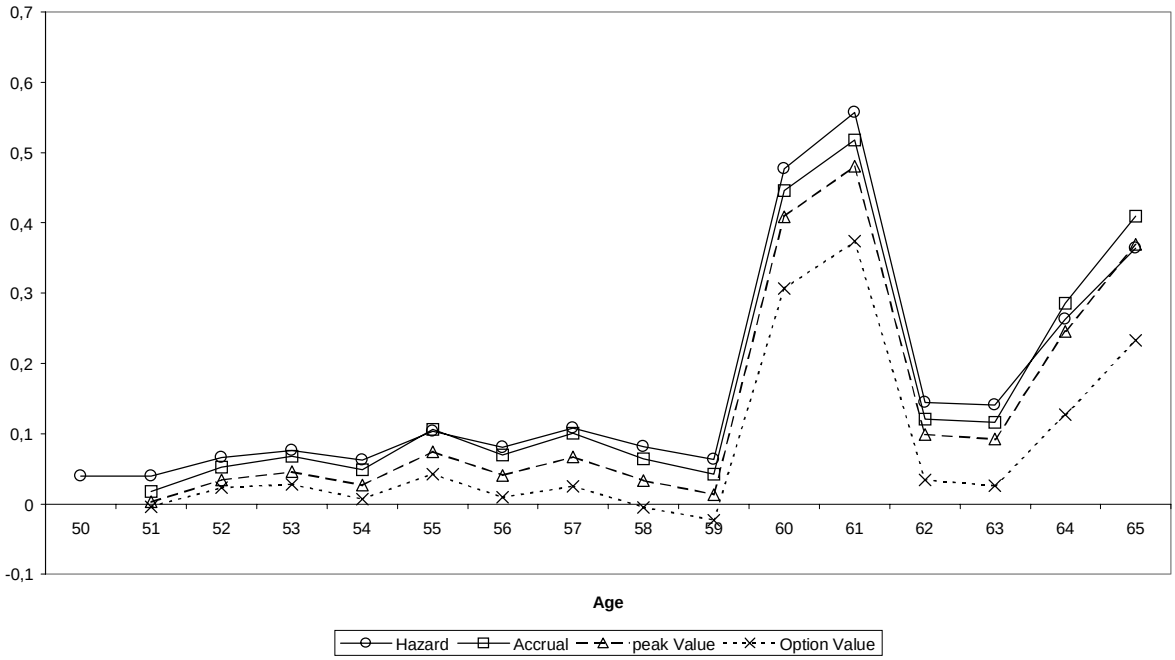

Table 6.1: Retirement Probits for Men

	Accrual				Peak Value				Option Value			
	Age		Age Dummies		Age		Age Dummies		Age		Age Dummies	
	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Intercept	-7.3943	0.2965	-2.3945	0.1682	-7.0319	0.3218	-2.2489	0.1693	-6.4041	0.4342	-2.0908	0.1764
Incentive Measures												
SSW (1000's)	0.0008	0.0003	0.0006	0.0003	0.0007	0.0003	0.0007	0.0003	0.0002	0.0003	0.0003	0.0003
Probability effect	*(0.0086)*		*(0.0065)*		*(0.0081)*		*(0.0078)*		*(0.0019)*		*(0.0029)*	
AC, PV, OV (1000's)	-0.0252	0.0020	-0.0201	0.0025	-0.0150	0.0015	-0.0105	0.0015	-0.0376	0.0053	-0.0316	0.0054
Probability effect	*(-0.2820)*		*(-0.2189)*		*(-0.1642)*		*(-0.1137)*		*(-0.3993)*		*(-0.3323)*	
Demographic Variables												
Age	0.1021	0.0045	.	.	0.0973	0.0049	.	.	0.0867	0.0070	.	.
Married	-0.0157	0.0498	0.0052	0.0505	-0.0104	0.0496	0.0023	0.0504	-0.0036	0.0496	0.0034	0.0505
Active Spouse	-0.0744	0.0384	-0.0796	0.0389	-0.0703	0.0388	-0.0783	0.0391	-0.1008	0.0383	-0.0987	0.0388
Age Difference	0.0007	0.0039	-0.0006	0.0039	0.0001	0.0038	-0.0014	0.0039	0.0034	0.0040	0.0022	0.0040
Dependent	-0.0907	0.0352	-0.0843	0.0355	-0.0793	0.0353	-0.0802	0.0355	-0.0684	0.0353	-0.0748	0.0355
Earnings Variables												
Life Cycle Earnings	0.0188	0.0067	0.0206	0.0068	0.0167	0.0067	0.0190	0.0068	0.0180	0.0067	0.0205	0.0068
Projected Earnings (1000's)	-0.0083	0.0012	-0.0084	0.0012	-0.0083	0.0012	-0.0085	0.0012	0.0015	0.0018	-0.0002	0.0019
Spouse Earnings (1000's)	0.0021	0.0023	0.0021	0.0024	0.0043	0.0024	0.0032	0.0024	0.0042	0.0024	0.0033	0.0024
Age and Schemes Dummies												
Age51	.	.	0.0942	0.0801	.	.	0.0310	0.0795	.	.	-0.0201	0.0797
Age52	.	.	0.2682	0.0752	.	.	0.2125	0.0751	.	.	0.1495	0.0761
Age53	.	.	0.2707	0.0762	.	.	0.2106	0.0759	.	.	0.1184	0.0777
Age54	.	.	0.4239	0.0758	.	.	0.3001	0.0745	.	.	0.1741	0.0779
Age55	.	.	0.6622	0.0704	.	.	0.5573	0.0701	.	.	0.4237	0.0760
Age56	.	.	0.6493	0.0735	.	.	0.4986	0.0726	.	.	0.3373	0.0807
Age57	.	.	0.8607	0.0715	.	.	0.7255	0.0718	.	.	0.5531	0.0830
Age58	.	.	0.9712	0.0729	.	.	0.8497	0.0740	.	.	0.6610	0.0878
Age59	.	.	0.6235	0.0839	.	.	0.4520	0.0843	.	.	0.2219	0.1001
Age60	.	.	1.4593	0.0762	.	.	1.3921	0.0797	.	.	1.2283	0.0976
Age61	.	.	1.4515	0.0823	.	.	1.3808	0.0857	.	.	1.2077	0.1035
Age62	.	.	1.0042	0.0973	.	.	0.9452	0.1000	.	.	0.7620	0.1172
Age63	.	.	1.0666	0.1036	.	.	1.0098	0.1062	.	.	0.8162	0.1237
Age64	.	.	0.9635	0.1136	.	.	0.9143	0.1158	.	.	0.7128	0.1330
Age65	.	.	2.0195	0.1098	.	.	1.9839	0.1123	.	.	1.7605	0.1338
Civil Servant	0.2663	0.1252	0.2864	0.1273	0.2454	0.1249	0.2659	0.1271	0.2857	0.1256	0.3074	0.1282
Self-Employed	-0.1562	0.1226	-0.1381	0.1247	-0.2291	0.1221	-0.1970	0.1244	-0.0975	0.1238	-0.0862	0.1265
Pseudo R^2		0.1580		0.1762		0.1548		0.1750		0.1507		0.1739

Table 6.2: Retirement Probits for Women

	Accrual				Peak Value				Option Value			
	Age		Age Dummies		Age		Age Dummies		Age		Age Dummies	
	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.	Coef.	Std.Err.
Intercept	-6.1769	0.4167	-1.9437	0.2504	-5.7999	0.4433	-1.7934	0.2508	-4.4564	0.5819	-1.5188	0.2569
Incentive Measures												
SSW (1000's)	0.0003	0.0003	0.0006	0.0004	0.0002	0.0003	0.0006	0.0004	-0.0004	0.0004	-0.0001	0.0004
Probability effect	*(0.0042)*		*(0.0081)*		*(0.0033)*		*(0.0076)*		*(0.0060)*		*(0.0014)*	
AC, PV, OV (1000's)	-0.0323	0.0029	-0.0192	0.0035	-0.0161	0.0018	-0.0103	0.0018	-0.0633	0.0085	-0.0539	0.0087
Probability effect	*(-0.4436)*		*(-0.2593)*		*(-0.2183)*		*(-0.1387)*		*(-0.8481)*		*(-0.7119)*	
Demographic Variables												
Age	0.0860	0.0062	.	.	0.0803	0.0067	.	.	0.0585	0.0093	.	.
Married	0.1867	0.0703	0.1840	0.0720	0.2479	0.0699	0.2210	0.0720	0.2486	0.0705	0.2259	0.0727
Active Spouse	-0.0105	0.0551	-0.0578	0.0567	-0.0476	0.0544	-0.0794	0.0561	-0.0912	0.0541	-0.1095	0.0559
Age Difference	0.0163	0.0063	0.0103	0.0064	0.0245	0.0065	0.0163	0.0067	0.0301	0.0070	0.0248	0.0072
Dependent	-0.1948	0.0580	-0.1985	0.0585	-0.1694	0.0581	-0.1898	0.0586	-0.1547	0.0581	-0.1793	0.0587
Earnings Variables												
Life Cycle Earnings	0.0142	0.0107	0.0096	0.0108	0.0138	0.0108	0.0101	0.0109	0.0105	0.0108	0.0088	0.0109
Projected Earnings (1000's)	-0.0098	0.0027	-0.0093	0.0027	-0.0094	0.0027	-0.0092	0.0027	0.0086	0.0038	0.0072	0.0039
Spouse Earnings (1000's)	-0.0022	0.0020	-0.0019	0.0021	-0.0017	0.0019	-0.0016	0.0020	-0.0009	0.0020	-0.0009	0.0020
Age and Schemes Dummies												
Age51	.	.	0.1209	0.0940	.	.	0.0196	0.0911	.	.	-0.0294	0.0915
Age52	.	.	0.3225	0.0880	.	.	0.2245	0.0862	.	.	0.1601	0.0871
Age53	.	.	0.3977	0.0903	.	.	0.2874	0.0886	.	.	0.1889	0.0905
Age54	.	.	0.3006	0.0955	.	.	0.1779	0.0937	.	.	0.0520	0.0965
Age55	.	.	0.5648	0.0894	.	.	0.4311	0.0882	.	.	0.2741	0.0937
Age56	.	.	0.4032	0.0951	.	.	0.2593	0.0946	.	.	0.0667	0.1026
Age57	.	.	0.5367	0.0957	.	.	0.3910	0.0965	.	.	0.1723	0.1075
Age58	.	.	0.3753	0.1065	.	.	0.2157	0.1075	.	.	-0.0362	0.1206
Age59	.	.	0.2642	0.1172	.	.	0.0936	0.1180	.	.	-0.1995	0.1340
Age60	.	.	1.5553	0.0975	.	.	1.4633	0.1021	.	.	1.1993	0.1231
Age61	.	.	1.7226	0.1135	.	.	1.6281	0.1173	.	.	1.3626	0.1351
Age62	.	.	0.6024	0.1810	.	.	0.5193	0.1823	.	.	0.2211	0.1957
Age63	.	.	0.5853	0.1970	.	.	0.4917	0.1987	.	.	0.1717	0.2133
Age64	.	.	1.1063	0.1982	.	.	1.0004	0.2003	.	.	0.6317	0.2175
Age65	.	.	1.4254	0.2093	.	.	1.3261	0.2114	.	.	0.9679	0.2269
Civil Servant	0.0849	0.1232	0.0265	0.1248	0.1198	0.1239	0.0631	0.1260	0.0566	0.1233	0.0367	0.1258
Self-Employed	-0.2717	0.1307	-0.3052	0.1328	-0.3007	0.1307	-0.3200	0.1333	-0.2723	0.1303	-0.2887	0.1334
Pseudo R^2		0.1426		0.1817		0.1364		0.1824		0.1313		0.1832

Table 7: Average Retirement Age

Model	Simulation	Simulated Reform	
		Policy 1	Policy 2
Men			
Baseline		58.38	58.38
Accrual (AC)	S1	59.43	58.68
	S2	59.36	58.64
	S3	61.10	58.86
Peak value (PV)	S1	59.52	58.82
	S2	59.43	58.85
	S3	61.07	59.13
Option value (OV)	S1	60.02	58.98
	S2	59.88	59.01
	S3	61.26	59.32
Women			
Baseline		57.40	57.40
Option value (OV)	S1	58.33	57.79
	S2	58.29	57.81
	S3	59.13	57.91

Figure 7.1a: Hazard Rates for Men - Accrual Model (AC) - Simulation S1

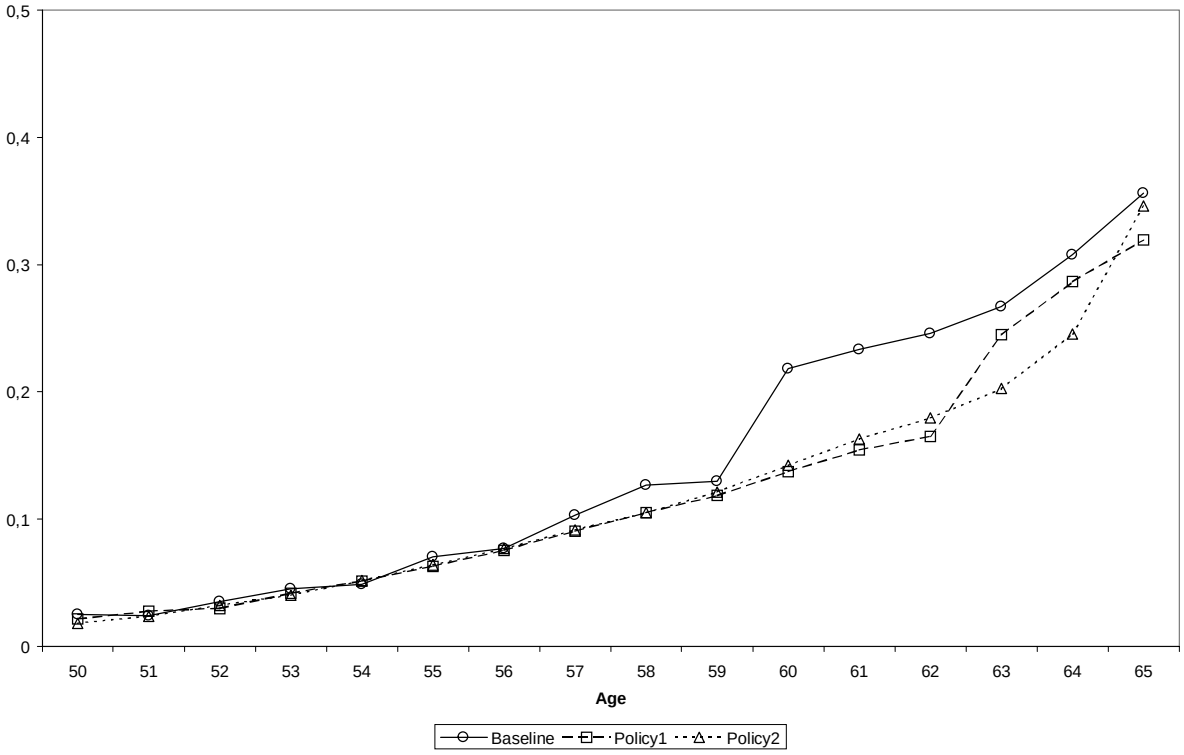

Figure 7.1b: CDF for Men - Accrual Model (AC) - Simulation S1

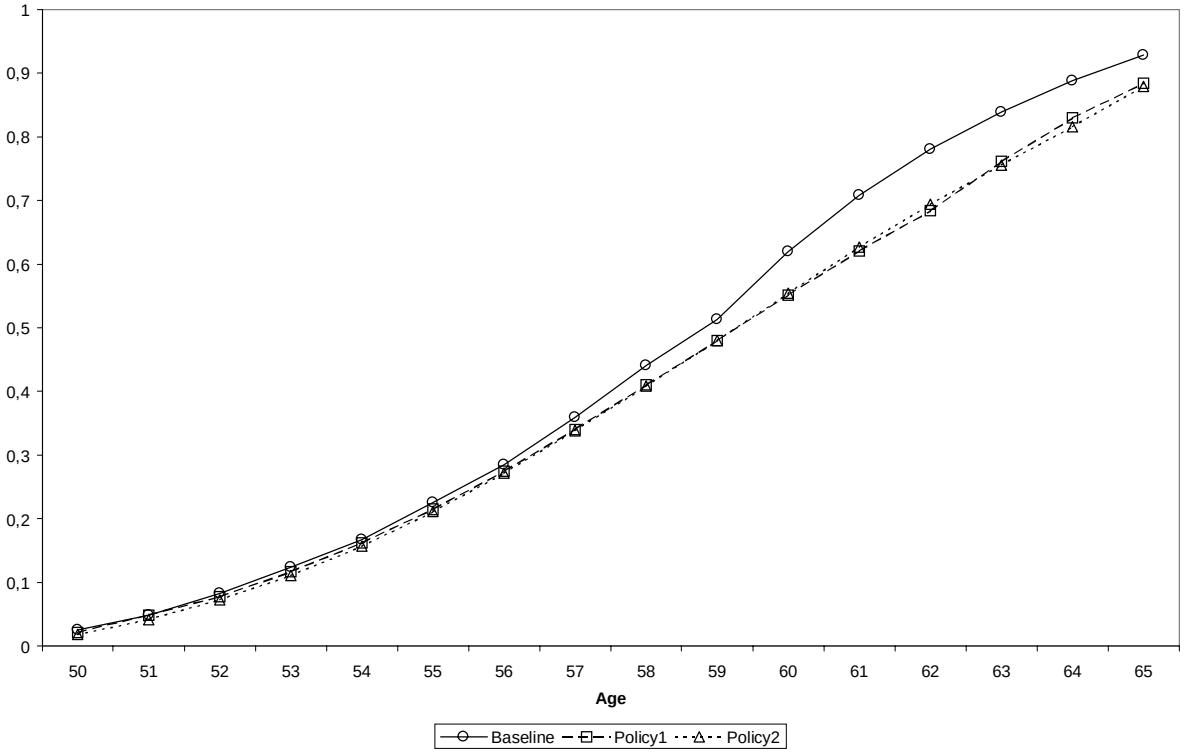

Figure 7.2a: Hazard Rates for Men - Accrual Model (AC) - Simulation S2

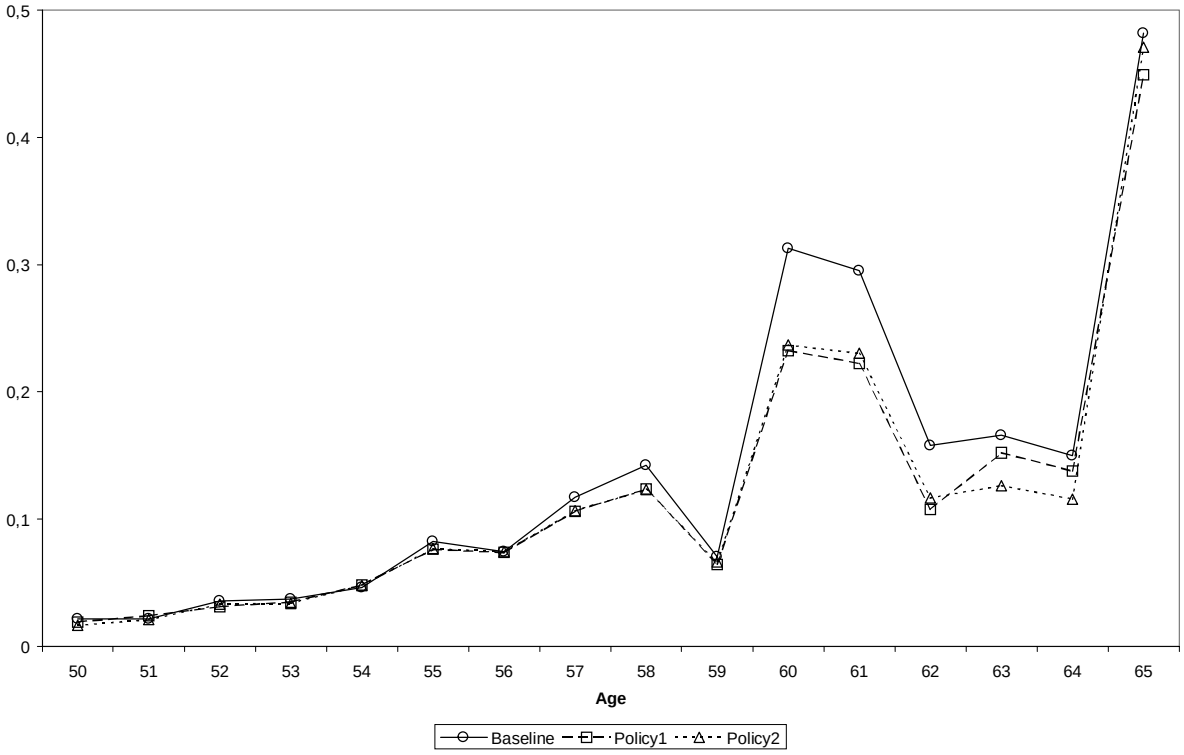

Figure 7.2b: CDF for Men - Accrual Model (AC) - Simulation S2

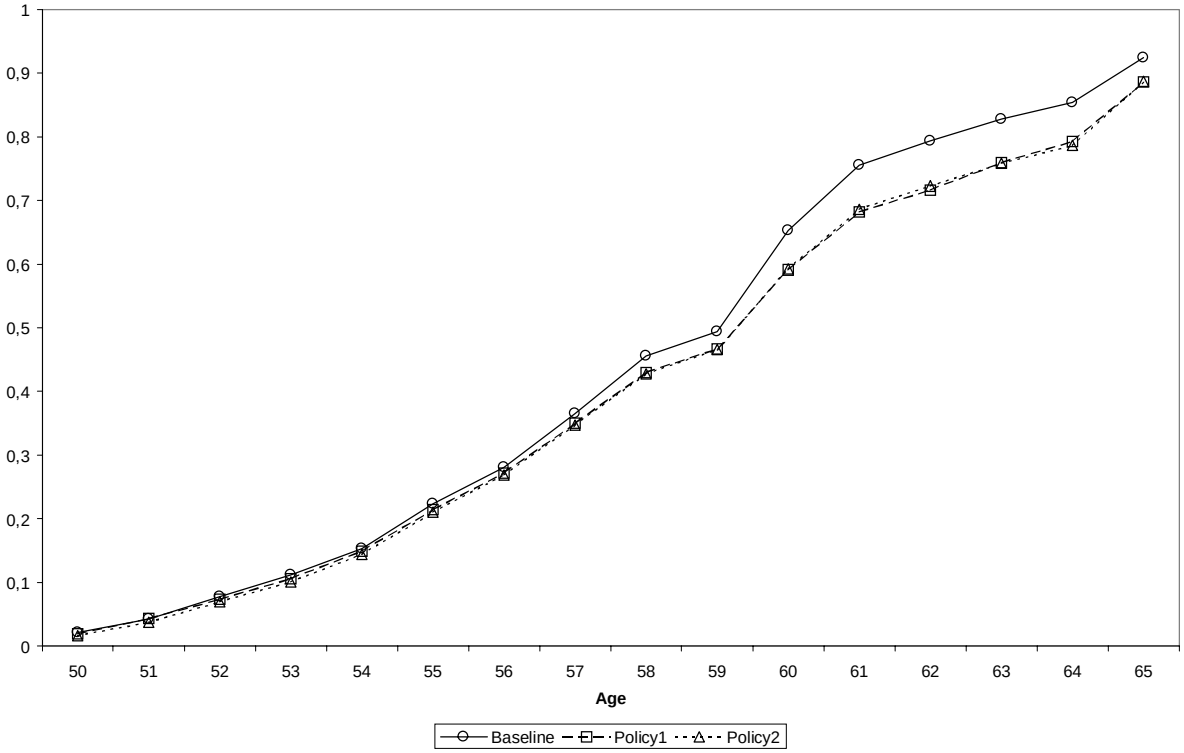

Figure 7.3a: Hazard Rates for Men - Accrual Model (AC) - Simulation S3

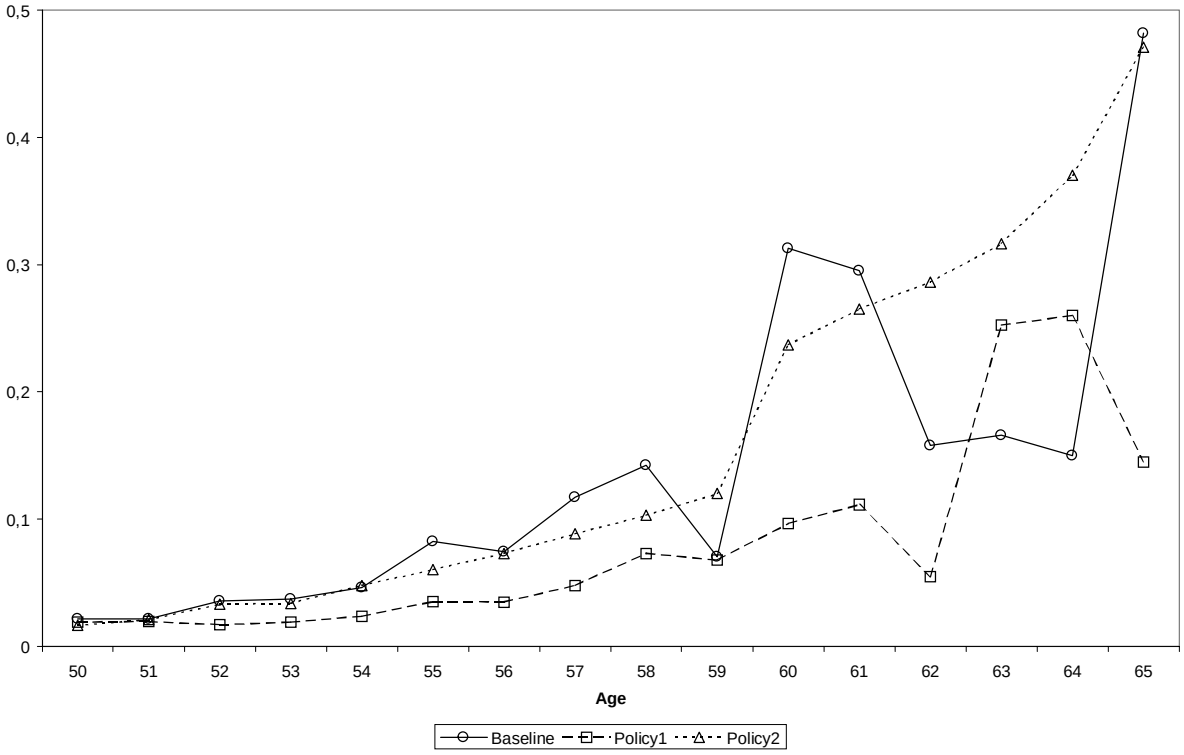

Figure 7.3b: CDF for Men - Accrual Model (AC) - Simulation S3

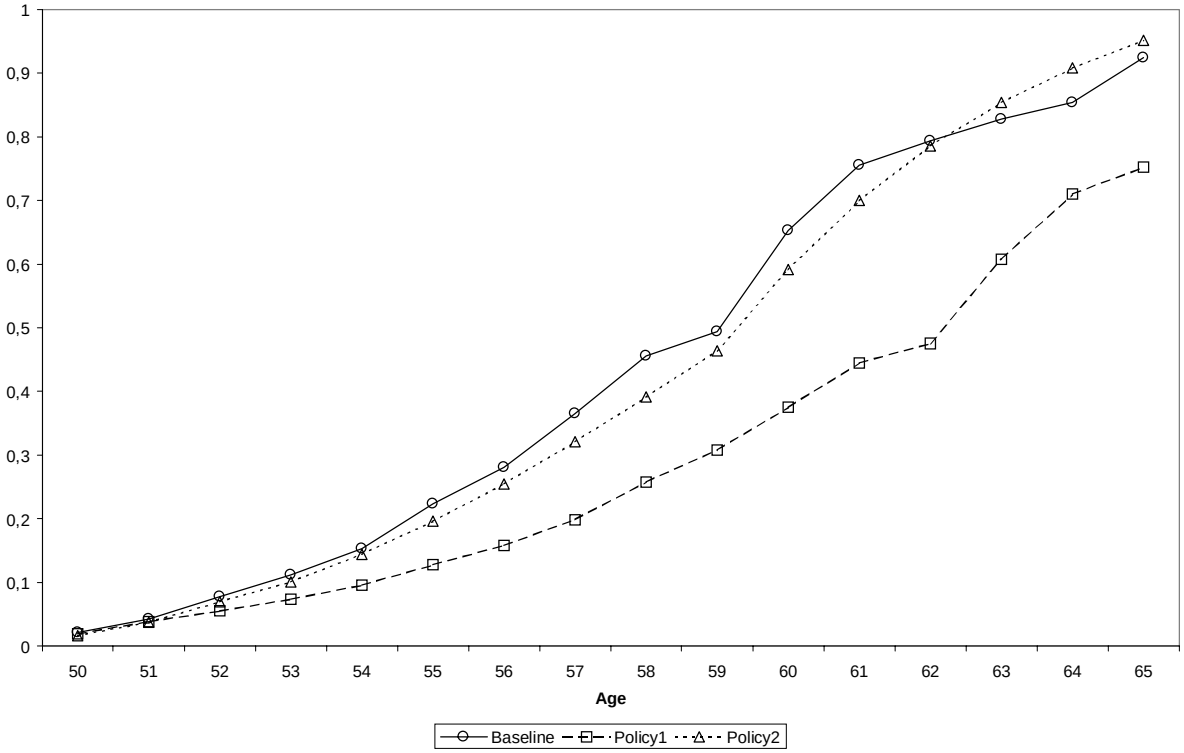

Figure 7.4a: Hazard Rates for Men - Peak Value Model (PV) - Simulation S1

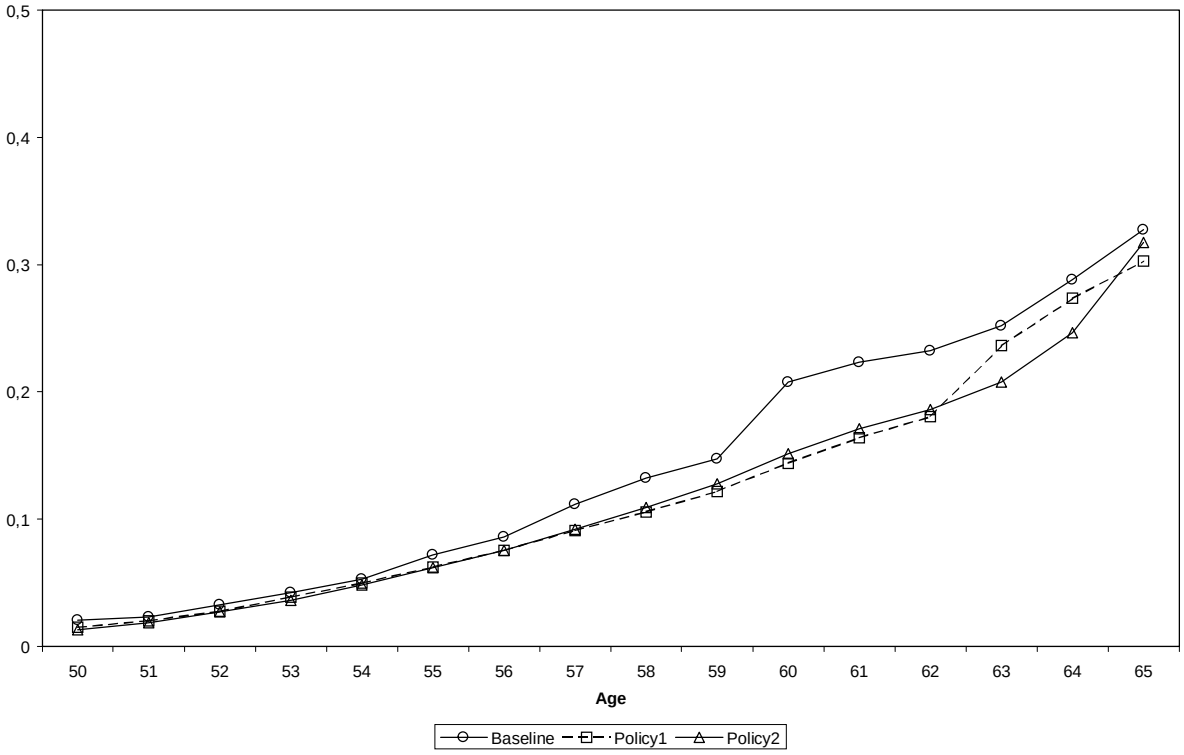

Figure 7.4b: CDF for Men - Peak Value model (PV) - Simulation S1

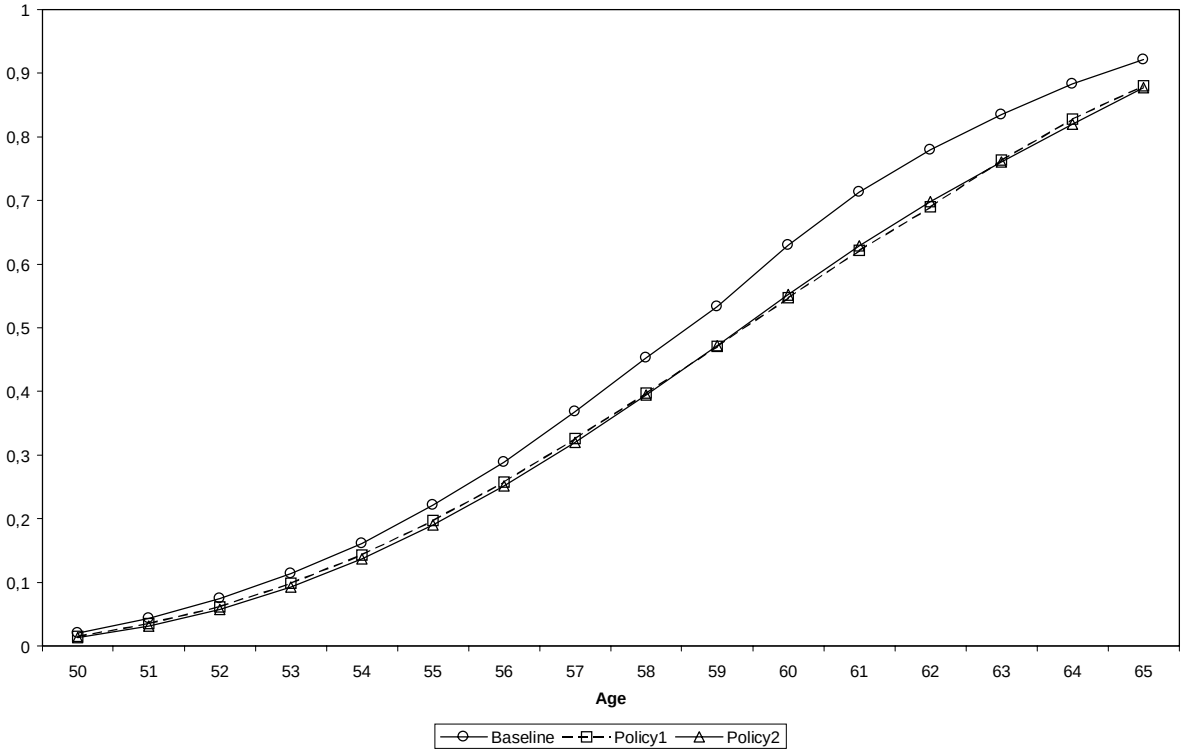

Figure 7.5a: Hazard Rates for Men - Peak Value Model (PV) - Simulation S2

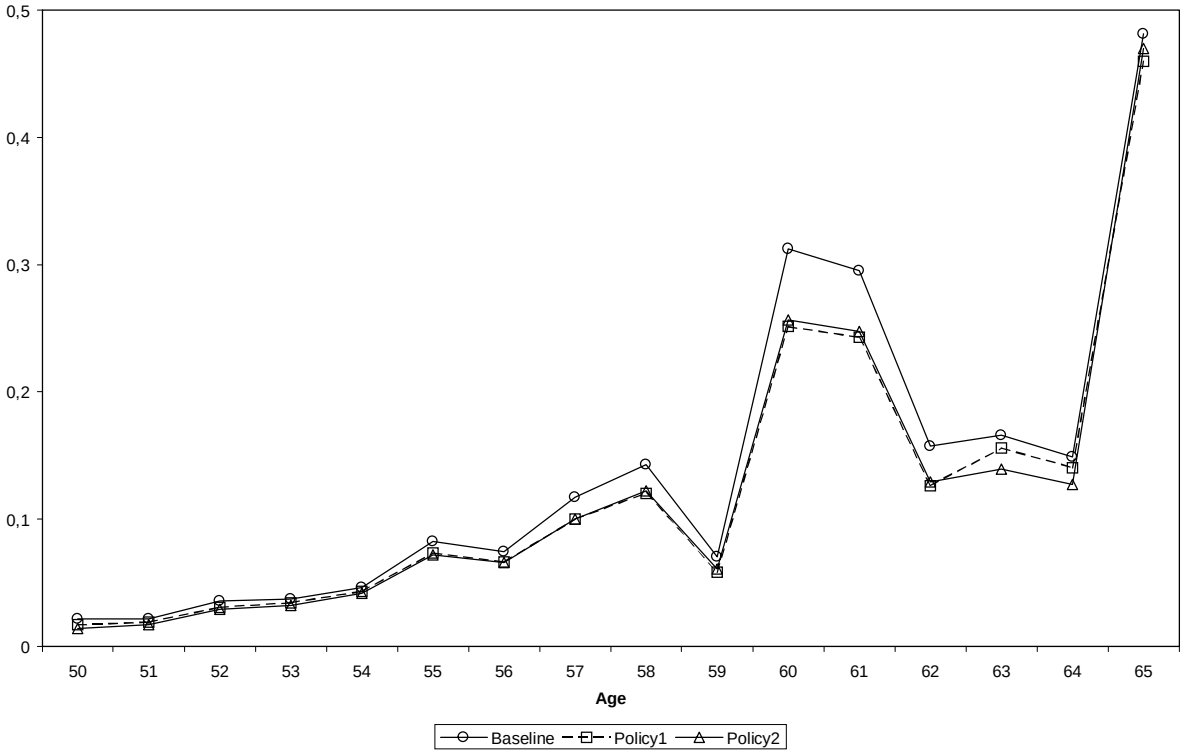

Figure 7.5b: CDF for Men - Peak Value Model (PV) - Simulation S2

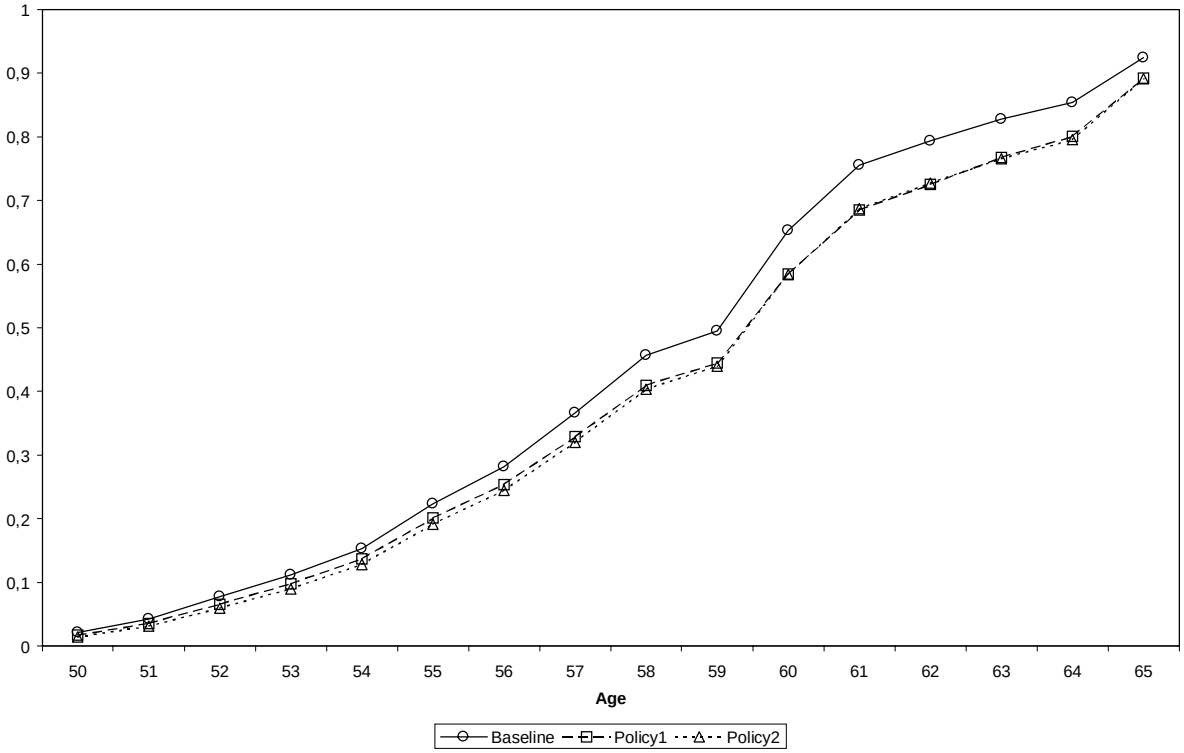

Figure 7.6a: Hazard Rates for Men - Peak Value Model (PV) - Simulation S3

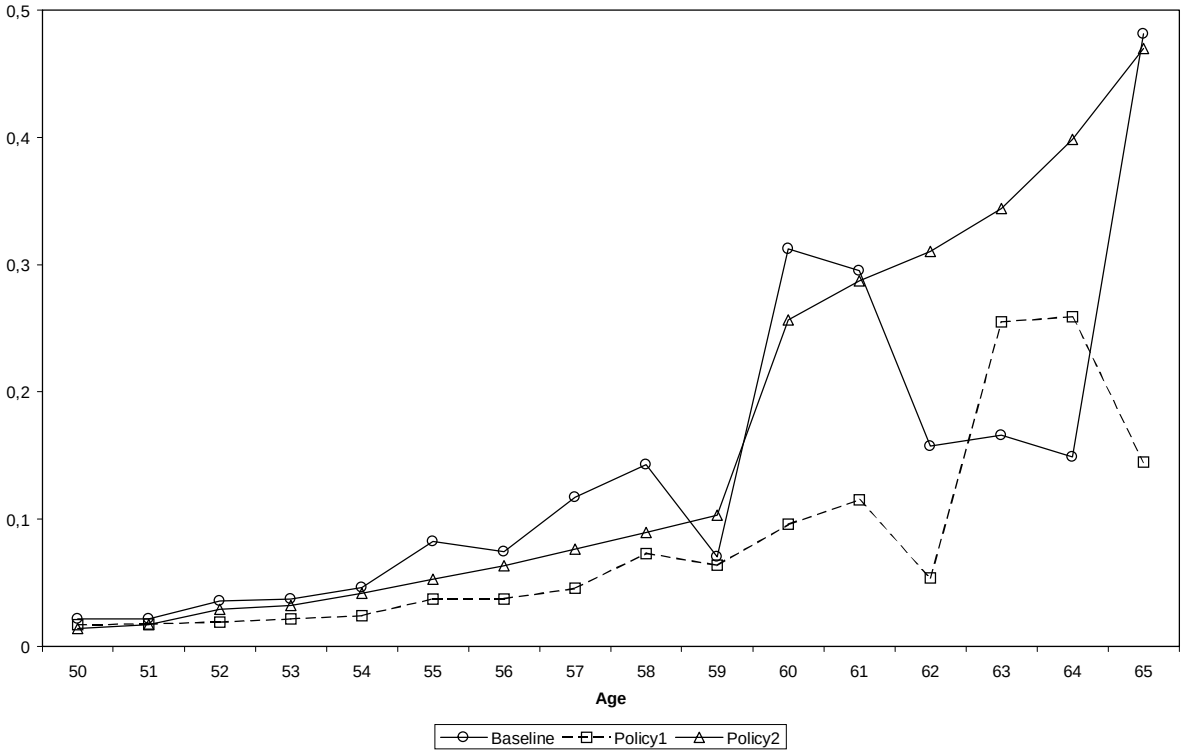

Figure 7.6b: CDF for Men - Peak Value Model - Simulation S3

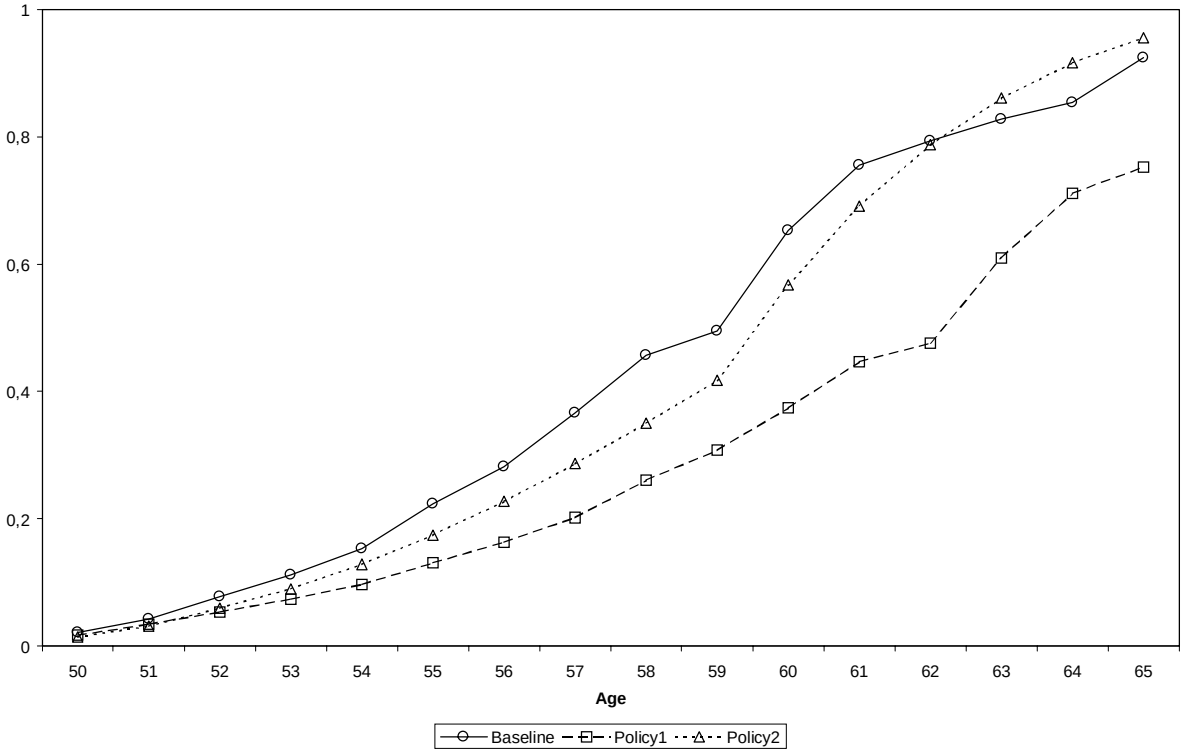

Figure 7.7a: Hazard Rates for Men - Option Value Model (OV) - Simulation S1

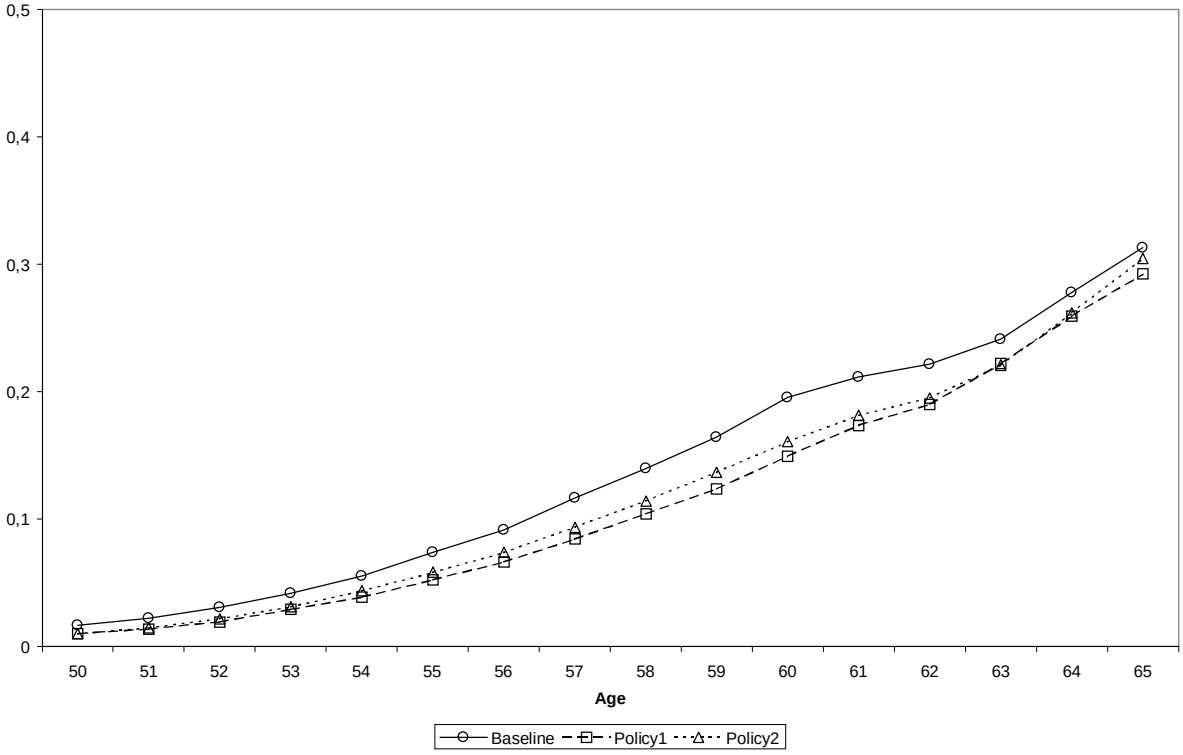

Figure 7.7b: CDF for Men - Option Value Model (OV) - Simulation S1

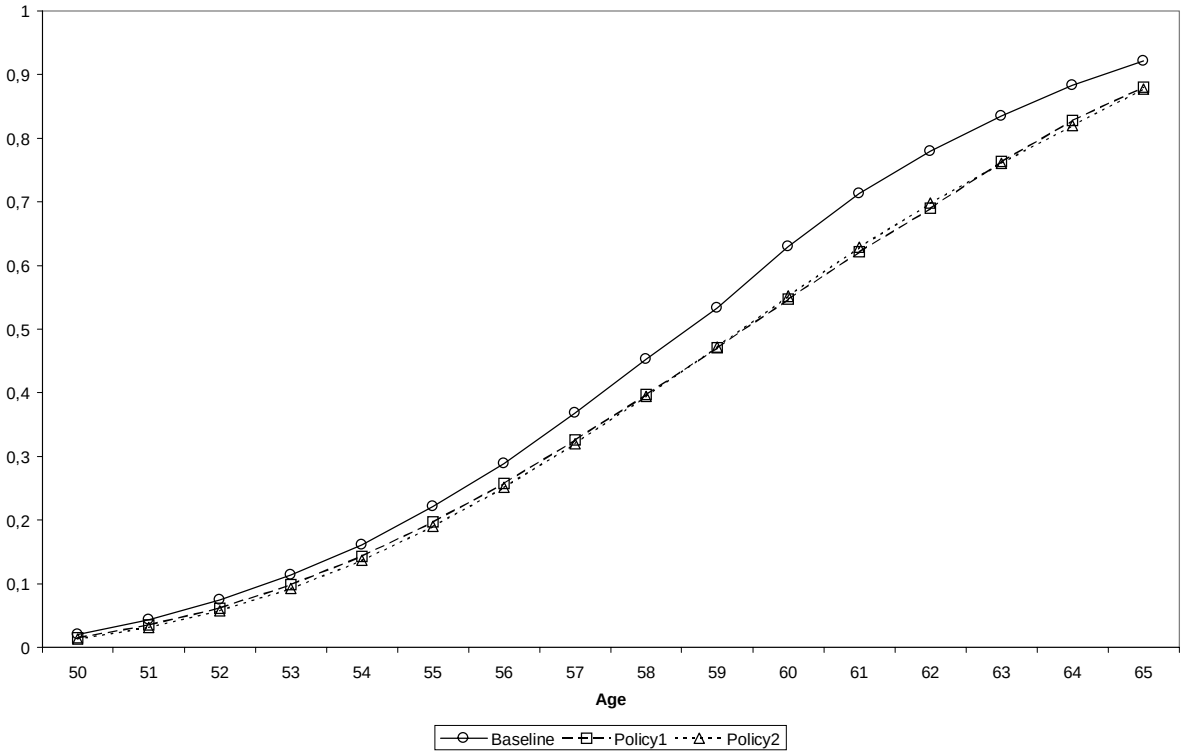

Figure 7.8a: Hazard Rates for Men - Option Value Model (OV) - Simulation S2

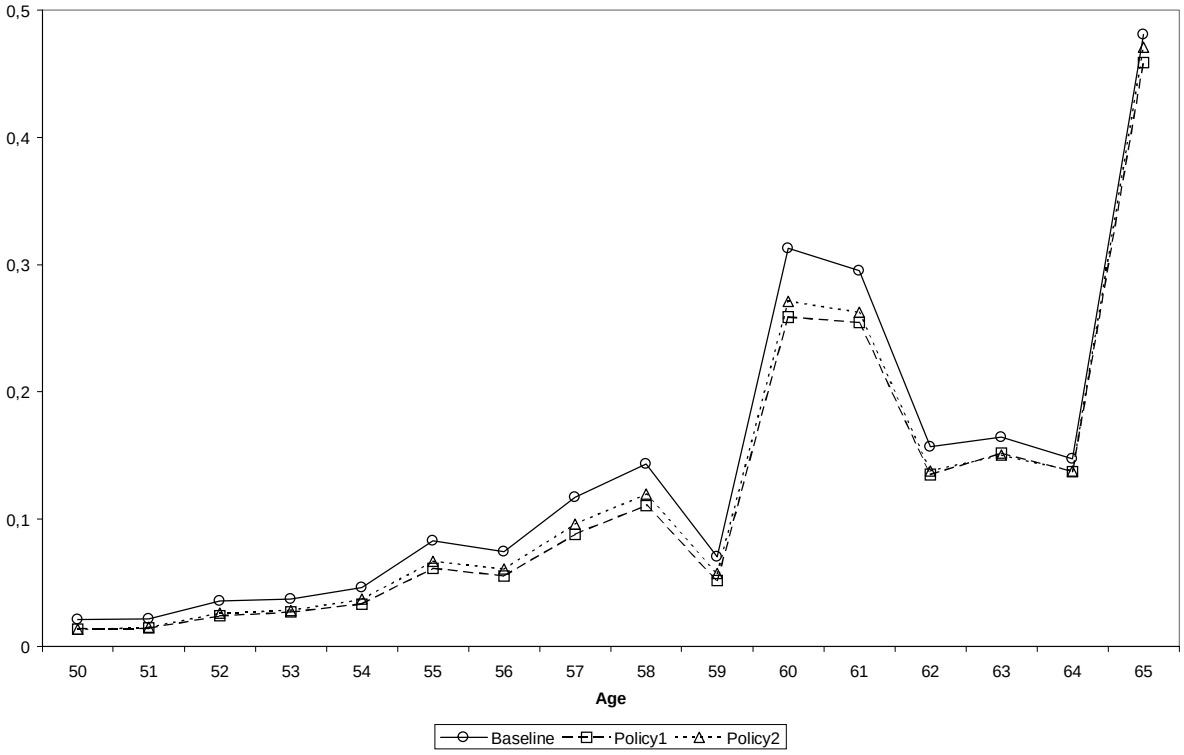

Figure 7.8b: CDF for Men - Option Value Model (OV) - Simulation S2

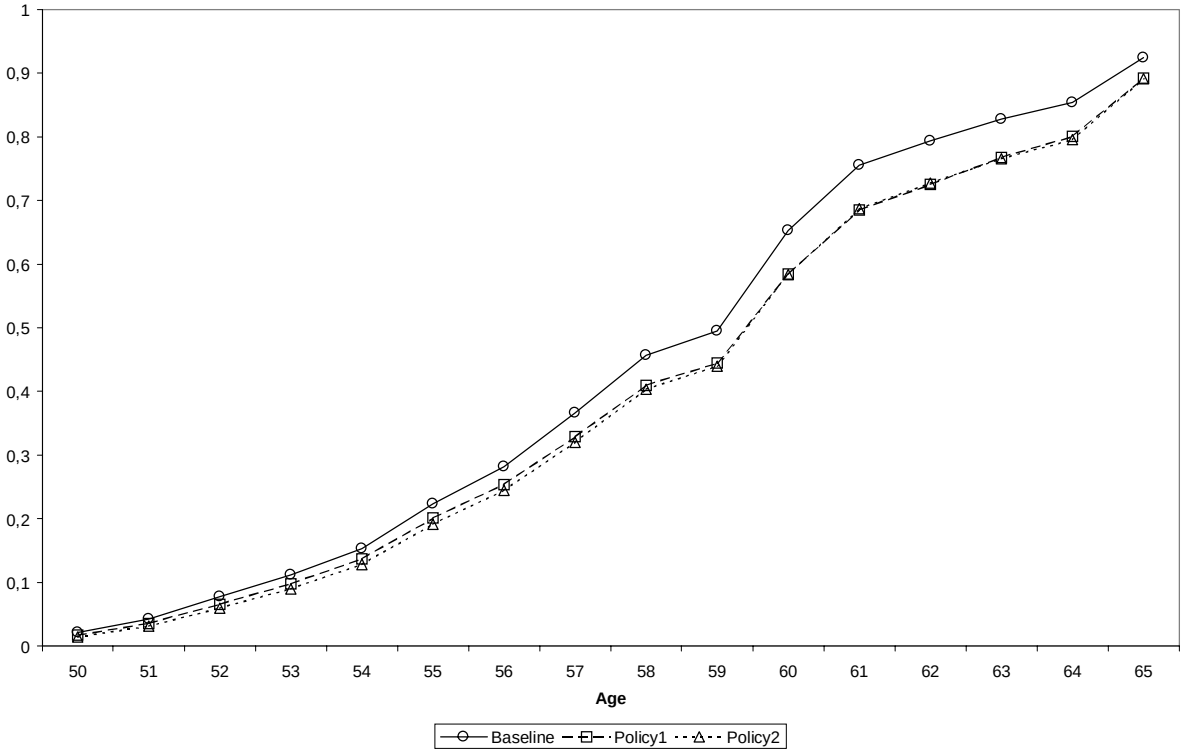

Figure 7.9a: Hazard Rates for Men - Option Value Model (OV) - Simulation S3

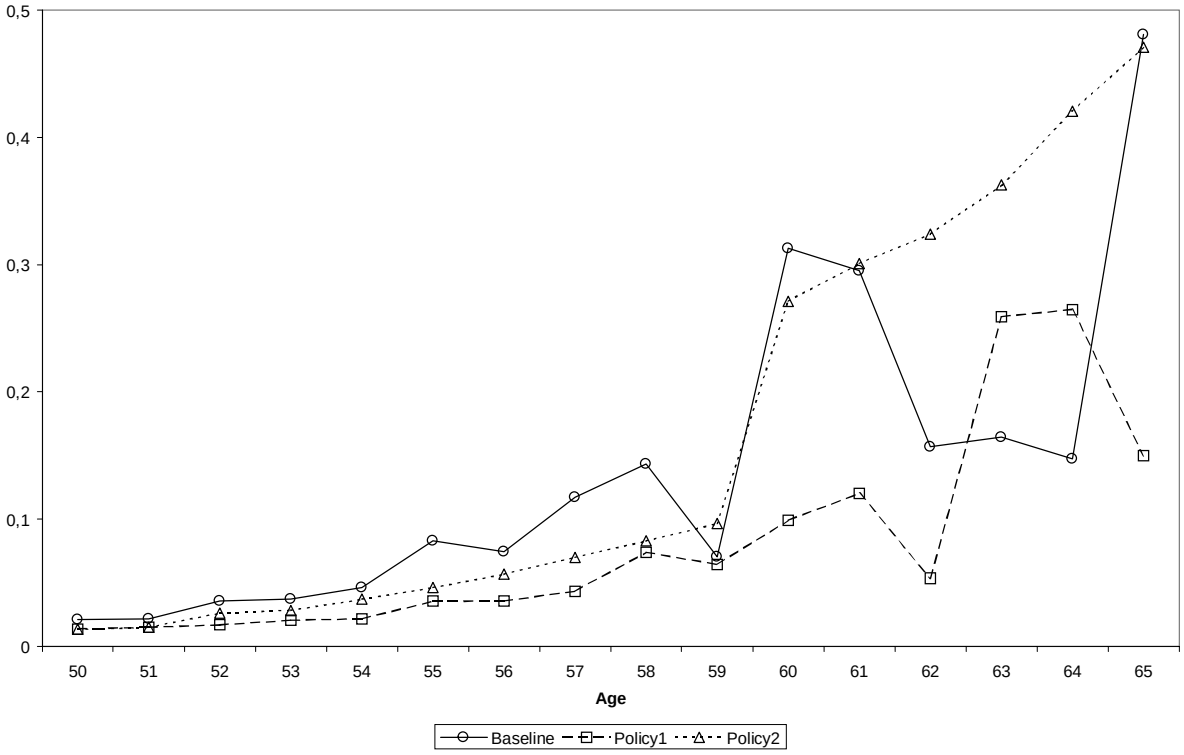

Figure 7.9b: CDF for Men - Option Value Model (OV) - Simulation S3

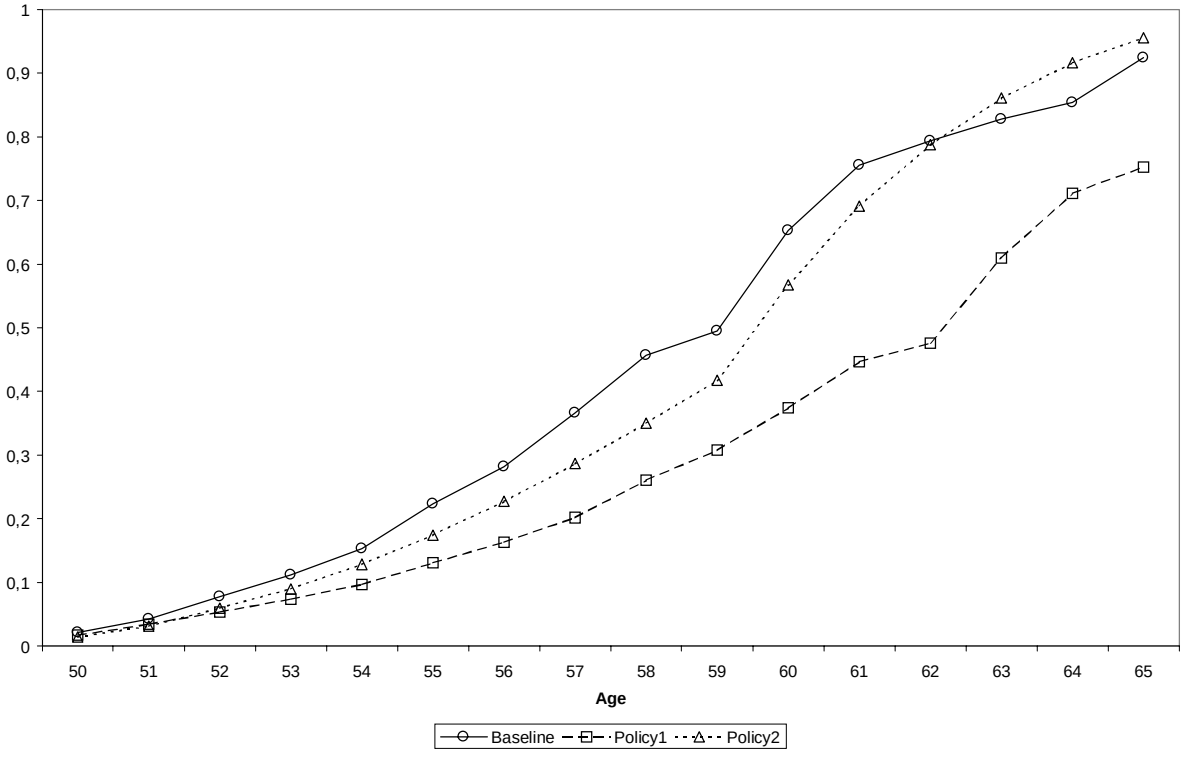

Figure 7.10a: Hazard Rates for Women - Option Value Model (OV) - Simulation S1

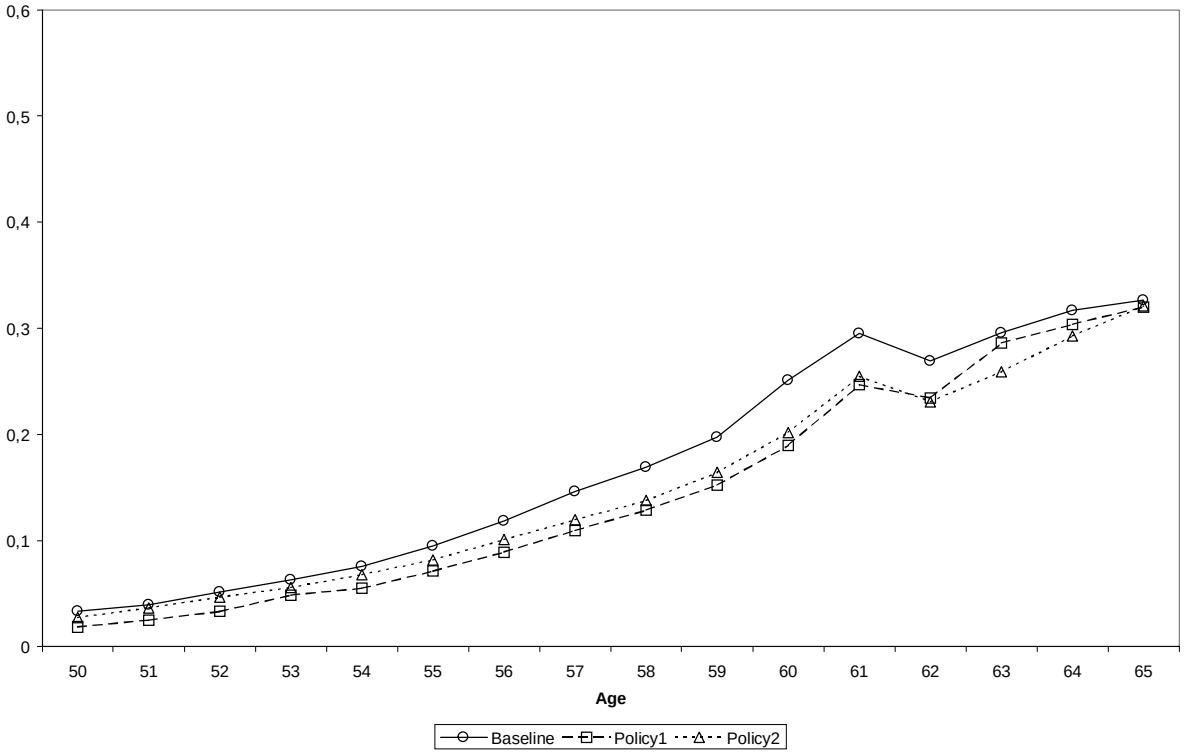

Figure 7.10b: CDF for Women - Option Value Model (OV) - Simulation S1

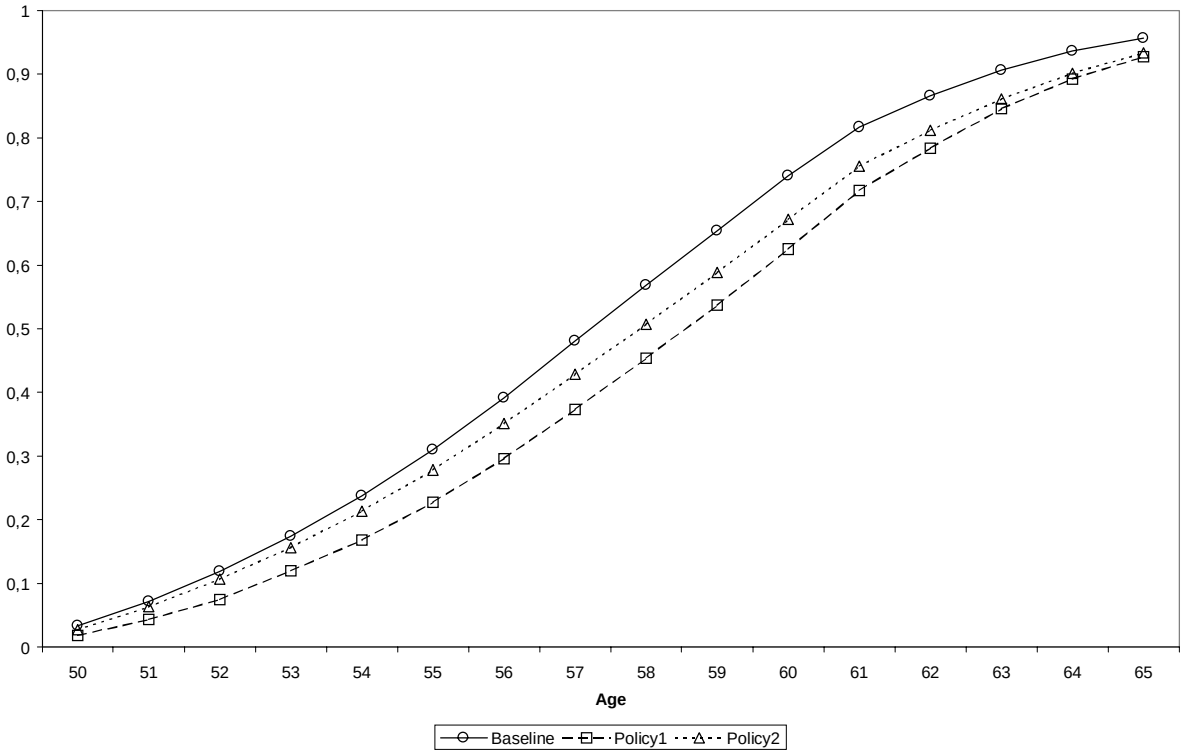

Figure 7.11a: Hazard Rates for Women - Option Value Model (OV) - Simulation S2

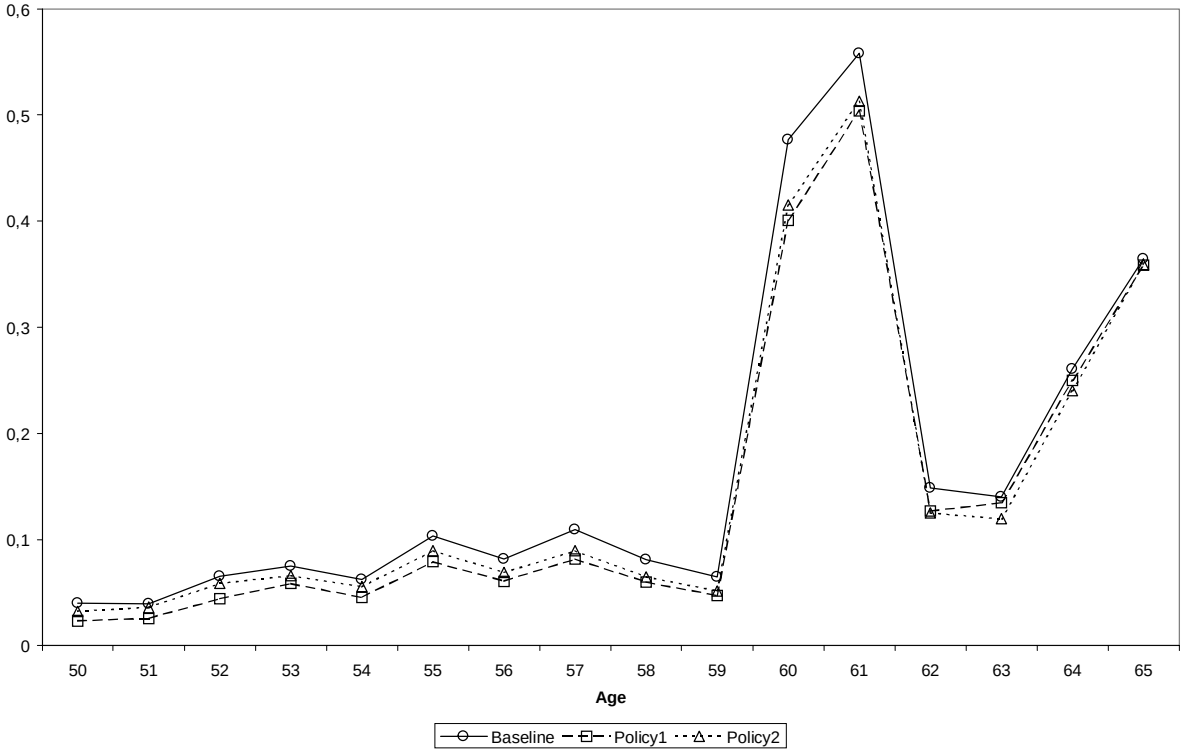

Figure7.11b: CDF for Women - Option Value Model (OV) - Simulation S2

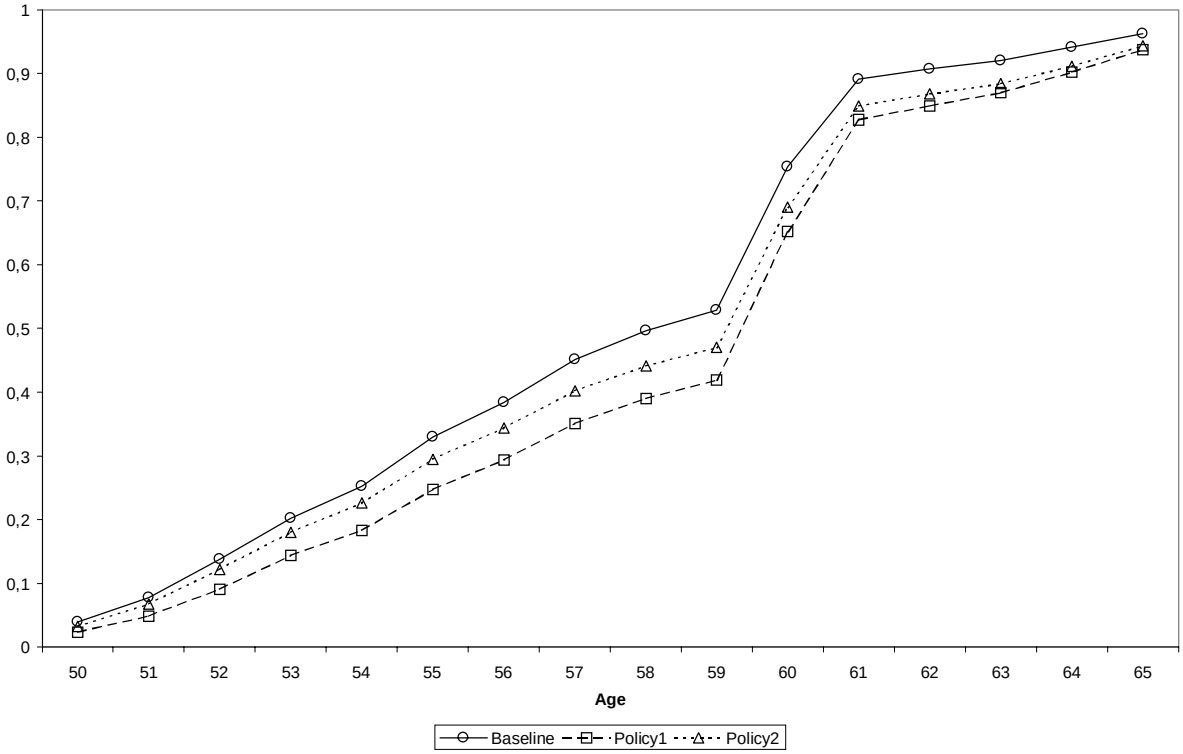

Figure7.12a: Hazard Rates for Women - Option Value Model (OV) - Simulation S3

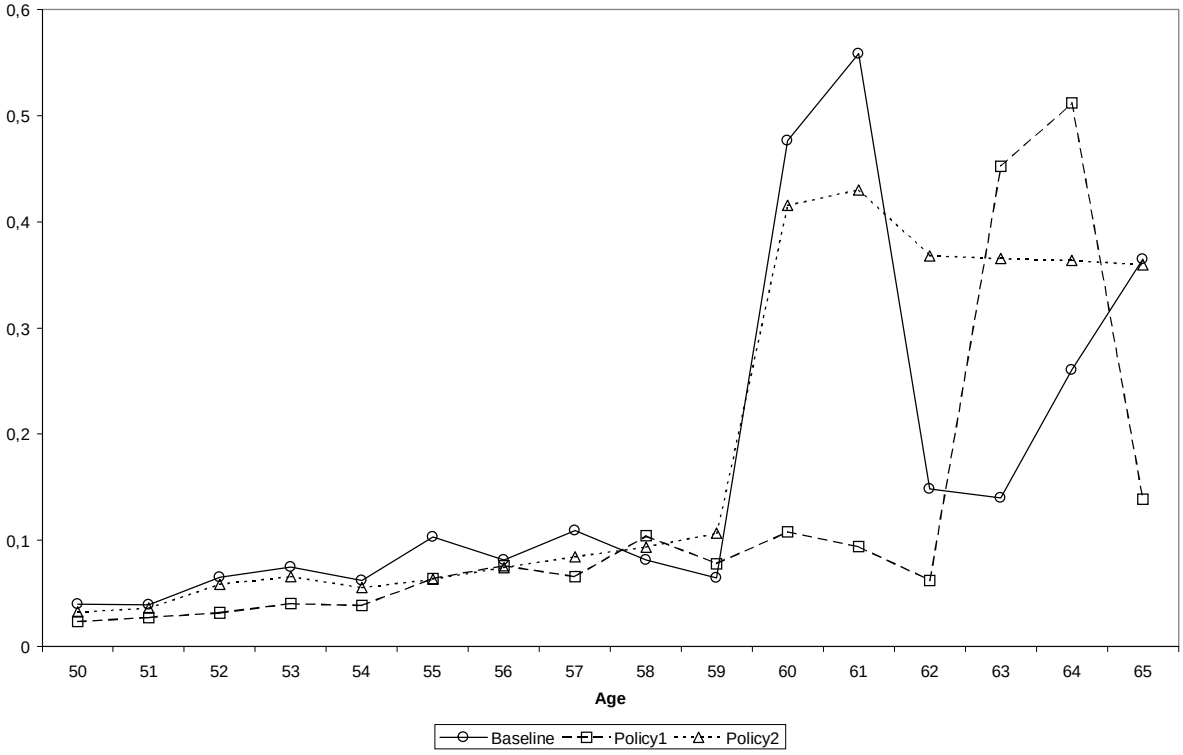

Figure 7.12b: CDF for Women - Option Value Model (OV) - Simulation S3