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Incentives and Exit Routes to Retirement in the Netherlands

Klaas de Vos and Arie Kapteyn

8.1 Introduction

The programs providing income to the elderly in the Netherlands may be characterized by a limited number of salient features. First, there is a distinct cutoff at age sixty-five. Broadly speaking, all individuals aged sixty-five or over are entitled to the same basic state pension (social security; we will abbreviate social security to SS throughout). Most other benefits (e.g., disability [DI], unemployment [UI], and welfare) expire when someone turns sixty-five. Second, for people both above and below sixty-five, in addition to the public entitlement programs guaranteed by law, relatively many people who stop working are entitled to other, private benefits (e.g., occupational pensions supplementing SS for individuals over sixty-five and early retirement [ER] benefits for individuals below sixty-five).

Like most other developed countries, the Netherlands is faced with an increasing share of elderly in the total population. The share of the population over sixty-five has grown from 8 percent in 1950 to 14 percent in 2000 and is expected to rise to 24 percent by the year 2035. If nothing else changes, this will cause a considerable increase in SS expenditures. Faced with this prospect, the government has recently come up with policy measures to maintain its sustainability. Still, because of the relatively large role of fully funded occupational pensions supplementing SS, the problems facing the future of the SS system in the Netherlands are less severe than in countries like Germany, France, and Italy.

A greater and more immediate concern is the low labor force participation rate of individuals aged below sixty-five and the costs of the programs

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providing income to the individuals in this age group who have left the labor force. This concerns public programs, such as DI, but also private ER schemes. During the 1980s and 1990s, these programs have been used explicitly or implicitly to enable almost all employees to retire before reaching the age of sixty-five. The ER programs were originally devised to help combat high unemployment by creating job opportunities for younger individuals. Public DI and UI programs have also been used to enable employers to shed older, less-productive workers. Since the financial conditions for retirement through all of these routes were quite attractive, most of the individuals eligible chose to retire before the normal retirement age of sixty-five.

All of this has led to highly increased costs, both for the public DI and UI programs as well as for the employer-financed ER schemes. In reaction, eligibility conditions for DI and UI benefits have been tightened, and, increasingly, ER schemes are replaced by flexible retirement programs offering less attractive and more actuarially fair pensions. In addition, the earlier pressure on elderly employees to vacate one's job for a younger jobseeker has decreased dramatically with the spectacular reduction in unemployment. It remains to be seen to what extent all these phenomena will actually contribute to a reversal of the trend of decreasing labor market participation of the elderly.

In this paper, using micro-data from the years 1984 to 1995, we try to assess to what extent financial incentives can be seen to determine the retirement decision. In doing so, we can also simulate the effects of possible reforms on participation rates. The remainder of the paper is structured as follows. In section 8.2, we sketch the institutional framework within which people retire in the Netherlands. Sections 8.3 and 8.4 describe the data and the way in which we use them for our analysis. Section 8.5 provides a brief summary of research on retirement in the Netherlands. Section 8.6 is devoted to the construction of incentive measures that are used in the estimation of the retirement equations. These equations are specified according to a common model that is, by and large, used for all countries represented in this study. Section 8.7 presents the estimation results for the common model, and section 8.8 gives results of some policy simulations based on the estimated common model. We find strong and statistically significant incentive effects for males. For females, the estimated effects are smaller and much less significant. Section 8.9 concludes.

8.2 Institutional Background

Social security guarantees a sufficient income to virtually all individuals of sixty-five or over. Basically, SS is a flat-rate benefit equal to half the statutory minimum wage (after tax) with supplements for single individuals and for individuals with a spouse aged younger than sixty-five with a

low income. Social security is financed largely as a pay-as-you-go scheme administered through a payroll tax on taxable income of individuals aged below sixty-five. The 2000 associated tax rate was 17.9 percent levied on taxable income up to a maximum (of Dutch Fl 48,994 per annum). In 1999, SS benefits amounted to almost Fl 41 billion, or 5 percent of gross domestic product (GDP). Currently, about one in every five households in the Netherlands receives SS. The entitlement to SS does not require retirement from the labor force.

8.2.1 Other Public Programs

A number of arrangements exist which enable individuals to stop working before turning sixty-five. The main ones are DI, UI, and various ER schemes. DI covers all employees against loss of earnings due to long-term sickness and disability. Currently, DI guarantees employees who lost more than 80 percent of their earnings capacity a benefit equal to 70 percent (80 percent before 1985) of their daily wage (up to a maximum amount). The benefit falls to a lower level after a certain period (both the length of this period and the percentage depend on age) and terminates at age sixty-five. Most employees have taken out an additional insurance to cover the risk of a DI benefit falling below 70 percent of their previous earnings.[1]

In the 1980s, the DI program became a very popular arrangement that employers could use to shed elderly, less-productive employees. Severe legal obstacles existed (and still exist) to lay off employees, while DI benefits were more generous than UI benefits. As a result of this, both employers and employees had a preference for the DI route to unemployment. The ensuing rise in costs of DI has induced the government to limit eligibility for DI by tightening entry conditions and reducing benefit levels. Moreover, individuals receiving DI benefits are now subject to a more rigorous screening of their loss of earnings capacity.

The main reason why UI is less attractive than DI is that UI benefits are only paid for a limited period (dependent on the number of years worked before unemployment). However, most people aged sixty or above who become unemployed can expect to receive unemployment benefits equal to 70 percent of their previous earnings up to age sixty-five.[2]

All public benefits for individuals younger than sixty-five are only paid to the extent that an individual is not employed.[3]

1. It should be noted that for single earners who lost more than 80 percent of their earnings capacity, DI benefits are always at least as high as the relevant social assistance (welfare) level, which (for a couple) is approximately equal to the after-tax minimum wage. In contrast to the entitlement to social assistance, household wealth is not taken into account when determining eligibility.

2. Similar to the case for DI benefits, if necessary, the UI benefit is supplemented by welfare benefits to reach the social assistance level, without taking household wealth into account. Hence, for single earners with low wages, the replacement rate can be almost 100 percent.

3. For individuals in part-time employment, benefits may supplement their earnings.

8.2.2 Private Transfers

Next to SS, a majority of the population over sixty-five is entitled to a supplementary occupational pension. In general, if an employer offers a pension scheme, then participation in such a scheme is compulsory. Until recently, more than 99 percent of the pension schemes were of the defined-benefit type, most of them being defined on the basis of final pay. Typically, occupational pensions supplement SS to 70 percent of final pay for individuals who have worked for forty years. After tax, the replacement rate is usually substantially higher.

Most large firms have their own pension fund, smaller firms usually participate in sector-wide pension funds. Usually, these private pension arrangements require that people leave the job in which they accumulate pension rights at age sixty-five at the latest. There is no earnings test, however, and people may consider looking for secondary jobs once they retire.

Early retirement became increasingly common during the 1980s and was viewed as a means of reducing unemployment. Typically, the ER schemes guarantee an employee a benefit equal to 70 or 80 percent of previous earnings up to the age of sixty-five. In after-tax terms, replacement rates are even higher. Furthermore, while being in ER, one often keeps accumulating pension rights, although possibly at a lower rate than when one would be working.

ER may be organized via the pension funds, which also provide the occupational pensions, or via the employer. Moreover, in contrast to pensions, ER is mostly financed as pay-as-you-go and usually requires ten years of employment with the same employer before the ER date, whereas old age pension rights remain valid if the worker changes jobs. The receipt of ER pensions usually requires a complete withdrawal from the labor market.

In recent years, costs of ER have increased considerably, and many firms are currently trying to reduce these costs. In particular, as mentioned in the introduction, instead of the original arrangements that provided incentives to retire as soon as one was eligible, more and more programs are being introduced which offer flexible ER pensions of which the level depends on the retirement age.

Despite these developments, the general conclusion remains that an elaborate system of income-replacing transfers exists in the Netherlands, which can be expected to act as incentives to leave the labor force on one's sixty-fifth birthday at the latest. Moreover, it should be noted that whereas rather strict laws are in force that prevent employers from laying off younger employees, reaching the age of sixty-five is a legal reason for dismissal, and social insurances protecting against loss of earnings as a result of sickness, disability, or unemployment only cover employees younger than sixty-five.

Table 8.1 **Labor Force Participation and Benefit Receipt of Males and Females Aged 50 or Over (3,149 observations)**

	Full-Time	Part-Time	Not Working	
	A. Labor Force Participation			
Males				
50–54	77.3	6.0	16.7	
55–59	49.2	12.4	38.3	
60–64	3.1	5.4	91.5	
65+	1.6	3.0	95.4	
Females				
50–54	12.6	45.7	41.7	
55–59	8.5	24.7	66.8	
60–64	2.1	6.4	91.4	
65+	0.0	1.0	99.0	
	SS	PP	DI	UI/Other
	B. Benefit Receipt			
Males				
50–54	0.0	0.6	14.4	10.9
55–59	0.0	9.0	26.3	17.3
60–64	0.0	53.6	34.4	14.3
65+	95.7	79.6	2.1	1.1
Females				
50–54	0.0	0.6	8.6	10.6
55–59	0.0	4.1	12.2	17.0
60–64	0.0	17.5	13.9	21.1
65+	97.3	41.6	0.5	1.3

Source: Data from the Socio-Economic Panel (SEP) for 1996.

Notes: SS = social security; PP = private pension; DI = disability insurance; and UI = unemployment insurance.

Table 8.1 summarizes labor market participation and benefit program participation of individuals aged fifty and over, based on data of the Socio-Economic Panel (SEP) for 1996. The table confirms the low labor force participation rate of males aged sixty or over and, next to the high level of nonparticipation, the relatively high incidence of part-time work for females. The table also illustrates that relatively many females aged fifty or over still perform the traditional role of housewife: They do not work and do not receive an income-replacing benefit, but are likely to be dependent on their spouse. Still, as of age sixty-five, these women are entitled to SS. The role of private ER benefits is especially prominent for males aged sixty to sixty-four, while more than 80 percent of males aged over sixty-five receive a private pension supplementing SS. The incidence of DI benefits among males increases from 14 percent for fifty to fifty-four year olds to 34 percent for sixty to sixty-four year olds.

Table 8.1 suggests that for males the most common route to SS is

Table 8.2 Transition of Male and Female Income Sources Between Ages 64 and 66

Age 64	Age 66		
	SS only	SS+PP	Total
	Males		
No work, no benefit	2.0	1.3	3.4
Paid work	4.7	4.7	9.4
PP (early retirement)	2.7	45.0	47.7
DI	6.7	25.5	32.2
UI/Other	2.0	5.4	7.4
Total	18.1	81.9	100.0
	Females		
No work, no benefit	53.4	1.6	55.0
Paid work	2.6	0.5	3.2
PP (early retirement)	4.2	15.3	19.6
DI	2.6	3.7	6.3
UI/Other	6.9	9.0	15.9
Total	69.8	30.2	100.0

Source: Data from SEP for 1992 to 1996.

through ER, whereas many females have been without income or benefits of their own before turning sixty-five and become eligible for SS after sixty-five. This is confirmed by table 8.2, which divides sixty-six year olds of the last three waves of the SEP according to their income sources at age sixty-six (SS or SS and private pension) and their income situation at age sixty-four. In contrast to table 8.1, individuals receiving pensions, wages, or both, as well as other benefits, are lumped together in one group. Almost half of the males received a private (ER) pension at age sixty-four and SS plus a private pension at age sixty-six, while a quarter received a DI benefit at age sixty-four and SS plus a private pension at age sixty-six. More than half of the females received nothing at age sixty-four and SS only at age sixty-six. The route directly from work to SS is taken by just a small minority of both males and females.

8.3 Research Background

Until recently, the literature on the retirement effects of SS, DI, or UI programs in the Netherlands was quite scarce, and usually descriptive and qualitative in nature. This situation has changed in the 1990s, when, due to an initiative of the Netherlands Program for Research on Aging (NESTOR),[4] a substantial grant was given to a group of researchers at the University of Leiden (who subsequently called themselves CERRA, Centre for Economic Research on Retirement and Aging) to set up a panel of

4. This program is now defunct.

elderly households (at the time of the first wave, 1993), the head of the household had to be between forty-three and sixty-three years old). A fair amount of research of CERRA has been on retirement.

One of the few examples of the earlier literature is Henkens and Siegers (1990), who provide one of the first quantitative analyses of retirement decisions of males in the Netherlands. The most prominent study is undoubtedly Aarts and de Jong (1992), who report on a project covering more than a decade of research into the determinants of disability. Next to obvious health factors, financial considerations are found to play an important role. Indeed this study was the first to document by means of quantitative analysis the fact that the DI scheme was both a financially attractive route into early retirement for the employee and a convenient way to lay off elderly employees.

In view of the tightening of eligibility rules and the reduction of the benefit levels for DI, and the simultaneous introduction of various generous ER schemes, one would expect a substitution of channels into retirement. Woittiez, Lindeboom, and Theeuwes (1994) study this by modeling the probability of finding elderly individuals (defined as being between forty-eight and sixty-two years old) in one of four states: working, disabled, unemployed, or early retired. They find a significant role for financial incentives—that is, a state becomes more likely if the associated income level is higher. The authors also find evidence for stigma effects (cf. Moffit 1983), indicating that the state of unemployment is valued below the state of disability, and both are valued below early retirement. This finding is partly supported by Woittiez and Theeuwes (1997), who use self-reported measures of life satisfaction, as well as several measures of mental and somatic health, to find that, other things being equal, people who work are generally better off than nonworking people, but early retirees are a close second. The disabled are least satisfied with their life, whereas the unemployed are above the disabled and below the early retired. The key difference between the unemployed and the early retired lies in the involuntary nature of the former state, which is found to explain most of the dissatisfaction of the unemployed.

In principle, also early retirement can have a nonvoluntary nature, as an employer may put pressure on an employee who is eligible for ER to leave the firm. Thio (1995) uses a competing-risks model to explain the different routes into retirement and does find some evidence for involuntary ER, although this is not significant. Nevertheless, ER remains the favorite exit route out of employment. In Kerkhofs, Theeuwes, and Woittiez (1996), transitions out of a job are analyzed by means of a duration model. They also establish a substitution pattern in the choice of exit routes. When the ER route is available, it dominates the other exit routes. As both eligibility rules and replacement rates for ER differ across firms (or sectors), one may suspect that employees and employers match to their mutual benefit.

Workers with a preference for ER may match with firms that offer relatively low wages and the possibility to retire early. Firms (or sectors) that need healthy young workers may decide to offer generous ER schemes. Thio and Woittiez (1996) investigate this issue by estimating a hedonic price relation in which the wage offered to an individual employee is related to characteristics determining worker productivity and ER benefits. It is found that there is a trade-off between wages and ER benefits, but not one for one (i.e., the better ER benefits are not fully reflected in lower wages). This finding seems to be consistent with the behavior of employers in the Netherlands, who are increasingly anxious to change the ER rules as the current rules turn out to be much more expensive than originally anticipated.

Clearly, for this type of study, the availability of data for both employees and employers is essential. Another study taking advantage of this is Theeuwes and Lindeboom (1995), who match firm and employee data to analyze the effect of exit routes on the number of elderly employees leaving the firm. They provide evidence that there is some, but not full, substitution between channels into retirement. This gives room for policy measures to reduce retirement. Based on employee data only, they find that eligibility requirements, rather than the benefit heights, determine the moment of retirement. Heyma and Thio (1994) take up the issue of explaining differences in labor force participation among elderly workers between the United States and the Netherlands, exploiting the Health and Retirement Study (HRS) and the CERRA samples. The interesting part of their analysis is where they use the U.S. estimates to predict participation in the Netherlands and vice versa. This shows that if the Dutch would have the American coefficients, labor force participation would even be higher than in the United States, whereas if the Americans would have the Dutch coefficients, labor force participation in the United States would have been even lower than in the Netherlands. This suggests that the explanation for the observed differences between the United States and the Netherlands is not a matter of different characteristics of individuals, but rather a matter of a different institutional environment—the two main features of this being financial incentives and eligibility rules.

Heyma (1996) addresses both financial incentives and eligibility rules in a dynamic-programming model of retirement decisions. Having estimated the model, he simulates various policy changes, like later eligibility for ER, raising the mandatory retirement age by two years, and lower ER benefits. The effects found are substantial. For example, if the ER benefits are set equal to disability benefits, labor force participation of sixty-two-year olds easily doubles. Heyma, Lindeboom and Kerkhofs (1997) extend this model by using data on individual behavior, survival rates, private pensions and firm data. The effects are similar to the ones found in Heyma (1996). Putting emphasis on the institutional characteristics they are able to explain quite a lot of the dynamics in retirement behavior. Lindeboom (1998), estimating a competing-risk duration model that explicitly takes

into account eligibility rules and replacement rates, also finds that ER schemes, in particular, create strong incentives to early withdrawal from the labor market.

Using both information on health and financial incentives, Kerkhofs, Lindeboom, and Theeuwes (1999) find that the effect of health on retirement depends crucially on the health measure used, but that incentive effects are relatively insensitive to alternative specifications for health.

The research reviewed here provides ample evidence for the dominant role of financial incentives and eligibility rules in the explanation of the low labor force participation rate among the elderly in the Netherlands. However, no study has yet fully quantified the part of the decrease in labor force participation among the elderly that can be ascribed to the changes in incentives and eligibility rules over the last three decades.

8.4 Data Overview

Most of the results presented in this paper are derived using the SEP. The SEP is a longitudinal survey administered by Statistics Netherlands (CBS) consisting of approximately 5,000 households. The survey is representative of the Dutch population, excluding those living in special institutions like nursing homes. The SEP has been launched in April 1984. The same households were interviewed in October 1984 and then twice a year (in April and October) until 1989. Since 1990, the survey has been conducted once a year in May. In order to address the problem of sample attrition, Statistics Netherlands regularly adds new households to the SEP.

In the October interview, information has been collected at the respondent level on socioeconomic characteristics, income, and labor market participation. The April interviews also contain information about socioeconomic characteristics, but rather than gathering data about income, beginning in October 1987, the April questionnaire includes questions on a wide range of assets and liabilities. Since 1990, these questions are part of the annual May questionnaire. Data are available for the period 1984–1996.

In the analysis, we include men and women aged fifty to sixty-four who had positive earnings in 1984. Individuals are added in later years (until 1994), as they turn fifty, subject to positive earnings at age fifty. For all individuals, we observe whether or not they retire during the next year, and if so, whether or not they receive (early) retirement pensions, DI or UI benefits, or no benefits at all. In addition, we observe education level, labor market sector, number of hours worked, and so forth. All information available for the individual is also available for their partner. In addition, we have information on assets and income from capital received by the household. However, this information is fairly unreliable and not used in our analyses. Table 8.3 presents the means of the most important variables used.

As we are trying to model the individual retirement decision, we are lim-

Table 8.3 Summary Statistics

	Males	Females
No. of observations	3,492	1,388
Retired		
ER/PP	0.078	0.048
DI/UI	0.031	0.032
No benefits	0.010	0.038
Married	0.900	0.690
Low education	0.380	0.532
High education	0.221	0.151
Agriculture	0.046	0.022
Industry	0.368	0.063
Noncommercial services	0.302	0.644
Age		
50	0.124	0.140
51	0.115	0.113
52	0.114	0.108
53	0.107	0.097
54	0.096	0.097
55	0.088	0.089
56	0.082	0.073
57	0.068	0.063
58	0.062	0.066
59	0.050	0.050
60	0.035	0.040
61	0.018	0.024
62	0.014	0.019
63	0.015	0.013
64	0.011	0.009
Earnings (dfl. before tax)		
Mean (standard deviation)	74,247 (52,483)	29,639 (43,290)
25th percentile	46,906	8,135
Median	64,696	19,028
75th percentile	91,551	39,159

ited by a lack of information on the eligibility for the various exit routes out of the labor force. In particular, we do not know whether or not and at which age individuals can take ER. We also do not know whether or not they might be entitled to DI benefits—and we have insufficient health information to be used as a proxy (although health would not present the full picture anyway). For the eligibility for ER we have used information based on one wave of an alternative panel, the CentER panel,[5] in which employed individuals were asked whether or not they were participating in an occupational pension plan and at which age that would allow them to retire. The probability of being eligible for ER at a certain age is approximated by multiplying the estimated probability of participation in an occupational pen-

5. The CentER panel comprises about 2,000 households and is run by CentER data, a survey research institute affiliated with Tilburg University.

Table 8.4 **Logit Equation for Eligibility for Private Pension**

Variable	Estimate	SE	Significance Level[a]
Sector			
Industry	0.933	0.361	0.010
Noncommercial services	1.595	0.270	0.000
Age	0.230	0.104	0.026
Age squared	–0.003	0.001	0.037
Full time (>32 hrs/week)	0.734	0.315	0.020
Female	–1.039	0.324	0.001
Constant	–3.417	2.277	0.133

Note: SE = standard error.

[a]Test of null hypothesis that the parameter in question is zero.

Table 8.5 **Distribution of Age of Eligibility for Early Retirement Given Eligibility for Private Pension**

Sector	Industry	Agriculture, Commercial Services	Noncommercial Services
Age			
55	0.043	0.044	0.095
56	0.012	0.016	0.011
57	0.067	0.027	0.046
58	0.037	0.022	0.052
59	0.018	0.055	0.032
60	0.244	0.224	0.204
61	0.220	0.126	0.187
62	0.244	0.137	0.236
63	0.012	0.055	0.043
64	0.000	0.000	0.006
65	0.104	0.295	0.089

sion plan by the fraction of individuals in an occupational pension plan who say they can retire at that age. The estimated probability to be in an occupational pension plan is based on a logit specification with sector of employment, age, sex, and whether or not they are working full-time as explanatory variables. The logit estimates are presented in table 8.4. The eligibility age distribution for ER is differentiated by sector of employment (table 8.5).

8.5 Earnings Histories and Projections

As SS is a flat-rate benefit, whereas ER, DI, and UI benefits and occupational pensions are (usually) based on final pay, information on earnings histories is not needed to determine Social Security Wealth (SSW), the actuarially discounted sum of future benefits. The benefits include not only SS benefits, but also private pension (PP), DI, and UI benefits wherever appropriate. Only information on the number of years in pensionable employment together with information on the final earnings would be suffi-

cient to determine the benefit level to which the individual is entitled. The number of years in pensionable employment is generally unknown, but in the Dutch system this number, although clearly affecting SSW, generally has only a marginal effect on most of the incentive variables to be included in the retirement decision (accrual, peak value, and option value; to be defined later): The effect of working an additional year is, by and large, constant over a rather wide interval of years.

As the jumping-off point for the forward projections we use actual earnings, assuming constant real earnings. We do not calculate three-year averages because this would limit the number of observations that could be included in the analysis.

8.6 Construction of Incentive Measures

In our calculations we do not distinguish UI benefits from DI benefits (both are received until the age of sixty-five), and we assume that, like SS, which is received after age sixty-five, the benefits do not depend on the age of retirement. After becoming unemployed or disabled, the older worker can expect to keep the same level of benefits up to age sixty-five. After age sixty-five, SS is independent of work history. Hence, if we would limit ourselves to these three benefit types, the implicit tax or subsidy rate on retiring, which is the change in the worker's future benefits, relative to what he would earn in the coming year, would be equal to the replacement rate (the level of benefits in the coming year relative to their earnings in the coming year). The only way in which an employee's future income (after the coming year) may be affected by retiring one year earlier is via their private pension. Retiring before the age of sixty-five may affect the level of PP to be received after age sixty-five by reducing the number of years counting towards pension benefits. Moreover, if an employee were to retire before his ER age, he would no longer be eligible for ER benefits.

In this section we describe how SSW, accrual rates, implicit tax or subsidy rates, option values, and peak values are calculated. As in Gruber and Wise (1999), accrual rates are defined as the change in the worker's SSW relative to the SSW if they would retire one year earlier, and tax or subsidy rates are defined as the change in the SSW relative to what they would earn over the coming year. As mentioned above, SSW is calculated as the actuarially discounted sum of future benefits. In contrast to the earlier volume (Kapteyn and de Vos 1999), contributions paid toward the various benefit and pension programs during the remaining working life are no longer deducted from SSW. In our incentive calculations we distinguish the following cases.

1. Eligibility for early retirement at a certain age between fifty-five and sixty-five (eligible individuals will receive a PP in addition to SS once they turn sixty-five)

2. Eligibility for disability or unemployment benefit upon retirement before age sixty-five and receipt of a PP in addition to SS as of age sixty-five
3. Eligibility for SS only (as of age sixty-five).

For all entitlements we assume zero growth in real terms after 1995.[6] For survival probabilities, we use sex- and age-specific survival tables of Statistics Netherlands (1992). We assume independence between the mortality rates of the worker and their spouse. We use a real discount rate of 3 percent. To compute net-benefit and pension levels, we subtract payroll and income taxes. For the years after 1995, we use the tax schedule for 1995, keeping tax rates and brackets fixed in real terms. For individuals with working spouses, we assume that the spouse will stop working at age sixty-five. In our calculations, we take into account that if an individual retires before age sixty-five and is not entitled to any benefit or pension, the spouse (if older than sixty-five) may be entitled to a supplement to his SS benefit.

The option value of postponing retirement is approximated as:

$$G_t(r^*) = V_t(r^*) - V_t(t), \tag{1}$$

where $V_t(t)$ represents the utility of retiring now, and $V_t(r^*)$ represents the highest feasible utility (obtained by retiring at age r^*). $V_t(r)$ is calculated as:

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} Y_s^{\gamma} + \sum_{s=r}^{S} \beta^{s-t} [kB_s(r)]^{\gamma}, \tag{2}$$

where Y_s represents earnings in the years before retirement, and $B_s(r)$ represents benefits received in the years after retirement at age r. We use k equal to 1.5, β equal to 0.97, and γ equal to 0.75.

The incentive measures used in the estimations in the next section are weighted averages of the incentives for the various exit routes (DI, ER, and SS only), where the weights are determined by the empirical take-up rates differentiated by age. Notably, in these calculations, the fact that persons may be eligible for ER at a later age is taken into account by using the probabilities for eligibility by age based on results of the CentER panel, as described earlier, multiplied by the empirical take-up rate of continued work. In this way, the weighted SSW measure of individuals aged sixty, for example, is calculated as

$$\begin{aligned} \mathrm{SSW}_{60} = {} & p_{\mathrm{ER},60} \cdot \mathrm{SSW}_{\mathrm{ER},60} + p_{\mathrm{DI},60} \cdot \mathrm{SSW}_{\mathrm{DI},60} + p_{\mathrm{exit},60} \cdot \mathrm{SSW}_{\mathrm{SSonly},60} \\ & + (1 - p_{\mathrm{ER},60} - p_{\mathrm{DI},60} - p_{\mathrm{exit},60}) \cdot (pp \cdot (p_{\mathrm{ER},61} \cdot \mathrm{SSW}_{\mathrm{ER},61} \\ & + p_{\mathrm{ER},62} \cdot \mathrm{SSW}_{\mathrm{ER},62} + p_{\mathrm{ER},63} \cdot \mathrm{SSW}_{\mathrm{ER},63} + p_{\mathrm{ER},64} \cdot \mathrm{SSW}_{\mathrm{ER},64} \\ & + p_{\mathrm{ER},65} \cdot \mathrm{SSW}_{\mathrm{ER},65}) + (1 - pp) \cdot \mathrm{SSW}_{\mathrm{SSonly},60}), \end{aligned} \tag{3}$$

6. For DI, SS, and UI benefits, this is more or less in line with current government policy.

Table 8.6 **The Distribution of One-Year Accrual: Weighted Accrual as Used in Estimations**

Age	*N*	Median SSW	Accrual Median	10th Percentile	90th Percentile	SD
Males						
50	433	317,375	2,835	–8	7,458	3,588
51	402	335,555	3,592	–4	7,910	3,879
52	399	344,972	3,390	0	7,696	4,001
53	375	358,162	3,670	–9	7,683	4,481
54	334	387,512	16,405	6,943	40,604	15,031
55	306	389,206	5,946	390	10,597	4,237
56	288	394,186	9,857	218	19,843	7,346
57	238	385,403	6,231	–13	16,919	7,934
58	216	434,945	1,597	–1,665	7,710	4,790
59	174	424,633	17,338	2,441	34,294	12,047
60	123	447,151	12,466	–26	32,026	12,913
61	62	342,854	12,680	–18	65,061	24,192
62	50	365,585	4,421	–30	22,173	8,073
63	53	421,203	–34	–1,708	3,576	5,763
64	39	371,499	–8,659	–12,668	–14	5,532
Females						
50	195	300,180	–123	–362	2,980	1,914
51	157	297,623	–74	–269	3,185	2,092
52	150	288,047	–116	–373	3,918	2,943
53	134	293,246	–133	–501	3,520	3,922
54	134	275,090	3,967	0	18,596	8,865
55	123	294,974	139	–91	6,373	2,805
56	101	313,990	1,383	–206	11,201	11,561
57	88	285,680	657	–555	9,622	4,730
58	92	291,082	–537	–2,512	4,061	2,545
59	70	290,916	2,785	–564	22,175	9,026
60	55	285,620	1,040	–1,598	21,197	7,883
61	33	295,074	5,503	–1,433	48,767	16,851
62	26	293,533	844	–7,072	10,171	5,696
63	18	305,938	–781	–2,207	616	1,320
64	12	305,730	–3,522	–15,404	–47	5,297

Note: *N* = number of observations; SD = standard deviation.

where $p_{\mathrm{ER},60}$, $p_{\mathrm{DI},60}$ and $p_{\mathrm{exit},60}$ are empirical take-up rates, and *pp* and $p_{\mathrm{ER},61}$, . . . , $p_{\mathrm{ER},65}$ represent sex- and sector-specific eligibility probabilities (for PP and ER at age sixty-one through sixty-five, respectively, given eligibility for PP) based on the CentER panel data. The same weighting scheme is used for the calculation of accrual, option, and peak values.

Tables 8.6 and 8.7 summarize the (weighted) incentive measures differentiated by age and sex. It should be noted that these weighted figures do not represent the incentives as faced by individuals, since one usually knows whether or not and at which age one is eligible for ER. In tables 8.8 and 8.9, the incentives for males are shown separately for the cases in which individuals are eligible for ER at age sixty and SS supplemented by PP as

Table 8.7 **The Distribution of Peak and Option Value: Weighted Incentives as Used in Estimations**

	Peak Value				Option Value			
Age	Median	10th Percentile	90th Percentile	SD	Median	10th Percentile	90th Percentile	SD
50	122,504	46,158	220,293	72,518	40,195	27,513	59,058	14,444
51	131,172	45,290	221,813	84,788	39,556	26,219	55,427	15,933
52	126,521	51,930	213,795	80,833	37,139	24,858	51,319	14,263
53	125,900	49,236	221,577	96,542	35,387	23,100	48,804	14,412
54	122,944	58,930	203,457	75,628	31,439	21,379	44,119	12,494
55	111,062	31,514	187,141	62,055	29,343	18,413	41,019	10,449
56	94,440	12,186	166,165	56,703	23,077	14,846	35,094	8,753
57	79,704	18,756	149,364	63,207	19,174	11,594	31,703	8,963
58	66,113	14,704	127,589	49,935	15,609	8,989	25,135	7,795
59	50,606	6,532	100,447	33,820	11,640	5,971	18,385	5,002
60	35,431	–15	78,583	29,855	9,524	3,017	16,142	5,225
61	20,383	–18	76,114	28,758	8,343	1,211	14,942	5,150
62	7,518	–29	32,652	12,461	6,977	1,562	12,318	3,630
63	9	–1,203	11,983	14,382	5,136	1,467	7,917	4,311
64	–8,659	–12,668	–14	5,532	1,969	619	3,285	903
Females								
50	23,015	1,140	132,476	53,649	15,427	6,055	39,144	13,129
51	25,900	161	130,944	54,716	15,068	4,809	37,080	12,969
52	24,409	403	153,484	71,471	14,718	5,367	38,902	16,998
53	24,134	0	135,627	92,281	12,676	4,302	32,823	15,578
54	20,690	0	91,100	43,028	10,377	3,798	23,909	9,176
55	21,489	64	110,312	46,371	9,515	3,004	28,698	9,603
56	26,730	598	108,188	97,856	9,750	2,253	25,230	14,571
57	16,955	–33	88,796	39,060	7,189	1,669	23,785	8,053
58	12,131	–294	70,873	32,284	5,563	1,402	19,118	6,646
59	9,823	–87	66,793	25,473	4,270	804	15,155	5,509
60	5,140	–600	54,316	18,696	2,838	668	11,513	4,497
61	6,473	–1,114	59,557	20,392	2,491	557	11,666	3,854
62	1,053	–7,072	13,990	7,381	2,104	0	7,693	2,711
63	–482	–2,207	3,426	2,702	1,220	0	5,666	2,031
64	–3,522	–15,404	–47	5,297	101	0	1,433	512

Note: SD = standard deviation.

of age sixty-five; for DI now and SS supplemented by PP as of age sixty-five; and for SS only (as of age sixty-five). Table 8.8 also compares the median implicit tax rates ("tax rate 1") with the implicit tax rate for the median worker as presented in Kapteyn and De Vos (1999; "tax rate 2").

8.7 Estimation Results for the Common Model

Tables 8.10 and 8.11 present the estimation results for males and females, respectively. The results for males are (statistically) much more significant than for females. To a considerable extent, this may be due to the

Table 8.8 The Distribution of One-Year Accrual for Males (assuming eligibility)

Age	*N*	Median SSW	Accrual Median	10th Percentile	90th Percentile	SD	Median Tax Rate 1	Tax Rate 2
				A. ER(60) + SS + PP				
50	433	317,103	4,008	671	8,987	3,902	0.458	
51	402	339,826	4,640	802	9,041	4,201	0.468	
52	399	347,457	4,629	1,127	9,104	4,361	0.465	
53	375	365,761	5,541	1,273	9,374	4,803	0.453	
54	334	379,949	5,606	1,368	9,032	4,196	0.449	
55	306	386,860	5,386	789	9,367	3,959	0.431	0.687
56	288	388,246	4,562	619	9,354	3,935	0.430	0.650
57	238	379,782	4,137	94	9,383	4,922	0.415	0.612
58	216	409,105	4,148	–1	9,718	5,284	0.417	0.578
59	174	405,987	138,109	58,093	246,498	72,501	–3.603	–3.777
60	123	587,764	–28,384	–45,276	–8,040	14,211	1.353	1.410
61	62	480,417	–25,061	–42,949	–5,082	15,721	1.264	1.384
62	50	494,865	–27,397	–43,750	–5,282	13,703	1.320	1.339
63	53	542,783	–27,913	–44,591	–5,707	22,635	1.310	1.282
64	39	537,045	–28,897	–45,350	–6,471	12,339	1.295	1.222
				B. DI + SS + PP				
50	433	713,792	–27,687	–33,110	–19,653	6,758	1.263	
51	402	719,464	–28,041	–32,973	–19,255	6,766	1.260	
52	399	701,801	–27,457	–32,850	–19,514	6,272	1.263	
53	375	688,347	–27,331	–32,688	–19,435	6,330	1.240	
54	334	677,054	–26,927	–32,827	–18,877	6,381	1.242	
55	306	659,681	–26,863	–32,651	–18,475	6,839	1.226	1.478
56	288	623,541	–26,135	–32,514	–18,019	6,589	1.223	1.428
57	238	577,718	–24,600	–32,081	–16,010	7,020	1.191	1.379
58	216	588,773	–24,517	–32,815	–14,682	7,841	1.203	1.338
59	174	544,953	–23,418	–31,646	–12,076	7,663	1.194	1.269
60	123	567,890	–23,926	–31,623	–7,601	8,317	1.202	1.184
61	62	466,454	–21,056	–31,355	–4,438	10,225	1.096	1.160
62	50	483,669	–23,537	–31,634	–4,565	9,599	1.175	1.121
63	53	534,627	–23,294	–31,208	–3,584	12,874	1.164	1.099
64	39	532,769	–23,921	–31,445	–5,604	7,842	1.150	1.009
				C. SS *Only*				
50	433	200,054	–12	–19	–6	550	0.369	
51	402	205,284	–13	–21	–7	551	0.374	
52	399	210,964	–14	–23	–7	755	0.372	
53	375	217,441	–15	–26	–6	667	0.371	
54	334	224,578	–16	–29	–4	10	0.365	
55	306	228,552	–17	–31	0	10	0.354	0.475
56	288	234,374	–19	–34	0	11	0.361	0.464
57	238	245,483	–19	–37	–6	12	0.344	0.447
58	216	252,475	–22	–38	0	13	0.349	0.436
59	174	259,868	–23	–40	0	14	0.329	0.407
60	123	267,729	–26	–47	–8	1,432	0.332	0.421
61	62	276,134	–22	–49	0	251	0.283	0.415
62	50	285,173	–24	–45	0	16	0.337	0.431
63	53	294,950	–31	–53	0	1,437	0.339	0.410
64	39	311,367	–31	–47	0	193	0.347	0.380

Note: N = number of observations; SD = standard deviation.

Table 8.9 The Distribution of Peak and Option Value for Males (assuming eligibility)

	Peak Value				Option Value			
Age	Median	10th Percentile	90th Percentile	SD	Median	10th Percentile	90th Percentile	SD
				A. ER(60) + SS + PP				
50	150,693	80,603	258,249	79,438	41,873	28,894	61,469	14,903
51	163,625	80,051	253,427	96,412	41,725	27,051	56,668	16,289
52	166,593	86,275	249,882	92,394	39,752	26,009	52,663	14,575
53	166,799	91,733	255,650	103,591	36,915	24,978	50,721	14,701
54	169,749	92,502	251,471	92,974	34,383	23,380	46,917	13,017
55	167,100	86,411	257,709	82,074	31,751	20,319	43,988	11,365
56	157,076	84,069	261,287	77,581	27,882	18,033	40,014	9,944
57	138,857	68,104	257,614	88,716	22,632	13,739	36,216	9,915
58	144,377	69,874	257,907	94,570	20,584	12,243	31,974	9,725
59	138,109	58,093	246,498	72,501	17,465	9,070	26,812	6,898
60	–28,384	–45,276	–8,040	14,211	0	0	221	379
61	–25,061	–42,949	–5,082	17,087	0	0	221	165
62	–27,397	–43,750	–5,282	13,703	0	0	261	127
63	–27,913	–44,592	–5,707	22,635	0	0	114	841
64	–28,897	–45,350	–6,471	12,339	0	0	111	50
				B. DI + SS + PP				
50	–27,687	–33,110	–19,653	6,758	799	0	14,430	8,420
51	–28,042	–32,973	–19,225	11,882	1,017	0	12,652	10,855
52	–27,457	–32,850	–19,514	10,772	1,132	0	10,878	10,014
53	–27,331	–32,688	–19,435	21,742	1,127	0	11,703	11,065
54	–26,927	–32,827	–18,877	6,501	1,063	0	11,121	9,279
55	–26,863	–32,651	–18,475	6,841	906	0	10,132	6,813
56	–26,135	–32,514	–18,029	6,591	699	0	9,354	5,651
57	–24,600	–32,081	–16,010	11,766	259	0	8,128	6,120
58	–24,517	–32,815	–14,682	8,933	386	0	7,163	6,381
59	–23,418	–31,646	–12,076	7,663	339	0	5,454	2,979
60	–23,926	–31,612	–7,601	8,317	284	0	6,329	3,974
61	–21,056	–31,355	–4,438	10,232	0	0	4,027	2,366
62	–23,537	–31,634	–4,565	9,599	71	0	3,216	1,507
63	–23,294	–31,208	–3,584	17,377	306	0	2,235	3,971
64	–23,921	–31,445	–5,604	7,842	129	0	1,249	558
				C. SS *Only*				
50	–12	–19	–6	550	34,469	24,681	49,388	11,327
51	–13	–21	–7	551	32,854	23,640	45,871	12,271
52	–14	–23	–7	755	30,916	22,483	42,589	10,914
53	–15	–26	–6	667	28,881	21,506	40,658	10,833
54	–16	–19	–4	10	26,519	19,773	37,626	9,582
55	–17	–31	0	14	24,168	17,066	34,764	8,579
56	–19	–34	0	15	21,618	14,913	31,873	7,546
57	–19	–37	–6	12	18,459	11,530	28,695	7,346
58	–22	–38	0	17	16,421	8,140	25,156	7,271
59	–23	–40	0	15	13,813	7,162	20,979	5,264
60	–26	–47	–8	1,435	12,092	4,057	18,603	5,722
61	–22	–49	0	254	8,593	1,376	14,536	4,953
62	–24	–45	0	17	7,031	1,569	11,221	3,306
63	–31	–53	0	1,437	5,110	1,285	7,682	3,554
64	–31	–47	0	193	2,664	858	4,031	1,033

Note: SD = standard deviation.

Table 8.10 Retirement Probits for Males (marginal effects)

Variable	Accrual		Peak Value		Option Value	
SSW	1.40e-07	9.48e-08	2.50e-07	2.03e-07	1.54e-07	1.32e-07
	(2.51)	(1.68)	(4.65)	(3.69)	(3.22)	(2.7)
Accrual	1.59e-06	1.87e-06				
	(3.46)	(2.84)				
Peak value			–4.41e-07	–3.37e-07		
			(3.34)	(2.46)		
Option value					–5.28e-06	–4.27e-06
					(5.80)	(4.40)
Earnings	–1.82e-06	–1.77e-06	–6.07e-07	–7.19e-07	1.78e-06	1.25e-06
	(3.10)	(2.96)	(.98)	(1.15)	(2.31)	(1.55)
Earnings^2	–1.07e-12	1.17e-12	–7.13e-12	–4.17e-12	–9.87e-12	–6.75e-12
	(.32)	(.37)	(1.89)	(1.10)	(2.69)	(1.80)
Earnings, $\chi^2(1)$	9.60**	8.77**	.97	1.32	5.35**	2.41
Earnings partner	1.46e-06	1.26e-06	1.53e-06	1.38e-06	1.67e-06	1.53e-06
	(.97)	(.80)	(.86)	(.73)	(.98)	(.85)
Earnings partner^2	–1.78e-11	–1.45e-11	–2.80e-11	–2.49e-11	–2.45e-11	–2.24e-11
	(.70)	(.54)	(.82)	(.67)	(.74)	(.64)
Earnings partner, $\chi^2(1)$	.94	.64	.74	.54	.95	.72
Age	.062		.11		.07	
	(1.68)		(3.12)		(2.06)	
Age^2	–3.77e-04		–8.66e-04		–5.75e-04	
	(1.14)		(2.70)		(1.92)	
Age $\chi^2(1)$	160.7**		58.1**		6.95**	
Two earners (yes = 1)	–.022	–.019	–.018	–.016	–.016	–.015
	(1.20)	(.98)	(.92)	(.78)	(.83)	(.75)
Partner? (yes = 1)	–.0093	–.0029	–.031	–.022	–.0099	–.0072
	(.46)	(.14)	(1.50)	(1.10)	(.54)	(.39)
Age dummies, $\chi^2(14)$		221.1**		112.5**		49.9**
Log-likelihood	–1,050.8	–1,023.0	–1,050.9	–1,023.8	–1,039	–1,016.9
Pseudo R^2	.174	.197	.175	.196	.184	.201

Notes: Numbers in parentheses are *t*-values. 3,492 observations.
**Significant at the 5 percent level.

larger number of observations for males than for females (the number of observations for males is about three times larger than for females), but the fit is also better for males than for females. We will discuss the results for males and females consecutively.

Table 8.10 shows that the inclusion of option value as an incentive variable gives a substantially better fit than the inclusion of accrual or peak value. Furthermore, the results with accrual included are economically implausible. The coefficient of the accrual variable has the wrong sign and is significantly different from zero. In the specification without age dummies, the incentive variables are more significant and bigger in absolute value than in the specifications with the age dummies included. The age functions for the specification without age dummies have been specified as a

Table 8.11 Retirement Probits for Females (marginal effects)

Variable	Accrual		Peak Value		Option Value	
SSW	2.74e-08	–3.70e-09	3.01e-08	1.66e-08	–2.56e-08	–2.78e-08
	(.22)	(.03)	(.25)	(.14)	(.23)	(.25)
Accrual	–6.52e-07	5.48e-07				
	(.44)	(.31)				
Peak value			–2.27e-07	–1.64e-07		
			(.64)	(.46)		
Option value					–2.29e-06	–2.00e-06
					(1.24)	(1.08)
Earnings	1.45e-06	1.53e-06	1.64e-06	1.68e-06	2.44e-06	2.42e-06
	(.94)	(.99)	(1.05)	(1.07)	(1.42)	(1.40)
Earnings^2	–4.51e-11	–4.80e-11	–4.34e-11	–4.44e-11	–4.13e-11	–4.23e-11
	(.88)	(.90)	(1.09)	(1.16)	(2.01)	(1.96)
Earnings, $\chi^2(1)$	1.47	1.56	1.43	1.49	1.40	1.46
Earnings partner	–3.67e-07	–1.26e-07	–3.84e-07	–2.30e-07	4.79e-08	1.35e-07
	(.29)	(.10)	(.31)	(.19)	(.04)	(.11)
Earnings partner^2	–2.04e-12	–1.44e-12	–1.77e-12	1.62e-12	–1.53e-12	–1.53e-13
	(.22)	(.26)	(.25)	(.28)	(.29)	(.32)
Earnings partner, $\chi^2(1)$	.08	.01	.10	.04	.00	.01
Age	–.022		–.023		–.033	
	(.37)		(.39)		(.56)	
Age^2	3.67e-04		3.67e.04		4.45e-04	
	(.70)		(.71)		(.86)	
Age $\chi^2(1)$	64.6**		49.9**		34.6**	
Two earners (yes = 1)	.0070	–1.84e-04	.0077	.0041	7.22e-04	–.0015
	(.19)	(.01)	(.22)	(.12)	(.02)	(.04)
Partner? (yes = 1)	.0165	.0249	.0152	.0197	.0185	.0216
	(.67)	(1.03)	(.61)	(.80)	(.80)	(.94)
Age dummies, $\chi^2(14)$		75.2**		60.4**		45.3**
Log-likelihood	–448.9	–442.5	–448.7	–442.5	–448.2	–442.0
Pseudo R^2	.110	.122	.110	.122	.111	.123

Notes: Numbers in parentheses are *t*-values. 1,388 observations.
**Significant at the 5 percent level.

quadratic. The estimated age functions are shown in figure 8.1 for all specifications given in tables 8.10 and 8.11. With one exception (the specification with option value for males), the age functions are all monotonically increasing. Of course, a quadratic specification may be too restrictive to capture incentive effects at particular ages.

Figure 8.2 therefore presents the estimated age dummies for the specifications with the three different incentive variables. Furthermore, figure 8.2 also shows the empirical retirement hazards. In all specifications (and in the empirical hazard), we observe a peak at age sixty. Up until sixty, the probability of retirement increases with age. After age sixty, it falls and then gradually goes up again until the age of sixty-five.

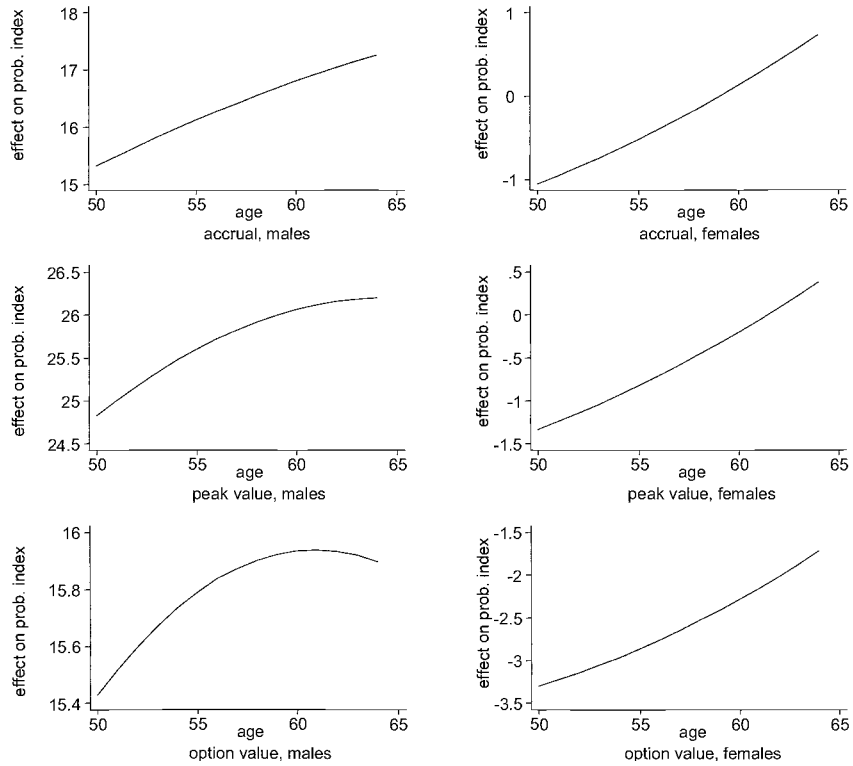


Fig. 8.1 Age effects on retirement

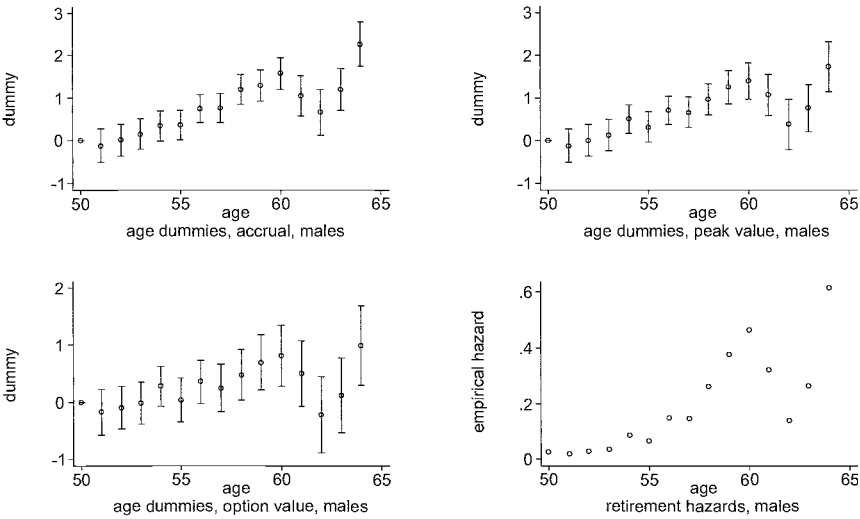


Fig. 8.2 Age dummies and hazard rates, males

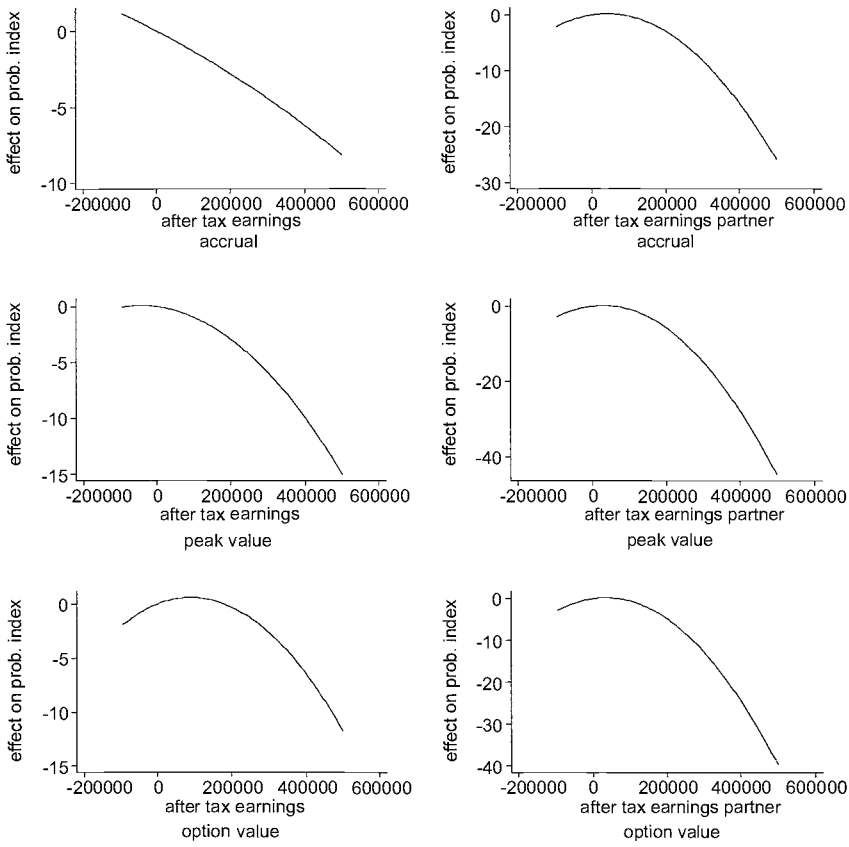


Fig. 8.3 Earnings effects on retirement, no age dummies, males

Figures 8.3 and 8.4 present the influence of own and partner's earnings (if present) on the retirement index. Although the pictures suggest a negative effect of both own and partner's earnings on the probability of retirement in any given year, we should be aware of the fact that the earnings terms are rarely significant. Partner's earnings are never significant at the 5 percent level. Own earnings are significant for the accrual and option value specifications.

In table 8.11 (females) very few coefficients are significant. The *t*-values corresponding to the incentive variables are quite low. The age dummies are jointly highly significant and exhibit a pattern that is similar to that for males (cf. figure 8.2). The same is true for the quadratic age functions. Neither own earnings nor partner's earnings appears to exhibit a significant effect on the probability of retirement. We abstain therefore from presenting these earnings functions. It appears that the incentive variables used

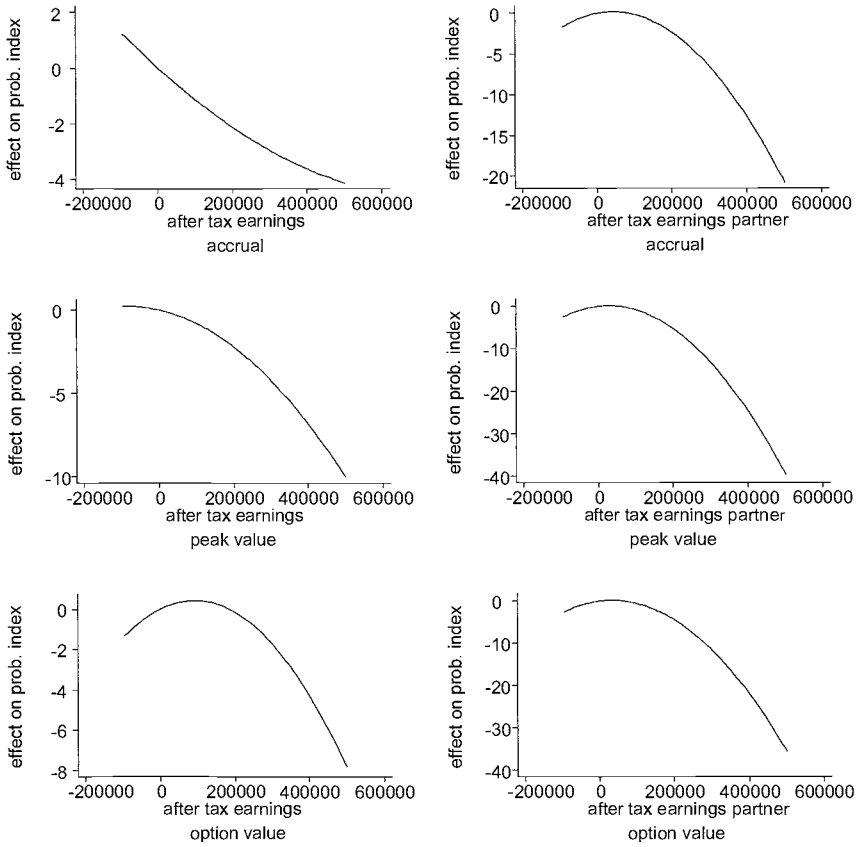


Fig. 8.4 Earnings effects on retirement, age dummies, males

are not very successful in capturing the motivating forces behind the retirement decisions of females.

8.8 Simulations

We consider a number of incentive changes and their effects on retirement probabilities. The reforms and their implications for retirement are discussed consecutively. In view of the difference in statistical significance between the results for males and females, we mainly concentrate on the results for males.

8.8.1 A Three-Year Increment in Eligibility Ages

Since eligibility is not directly observed and the computation of the incentives is based on actual retirement behavior, there are different ways in

which one can implement such a reform in the context of the model presented so far. We choose a particularly straightforward approach by calculating for every individual in the sample (and their partner, if any) the incentive variables as if this individual were three years younger. That is, we assign eligibility probabilities (but not mortality rates) as if the individual is three years younger and then recalculate the incentive variables. We present three different types of simulations. The first and second simulations simply use the models with and without dummies and replace the incentive variables by the new ones based on delayed eligibility. Regarding the model with age dummies, this may be less than appropriate, as the age dummies probably partly reflect variations in eligibility across age that are not captured by the incentive variables. Thus a third simulation shifts the age dummies backward by three years. That is, for ages fifty-one, fifty-two, and fifty-three, the age dummies are set equal to zero. The new age dummy for age fifty-four is set equal to the estimated age dummy for age fifty-one, the new age dummy for age fifty-five is set equal to the estimated age dummy for age fifty-two, and so forth. Notice that our data set only comprises individuals between fifty and sixty-four, so we cannot simulate the effect of a change in policy beyond the age of sixty-four.

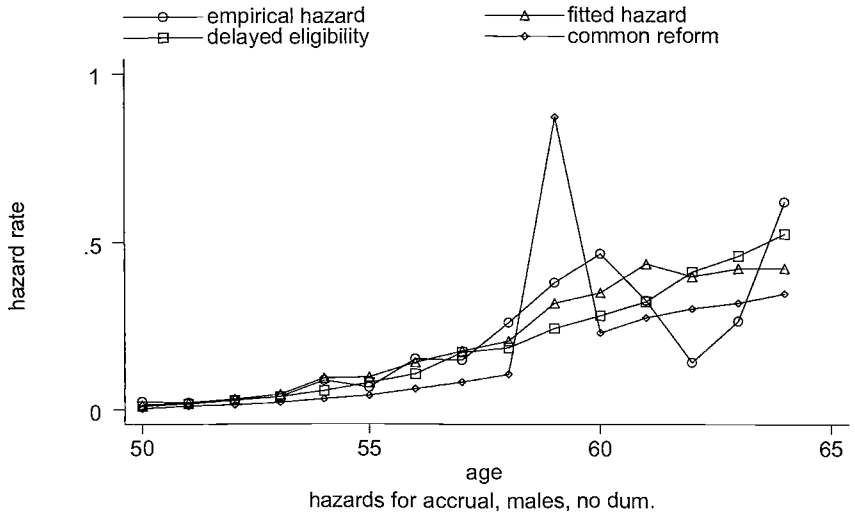
8.8.2 The Common Reform

The common reform involves early retirement at age sixty and normal retirement at age sixty-five. The replacement rates depend on age. The replacement rate at age sixty-five is equal to 60 percent of wages that one would have earned at age sixty. At other ages an actuarial adjustment of 6 percent is applied. That is, when retiring at age sixty, an individual receives 70 percent of 60 percent of wages; when retiring at age sixty-one, the individual receives 76 percent of 60 percent of age sixty wages; and so on. This also applies to retirement ages higher than sixty-five. For instance, when retiring at age seventy, an individual receives 130 percent of 60 percent of age sixty wages. However, as mentioned previously, since we have no individuals over sixty-four in the sample, the latter part of the reform cannot be simulated.

Again, we consider three different types of simulations. The first two take the model without and with age dummies and change the incentive variables. The third simulation also adapts the age dummies. Between ages fifty and sixty, the age dummies are linearly interpolated between zero and the estimated age dummy for age sixty. Between ages sixty-one and sixty-four, the age dummies are linearly interpolated between the estimated age dummies for ages sixty and sixty-four.

8.8.3 Simulation Results

Figures 8.5 through 8.13 provide a graphical representation of the simulation outcomes for males. In each graph, the top panel shows hazards



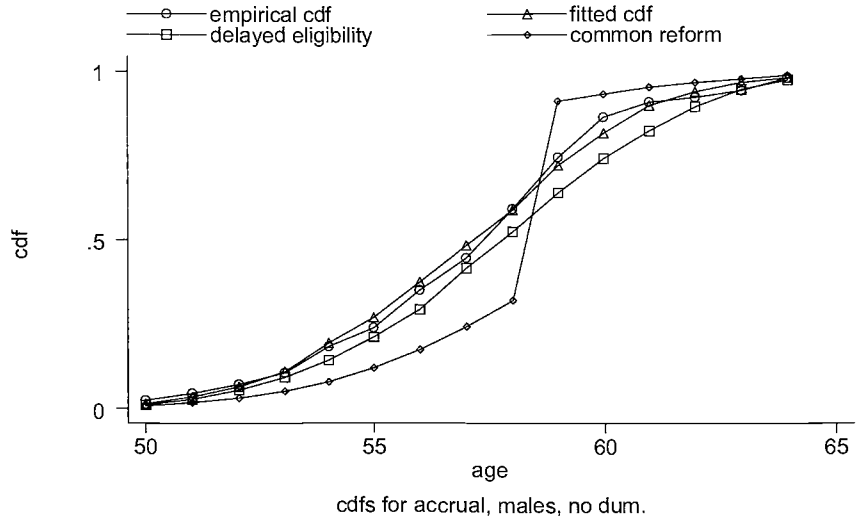
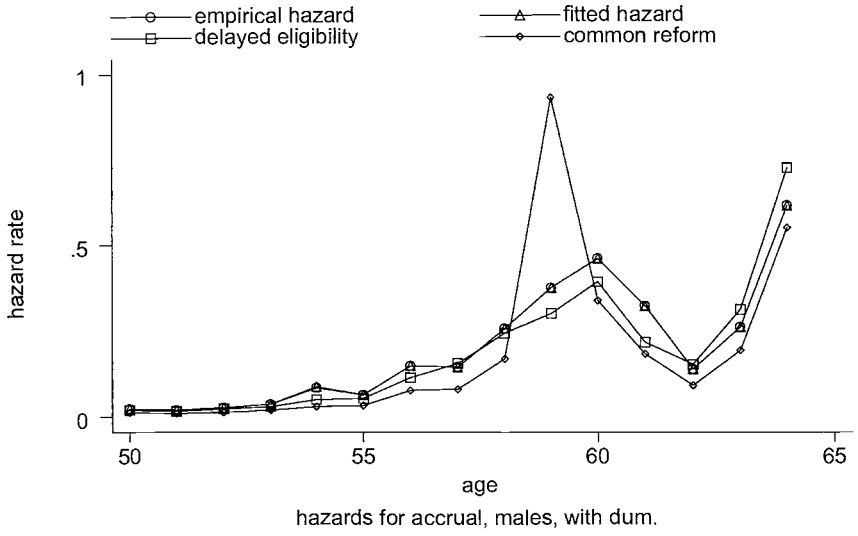


Fig. 8.5 Accrual, males, no dummies



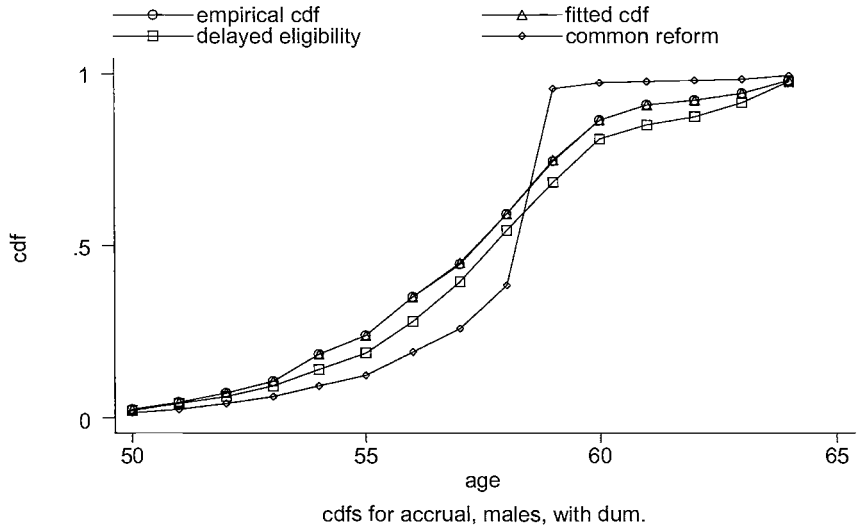
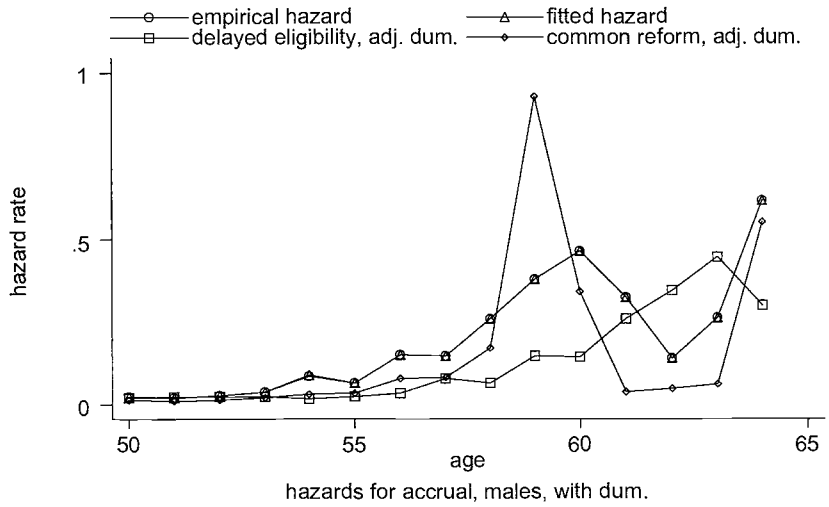


Fig. 8.6 Accrual, males, with dummies



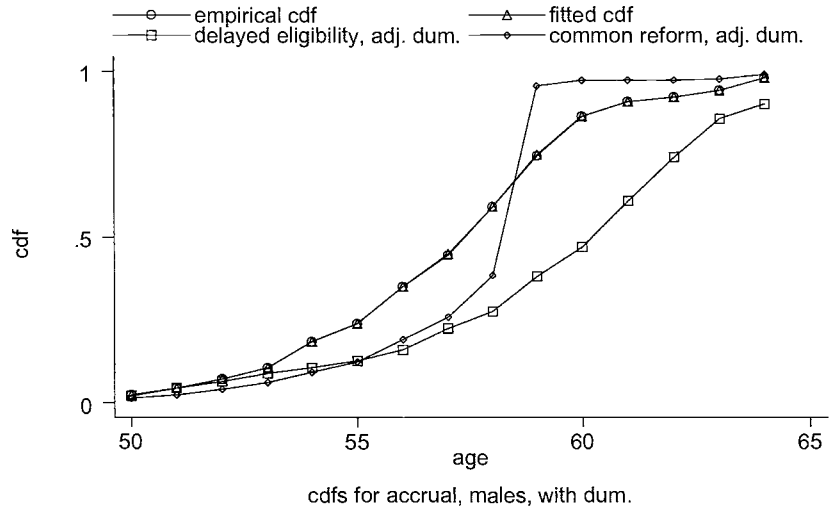
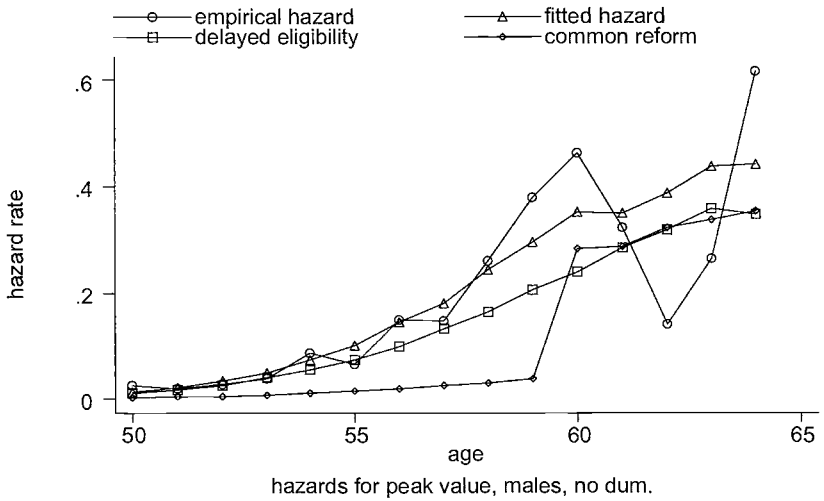


Fig. 8.7 Accrual, males, with dummies



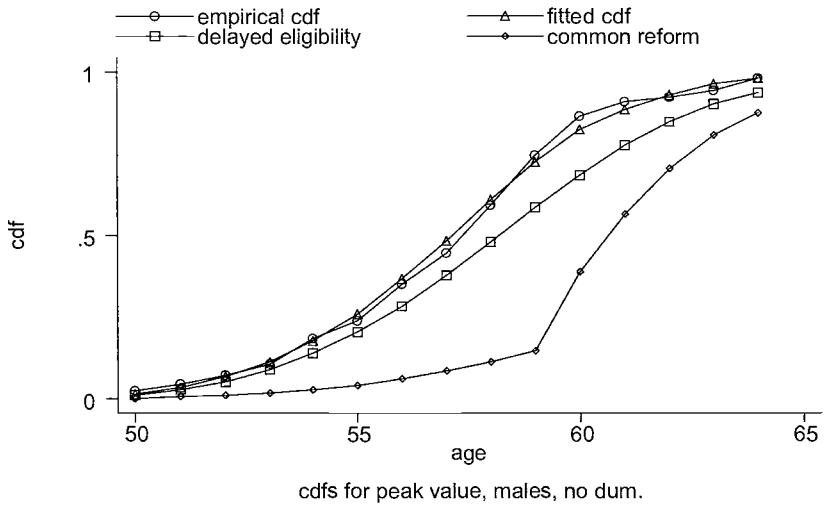
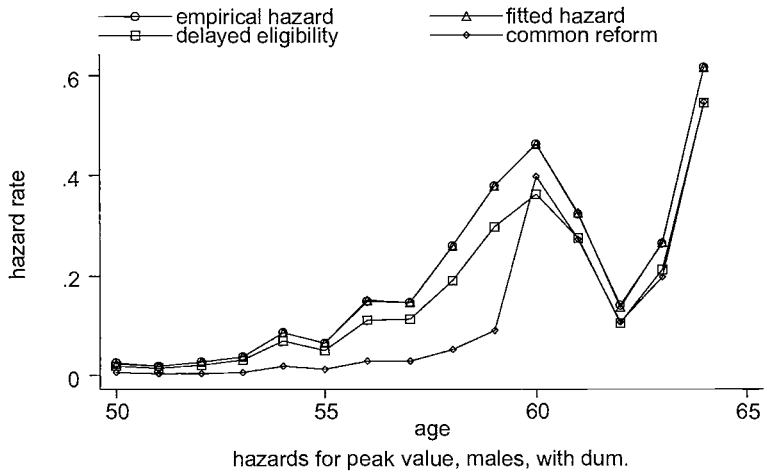


Fig. 8.8 Peak value, males, no dummies



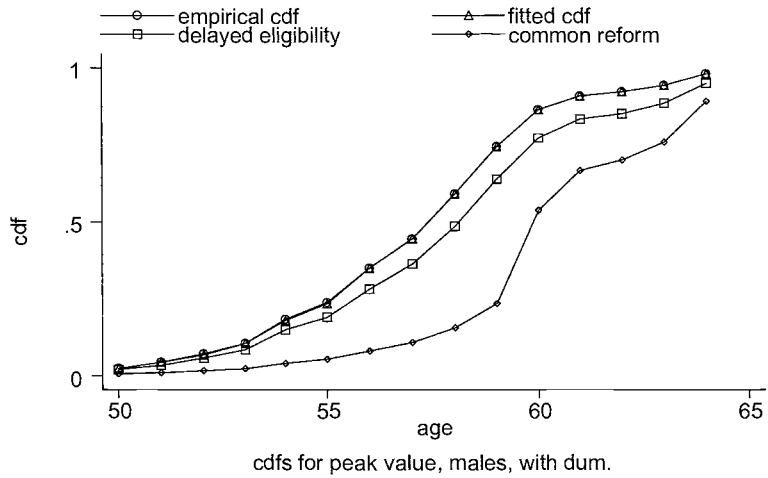
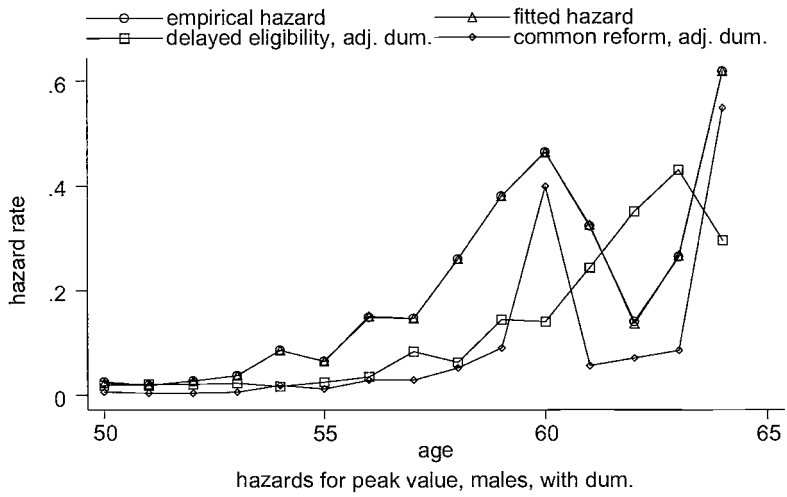


Fig. 8.9 Peak value, males, with dummies



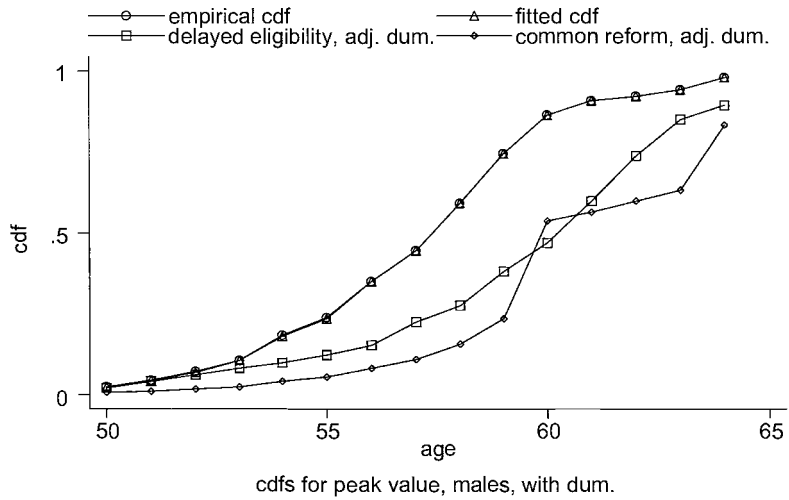
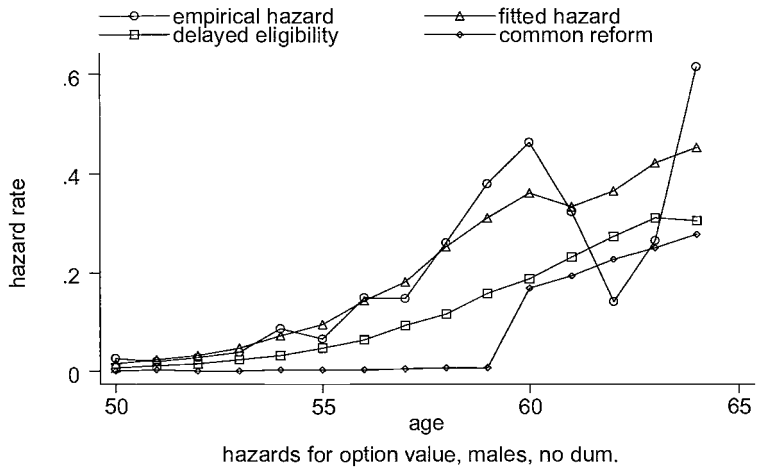


Fig. 8.10 Peak value, males, with dummies



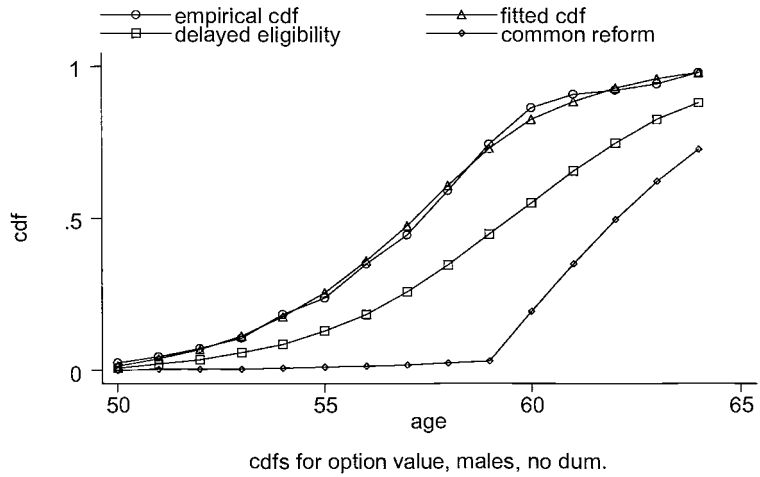
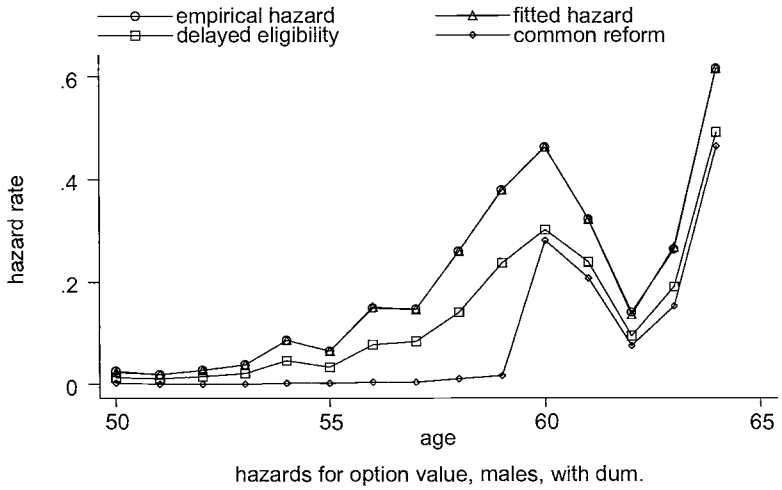


Fig. 8.11 Option value, males, no dummies



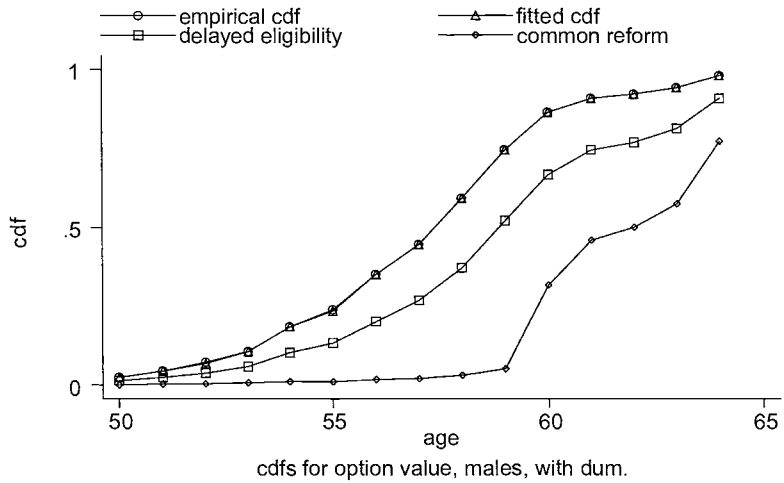
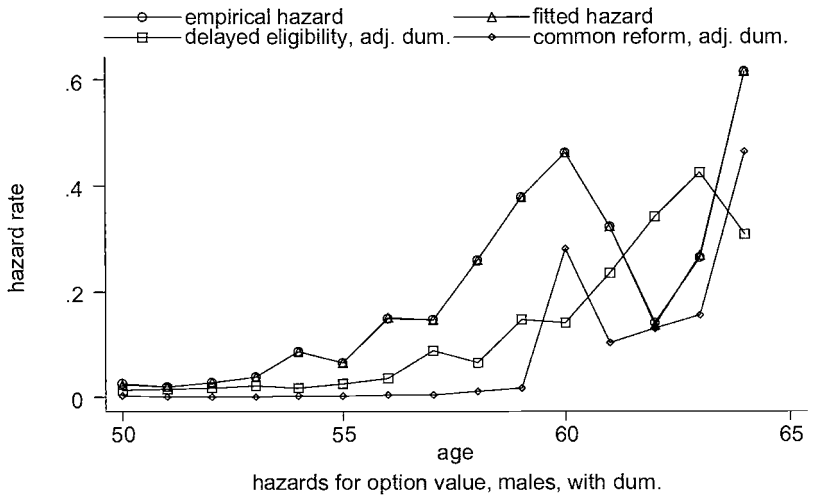


Fig. 8.12 Option value, males, with dummies



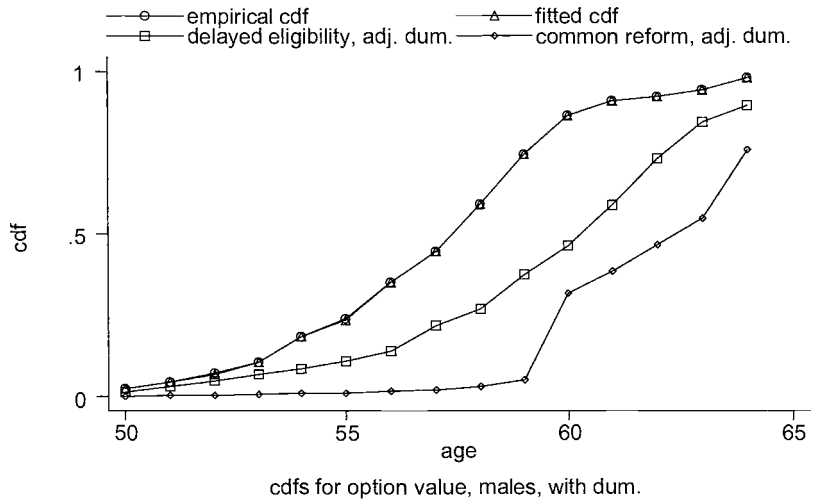


Fig. 8.13 Option value, males, with dummies

Table 8.12 **Average Retirement Ages under Different Policies**

	Delayed Eligibility	Common Reform
	Males	
Baseline	57.8	58.2
Accrual		
No dummies	58.2	58.0
With dummies	58.1	58.0
Adjusted dummies	59.9	61.2
Peak value		
No dummies	58.6	60.7
With dummies	58.4	61.6
Adjusted dummies	60.0	62.5
Option value		
No dummies	59.8	62.2
With dummies	59.4	62.4
Adjusted dummies	60.1	57.3
	Females	
Option value		
No dummies	57.6	58.7
With dummies	57.6	58.6
Adjusted dummies	59.0	58.8

and the bottom panel shows the corresponding cumulative distribution functions (CDFs).[7] Within each top panel we show the empirical hazards, the hazard as predicted by the fitted model, and then the hazards according to the two policies considered (delayed eligibility and common reform). The bottom graphs show the corresponding CDFs. Notice that we have nine graphs in total: three incentive measures and three simulations per policy measure. In addition table 8.12 presents the average retirement ages under the different policies and for the different model specifications. The average retirement ages have been calculated under the assumption that everyone retires at age sixty-five at the latest.[8] This involves an underestimation of the true average; probably not by much for actual retirement (labor force participation after sixty-five is less than 5 percent in the Netherlands), but for simulations where participation is still substantial at age sixty-four, our calculation of mean retirement may be off by a non-negligible amount.

7. The CDFs are related to the hazards as follows. Let the hazards beλ_{50}, λ_{51}, λ_{52}, and so forth. Then the corresponding values of the CDF are $c_{50} = \lambda_{50}$; $c_{51} = c_{50} + \lambda_{51}(1 - c_{50})$; $c_{52} = c_{51} + \lambda_{52}(1 - c_{51})$; and so forth.

8. The calculation of the CDF (see note 7) yields values of the retirement density equal to $d_{50} = \lambda_{50}$; $d_{51} = \lambda_{51}(1 - c_{50})$; $d_{52} = \lambda_{52}(1 - c_{51})$; and so forth. The mean retirement age is computed as $\Sigma(t = 50 \cdot \cdot 64)\, d_{\tau}\tau + (1 - c_{64})65$. The last term is based on the assumption that at age sixty-five everyone retires.

As noted before, the estimation results for accrual are economically implausible and inferior to the results for option values on statistical grounds. Although the results for accrual have been included for completeness, we will not discuss them any further. First, then, consider the outcomes for peak value. Not surprisingly, the specifications including age dummies do a better job in reproducing the observed hazard rates than the specifications without the age dummies: For the specifications with age dummies, observed and fitted hazard rates are essentially equal.

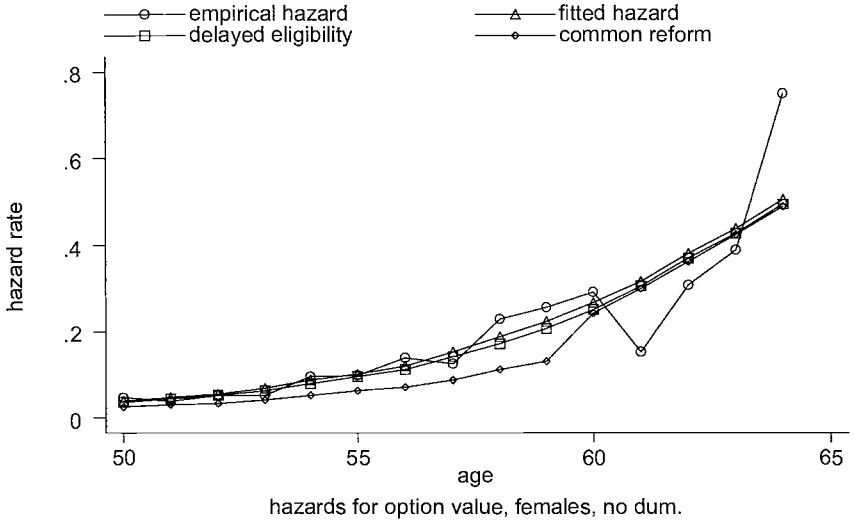
Clearly, the common reform has a much more dramatic effect on the average retirement age than the delayed-eligibility policy. The graphs show that under the common reform, the retirement hazard jumps at age sixty, except for one case (figure 8.10): The CDF for the common reform remains uniformly below the CDF for the delayed-eligibility policy. Although the specifications with age dummies show smaller policy effects than the specifications without dummies, the differences are not large (at least not for our preferred incentive measure, the option value). If, in the specification with age dummies, we adjust the dummies, the size of the policy effects increases somewhat.

Since the estimation results for women were generally not significant, we only pay limited attention to the simulation results for females. The bottom part of table 8.12 and figures 8.14–8.16 present the results for option value as an incentive variable. By and large, the policy effects are minor, in line with the small and statistically insignificant effects found in estimation.

8.9 Conclusion

In this paper, we have tried to estimate the incentive effects of the various programs providing earnings-replacing benefits upon the decision to retire in the Netherlands. Despite the fact that we are hampered by a lack of information with respect to the actual eligibility for these programs, we find significant effects for the peak and option values for males, in particular. Moreover, we think these results can be improved upon by a more sophisticated method that takes into account the (unknown) eligibility for the various programs.

Preliminary simulations show that changing the incentives can have considerable effects on the average retirement age, for example. This is important for a period in which increasing the labor force participation of the elderly is a major policy objective, both for decreasing the mounting shortages on the labor market and for guaranteeing the sustainability of the pay-as-you-go SS system.



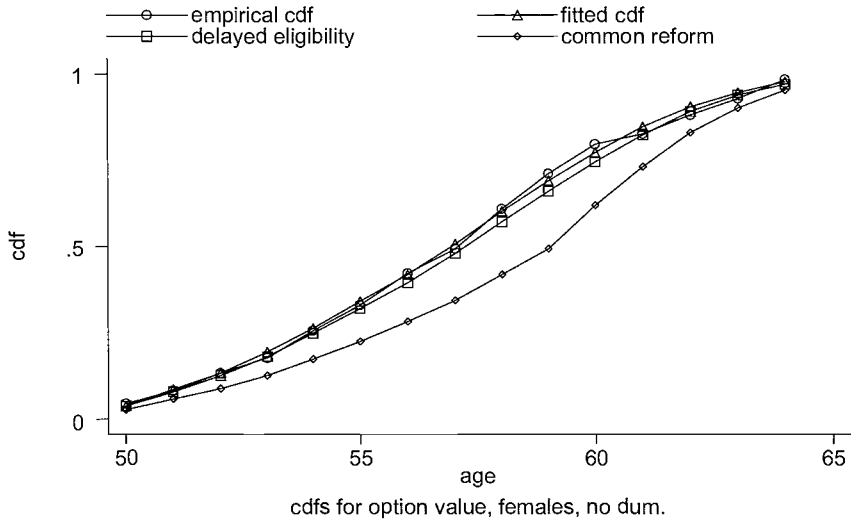
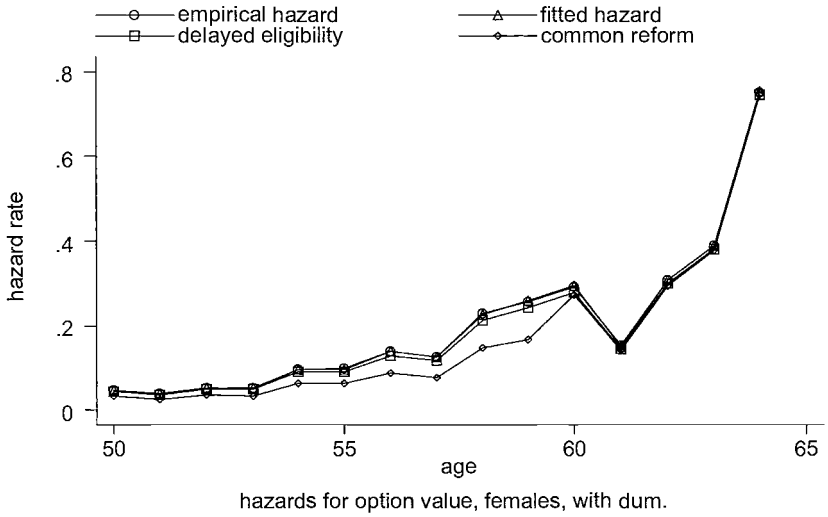


Fig. 8.14 Option value, females, no dummies



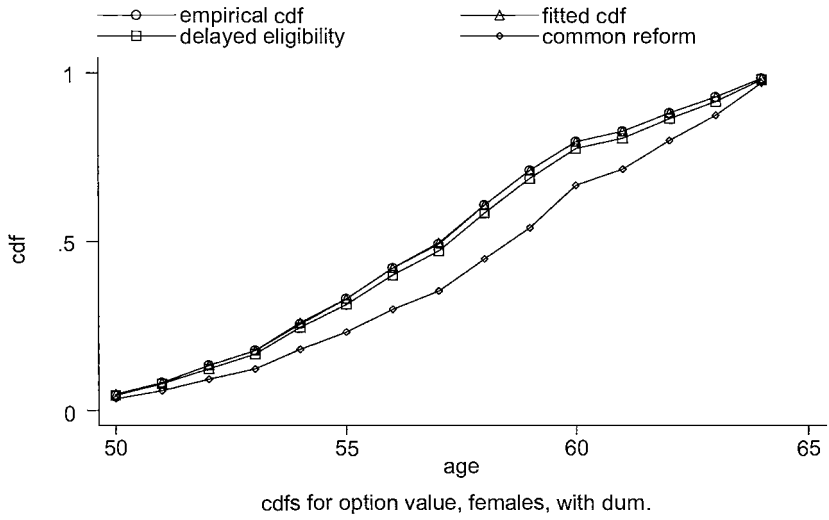
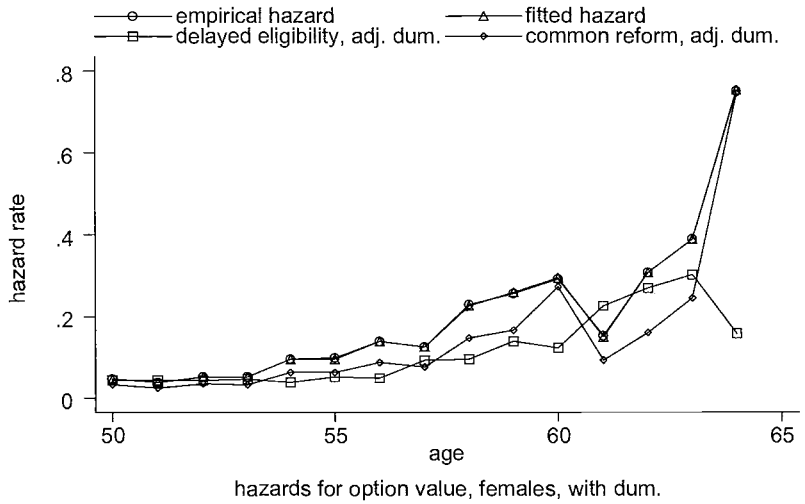


Fig. 8.15 Option value, females, with dummies



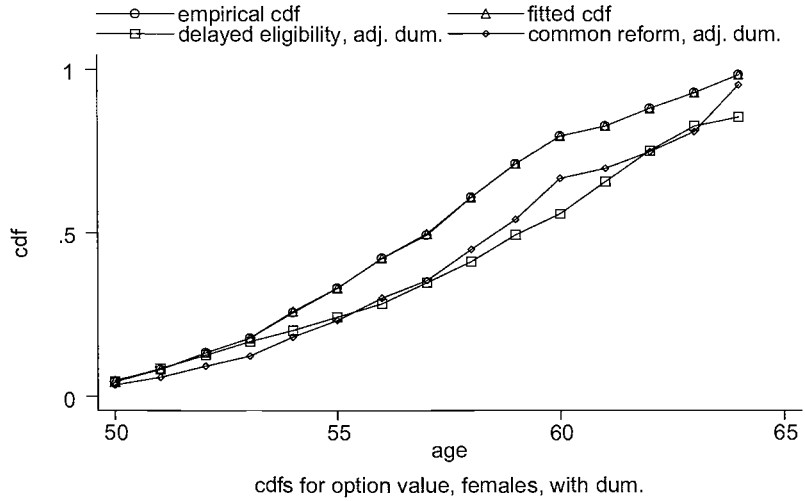


Fig. 8.16 Option value, females, with dummies

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