Volume Title: Social Security Programs and Retirement around the World: Micro-Estimation

Volume Author/Editor: Jonathan Gruber and David A. Wise, editors

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-31018-3

Volume URL: http://www.nber.org/books/grub04-1

Publication Date: January 2004

Title: Estimating Models of Retirement Behavior on French Data

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URL: http://www.nber.org/chapters/c10702

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# Estimating Models of Retirement Behavior on French Data

Ronan Mahieu and Didier Blanchet

## 4.1 Introduction

The pension debate in France has essentially focused, until recently, upon ways of financing retirement, with a strong opposition between supporters of maintaining the quasi-exclusivity for pay-as-you-go (PAYG) financing and supporters of a progressive introduction of funded pensions, in addition to the existing PAYG basic and complementary schemes. However, attention has shifted recently toward another variable of adjustment to the new demographic context, which is the age at retirement or, more widely, the age at exit from the labor force (Bommier, Magnac, and Roger 2001). The mean age at retirement in France is in the lower tail of the European distribution and has kept on diminishing for the past twenty years for two main reasons.

- The incentive structure of the pension system, itself creates issues, especially since the introduction of the *retraite à 60 ans.* Until 1982, the first age of eligibility to social security (SS) benefits was sixty-five, and it was shifted to sixty for all wage earners in 1983. Retirement before reaching a total tenure of 37.5 years remained strongly penalized in the *régime général,* which covers about 65 percent of wage earners, but this constraint did not bind most older male workers (since they often

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We thank the Direction de la Recherche, des Etudes, de l'Evaluation et des Statistiques (DREES) for access to data from the *Echantillon Interrégime de Retraités.* We also thank Béatrice Sedillot, Thierry Magnac, and Guy Laroque for their useful comments. The usual disclaimer applies.

began to work about age fifteen) and thus did not prevent a continuous decline in participation rates.
- The relative generosity of unemployment benefits or early retirement provisions before this age of sixty is the second reason. As unemployment rose in the 1970s, the generosity of these schemes was expanded, allowing people aged between sixty and sixty-five to retire. When the early retirement age was set at sixty, unemployment or early retirement provisions were targeted at people aged fifty-five to fifty-nine, whose participation rates also sharply decreased.

Age at retirement appears to be the key economic variable for potential adjustments. A first step in the direction of increasing employment rates was the 1993 reform of the *régime général,* which planned a progressive strengthening of the conditions giving access to "normal" (full-rate) retirement at age sixty: The previous condition was the accumulation of at least 150 quarters (or 37.5 years) of contributions to pension schemes. This threshold progressively increases to reach 160 quarters (i.e., forty years) from 2003. One of the propositions discussed in the Charpin report (Charpin 1999; ordered by the prime minister) is to go further in the same direction, raising this threshold to 170 quarters.

Of course, modifying this state of affairs raises many issues. Early retirement policies are historically a response to an employment shortage, and it is often feared that less permissive policies may worsen the situation on the labor market. Conversely, policies of early withdrawal from the labor force have never proved to be of any help in mitigating employment problems (unemployment reached a peak at 12.4 percent of the labor force in 1997, which was high compared to other European countries). Another issue is identifying the best way to induce people to leave the labor force later. A first possibility is coercion. A second one preferably relies on incentives, with the idea to compensate for the desired increase of the average retirement age by the introduction of more flexibility in this retirement age (Taddei 2000). This is specifically the option proposed by the Charpin report, which suggests to compensate for the strengthening of conditions necessary to get a normal pension at age sixty with a reduction of penalties associated with either anticipating or postponing retirement. The French system is characterized by a strong deviation from marginal actuarial fairness, and the proposition consists in bringing it closer to this rule.

This context calls for closer inspection on what factors determine retirement behavior, from both demand and supply sides. The analysis presented below will essentially focus on supply-side effects, although we shall try, systematically, to remind the reader of the importance of the demand side.

We shall proceed in five steps. We shall first recall the features of the

French pension system, which will be necessary to understand the rest of the paper (section 4.2). The analysis will concentrate on two subpopulations: wage earners belonging to the private sector and civil servants. We shall give a detailed account of rules governing pensions for these two categories, including possibilities of early exit from the labor force, through either early retirement or specific features of unemployment insurance.

We shall then describe data sets that are used and explain why we focused the analysis on three specific cohorts: cohort 1930 for workers in the private sector and cohorts 1930 and 1932 for civil servants (section 4.3). We shall then move to a descriptive analysis of incentives to withdraw from the labor force that applied to these cohorts, given their specific histories. This analysis completes the one performed earlier on this specific sample by Blanchet and Pelé (1999; section 4.4).

These incentives will then be introduced in probit models of withdrawal from the labor force (section 4.5). Section 4.6, at last, will present simulations derived from these models.

## 4.2 Basic Facts about the French Pension System

### 4.2.1 The General Structure

The French system is complex, but its structure can nevertheless be summed up quite simply. For a large part of the population (wage earners in the private sector), pensions rely on two compulsory pillars.

- The basic general scheme (SS) offers benefits corresponding to the share of gross wages below a SS ceiling (€2,352 per month in 2002). In 1992, 70.5 percent of people aged sixty or older received benefits from this general scheme. On the contributors' side, in the same year, the general scheme gathered 64.8 percent of the labor force.
- Complementary schemes are organized on a occupational basis. They consist of a large number (about 180) of specific schemes that are federated in two main organisms, ensuring interscheme demographic compensation: the Association Générale des Institutions de Retraite des Cadres (AGIRC) for executive workers, which applies only to the fraction of their wages over the SS ceiling, and the Association des Régimes de Retraite Complémentaire (ARRCO) for other workers' and executives' wages below the ceiling. In 1972, contributing to a complementary scheme became compulsory. Today, complementary schemes provide 40 percent of pensions for wage earners in the private sector. Receiving a complementary pension is conditioned on receiving SS benefits.

Besides this simple two-pillar structure, the complexity of the French system is essentially due to the existence of a large number of exceptions to

this general rule of organization. These exceptions are the result of two factors. When SS was created in 1945, people who already benefited from more generous dispositions refused to join the new system (for instance civil servants or people employed in large state-owned companies). Conversely some categories chose cheaper systems offering lower protection because they thought that a large part of their retirement needs was likely to be covered by other sources, such as professional assets for the self-employed. Besides the two-pillar system constituted by the general scheme and ARRCO and AGIRC, there are a multiplicity of specific schemes (e.g., those for civil servants and the self-employed) applying specific rules. In particular, it must be observed that civil servants are not really covered by an autonomous pension system, since their pensions are directly paid on the state budget.

For all categories of people, there is, at last, a system of old-age minimum allowance (*minimum vieillesse*), which is a means-tested allowance available for people aged sixty-five or older. The population benefiting from this minimum pension has regularly declined in the past, due to the increasing maturity of normal pensions. It is now slightly below 1 million, compared to 2.55 million in 1959 (Commissariat Général du Plan 1995).

The following analysis will deal with two subpopulations: wage earners from the private sector and civil servants. We now give more details about the computation of pensions for these two categories.

### 4.2.2 Wage Earners in the Private Sector: Rules for the General Regime

The basic general scheme offers contributory benefits corresponding to the share of wages below the SS ceiling. The SS benefits are proportional to the number of quarters of contribution to the system (truncated to $N_{\max}$ quarters), and to a reference wage that, until 1993, has been the average wage of the $D$ best years of the pensioners' career (past nominal wages being reevaluated at time of liquidation according to a set of retrospective coefficients). The equation giving the initial pension level is therefore

$$\text{Pension} = \alpha \times \left( \frac{N \text{ of quarters, truncated to } N_{\max}}{N_{\max}} \right) \times (\text{average wage of the } D \text{ best years}) \tag{1}$$

with the proportionality coefficient $\alpha$ being itself modulated. It is maximal when the pensioner leaves at age sixty, with $N'_{\max}$ quarters of contributions or more to all pension schemes: In that case, its value is set at 50 percent, and this exactly ensures a replacement rate of the reference wage (not necessarily the last wage) equal to 50 percent. The same value of $\alpha$ also applies whatever the number of years contributed when the individual leaves at age sixty-five. In all other cases, the coefficient is reduced (table 4.1)

**Table 4.1** **Value of α Depending on Age at Receipt of First Benefit and *N*, Number of Quarters of Contribution to the General Regime**

| | Age (%) | | | | | |
|---|---|---|---|---|---|---|
| *N* | 60 | 61 | 62 | 63 | 64 | 65 |
| 32.5 | 25 | 30 | 35 | 40 | 45 | 50 |
| 33.5 | 30 | 30 | 35 | 40 | 45 | 50 |
| 34.5 | 35 | 35 | 35 | 40 | 45 | 50 |
| 35.5 | 40 | 40 | 40 | 40 | 45 | 50 |
| 36.5 | 45 | 45 | 45 | 45 | 45 | 50 |
| ≥37.5 | 50 | 50 | 50 | 50 | 50 | 50 |

- Either by 1.25 percentage point for each quarter missing to reach the value of $N'_{max}$ quarters;
- Or by 1.25 percentage point for each quarter missing to reach age sixty-five, the adjustment actually applied being the one that leads to the most favorable outcome for the pensioner (see table 4.1).

For cohorts born before 1934, $N'_{max} = N_{max} = 150$. Access to the full rate is also possible before sixty-five for people having less than 150 quarters if they are considered as disabled or suffer from handicap.

Values of $N'_{max}$ and $D$ are currently changing, while $N_{max}$ remains set at 150. As mentioned in the introduction, the value of $N'_{max}$ should reach 160 quarters when the 1993 reform fully produces its effects (cohorts born from 1943). The same reform also scheduled a progressive increase of $D$, up to twenty-five years (to be reached for cohorts born from 1948). But for the cohorts considered here, the rules are the ones that prevailed between 1983 (when the possibility of retiring at age sixty was generalized) and 1993—that is, $N'_{max}$ equals 150 (37.5 years) and $D$ equals ten years.

This system means that the number of years of contributions affects the pension level in two ways, which may imply, in some cases, a very strong dependency between the age at retirement and the level of SS benefits. To provide a full understanding of this interaction, table 4.2 shows the consequences of this system, with pre-1993 parameters, for three reference cases with individuals arriving at age sixty with, respectively, twenty-five, thirty, and thirty-five years of contribution.

- The first individual has to wait until age sixty-five to get retirement at a full rate α (50 percent). Nevertheless, their pension is reduced by the fact that they only have 120 quarters of contribution at this age. Their replacement ratio is therefore only equal to four-fifths (120 quarters divided by 150) of the maximum replacement ratio, which is equal to 50 percent. Note that, at each age lower than sixty-five, the downward adjustment of α is here computed on the basis of the number of years

**Table 4.2** **Replacement Rate Provided by the General Regime and the Civil Servants Regime for Three Reference Cases**

| Age | Tenure (years) | α (General Retime) (%) (1) | α (Civil Servants) (%) (2) | No. of Years/ 37.5 (3) | Replacement Ratio (General Regime) (%) (1) × (3) | Replacement Ratio (Civil Servants) (%) (2) × (3) |
|---|---|---|---|---|---|---|
| | | | | *Individual A* | | |
| 60 | 25 | 25 | 75 | 0.667 | 16.7 | 50.0 |
| 61 | 26 | 30 | 75 | 0.693 | 20.8 | 52.0 |
| 62 | 27 | 35 | 75 | 0.720 | 25.2 | 54.0 |
| 63 | 28 | 40 | 75 | 0.747 | 29.9 | 56.0 |
| 64 | 29 | 45 | 75 | 0.773 | 34.8 | 58.0 |
| 65 | 30 | 50 | 75 | 0.800 | 40.0 | 60.0 |
| | | | | *Individual B* | | |
| 60 | 30 | 25 | 75 | 0.800 | 20.0 | 60.0 |
| 61 | 31 | 30 | 75 | 0.827 | 24.8 | 62.0 |
| 62 | 32 | 35 | 75 | 0.853 | 29.9 | 64.0 |
| 63 | 33 | 40 | 75 | 0.880 | 35.2 | 66.0 |
| 64 | 34 | 45 | 75 | 0.907 | 40.8 | 68.0 |
| 65 | 35 | 50 | 75 | 0.933 | 46.7 | 70.0 |
| | | | | *Individual C* | | |
| 60 | 35 | 37.5 | 75 | 0.933 | 35.0 | 70.0 |
| 61 | 36 | 42.5 | 75 | 0.960 | 40.8 | 72.0 |
| 62 | 37 | 47.5 | 75 | 0.987 | 46.9 | 74.0 |
| 63 | 38 | 50 | 75 | 1.000 | 50.0 | 75.0 |
| 64 | 39 | 50 | 75 | 1.000 | 50.0 | 75.0 |
| 65 | 40 | 50 | 75 | 1.000 | 50.0 | 75.0 |

needed to reach age sixty-five, rather than the number of quarters missing to reach a value of *N* equal to 150, since the rule consists in applying the most advantageous of the two adjustments.

- The second individual also has to wait until age sixty-five to get the full rate α, but benefits at this age are at a higher replacement rate, equal to fourteen-fifteenths (120 quarters divided by 150) of the maximum replacement ratio of 50 percent. In this case again the downward adjustment before age sixty-five is based on the number of years needed to reach this age of sixty-five.
- The third person will not have to wait until age sixty-five. They benefit from the maximum replacement rate as soon as they reach a cumulated number of years of contributions equal to 150 (i.e. at sixty-two-and-one-half years). If they decide to leave between age sixty and this sixty-two-and-one-half years, the downward adjustment will then be computed according to the number of years missing to reach the total of 150 contributed quarters, rather than the number of years needed to reach age sixty-five, since the first rule is now the most generous. Note

also that, for this person, working past sixty-two-and-one-half years does not increase their SS entitlements.

Some additional observations must be added to this presentation of the general scheme.

- Some people were successively affiliated to different schemes, especially in older cohorts (for instance, people transiting from agriculture or self-employment to the status of wage earner in the industry or in services). These people will cumulate two basic pensions: one from their initial scheme and one from the general scheme. The latter one will be proportional to the number of years spent in this scheme, according to equation (1), yet coefficient $\alpha$ will be evaluated taking into account the *total* number of years contributed, regardless of the scheme. Reductions of $\alpha$, furthermore, do not apply in a certain number of cases: veterans, disabled workers, and female workers with twenty-four contributed years who have raised three children.
- Equation (1) also implies that pensions, at the time they are claimed, are computed in current euros. They are then reevaluated each year on a discretionary basis. During the 1970s and early 1980s, the general policy was to overindex these pensions (with respect to the average gross wage), in order to suppress the initial gap between standards of living of workers and pensioners. Since the mid-1980s, the practice has consisted rather in an indexation on prices. This practice has been confirmed by the 1993 reform.
- When the average annual wage ($D$ best years) falls below a floor (about €12,000 in 2000), it is raised to the level of that floor for individuals who can claim a full-rate pension. These provisions (the *minimum contributif*) mainly concern women who had part-time jobs or whose careers were short and whose annual earnings are thus very low. They involve an additional strong incentive to postpone retirement until the full-rate threshold.
- For women, $N_{\max}$ and $N'_{\max}$ are increased by two years for each child they bred. Moreover, people (either men or women) who bred at least three children enjoy a 10 percent increase in their basic pension.

### 4.2.3 Wage Earners from the Private Sector: Complementary Schemes

These schemes are almost fully contributory and are organized in a defined-contribution way (although they are not funded). Workers accumulate "points" during their careers, which are the pension's basic unit of calculation.

- The points are accumulated during workers' careers in proportion to their contributions: The contribution rate is fixed, and €1 contributed

in year $t$ is considered as equivalent to the formal buying of $1/\mathrm{PP}_t$ points, where $\mathrm{PP}_t$ is the purchase price of one point (the official term for this purchase price is *salaire de référence*).
- The pension is then equal to the total number of points accumulated over the pensioner's career, multiplied by a coefficient $V$ (the official term being *valeur du point*), which is fixed every year.

For a pensioner who started working at time $t_0$ and stopped at time $t_1$, the pension level at time $t$ can therefore be written as

$$\text{Pension} = V(t_1) \cdot \sum_{t'=t_0}^{t_1} \frac{\tau(t')w(t')}{\mathrm{PP}(t')}, \tag{2}$$

where $\tau(t')$ and $w(t')$ are respectively the contribution rate and the worker's wage at time $t'$. As explained before, only a fraction of the wage is taken into account for computing contributions and points accumulated each year:

- For executives, contributions are collected by ARRCO for the part of the wage below the ceiling, and by AGIRC for the segment of the wage comprised between the SS ceiling and four times the ceiling; and
- For nonexecutives, the wage is truncated to three times the SS ceiling and contributions are collected by ARRCO.

Concerning retirement age in these complementary schemes, normal retirement theoretically remains at age sixty-five even after the 1983 reform, which introduced retirement at age sixty in the general scheme. For retirement below sixty-five, a quasi-actuarial adjustment is supposed to be applied. But since the 1983 reform, this adjustment is not applied to people who fulfill the conditions for a basic retirement at full rate (more than 37.5 years of contribution).

### 4.2.4 Civil Servants

Civil servants have a unique pension scheme, directly financed by the state budget. As a general rule, claiming the pension is possible at age sixty if people have at least fifteen years of service. A rather large minority, however, can leave beginning at age fifty-five: primary-school teachers, policemen, prison officers, and the like. For women who have bred at least three children, the age condition is completely relaxed (but the fifteen-years-of-service condition remains valid). The benefit formula is

$$\text{Pension} = 0.75 \times \left( \frac{N \text{ of quarters, truncated to } N_{\max}}{N_{\max}} \right) \times (\text{last gross wage, excluding bonuses}). \tag{3}$$

The pension is a proportion of the last gross wage. Note that this gross wage excludes bonuses, which represent up to 50 percent of the total net in-

come for some specific categories (i.e., the ones with the highest incomes): These bonuses remain insignificant for most civil servants working for the Education Department, which is the largest employer.

The key variable is the number of years a civil servant worked. Each year entitles him to a 2 percent annuity (table 4.2), the sum being truncated to 75 percent. Once this basic annuity is computed, some other periods may be taken into account: The most important provision is the additional year given to women for each child they bred. Each additional year also yields an additional 2 percent annuity that may increase the basic annuity up to 80 percent. Finally, people (either men or women) who bred at least three children enjoy a substantial increase in their pension. This increase is 10 percent if they have bred three children and 5 percent for every additional child. These provisions are roughly the same as in the private sector.

Note that this system strongly differs from the general regime as regards incentives to retire early: Let us consider the example of people reaching the legal minimum age of retirement with only 32.5 years contributed and who decide to claim immediately for their benefits. The civil servant's replacement rate is 65 percent (instead of 75 percent for a complete career). The private sector wage earner's replacement rate (basic pension only) is 21.7 percent (instead of 50 percent for a complete career).

### 4.2.5 Other Regulations Concerning Age at Retirement: Mandatory Retirement and Eligibility to Early Retirement

Mandatory retirement as such only exists for civil servants or within specific schemes. The age for mandatory retirement is generally sixty-five, with some exceptions either below that age (e.g., militaries, etc.) or above (very limited categories are allowed to work until age sixty-eight, such as academics).

In the private sector, a firm is not allowed to layoff a worker according to any age criterion. Yet it is allowed to do so when this worker reaches the conditions to get a full-rate SS pension. Given the employment context of the 1990s—and the relatively large wage gap between elder and younger workers—it is quite likely that firms will quasi-systematically make use of this possibility. A consequence, which shall be recalled later when interpreting results, is that decisions to retire at the age where people get the full rate may be interpreted as demand-side as well as supply-side decisions.

Supply- and demand-side aspects are also strongly intertwined for all forms of early retirement. Early retirement developed in France in several steps. We shall only describe rules set in after the 1983 reform, that is, after the generalization of possibilities to retire at age sixty. There are two main paths to early exit from the labor force:

- One is through unemployment insurance. People falling into unemployment are entitled to a compensation for a limited period of time,

and the level of unemployment benefits, from 1992 to 2001, was decreasing with the duration of unemployment. But these rules do not apply to people losing their jobs past a certain age (fifty-seven until mid-1993, when it was raised to fifty-eight) who can benefit from a full compensation until they are able to benefit from a normal SS pension at a full rate. This system is not officially described as an early retirement system, and people cannot enter into it completely freely: They can do so only if they have been explicitly laid off by their employers. Yet this system is more or less equivalent to an early retirement scheme;

- The second path for early exit is the *Fonds National pour l'Emploi* (FNE; National Fund for Employment). The level of early retirement benefits is roughly similar to the level of unemployment benefits. People benefiting from this system can leave the labor force around fifty-eight with benefits maintained until access to a full-rate pension in the general regime. The difference with the former path is that this system is under direct control by the state: Access to the FNE only concerns workers laid off in the context of a social plan negotiated between the firm and the state, with some compensations offered by the firm (for instance, a commitment to hire new young workers).

## 4.3 Data Description and Scope of the Present Study

### 4.3.1 Empirical Observations and Research on Labor Force Trends at Older Ages

How do these institutional rules affect aggregate labor force participation at older ages? In 1998 (table 4.3), employment rates reached 75 percent for people aged fifty to fifty-four, but sharply decreased thereafter to 53 percent for the fifty-five to fifty-nine age group and only 12.4 percent (most of them being self-employed) for the sixty to sixty-four age group. Participation rates are close to zero after sixty-five. Very few self-employed retire before sixty, but exit rates are high from fifty-five for wage earners.

**Table 4.3** **Labor Market Participation, by Age Group**

| | | Employed | | | |
|---|---|---|---|---|---|
| Age | Cohort | Public Sector | Private Sector | Self-Employed | Not Working |
| 50–54 | 1944–48 | 22.6 | 33.4 | 18.8 | 25.2 |
| 55–59 | 1939–43 | 13.3 | 21.9 | 18.0 | 46.8 |
| 60–64 | 1934–38 | 2.5 | 3.5 | 6.4 | 87.6 |
| 65–69 | 1929–33 | 0.0 | 0.3 | 1.2 | 98.5 |

*Source:* INSEE, 1998 *Financial Assets Survey.*

As mentioned in the introduction, for men, this is the result of a large decrease in labor force participation after age fifty over the past twenty years. The share of men employed at ages fifty-five, sixty, and sixty-five decreased from 83.4 percent, 47.0 percent, and 14.7 percent, respectively, in 1983 to 78.5 percent, 32.1 percent, and 4.9 percent in 1998. Nonetheless, the regular decrease in male employment rates appears to have slowed down since 1997, due to the economic recovery. For women, current figures are the result of the combination between this tendency to earlier exits from the labor force and the impact of the long-run increase in overall labor force participation between successive cohorts. The decline at ages fifty-five to fifty-nine and sixty to sixty-four has been lower than for men: from respectively 29.1 percent and 9.4 percent in 1983 to 25.9 percent and 5.9 percent in 1998. And the trend remained positive in the age group fifty to fifty-four: from 52.2 percent to 57.9 percent over the same period.

About 8 percent of the population received public benefits (mainly unemployment benefits) between fifty and fifty-four in 1998 (table 4.4). This figures reaches 23.7 percent between fifty-five and fifty-nine, due to unemployment, early retirement (in the private sector), or SS benefits (for a strong minority of civil servants). Between sixty and sixty-four, 72.7 percent of the population receives public benefits (mainly SS benefits).

Previous research on retirement behavior in France is relatively scarce, partly because economists lacked suitable data until appropriate administrative files were built. Moreover, individuals were so heavily constrained by SS incentives that explaining actual behaviors did not require a sophisticated approach (in econometric terms, for instance). In the first part of this project, Blanchet and Pelé (1999) showed that incentives to retire at the full rate were very strong, and Pelé and Ralle (1997), using a lifecycle model (based on an intertemporal budget constraint), demonstrated that retiring at the full rate was consistent with a rational utility-maximizing behavior.

Of course, retirement cannot entirely be explained by SS incentives: Analyzing early retirement behaviors in France as a three-player game (the firm, the employee, and the government) may be of great interest, but once again, the lack of appropriate firm data did not allow for a comprehensive analysis of individual behaviors concerning early retirement.

**Table 4.4** **Part of the Population Receiving Public Benefits, by Age Group**

| Age | Cohort | SS Benefits | ER Benefits | UI Benefits | Total |
|---|---|---|---|---|---|
| 50–54 | 1944–48 | 1.3 | 0.0 | 7.2 | 8.5 |
| 55–59 | 1939–43 | 9.4 | 6.0 | 8.3 | 23.7 |
| 60–64 | 1934–38 | 68.9 | 1.4 | 2.4 | 72.7 |
| 65–69 | 1929–33 | 86.2 | 0.0 | 0.0 | 86.2 |

*Source:* INSEE, 1998 *Financial Assets Survey.*

*Notes:* ER = early retirement; UI = unemployment insurance.

### 4.3.2 The Data Set: The *Echantillon Interrégime de Retraités*

Few systematic data sets exist in France concerning the economic situation of retired people. Income surveys only give instantaneous and imperfect pictures of transfer-income benefits to retirees: They do not allow the reconstitution of past labor income that would allow the evaluation of what these transfers would have been if pensioners had made other choices concerning their age at retirement.

Some other specific surveys were also realized to analyze the transition between activity and retirement (e.g., a questionnaire on this topic was added to the periodic *Labor Force Survey* in 1996). These surveys are especially useful for analyzing the variety of institutional paths from full-time activity to retirement (Heller 1985; Caussat and Roth 1997; and Burricand and Roth 2000) and provide some interesting information on standards of living before retirement. However, these surveys do not provide precise information on past wages and thus do not allow the computation of financial incentives to retirement. This is the reason why another approach has been developed since 1984 that consists of matching administrative data collected from all pension schemes that exist in France.

In practice, the only large-scale survey that is available and appropriate for the current study is a specific panel, the *Échantillon Interrégime De Retraités* (hereafter referred as EIR). The panel has been initially developed by the Service des Statistiques et des Systèmes d'Information (SESI),[1] the statistical unit within the Ministry of Social Affairs, in connection with the INSEE. For the first run in 1988, four cohorts of pensioners were selected: those born in 1906, 1912, 1918, and 1922. A total sample of 20,000 people belonging to these four cohorts was drawn by INSEE. Their national identification numbers were transmitted by INSEE to all existing pension schemes (more than 120 basic schemes and about 180 complementary schemes). All these pension schemes then had to search for these individuals in their records. If they were present, the information about their pension entitlements was then transmitted to the SESI, who then carried out the matching, for all individuals of the sample, of the information returned by all existing pension schemes.

The operation was renewed in 1993 and 1997. Each time, the same samples were redrawn for the cohorts included in the previous studies (and enlarged to compensate for mortality), and new cohorts added to the panel: cohort 1926 in 1993, cohorts 1930, 1932, 1934, 1936, 1938, 1940, and 1942 in 1997 (table 4.5). Since 1990, an additional matching has also been introduced with information from other administrative sources:

- The annual declarations of social data (DADS), made each year by firms, that allow retrieval of the wages of the sample participants over

1. See Dangerfield and Prangère (1996). Since 1998, the SESI has been integrated into a new department, the DREES, within the Ministry of Social Affairs.

**Table 4.5 The Structure of the Interregime Panel of Pensioners**

| Cohort | Pensions (if any) Observed In: 1988 | 1993 | 1997 | Wages and/or UI/ER Benefits Observed From:[a] |
|---|---|---|---|---|
| 1906 | × | | | |
| 1912 | × | × | × | |
| 1918 | × | × | × | |
| 1922 | × | × | × | |
| 1926 | | × | × | Age 59 → retirement |
| 1930 | | | × | Age 55 → retirement |
| 1932 | | | × | Age 53 → retirement |
| 1934 | | | × | Age 51 → retirement |
| 1936 | | | × | Age 49 → retirement |
| 1938 | | | × | Age 47 → retirement |
| 1940 | | | × | Age 45 → retirement |
| 1942 | | | × | Age 43 → retirement |

[a]One year missing (1990).

the years before retirement if these people were wage earners in the private sector or in state-owned companies;
- The wage files from the State Service for former civil servants; and
- Files from the Union Nationale pour l'Emploi dans l'Industrie et le Commerce (UNEDIC), the French system of unemployment insurance, for people in unemployment before retirement, allowing therefore the incorporation of the form of early retirement benefits offered by the UNEDIC and the FNE (see previous discussion).

This matching, however, does not allow a full reconstitution of past careers for these pensioners. The DADS, in particular, generally do not go back further than 1985, with one additional missing year in 1990. This matching, for this reason, has not been done for cohorts 1906, 1912, and 1918, for whom it would have been irrelevant.

Table 4.5 sums up the structure of data available in the panel. Our question has been to explore how these data could be best used for the estimation of model of retirement behavior for France. The choices which have been made resulted from two constraints:

- The need, conversely, to have people for whom the situation before retirement has been observed over a significant period, in order to be able to extrapolate what their standard of living would have been in case they would have retired later than they actually did; and
- The need to limit ourselves to cohorts for whom entry into retirement can be considered as fully completed. As detailed in the next subsection, our method for reconstructing individual pension entitlements under alternative retirement ages essentially relies on the pension level obtained at the *actual* retirement age. Of course, one possibility would have been, for people not yet retired, to evaluate entitlements on the

basis of past working records. But the length of our wage records was too short for such a reconstitution, and, for this population, our files did not provide any proxy at all for the key variable, which is the number of quarters of past contributions to SS.

The first constraint clearly ruled out cohorts 1906 to 1922. We also considered that wage data were too short on average for cohort 1926 (only two years of wages being observed for an individual of this cohort retiring in 1986). The second constraint, on the opposite, ruled out cohorts 1934 to 1942. Even if a significant share of these cohorts was retired in 1997, we would have missed the fraction retiring at sixty-five, which is precisely the fraction that brings the variance necessary to identify models. We considered that the same problem existed for workers from the private sector in cohort 1932. So that, for this category, we finally restricted ourselves to cohort 1930. For civil servants, however, we decided to use both cohorts 1930 and 1932, in order to increase somewhat the sample size, considering that the selection bias on cohort 1932 was lower than for the private sector and given an average age at retirement, which is lower in the public than in the private sector.

Concerning the key question of the definition of retirement, our data allowed two possible choices: either the age when people definitely leave the labor market or the age when people claim SS benefits. But this latter definition is not the most interesting from an economic point of view, since a huge majority of people in the private sector claim SS benefits as soon as they reach the full-rate age. It is more interesting to analyze the impact of SS provisions (and, if possible, preretirement or unemployment provisions) on the decision to definitely leave the labor market. We therefore decided to model the last year of recorded past employment using DADS data. This, of course, implies a restriction to people who are in paid employment in 1985, which limits our sample a bit further.

### 4.3.3 Reconstructing Wages and Pension Levels

What are the prerequisites concerning wage data in order to evaluate incentives to retire at different ages? A priori, wage data are needed for two things:

- Full wage histories are necessary to know how pension entitlements change with age at retirement, and
- A projection of wages is also necessary to evaluate earnings foregone in case of exit from the labor force.

As stated before, our data do not go back earlier than the mid-eighties, so wage histories in our sample are strongly truncated. As mentioned, a reconstitution of wages for earlier time periods could have been attempted, but the specific rules concerning the computation of pensions imply that

such a retropolation did not appear to be necessary once we restricted ourselves to cohorts for whom at least one observation concerning the level of pensions was available.

The strategy is the following: We know, for these people, their exact age at retirement $r$ and the basic and complementary pensions obtained at this age $P_b(r)$ and $P_c(r)$. We have to compute what pension entitlements would have been in case of claiming pension at ages $r'$ greater or lower than $r$. Concerning the basic pension, if we go back to equation (1) and if we consider that delaying or anticipating retirement would only have a marginal impact on the average wage of the ten best years,[2] the impact of a change in $r$ is only to change $N$, the total number of quarters of contribution (if not truncated to 150), and to change the coefficient $\alpha$, which for $60 < r < 65$ or $N < 150$ quarters, is reduced by 5 percent for each year of anticipation. The result of these changes on $P_b(r)$ is quite easy to compute. Information on wages is here superfluous.

Concerning complementary schemes, information on wages becomes necessary, but we do not need more than information on wages at later ages. Let us consider the case of an individual whose complementary pension only depends on ARRCO. From equation (2), we get that the variation of the expected pension level at $t$, if working until age $r + 1$ instead of $r$ would have been $\Delta V(t) = V(t)\tau(g + r + 1)w(g + r + 1)/\mathrm{PP}(g + r + 1)$ for an individual born in $g$, plus the eventual application of the reduction coefficient for those people not fulfilling the condition for the maximum value of the annuity rate $\alpha$ in the general scheme. This computation, too, does not require any retrospective information concerning wages. For civil servants, the only necessary information is the last wage: There is no need of past wages.

The only requirement concerning wages, therefore, is the extrapolation of notional wages for periods later than people's actual retirement ages. This extrapolation was made for workers from the private sector using wage equations more fully described in the appendix. For civil servants, we limited ourselves to extrapolations of observed wages, indexed only on prices.

### 4.3.4 Other Data

Computing the actual value of future pension benefits required some additional information regarding people's own mortality risk, as well as the presence of a spouse and this spouse's mortality risk, assuming that individual evaluations of benefits include the evaluation of survival benefits if the individual dies before their spouse.

2. This assumption is especially plausible given the truncation of wages. For people above the ceiling, the average wage of the ten best years will be generally equal to this ceiling, and one more year of work will generally not change this. This does not hold for people below the ceiling, but these people's careers are generally flatter, so that the same approximation may remain valid.

**Table 4.6** **Descriptive Statistics on the Sample**

| Variable | Mean Value |
|---|---|
| Sex (Male = 0, Female = 1) | 0.439 |
| Age | 57.4 |
| Married | 0.753 |
| Widowed | 0.113 |
| Single | 0.125 |
| Wage (€) | 20,095 |
| Private | |
| Executive | 0.126 |
| Technician | 0.154 |
| Employee | 0.215 |
| Skilled blue-collar | 0.189 |
| Unskilled blue-collar | 0.105 |
| Public | |
| Category A | 0.119 |
| Category B | 0.055 |
| Category C | 0.037 |
| Total tenure (years) | 36.4 |

*Note:* Sample size = 9,884 observations corresponding to 2.202 individual paths.

Mortality rates for people in the sample used are differentiated by sex, age, and socioprofessional group. One point must be noted here: Since the sample is conditioned on surviving until the age of sixty-four or sixty-six (depending on the cohort), a selection bias may result if there is a correlation between mortality and the retirement decision. If people with bad health status and a higher mortality risk tend to more frequently anticipate the claiming of their benefits, there will be a tendency to overestimate the actual age at retirement.

Concerning information on spouses, unfortunately, the EIR did not produce any reliable information, even limited to the indication of the presence of a spouse. The reason is that information on marital status, in these files, is only updated when it becomes necessary, that is, generally at the pensioner's death (if survival benefits are to be paid). We restricted ourselves to a model of retirement choice where only personal entitlements are taken into account, rather than attempting a reconstitution of variables relating to spouse's presence, age, and status.

The final sample consists in 9,884 observations (table 4.6) corresponding to 2,202 individuals still employed at fifty-five (who are thus observed on average between four and five years before they retire), 75% of which are employed in the private sector (with a majority of men). Note that the average tenure at fifty-five is pretty high (over thirty-six years) and close to the tenure required to reach the full rate at sixty: This reflects the fact that most people from the sample are entitled to full SS benefits as soon as sixty (especially men, see figure 4.1).

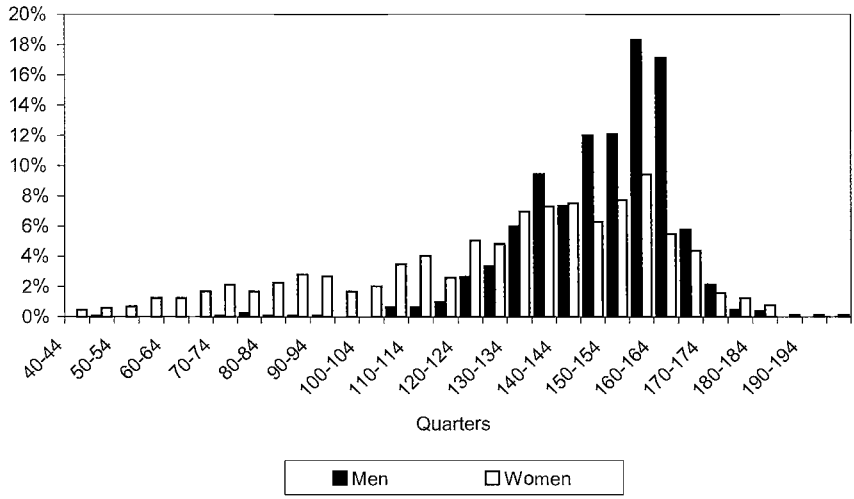


**Fig. 4.1 Distribution of tenure at age 55**

**Table 4.7 Pathways to Retirement in the Sample**

| | Retiree Category | | | |
|---|---|---|---|---|
| | Private Sector | | | Civil Servants |
| Pathway | Men | Women | Total | Total |
| Directly to SS | 57.4 | 60.8 | 58.7 | 100.0 |
| ER then SS | 20.7 | 18.4 | 19.8 | 0.0 |
| UI then SS | 21.9 | 20.8 | 21.5 | 0.0 |

*Source:* Authors' calculations from EIR, cohort 1930; people still working at 55 (data source).

Analyzing pathways to retirement is straightforward for civil servants (they have no other choice than waiting until the minimum age to claim SS benefits, unless they chose to consume their savings). In the private sector (table 4.7), about 60 percent of people still working at fifty-five do not receive public benefits other than SS benefits. The remaining 40 percent are roughly equally divided between people retiring through unemployment and early retirement schemes.

Table 4.8 provides information on the level of the parameter $\alpha$. A very tiny minority of men (0.3 percent) claim SS benefits at reduced rate, whereas the figure grows to 4.4 percent for women. About 4 percent of men and women are considered as disabled are thus allowed to claim full-rate SS benefits at sixty (even if their tenure is below 150 quarters). Also, 3.7 percent of men and 10.7 percent of women are "unfit" to do a job and thus benefit a full-rate pension at sixty. Others (over 80 percent of the sample)

**Table 4.8** **Level of the Pension Rate (α) when People Claim SS Benefits (private sector; %)**

| | Men | Women |
|---|---|---|
| Full rate | | |
| Normal conditions | 92.0 | 81.0 |
| "Unfit" for a job | 3.7 | 10.7 |
| Disabled | 4.0 | 3.9 |
| Reduced rate | 0.3 | 4.4 |

reach the full rate in normal conditions. In the public sector, there is no such incentive to postpone claiming SS benefits after the minimum age (mostly sixty) since α is set to 75 percent whatever the total tenure. Nonetheless, it is worthwhile to note that the retirement rate for the civil servants that reach age sixty with 150 quarters or more is 69 percent, whereas it drops to 53 percent for those who reach age sixty with less than 150 quarters. Moreover, the mean wage of civil servants who keep on working after sixty is €32,000 (instead of €23,400 for those who quit at sixty). Remember that highly paid civil servants have, on average, lower replacement rates since a large part of their wage consists of bonuses. At first glance, civil servants also seem sensitive to SS incentives (despite their weakness), but these preliminary observations must be confirmed by a deeper analysis.

## 4.4 A Descriptive Analysis of Incentives to Retire

### 4.4.1 Definition of Incentive Variables

Two kinds of models will be applied to the analysis of labor force participation rates of older workers. In a first step, we shall introduce simple measures of SS incentives to retire in probit models to describe the choice to retire at age $t$ for individuals still in the labor force at this age. For an individual aged $t$, we first compute SS wealth at age $t$. The value of this social security wealth (SSW) will depend on the age $t'$ greater than or equal to $t$ at which this individual will decide to retire. Also, $B_s(t')$ is the expected level of pension at age $s$ for an individual who retired at age $t'$; if $\pi(s/t)$ is the probability of surviving up to age $s$ for an individual ages $t$, and if $T$, at last, is the maximal age at death, we write:

$$\mathrm{SSW}_{t,t'} = \sum_{s=t'}^{T} \beta^{s-t} \pi\left(\frac{s}{t}\right) B_s(t')$$

From this value, we derive the pension accrual at age $t$ that is the algebraic increase in SSW, which results, at age $t$, from the postponement of retirement by one year, that is,

$$\text{Accrual}_t = \text{SSW}_{t,t+1} - \text{SSW}_{t,t}.$$

The accrual will be our first measure of SS incentives. The tax rate is directly derived from the accrual: It captures the fact that a negative *accrual* involves an implicit tax on continued work, because a part of the expected wage (if the agent postpones retirement) is taxed through the decrease in the SSW. The tax rate thus writes

$$\text{Tax rate}_t = \frac{\text{accrual}_t}{E_t w_{t+1}}.$$

An alternative measure is also directly derived from the definition of SSW. This variable is the peak index, which is the difference between the maximum of the SSWs associated to all possible ages at retirement beyond the current year, and SSW in case of an immediate retirement.

$$\text{Peak}_t = \max_{s \geq t+1}[\text{SSW}_{t,s}] - \text{SSW}_{t,t}$$

It assumes a less myopic behavior by the individual, who considers not only the potential gain in SSW resulting from delaying retirement by one year, but also gains that may be derived from retiring in any subsequent year. However, as with all measures derived from SSW, a limitation of this index is that it does not take into account the comparison that the individual can make between pension benefits and the level of his labor income. It assumes that the retirement decision is only affected by variations of pension entitlements. This limitation will be corrected in the following estimation by the introduction of wages as covariates in probit models, but it is more satisfactory to introduce incentive measures which introduce this comparison between benefit and wage levels in a less ad hoc way.

This is the case if we start from a model which fully includes expected flows of utility derived either from labor or retirement income. The model used is the Stock and Wise (1990) option value model. Let us again consider an individual still in the labor force at age $t$. If they expects to retire at age $r$, they can expect a flow of labor incomes of $(Y_t, \ldots Y_{r-1})$ until retirement and then a flow of pension benefits $(B_r(r), B_{r+1}(r), \ldots, B_s(r), \ldots)$. It is assumed that this individual derives an indirect utility $U_w$ from his labor income and an indirect utility $U_r$ from pension benefits. Time discounting occurs at rate $\beta$. For an age at retirement equal to $r$, the expected utility at age $t$ is therefore

$$V_t(r) = \sum_{s=t}^{r-1} \beta^{s-t} E_t[U_w(Y_s)] + \sum_{s=r}^{T} \beta^{s-t} E_t\{U_r[B_s(r)]\},$$

with

$$U_w(Y_s) = Y_s^{\gamma},$$
$$U_w(B_s) = [kB_s]^{\gamma}.$$

Note that this specification does not consider the possibility of smoothing income flows through private savings, an assumption that will be essentially valid for low- or medium-income workers. Given this definition of utility, we assume that the individual decides to retire if the resulting expected utility is higher than the maximum value of utilities expected for all other possible choices $r > t$. If we write

$$G_r(r) = V_t(r) - V_t(t),$$

the individual chooses to remain in the labor force if $G_t(r^*)$ greater than 0 where

$$r^* = \text{Arg} \max_{r \geq t+1} V_t(r).$$

The equation $G_t(r^*)$ greater than 0 is called the option value of postponing retirement in order to express that, given the irreversibility of retirement, remaining in the labor force offers the option to leave the labor force at a later age under better conditions. Stock and Wise (1990) performed a full maximum likelihood estimation of the model on U.S. data that yielded $\beta$ equals 0.97, $\kappa$ equals 1.25, and $\gamma$ equals 0.6. Our own estimation of the model on French data led us to adopt the following parameterization: $\beta$ equals 0.97, $\kappa$ equals 1.6, and $\gamma$ 0.25. These values imply some risk aversion and a moderate preference for leisure: In the context of a one−period model, a value of $\kappa$ equal to 1.6 means that an individual would demand a leisure income equal to 62.5 percent of his labor income to accept not to work.

### 4.4.2 Including Incentives Linked to Unemployment Benefits and Early Retirement

We next present evaluations of incentives that (imperfectly) take into account the additional incentives imbedded in unemployment insurance (UI) and early retirement schemes. Assume, as a first step, that an individual is actually free to choose one of these means of early exit from the labor force. We can therefore compute three values for the SSW: the one computed above on the basis of normal pension entitlements only and the values if we assume that the individual begins by spending a few years in unemployment or in the early retirement scheme and then moves on to normal retirement once he is entitled to the full-rate SS. For instance, for an individual aged fifty-five, we compute the following values, depending on age t at which they will leave the labor force:

$\text{SSW1}_{55,t} = \Sigma_{s=60}^{T} \beta^{s-t} \pi(s/t) B_s^{\text{Pension}}(t)$ is the individual only relies on his normal pension;

$\text{SSW2}_{55,t} = \Sigma_{s=t}^{59} \beta^{s-t} \pi(s/t) B_s^{\text{UI}}(t) + \Sigma_{s=60}^{T} \beta^{s-t} \pi(s/t) B_s^{\text{Pension}}(t)$ for a transition through UI;

$SSW3_{55,t} = \Sigma_{s=t}^{59} \beta^{s-t} \pi(s/t) B_s^{ER}(t) + \Sigma_{s=60}^{T} \beta^{s-t} \pi(s/t) B_s^{Pension}(t)$ for a transition through early retirement.

Benefits $B_s^{une}$ and $B_s^{pre}$ are computed as a fraction of the last wage by direct application of official rules.

We then compute a weighted average of these three SSWs. Weights are a function of the sector of activity and reflect take-up probabilities. We tested other covariates, like sex and professional status (executives versus blue-collars versus white collars), but their coefficients are mostly insignificant if sector dummies are included. This strategy is consistent with the results of previous studies that show that the sector of activity predicts access to early retirement or unemployment schemes far better than qualification or social group (Colin Iéhlé, and Mahieu 2000). As a general rule, the probability of facing a period of unemployment or early retirement at the end of one's career is markedly higher (at least for cohorts born around 1930) in industries. In particular, it is the automobile industry that concentrates the highest risks: At fifty-five, there was a 60 percent probability of entering into unemployment or early retirement for a wage earner in the automobile industry. The reason is that, around 1985, some sectors—including the automobile industry—benefited from exceptions allowing a lower age at entry in the Allocation Spéciale du Fonds National pour l'Emploi (ASFNE; fifty-five years instead of fifty-six years and two months). We finally compute incentives (accrual, peak value, and option value) with this weighted SSW.

### 4.4.3 Incentive Analysis

*Private Sector*

Individuals are followed between ages fifty-five and sixty-five. We ask what has been the structure of incentives to retire in this sample and how have these incentives determined actual retirement decisions? Given the discrepancy between SS incentives in the private sector and for civil servants, it seems appropriate to give separate results for each sector.

In the private sector, the median SSW for males regularly increases with age after fifty-five to reach €200,000 at sixty (table 4.9). This is due partly to the increase in pension entitlements while tenure grows, but also to a selection bias: People who quit before the early retirement age of sixty (who mostly receive unemployment or early retirement benefits) get, on average, lower wages than those who stay on the labor market. Since pension entitlements are strongly correlated with labor income, this partly explains the age profile of median SSW. The median accrual is positive (though diminishing) until fifty-nine, with a relatively large dispersion: Those who already have a tenure above 37.5 years have very low accruals (see the tenth

**Table 4.9 Retirement Incentives for Men in the Private Sector (€)**

| | | | Accrual | | | | Tax Rate | |
|---|---|---|---|---|---|---|---|---|
| Age | *N* | SSW Median | Median | 10th Percentile | 90th Percentile | SD | Median | Previous |
| 55 | 1,077 | 152,476 | 8,438 | 2,751 | 22,324 | 19,714 | –0.54 | –0.91 |
| 56 | 862 | 161,350 | 4,945 | 1,631 | 19,877 | 18,634 | –0.31 | –0.97 |
| 57 | 712 | 170,499 | 3,621 | 1,047 | 18,243 | 8,031 | –0.21 | –0.46 |
| 58 | 622 | 180,368 | 1,745 | –529 | 12,812 | 7,227 | –0.09 | 0.04 |
| 59 | 539 | 189,460 | 2,937 | 647 | 14,955 | 8,419 | –0.15 | 0.05 |
| 60 | 501 | 199,327 | –11,734 | –19,845 | –4,198 | 9,122 | 0.73 | 0.67 |
| 61 | 85 | 247,305 | –11,335 | –27,410 | 4,141 | 15,528 | 0.35 | 0.60 |
| 62 | 84 | 244,555 | –11,634 | –29,285 | 2,996 | 14,760 | 0.45 | 0.63 |
| 63 | 60 | 220,831 | –11,956 | –30,532 | 2,464 | 13,525 | 0.46 | 0.56 |
| 64 | 48 | 196,433 | –10,654 | –31,313 | 2,998 | 12,391 | 0.50 | 0.56 |
| 65 | 38 | 163,729 | –10,810 | –40,138 | –4,610 | 11,194 | 0.75 | 0.52 |

| | | Peak Value | | | | Option Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Median | 10th Percentile | 90th Percentile | SD | Median | 10th Percentile | 90th Percentile | SD |
| 55 | 1,077 | 12,792 | 4,120 | 53,414 | 45,792 | 46.46 | 38.94 | 64.70 | 15.66 |
| 56 | 862 | 6,962 | 1,680 | 43,187 | 48,979 | 36.52 | 30.00 | 54.61 | 14.33 |
| 57 | 712 | 4,819 | 1,057 | 36,087 | 18,072 | 28.73 | 24.27 | 44.25 | 9.98 |
| 58 | 622 | 3,339 | –529 | 24,602 | 16,306 | 20.16 | 16.91 | 32.63 | 9.12 |
| 59 | 539 | 2,958 | 647 | 16,144 | 18,491 | 11.56 | 9.84 | 20.76 | 9.96 |
| 60 | 501 | –11,734 | –19,845 | –4,198 | 18,010 | –0.57 | –1.86 | 5.56 | 8.87 |
| 61 | 85 | –11,335 | –27,410 | 4,937 | 30,251 | 1.50 | –2.02 | 20.18 | 12.32 |
| 62 | 84 | –11,634 | –29,285 | 4,143 | 24,864 | 0.51 | –2.05 | 14.67 | 9.83 |
| 63 | 60 | –11,956 | –30,532 | 2,858 | 15,841 | 0.20 | –2.21 | 11.78 | 7.24 |
| 64 | 48 | –10,654 | –31,313 | 2,998 | 13,056 | 0.00 | –2.46 | 8.00 | 4.71 |
| 65 | 38 | –10,810 | –40,138 | –4,610 | 11,194 | –0.68 | –3.81 | 1.91 | 2.50 |

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

percentile), while those whose tenure is below 37.5 years have very high accruals (see the ninetieth percentile). Median tax rates between fifty-five and fifty-seven exhibit quite large subsidies to work (from 20 percent to 50 percent) that nonetheless remain low compared to the base case computed by Blanchet and Pelé (1999; last column)—about 90 percent at ages fifty-five to fifty-six. This discrepancy results from the characteristics of their base case: a man who works continuously from age twenty. As a result, the base case exhibits very large subsidies until he reaches the full rate (at fifty-eight). After that age, the very low increase in pension entitlements (essentially through complementary schemes) cannot even compensate the loss of payroll taxes, which explains the slight tax on continued work at fifty-eight to fifty-nine (4–5 percent) in this previous study.

After age sixty, the median SSW suddenly increases by about 25 percent,

which reflects the fact that people who keep on working after the early retirement age are often better educated and thus better paid than the average. Of course, the median SSW declines from age sixty-one since median pension entitlements grow very slowly (most of these people could claim a full-rate SS benefit) while these people give up one year of benefits. The median accrual thus remains strongly negative (about –11,000) while a minority of men have positive accruals (see the ninetieth percentile) because they have a total tenure below 37.5 years. The median tax rate is lower at ages sixty-one to sixty-four (below 50 percent than at sixty (73 percent) due to this selection bias: People still on the labor market after sixty are either better paid than the average (and the denominator of the tax rate is higher) or they cannot get a full-rate SS pension (and their tax rate is negative). But tax rates reach 75 percent at age sixty-five (and accruals are systematically negative) since everybody may claim a full-rate SS pension from that age.

If we turn to peak value (PV) measures (table 4.9), the results are very close to those obtained with accrual measures: After age sixty, accrual and PV are negative (increases in pension entitlements cannot compensate the loss of one year or more of benefits since most men already have the full rate), and thus accrual and PV are mostly the same. Concerning option value (OV) measures, we now have further explanations for the behavior of men who keep on working after age sixty, although they are entitled to a full-rate SS pension. We mentioned that these people were quite well paid, which was suggested by tax rate measures but not by accrual measures (the median value of accrual was strongly negative). Here, the median OV value is positive at ages sixty-one to sixty-four, whereas it was negative at sixty. The OV measures include data on expected wages. Given the structural form of the utility used to build OV measures, the OV is decreasing with the replacement rate. Since the replacement rate is lower for highly paid employees, they face an incentive to postpone retirement, and their OV is thus positive. The distribution of OV is thus consistent with behaviors observed in the data.

Women in the private sector basically face similar incentives (table 4.10). The only serious difference is that a larger proportion of them cannot claim a full-rate SS pension at sixty since female careers are shorter than male careers (although this fact is somewhat weakened by our sample selection: Women who were still working at fifty-five had a larger tenure than the average). As a result, after age sixty, the median accrual is positive and the median tax rate exhibits a strong subsidy on continued work (about 30–40 percent). Note that the ninetieth percentile for accrual is particularly high at sixty-four: This results from the minimum pension provisions for low-wage earners (*minimum contributif*) that are available at sixty-five for people with short careers. The PV, in general, is larger than the accrual for these women with short careers: This accounts for the fact that they face a strong incentive to postpone retirement by several years.

**Table 4.10 Retirement Incentives for Women in the Private Sector (€)**

| | | | Accrual | | | | Tax Rate | |
|---|---|---|---|---|---|---|---|---|
| Age | *N* | SSW Median | Median | 10th Percentile | 90th Percentile | SD | Median | Previous |
| 55 | 679 | 98,405 | 5,042 | 2,469 | 16,636 | 6,055 | –0.44 | –0.91 |
| 56 | 563 | 108,031 | 3,818 | 1,955 | 15,536 | 6,001 | –0.41 | –0.97 |
| 57 | 474 | 114,757 | 3,271 | 1,305 | 14,891 | 5,379 | –0.32 | –0.46 |
| 58 | 404 | 121,668 | 1,987 | –147 | 11,636 | 5,012 | –0.21 | 0.04 |
| 59 | 343 | 130,117 | 2,873 | 771 | 11,604 | 5,098 | –0.26 | 0.05 |
| 60 | 325 | 139,462 | –4,734 | –12,774 | 7,965 | 8,094 | 0.45 | 0.67 |
| 61 | 94 | 108,838 | 3,686 | –10,766 | 10,444 | 8,048 | –0.44 | 0.60 |
| 62 | 94 | 118,268 | 3,967 | –11,117 | 9,157 | 7,818 | –0.36 | 0.63 |
| 63 | 80 | 112,247 | 2,901 | –10,315 | 7,265 | 7,813 | –0.31 | 0.56 |
| 64 | 65 | 112,234 | 5,273 | –9,625 | 29,056 | 15,150 | –0.47 | 0.56 |
| 65 | 52 | 119,365 | –5,188 | –12,036 | –1,895 | 5,398 | 0.41 | 0.52 |

| | | Peak Value | | | | Option Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Median | 10th Percentile | 90th Percentile | SD | Median | 10th Percentile | 90th Percentile | SD |
| 55 | 679 | 20,501 | 4,579 | 53,505 | 20,424 | 55.18 | 40.55 | 76.58 | 15.22 |
| 56 | 563 | 14,649 | 2,539 | 47,250 | 18,120 | 45.12 | 31.06 | 65.88 | 14.00 |
| 57 | 474 | 10,400 | 1,379 | 42,504 | 17,195 | 34.91 | 24.74 | 57.52 | 14.01 |
| 58 | 404 | 6,891 | –127 | 38,170 | 16,303 | 25.14 | 17.60 | 48.43 | 13.66 |
| 59 | 343 | 4,139 | 771 | 37,370 | 15,620 | 14.67 | 9.93 | 39.47 | 13.60 |
| 60 | 325 | –4,734 | –12,774 | 35,149 | 18,851 | 1.60 | –1.20 | 28.71 | 13.97 |
| 61 | 94 | 13,830 | –10,766 | 33,704 | 18,392 | 12.55 | 0.52 | 32.39 | 13.72 |
| 62 | 94 | 13,228 | –11,117 | 30,485 | 16,384 | 10.20 | 0.26 | 29.55 | 12.09 |
| 63 | 80 | 8,471 | –10,315 | 28,572 | 15,579 | 7.19 | –0.39 | 30.24 | 11.49 |
| 64 | 65 | 5,273 | –9,625 | 29,056 | 15,151 | 4.03 | –0.72 | 25.92 | 9.85 |
| 65 | 52 | –5,188 | –12,036 | –1,895 | 5,398 | 0.51 | –0.60 | 1.92 | 1.13 |

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

*Civil Servants*

If we turn to male civil servants (table 4.11), the median SSW is much higher than in the private sector since it reaches €375,000 at sixty (instead of €200,000). This discrepancy is first due to higher wages on average (civil servants are often better educated, and a large proportion of them are teachers). But the higher life expectancy at sixty for civil servants also plays a role in this gap. The male civil-servants sample may be divided between those are entitled to a pension from fifty-five and those who are entitled from sixty. In the first subsample, the accrual is always negative from age fifty-five: the increase in the pension for each additional year is too weak to compensate the loss of one year of pension. The tenth percentile of accrual is thus negative from fifty-five. But, since a majority of civil servants cannot claim SS benefits before sixty, the median accrual remains positive

**Table 4.11** **Retirement Incentives for Male Civil Servants (€)**

| | | | Accrual | | | | |
|---|---|---|---|---|---|---|---|
| Age | *N* | SSW Median | Median | 10th Percentile | 90th Percentile | SD | Tax Rate Median |
| 53 | 88 | 266,692 | 5,694 | 3,659 | 7,444 | 1,776 | –0.27 |
| 54 | 89 | 280,429 | 2,845 | 1,774 | 4,215 | 1,468 | –0.13 |
| 55 | 174 | 296,910 | 4,506 | –14,276 | 7,622 | 9,241 | –0.21 |
| 56 | 157 | 307,998 | 2,728 | –17,613 | 4,719 | 8,990 | –0.12 |
| 57 | 132 | 332,907 | 4,793 | –2,957 | 7,504 | 5,975 | –0.19 |
| 58 | 128 | 350,753 | 3,142 | –5,134 | 5,307 | 5,903 | –0.13 |
| 59 | 126 | 360,674 | 3,510 | –3,050 | 9,161 | 5,863 | –0.14 |
| 60 | 123 | 375,387 | –19,292 | –29,377 | –12,145 | 7,697 | 0.66 |
| 61 | 46 | 409,197 | –22,290 | –31,295 | –11,669 | 8,346 | 0.59 |
| 62 | 34 | 409,402 | –21,885 | –32,314 | –9,008 | 8,892 | 0.50 |
| 63 | 22 | 416,091 | –28,092 | –36,585 | –11,335 | 10,489 | 0.67 |
| 64 | 18 | 400,195 | –25,848 | –38,011 | –10,560 | 9,755 | 0.56 |
| 65 | 13 | 462,172 | –33,517 | –44,240 | –13,348 | 12,272 | 0.61 |

| | | Peak Value | | | | Option Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Median | 10th Percentile | 90th Percentile | SD | Median | 10th Percentile | 90th Percentile | SD |
| 53 | 88 | 14,754 | 6,966 | 40,109 | 13,121 | 76.37 | 23.62 | 87.67 | 28.24 |
| 54 | 89 | 10,487 | 2,346 | 33,463 | 12,525 | 65.81 | 11.90 | 76.52 | 28.87 |
| 55 | 174 | 10,817 | –14,276 | 29,933 | 17,298 | 56.33 | –0.60 | 64.56 | 28.22 |
| 56 | 157 | 9,344 | –17,613 | 24,291 | 15,547 | 46.84 | –0.96 | 53.52 | 20.99 |
| 57 | 132 | 10,143 | –2,957 | 20,620 | 10,504 | 36.56 | 31.19 | 41.15 | 9.59 |
| 58 | 128 | 6,280 | –4,847 | 14,002 | 8,820 | 24.80 | 21.59 | 28.39 | 6.04 |
| 59 | 126 | 3,510 | –3,050 | 9,161 | 5,863 | 12.86 | 11.13 | 15.70 | 3.15 |
| 60 | 123 | –19,292 | –29,377 | –12,145 | 7,697 | –0.21 | –1.66 | 2.23 | 1.93 |
| 61 | 46 | –22,290 | –31,295 | –11,669 | 8,346 | 0.02 | –1.26 | 3.10 | 2.23 |
| 62 | 34 | –21,885 | –32,314 | –9,008 | 8,892 | 0.10 | –1.04 | 1.65 | 2.43 |
| 63 | 22 | –28,092 | –36,585 | –11,335 | 10,489 | –0.90 | –2.24 | 0.79 | 2.31 |
| 64 | 18 | –25,848 | –38,011 | –10,560 | 9,755 | –0.39 | –1.32 | 0.56 | 1.27 |
| 65 | 13 | –33,517 | –44,240 | –13,348 | 12,272 | –14.76 | –15.82 | –11.70 | 2.01 |

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

until fifty-nine. Conversely, from sixty, the accrual is negative for all. Median tax rates exhibit a slight subsidy to continued work until fifty-nine (10–20 percent) and then become clearly positive (above 50 percent).

Nonetheless, the very low decrease in the median tax rate after age sixty reflects the fact that those who postpone retirement after sixty often have higher wages and lower replacement rates (since a larger proportion of their labor income consists in bonuses that give no additional rights for pensions). This is confirmed by the slight increase in the OV measure between ages sixty and sixty-one (table 4.11), But this result is less robust than in the private sector. The OV measure becomes extremely negative at

**Table 4.12** Retirement Incentives for Female Civil Servants (€)

| Age | *N* | SSW Median | Accrual | | | | Tax Rate Median |
|---|---|---|---|---|---|---|---|
| | | | Median | 10th Percentile | 90th Percentile | SD | |
| 53 | 122 | 280,498 | 5,946 | –7,517 | 7,415 | 5,896 | –0.33 |
| 54 | 123 | 294,718 | 2,816 | –10,512 | 4,323 | 6,450 | –0.16 |
| 55 | 223 | 301,786 | 2,891 | –16,901 | 6,879 | 9,632 | –0.16 |
| 56 | 188 | 300,239 | 1,937 | –19,122 | 4,448 | 10,122 | –0.13 |
| 57 | 161 | 278,203 | 3,704 | –14,030 | 6,537 | 8,692 | –0.23 |
| 58 | 149 | 277,062 | 2,623 | –16,519 | 5,003 | 8,637 | –0.16 |
| 59 | 140 | 278,215 | 4,049 | –13,116 | 9,377 | 8,159 | –0.24 |
| 60 | 134 | 286,881 | –12,655 | –20,744 | –2,619 | 6,962 | 0.61 |
| 61 | 45 | 353,164 | –13,358 | –23,275 | –3,503 | 8,107 | 0.49 |
| 62 | 33 | 339,196 | –13,079 | –21,312 | –2,821 | 8,183 | 0.46 |
| 63 | 19 | 328,787 | –16,543 | –29,611 | –2,989 | 8,064 | 0.68 |
| 64 | 12 | 258,821 | –15,383 | –26,945 | –2,548 | 9,323 | 0.63 |
| 65 | 6 | 256,774 | –16,423 | –31,058 | –3,554 | 9,961 | 0.68 |

| | | Peak Value | | | | Option Value | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Median | 10th Percentile | 90th Percentile | SD | Median | 10th Percentile | 90th Percentile | SD |
| 53 | 122 | 11,507 | –7,517 | 40,915 | 17,456 | 69.40 | 0.56 | 86.71 | 33.17 |
| 54 | 123 | 5,415 | –10,512 | 33,879 | 16,875 | 60.01 | –0.22 | 75.23 | 31.06 |
| 55 | 223 | 2,891 | –16,901 | 29,366 | 17,977 | 49.77 | –1.03 | 62.91 | 28.96 |
| 56 | 188 | 4,854 | –19,122 | 23,567 | 16,920 | 41.90 | –1.25 | 51.52 | 22.95 |
| 57 | 161 | 9,319 | –14,030 | 19,866 | 13,335 | 33.22 | –0.39 | 39.80 | 16.04 |
| 58 | 149 | 6,135 | –16,519 | 14,084 | 11,496 | 23.03 | –0.44 | 28.21 | 10.53 |
| 59 | 140 | 4,049 | –13,116 | 9,377 | 8,159 | 12.20 | 0.62 | 16.89 | 5.56 |
| 60 | 134 | –12,655 | –20,744 | –2,619 | 6,962 | 0.11 | –1.84 | 5.67 | 3.14 |
| 61 | 45 | –13,358 | –23,275 | –3,503 | 8,107 | 0.44 | –1.02 | 6.04 | 3.20 |
| 62 | 33 | –13,079 | –21,312 | –2,821 | 8,183 | 0.46 | –0.83 | 5.09 | 2.42 |
| 63 | 19 | –16,543 | –29,611 | –2,989 | 8,064 | –0.37 | –1.29 | 4.35 | 1.85 |
| 64 | 12 | –15,383 | –26,945 | –2,548 | 9,323 | –0.50 | –1.08 | 2.24 | 1.32 |
| 65 | 6 | –16,423 | –31,058 | –3,554 | 9,961 | –12.36 | –14.54 | –8.84 | 2.02 |

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

sixty-five because of mandatory retirement: If people postpone claiming their pension, they do not enjoy any labor income flows. The results are similar for female civil servants (table 4.12).

## 4.5 Econometric Analysis

We now analyze the decision to retire with probit models including incentive variables among regressors. Control variables are age, tenure, socioprofessional group, sector dummies, expected earnings and its square, and linear age or age dummies. Estimations are performed separately for

**Table 4.13 Probit Models (men, no full-rate dummy)**

| | Accrual Model (linear age) | Accrual Model (age dummies) | PV Model (linear age) | PV Model (age dummies) | OV Model (linear age) | OV Model (age dummies) |
|---|---|---|---|---|---|---|
| SSW (10,000) | –0.017** | –0.006 | –0.008** | –0.002 | –0.015** | –0.013** |
| Standard deviation | 0.003 | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 |
| Implied probability | 0.001 | 0.075 | 0.013 | 0.465 | 0.001 | 0.001 |
| Incentive variable (10,000) | –0.498** | –0.212** | –0.240** | –0.088** | –0.041** | –0.035** |
| Standard deviation | 0.031 | 0.035 | 0.020 | 0.020 | 0.003 | 0.003 |
| Implied probability | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Projected earnings (1,000) | 0.115 | –0.117 | –0.114 | –0.228 | 0.892** | 0.766** |
| Square of projected earnings | 0.022** | 0.014** | 0.037** | 0.019** | –0.124 | –0.112 |
| Age (linear) | 0.009 | | 0.061** | | –0.120** | |
| 55 | | REF | | REF | | REF |
| 56 | | 0.159** | | 0.173** | | –0.052 |
| 57 | | –0.046 | | –0.043 | | –0.473** |
| 58 | | –0.080 | | –0.060 | | –0.755** |
| 59 | | –0.537** | | –0.554** | | –1.527** |
| 60 | | 1.214** | | 1.387** | | 0.133 |
| 61 | | –0.023 | | 0.167 | | –1.107** |
| 62 | | 0.256** | | 0.450** | | –0.860** |
| 63 | | 0.011 | | 0.228 | | –1.112** |
| 64 | | 0.143 | | 0.352 | | –1.039** |
| 65 | | 1.293** | | 1.524 | | 0.070 |
| Pseudo $R^2$ | 0.159** | 0.240** | 0.132** | 0.237** | 0.148** | 0.256** |

**Coefficients are significant at the 5 percent level.

men and women. In the following tables, SSW and incentive variables (IV) amounts are given in € ten thousands and annual wages in € thousands. We did not include lifetime earnings as suggested in the template since we lacked appropriate data.

Models run on men or women have a quite satisfactory predictive power (tables 4.13 and 4.14): Pseudo $R^2$ values range from 12.5 percent to 16.2 percent with linear-age specifications, and from 23.7 percent to 26.6 percent with the age-dummies specifications. The SSW variable is always significant with linear-age specifications. In models with the age-dummy specifications, it is significant only with the OV as IV. The coefficient is always negative: The larger the SSW, the more the individual postpones retirement. This result may be surprising since an increase in SSW may be seen as a wealth effect and, thus, as an incentive to increase the consumption of leisure, which requires retiring earlier. Another possible explanation is that highly paid people have more interesting jobs than blue-collar workers and thus quit later.

The IV is always strongly significant with the expected negative sign. Note that models with OV measures provide more robust coefficients for the IV, which is consistent with our expectations: This variable contains a richer set

**Table 4.14** **Probit models (women, no full-rate dummy)**

| | Accrual Model (linear age) | Accrual Model (age dummies) | PV Model (linear age) | PV Model (age dummies) | OV Model (linear age) | OV Model (age dummies) |
|---|---|---|---|---|---|---|
| SSW (10,000) | –0.013** | –0.005 | –0.010** | –0.007 | –0.019** | –0.019** |
| Standard deviation | 0.006 | 0.006 | 0.006 | 0.007 | 0.007 | 0.007 |
| Implied probability | 0.034 | 0.374 | 0.028 | 0.265 | 0.004 | 0.008 |
| Incentive variable (10,000) | –0.530** | –0.336** | –0.212** | –0.136** | –0.024** | –0.020** |
| Standard deviation | 0.038 | 0.041 | 0.021 | 0.022 | 0.002 | 0.003 |
| Implied probability | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Projected earnings (1,000) | 0.647 | –0.123 | 0.770 | 0.019 | 1.086 | 1.227 |
| Square of projected earnings | –2.075 | –1.174 | –1.047 | –0.567 | –0.432 | –0.814 |
| Age (linear) | | 0.090** | | 0.094** | | 0.006 |
| 55 | | REF | | REF | | REF |
| 56 | | –0.047 | | –0.047 | | –0.140 |
| 57 | | –0.025 | | –0.048 | | –0.256** |
| 58 | | –0.098 | | –0.111 | | –0.445** |
| 59 | | –0.677** | | –0.743** | | –1.224** |
| 60 | | 1.242** | | 1.318** | | 0.758** |
| 61 | | –0.068 | | –0.017 | | –0.618** |
| 62 | | 0.345** | | 0.368** | | –0.274 |
| 63 | | 0.181 | | 0.216 | | –0.439** |
| 64 | | 0.503** | | 0.352** | | –0.330 |
| 65 | | 2.207** | | 2.241** | | 1.561** |
| Pseudo $R^2$ | 0.162** | 0.266** | 0.130** | 0.258** | 0.125** | 0.263** |

**Coefficients are significant at the 5 percent level.

of information than accrual or PV measures. The level of the coefficients does not crucially depend on the age specification (–0.041 with linear age versus –0.035 with age dummies for men [table 4.13] and –0.024 with linear age versus –0.020 with age dummies for women [table 4.14]). With accrual or PV measures, the coefficient of the incentive variable is divided by 2 or 3 if we turn from linear-age specifications to the age-dummy specifications. Moreover, the coefficient of SSW is more robust in models with OV measures (–0.015 with linear age versus –0.013 with age dummies), whereas it becomes insignificant in models with age dummies and accrual or PV measures.

Projected earnings are insignificant in models run on women samples. They have a significant positive impact on retirement for men. This result may be surprising at first glance since people with high earnings have, on average, lower replacement rates (which increases the price of leisure). Two possible explanations can be mentioned: First, highly paid people may have saved a lot in the past and thus may quit earlier since their retirement income has a significant nonpension component. Second, this may reflect demand-side effects on the labor market. Among blue-collars, those with the highest wages (and who may be paid far above their marginal produc-

tivity) might be more likely to be laid off by firms (through unemployment or early retirement schemes) than those with the lowest wages.

The estimated effect of age variables is uncertain. In linear-age specifications, we obtain significant positive coefficients in models run with accrual or PV measures (the only exception being the accrual model for women where the coefficient is insignificant). This result was expected as the disutility of work is assumed to increase with age. In models run with OV measures, the coefficient is insignificant for women and significantly negative for men, which may be puzzling. A reason for this may be found in unobserved individual heterogeneity on the disutility of work. Consider two populations that only differ in their disutility of work. Those who have a large disutility of work quit early, say at sixty. At sixty-one, the OV measure of the remaining population is lower than the OV measure of the whole population at sixty (there remain fewer years of potential continued work), but is underestimated since the computation does not account on the endogenous selection on the disutility of work. Nonetheless, the observed retirement rate will be lower at sixty-one than at sixty since the considered population has a low disutility of work. If the economist does not observe the disutility of work, the coefficients of linear-age variables will be significantly negative.

The models run with age dummies exhibit an irregular profile with strong spikes at sixty and sixty-five. Three reasons may be mentioned to explain these spikes: First, our variables do not perfectly capture incentives associated with SS rules. Second, these spikes may reflect demand-side effects: our incentives sum up supply-side effects, but employers are allowed to lay off workers as soon as they reach the full rate, mostly at sixty or sixty-five. Third, people may be induced to retire at sixty or sixty-five by a sort of social habit: sixty has been the normal retirement age since 1983, and sixty-five was the normal retirement age until 1983.

We also computed models with an early retirement, for civil servants, or a full-rate, for the private sector (early retirement/full-rate) dummy (tables 4.15 and 4.16): for civil servants this dummy is set to 1 if the agents' age is the minimum legal age to claim SS benefits (fifty-five or sixty, depending on his occupation) and to 0 otherwise. In the private sector, since claiming SS benefits is strongly discouraged below the full rate (virtually nobody claims SS benefits at a reduced rate, table 4.8), the dummy is set to one if the agent reaches the first year he can claim full-rate SS benefits. This dummy is strongly significant with linear age specifications and increases the pseudo $R^2$ that now reaches from 14.0 percent to 19.0 percent. But with age dummies specifications, it does not really improve the pseudo $R^2$ and is not significant in models run on males.

To sum up, these estimations provide a satisfactory description of retirement behavior: The coefficients on incentive variables are always significant with the expected sign. The impact of SSW on the retirement decision

**Table 4.15 Probit Models (men, full-rate dummy)**

| | Accrual Model (linear age) | Accrual Model (age dummies) | PV Model (linear age) | PV Model (age dummies) | OV Model (linear age) | OV Model (age dummies) |
|---|---|---|---|---|---|---|
| SSW (10,000) | –0.016** | –0.006 | –0.007** | –0.002 | –0.014** | –0.013** |
| Standard deviation | 0.003 | 0.003 | 0.003 | 0.003 | 0.004 | 0.004 |
| Implied probability | 0.001 | 0.077 | 0.024 | 0.471 | 0.001 | 0.001 |
| Incentive variable (10,000) | –0.463** | –0.208** | –0.211** | –0.085** | –0.038** | –0.036** |
| Standard deviation | 0.031 | 0.035 | 0.021 | 0.020 | 0.003 | 0.003 |
| Implied probability | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Early retirement/full rate dummy | 0.651** | 0.142 | 0.753** | 0.155 | 0.639** | –0.113 |
| Standard deviation | 0.095 | 0.108 | 0.094 | 0.108 | 0.095 | 0.112 |
| Implied probability | 0.001 | 0.187 | 0.001 | 0.148 | 0.001 | 0.001 |
| Projected earnings (1,000) | 0.112 | –0.120 | –0.118 | –0.231 | 0.822** | 0.791** |
| Square of projected earnings | 0.021** | 0.014** | 0.033** | 0.019** | –0.115 | –0.115 |
| Age (linear) | | 0.006 | | 0.057** | | –0.111** |
| 55 | | REF | | REF | | REF |
| 56 | | 0.169** | | 0.184** | | –0.066 |
| 57 | | –0.037 | | –0.033 | | –0.490** |
| 58 | | –0.071 | | –0.049 | | –0.778** |
| 59 | | –0.529** | | –0.543** | | –1.556** |
| 60 | | 1.199** | | 1.369** | | 0.119 |
| 61 | | –0.006 | | 0.184 | | –1.146** |
| 62 | | 0.274 | | 0.468** | | –0.901** |
| 63 | | 0.029 | | 0.245 | | –1.153** |
| 64 | | 0.164 | | 0.373** | | –1.084** |
| 65 | | 1.217** | | 1.438** | | 0.106 |
| Pseudo $R^2$ | 0.164** | 0.240** | 0.140** | 0.237** | 0.153** | 0.257** |

**Coefficients are significant at the 5 percent level.

is more difficult to analyze. The explanatory power of these models is pretty good since pseudo $R^2$ values range from 12.5 percent to 26.6 percent, which is relatively satisfactory with individual data. The PV models are clearly dominated by accrual models. The comparison of OV models with accrual models is less straightforward: On the one side, OV models mostly provide lower pseudo $R^2$ values than accrual models, but on the other side, the coefficient on the IV appears to be more robust to any change in specification (linear age versus age dummies, for instance) in OV models than in accrual models.

These estimations were performed with incentive variables including part of the incentives associated with early retirement or unemployment schemes. But our specification very poorly accounts for the discrepancy in access probabilities to these schemes. In particular, we use sector-specific access probabilities, whereas access probabilities are basically firm spe-

**Table 4.16 Probit Models (women, full-rate dummy)**

| | Accrual Model (linear age) | Accrual Model (age dummies) | PV Model (linear age) | PV Model (age dummies) | OV Model (linear age) | OV Model (age dummies) |
|---|---|---|---|---|---|---|
| SSW (10,000) | –0.014** | –0.006 | –0.016** | –0.008 | –0.019** | –0.019** |
| Standard deviation | 0.006 | 0.006 | 0.006 | 0.007 | 0.007 | 0.007 |
| Implied probability | 0.018 | 0.305 | 0.014 | 0.212 | 0.005 | 0.010 |
| Incentive variable (10,000) | –0.475** | –0.329** | –0.183** | –0.132** | –0.020** | –0.019** |
| Standard deviation | 0.039 | 0.041 | 0.022 | 0.022 | 0.002 | 0.003 |
| Implied probability | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Early retirement/full rate dummy | 0.999* | 0.308** | 1.086** | 0.328** | 1.056** | 0.226** |
| Standard deviation | 0.095 | 0.112 | 0.094 | 0.111 | 0.093 | 0.112 |
| Implied probability | 0.001 | 0.006 | 0.001 | 0.003 | 0.001 | 0.044 |
| Projected earnings (1,000) | 1.167 | –0.026 | 1.292 | 0.150 | 1.370 | 1.188 |
| Square of projected earnings | –2.539 | –1.236 | –1.616 | –0.653 | –0.875 | –0.809 |
| Age (linear) | | 0.072** | | 0.076** | | 0.001 |
| 55 | | REF | | REF | | REF |
| 56 | | –0.011 | | –0.009 | | –0.108 |
| 57 | | 0.007 | | –0.013 | | –0.221** |
| 58 | | –0.064 | | –0.074 | | –0.403** |
| 59 | | –0.063** | | –0.704** | | –1.173** |
| 60 | | 1.194** | | 1.266** | | 0.751** |
| 61 | | –0.037 | | 0.014 | | –0.565** |
| 62 | | 0.371** | | 0.394** | | –0.222 |
| 63 | | 0.212 | | 0.248 | | –0.383 |
| 64 | | 0.517** | | 0.371** | | –0.281 |
| 65 | | 1.958** | | 1.981** | | 1.416** |
| Pseudo $R^2$ | 0.190** | 0.267** | 0.164** | 0.260** | 0.160** | 0.263** |

**Coefficients are significant at the 5 percent level.

cific. But we lack appropriate firm data to model this phenomenon. We performed some other regressions including only SS incentives into incentive variables (access probabilities are set equal to 0). The predictive power of these models is not really weaker than the predictive power of the first regressions: Our attempt to account for incentives associated with early retirement or unemployment schemes is not conclusive.

## 4.6 Simulations

Two reforms are simulated in this section.

- The three-year-increase reform shifts the minimum age to claim SS benefits to sixty-three. The full rate is obtained if people have worked at least 162 quarters (instead of 150) or if they are sixty-eight. Access

probabilities to unemployment or early retirement schemes are incremented by three years (access to these schemes is therefore impossible before fifty-eight.
- The common reform allows people to claim SS benefits from sixty. Claiming SS benefits at sixty-five provides a 60 percent replacement rate. The pension is decreased or increased by 6 percent per year below or above sixty-five, respectively. Access to early retirement or unemployment schemes is impossible.

Figure 4.2 displays actual retirement rates for men and women and the profile provided with the OV model if the age dummies are the only source of variation: The data show pretty high retirement rates until fifty-nine (about 15 percent) and large spikes at sixty and sixty-five—but the latter only concerns a minority since most people quit before sixty-one. For each reform and each specification (accrual, PV, and OV), three simulations are performed (S1, S2, and S3):

- S1 is the simulation performed with linear age;
- S2 uses the results of the model run with age dummies without modifying the dummies;
- S3 uses the results of the model run with age dummies, but we modify the dummies in a "plausible" way. In the three-year increase reform, dummies are incremented by three years so that, for example, the age-fifty-eight dummy in the simulation is the estimated age-fifty-five dummy. In the common reform, dummies are the estimated dummies at sixty and at sixty-five (spikes at sixty and sixty-five are assumed to account for early and normal retirement). Between sixty-one and sixty-four, the dummy is the average of the estimated dummies at fifty-eight and fifty-nine.

### 4.6.1 Three-Year-Increase Reform

*Model S1*

Figures 4.3, 4.4, and 4.5 show the S1 results. Simulations performed with the accrual specification show a translation to the right of the graph: Before the minimum age to claim SS benefits—now sixty-three—the average increase in the pension caused by a one-year delay remains almost unchanged (it is unchanged for short careers, which cannot reach the full rate in any case, and for long careers, which already have 162 quarters). The age-sixty spike is thus moved to sixty-three, but the average age of retirement is only increased by 0.42 years since retirement rates between fifty-five and sixty-two remain pretty high (see table 4.17). This reflects the fact that we were not able to accurately model eligibility to early retirement benefits: As a result, the constant in the probit regression is likely to be

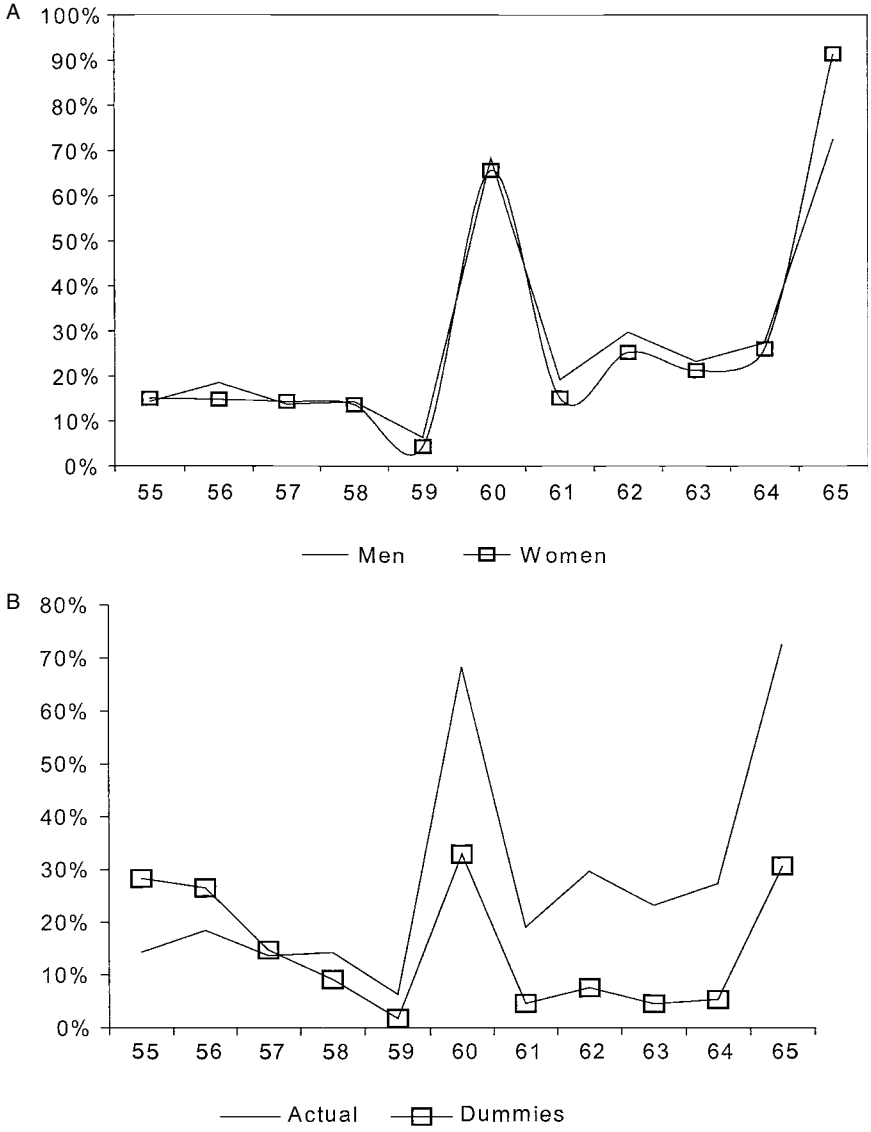


**Fig. 4.2 Male retirement rates: *A*, Actual retirement rates; *B*, Dummies profile**

*Note:* In this figure, we compare actual retirement rates for men with the simulated effect of age dummies on retirement rates. We fixed all other variables (SSW, option, earnings, etc.) to their mean sample value, and we use the estimated coefficients of the OV model (with age dummies) to assess the effect of age dummies. This helps us to understand which part of the fit is explained by the dummies.

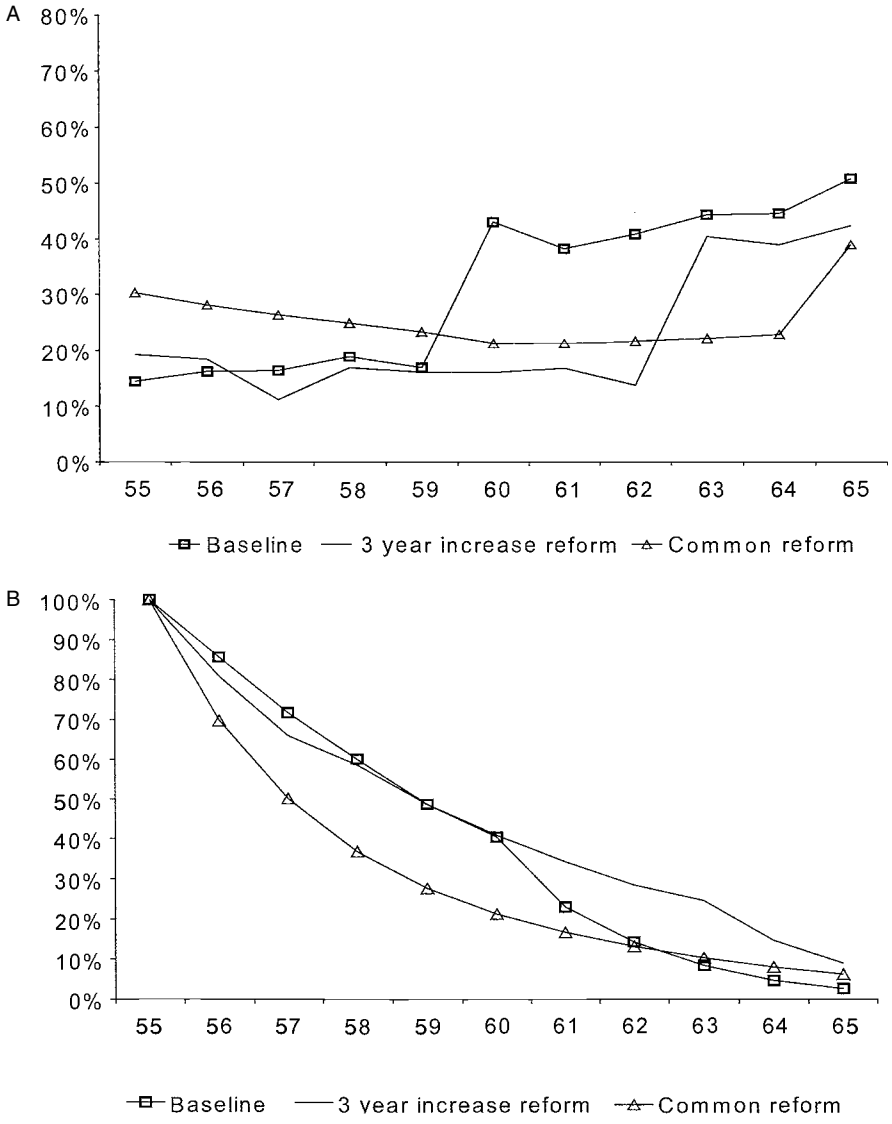


**Fig. 4.3 S1 men: *A*, Accrual, hazard; *B*, Accrual, cumulative**

overestimated and the coefficient on accrual underestimated, and the simulated impact of the reform is weak since the constant remains unchanged in the simulation. The effect before sixty is a bit larger with the PV specification: At age fifty-five, people realize that they may enjoy early retirement or unemployment benefits if they wait until fifty-eight (since access to these schemes is now impossible before age fifty-eight), which pulls down retire-

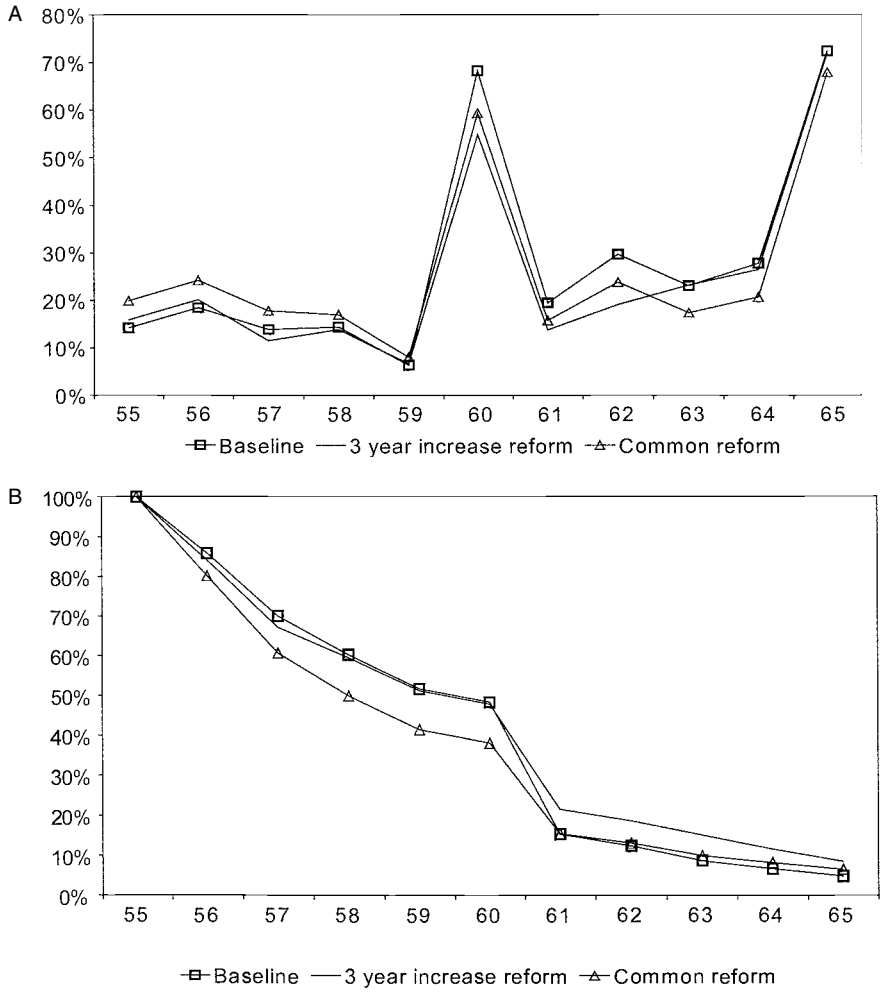


**Fig. 4.4 S1 men: *A*, PV, hazard; *B*, PV, cumulative**

ment rates (this fact is not captured by the accrual specification). The average retirement age grows by 1.39 years.

The effect is the largest with the OV specification. Two reasons for this may be mentioned: First, the OV measure is more appropriate since it includes not only the SSW, but also the wage component. This is an incentive to delay more retirement, since people do not want to stay several years without wage or pension income: Retirement rates are thus lower before sixty-three. Second, the problematic decreasing age profile, as previously discussed, explains that the age-sixty-three spike (three-year-increase reform) is lower than the age sixty spike (baseline). This latter fact explains

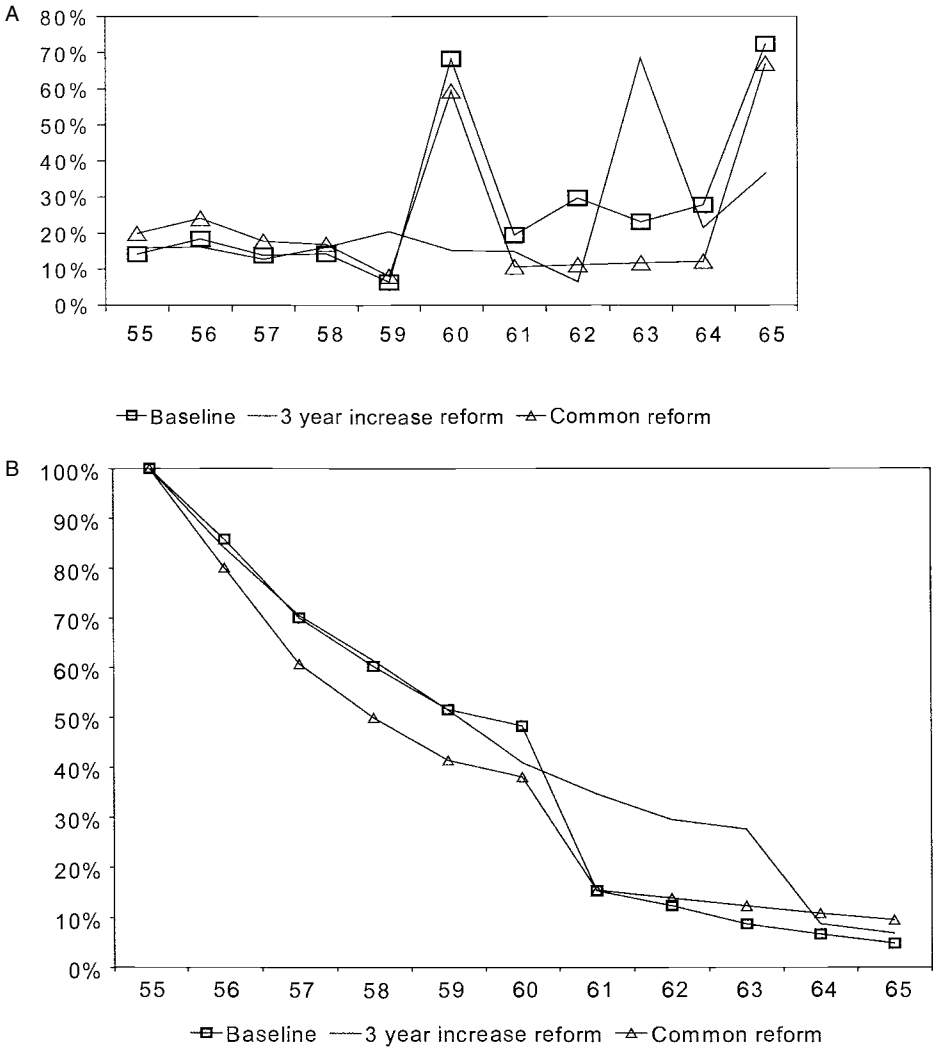


**Fig. 4.5** S1 men: *A*, OV, hazard; *B*, OV, cumulative

why the average retirement age increases by 3.14 years (a figure above 3 is of course doubtful).

*Model S2*

Figures 4.6, 4.7, and 4.8 show the S2 results (age dummies not incremented). Since age dummies remain unchanged, retirement rates remain close to the baseline case for accrual or PV specifications (with a slight decrease in the age-sixty spike since people do not reach the full rate at that

**Table 4.17 Average Retirement Age, Baseline, and Simulations**

| | Men | | Women | |
|---|---|---|---|---|
| | Three-Year Increase Reform | Common Reform | Three-Year Increase Reform | Common Reform |
| Baseline | 58.64 | 58.64 | 58.85 | 58.85 |
| Accrual | | | | |
| S1 | 59.06 | 57.60 | — | — |
| S2 | 58.85 | 58.23 | — | — |
| S3 | 59.16 | 58.32 | — | — |
| PV | | | | |
| S1 | 60.03 | 57.68 | — | — |
| S2 | 59.17 | 58.27 | — | — |
| S3 | 59.64 | 58.40 | — | — |
| OV | | | | |
| S1 | 61.78 | 60.20 | 60.43 | 59.32 |
| S2 | 61.39 | 59.88 | 60.17 | 59.14 |
| S3 | 60.50 | 59.95 | 59.97 | 59.28 |

*Note:* Dashes indicate that data is not available.

age). We do not observe any spike at sixty-three (although a majority of people can claim full rate SS benefits from sixty-three) since the age-sixty-three dummy is quite low. The increase in the average retirement age is thus only 0.21 and 0.53 years with the Accrual PV specifications, respectively. But the decrease in the age-sixty spike (and even in retirement rates before sixty) is far larger with the OV specification since the model captures the fact that people have no income for three years if they stop immediately. The average retirement age increases by 2.75 years.

*Model S3*

Figures 4.9, 4.10, and 4.11 show the S3 results. Since age dummies are incremented by three years, retirement rates are more or less shifted by three years to the right for accrual or PV specifications. The increase in the average retirement age is 0.52, 1.00, and 1.86 years with the Accrual, PV, and OV specifications, respectively. Once again, the effect is larger with the OV specification because this more forward-looking measure accounts for the fact that people include not only the SSW but also the wage component in making their decisions.

One unexpected result should be pointed out: In OV specifications, the increase in the average retirement age is larger with model S2 than S3 (it is the opposite with accrual or PV specifications). This is the result of the globally decreasing age profile in OV specifications (not only with linear age, but also with age dummies). In model S2, the simulated retirement rate at fifty-eight is computed with the age-fifty-eight dummy, which is quite low, and thus explains a very low probability of exit. In model S3, this sim-

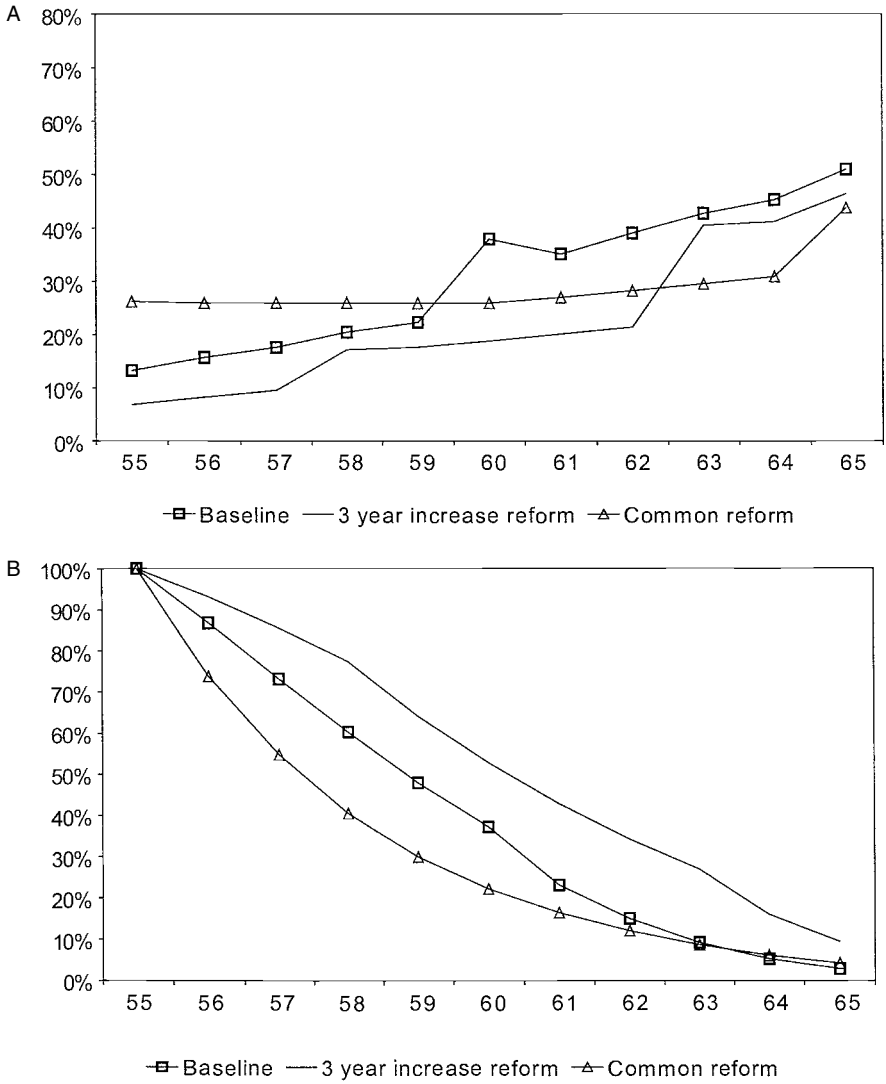


**Fig. 4.6 S2 men: *A*, Accrual, hazard; *B*, Accrual, cumulative**

ulation is performed with the age fifty-five dummy, which is much larger, and the simulated retirement rate is thus higher.

### 4.6.2 Common Reform

*Model S1*

Accrual and PV specifications provide very flat retirement rates (figures 4.3 and 4.4). This is the expected outcome of introducing an actuarially fair

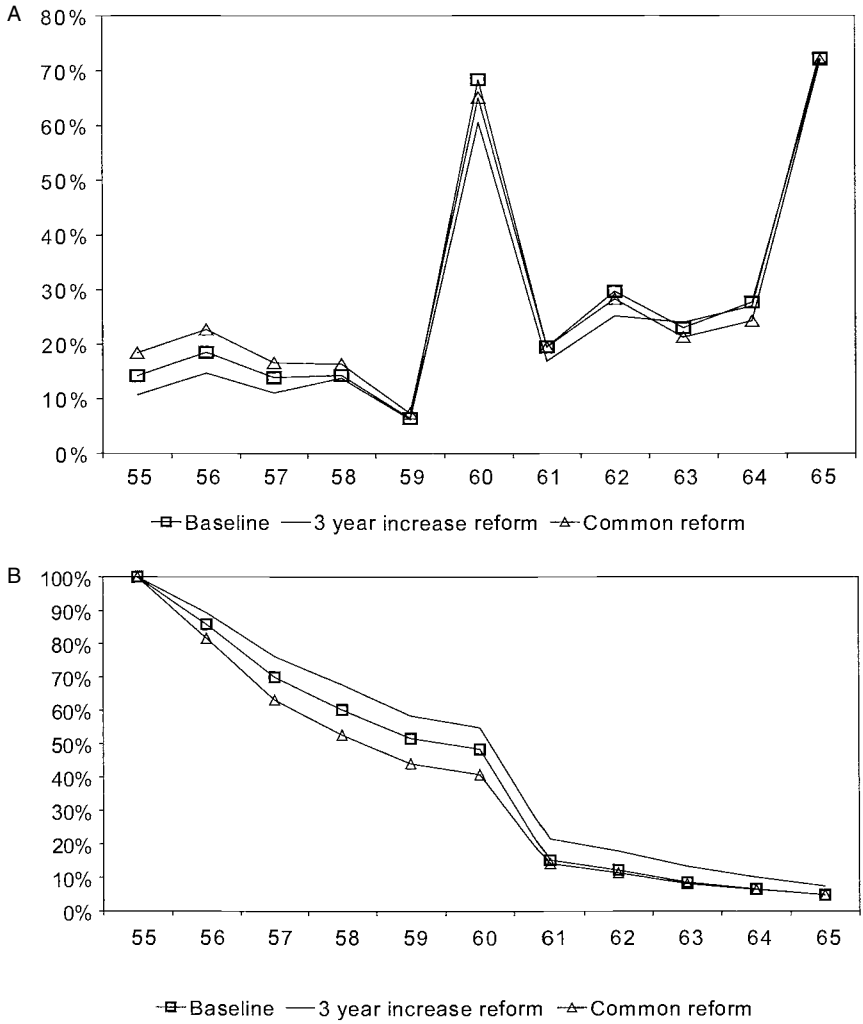


**Fig. 4.7 S2 men: *A*, PV, hazard; *B*, PV, cumulative**

pension scheme: the level of SSW is more or less the same, whatever the age of people who claim SS benefits. The accrual and PV measures are thus close to zero, and the annual retirement rates constant at pretty high levels: the average retirement age decreases by 1.04 and 0.96 years) with the accrual and PV specifications, respectively.

The OV measure seems more appropriate: Even if the age profile of SSW is flat, people may prefer to have a wage income until sixty instead of nothing if they quit earlier (figure 4.5). The retirement rate thus increases with age but is lower (by about 10 points) than in the baseline case since people are sensitive to SS incentives. After age sixty, retirement rates

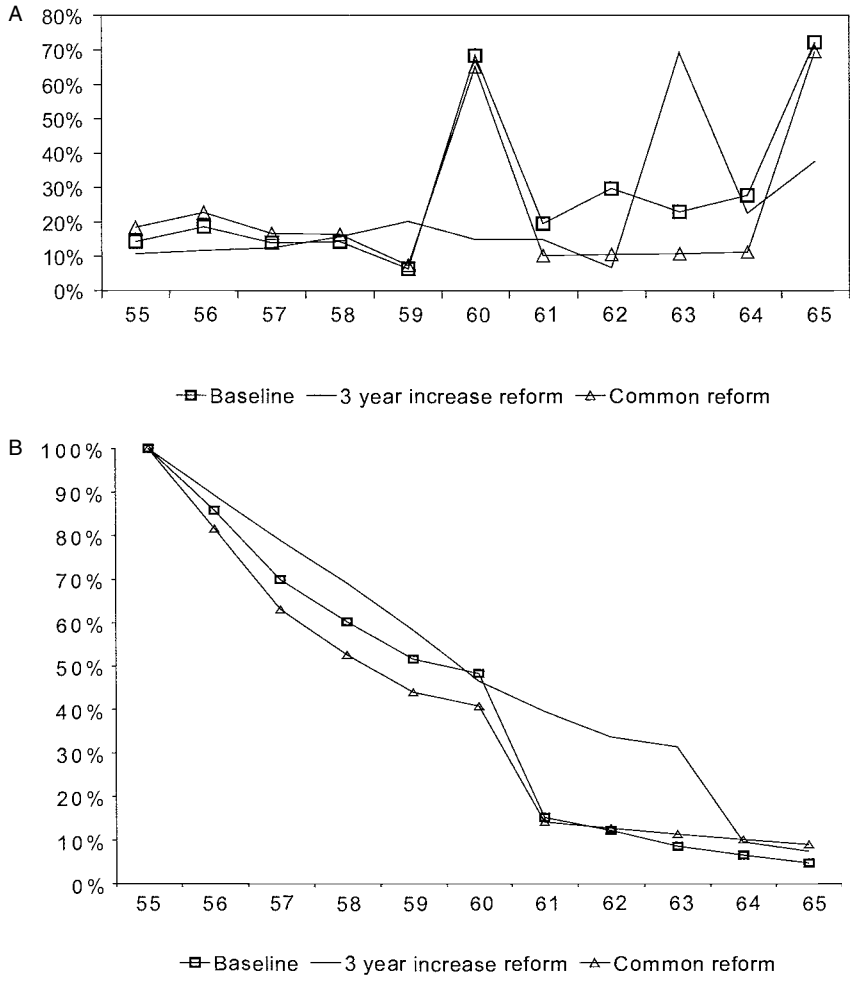


**Fig. 4.8 S2 men: *A*, OV, hazard; *B*, OV, cumulative**

are flat (the increase in the pension in case of continued work is offset by the loss of leisure). The average retirement age increases by 1.56 years, which is more likely than the results obtained with accrual or PV specifications.

*Model S2*

As in the 3-year increase reform case, retirement rates remain relatively close to the baseline case, but at a slightly lower level with accrual and PV specifications (figures 4.6 and 4.7). In the baseline case, a minority of people could enjoy in increase in their SSW if they stayed one year or more

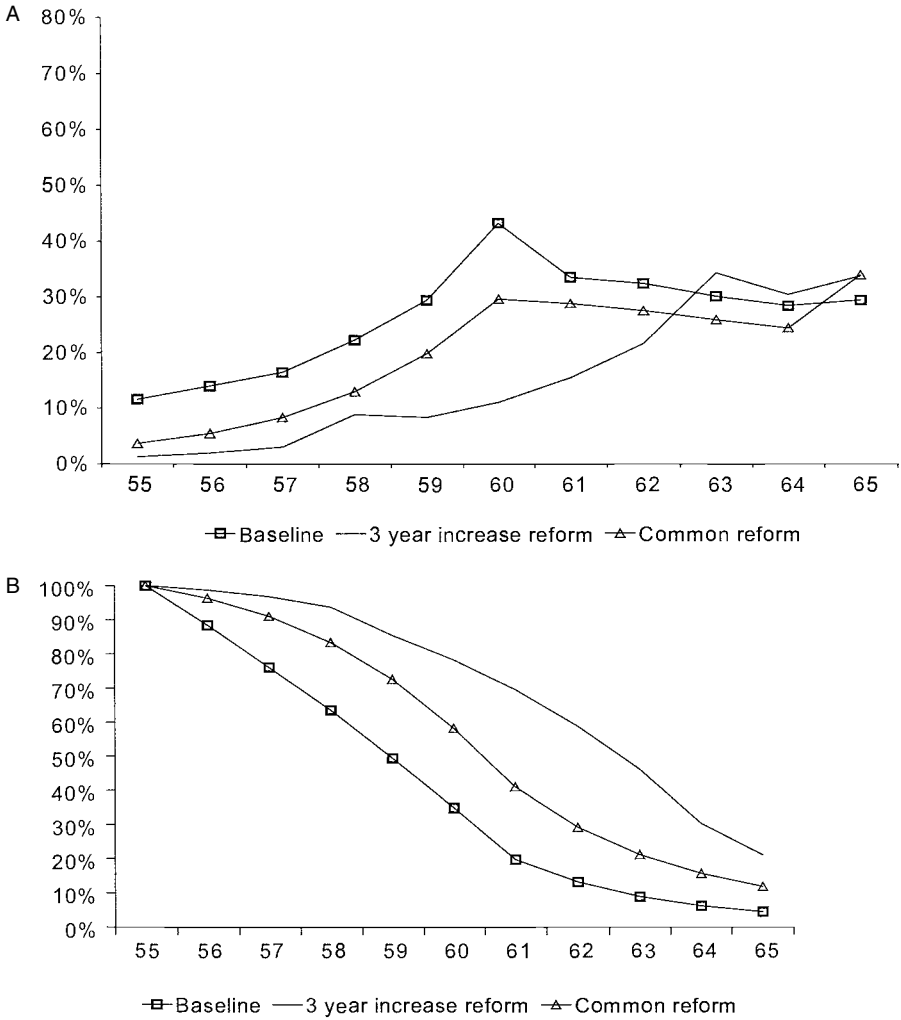


**Fig. 4.9** **S3 men: *A,* Accrual, hazard; *B,* Accrual, cumulative**

on the labor market. Things are now different: SSW is more or less constant and retirement rates thus increase. The average retirement age decreases by 0.41 and 0.37 years with the accrual and PV specifications, respectively.

The results are somewhat different with the OV specification: Retirement rates before sixty now decrease, in comparison with the baseline case, since people prefer to avoid a situation where they have no income until sixty (figure 4.8). The average retirement age increases by 1.24 years, which is the expected sign, but the effect remains moderate.

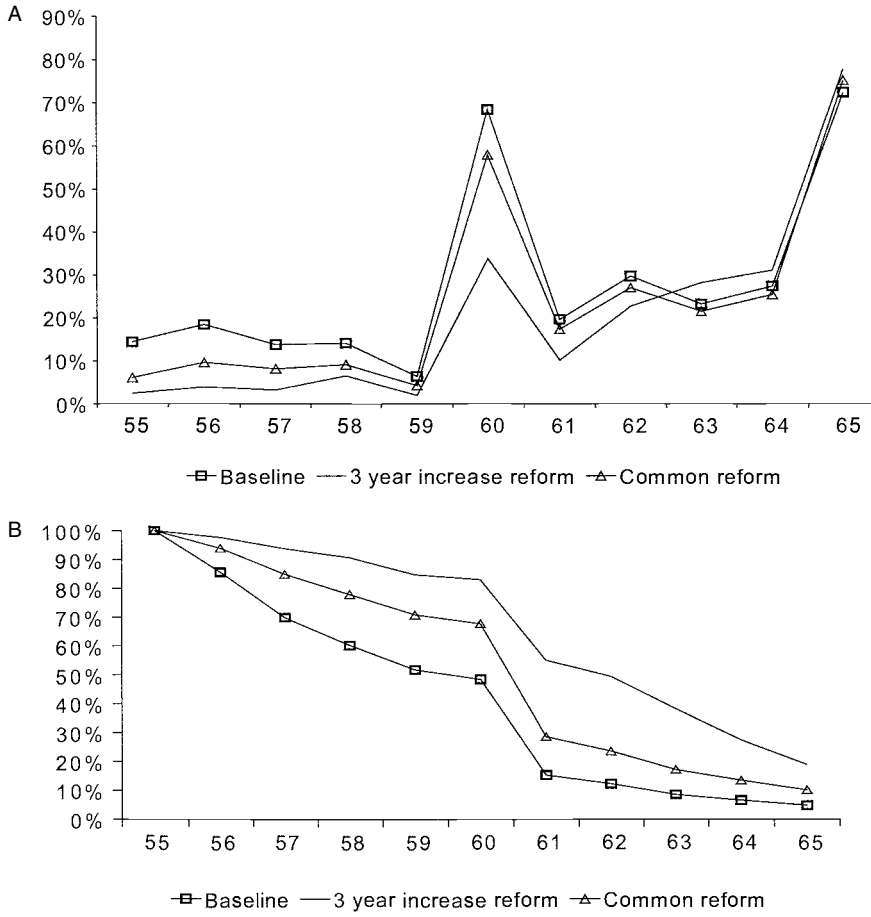


**Fig. 4.10 S3 men: *A*, PV, hazard; *B*, PV, cumulative**

*Model S3*

Results are very close to those obtained with model S2 since age dummies are not changed between fifty-five and sixty (figures 4.9, 4.10, and 4.11). Age dummies are somewhat lower than in model S2 between sixty-one and sixty-four, but this only concerns the minority of people who are still working at sixty-one. With accrual and PV specifications, the average retirement age decreases by 0.32 and 0.24 years, respectively. With the OV specification, it increases by 1.30 years.

### 4.6.3 Comparison of the Different Specifications—The Case of Women

The current structure of SS incentives induces high retirement rates when people get the full rate (mostly at sixty). At that age, the level of ac-

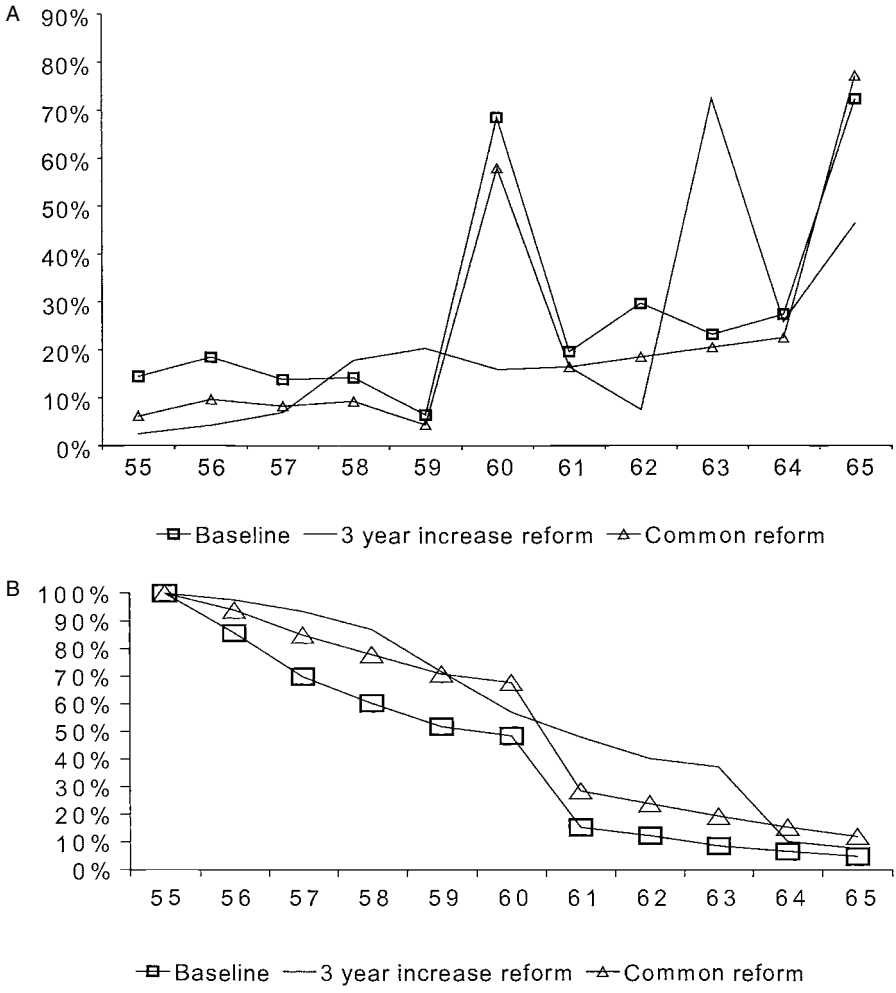


**Fig. 4.11 S3 men: *A*, OV, hazard; *B*, OV, cumulative**

crual suddenly falls for most agents. This explains the very high explanatory power of the accrual specification (greater than the explanatory power of the OV specification, although the latter approach is richer). But while analyzing the impact of changes in the computation of pensions, the OV specification proved to be more appropriate. In particular, enforcing the common reform (with an increase of incentives to postpone retirement after sixty for a majority and the suppression of early retirement schemes) should logically induce a decrease in retirement rates before sixty. This is not the case with accrual or PV specifications.

We thus chose to present simulations performed with the OV specifica-

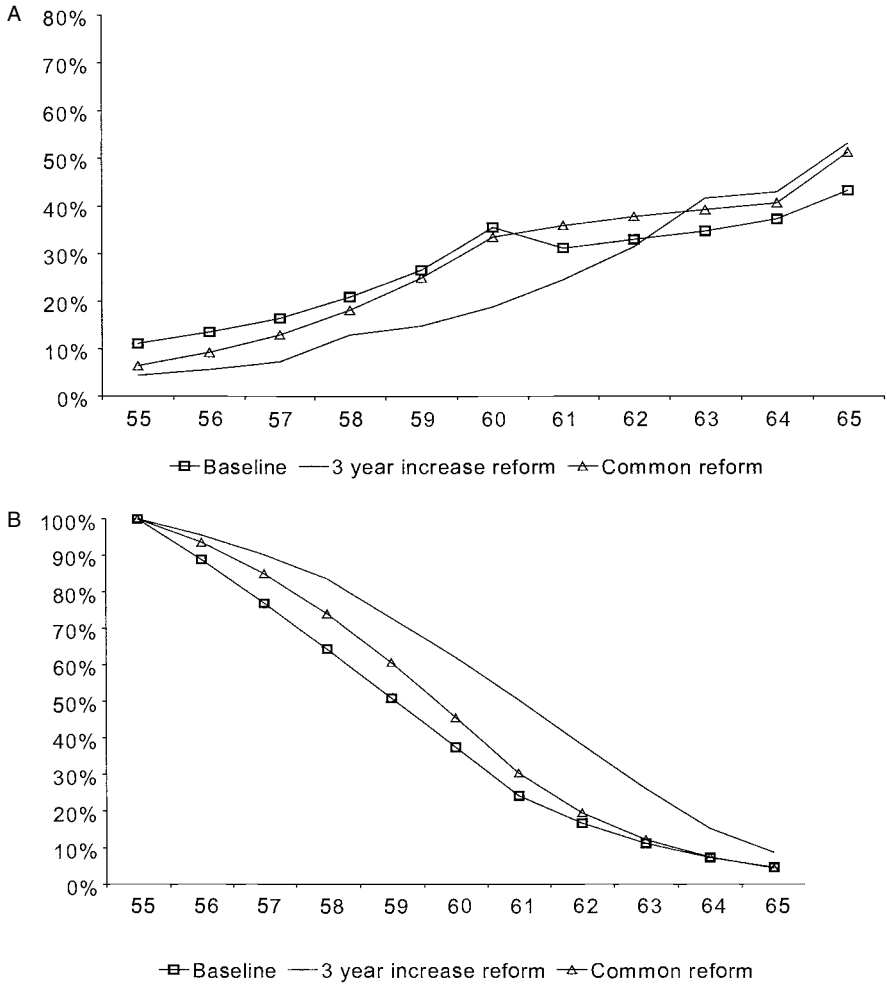


**Fig. 4.12 S1 women: *A*, OV, hazard; *B*, OV, cumulative**

tion for women (figures 4.12, 4.13, and 4.14). For women, the only drawback of the OV specification should disappear. With men the negative coefficient on linear age (and the decreasing profile of age dummies) were puzzling and led to an excessive simulated impact of the three-year increase reform (see previous). This should not be the case for women since the coefficient on linear age is insignificant in the OV specification.

The three-year increase reform would involve an increase by 1.58, 1.32, and 1.12 years of the average retirement age for women with model S1, S2, and S3, respectively. With the common reform, as expected, the effect is

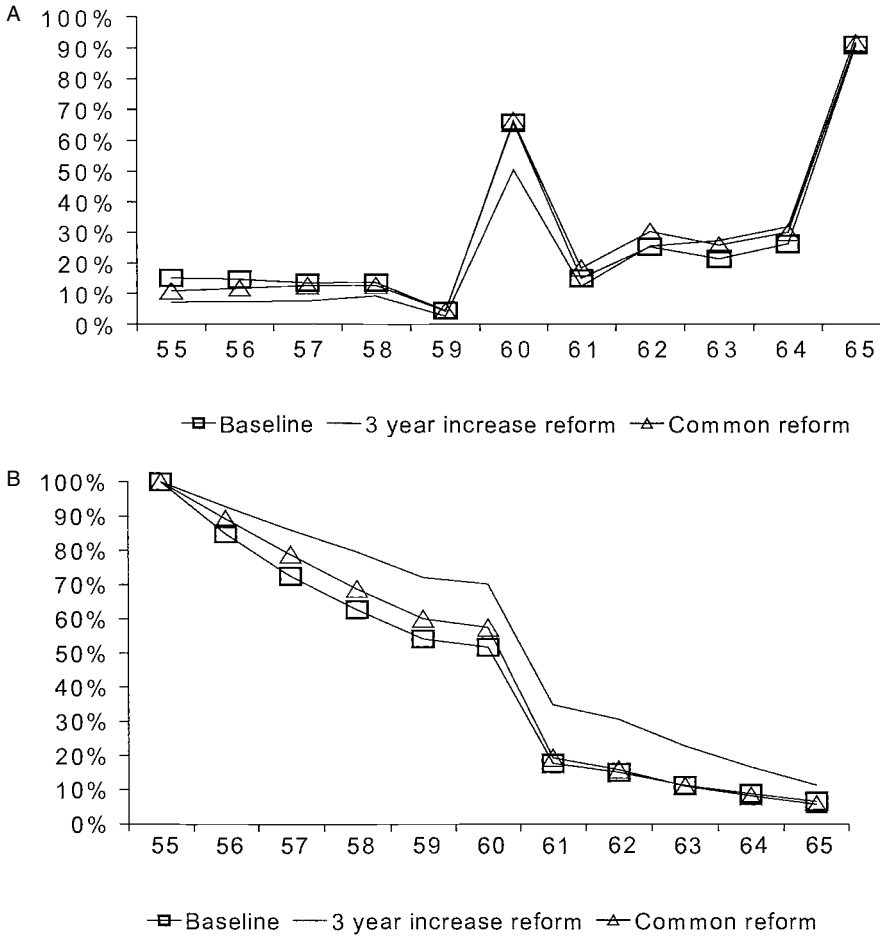


**Fig. 4.13 S2 women: *A,* OV, hazard; *B,* OV, cumulative**

smaller: The average retirement age increases by 0.47, 0.29, and 0.43 years with model S1, S2 and S3.

## 4.7 Conclusion

This project allowed us to assess the sensitivity of individual retirement behavior to the structure of SS incentives. Of course, the robustness of these results may be in question for mainly two reasons:

- First, precisely estimating this sensitivity is difficult since the strength of current incentives in France deeply limits the heterogeneity of behaviors in available data;

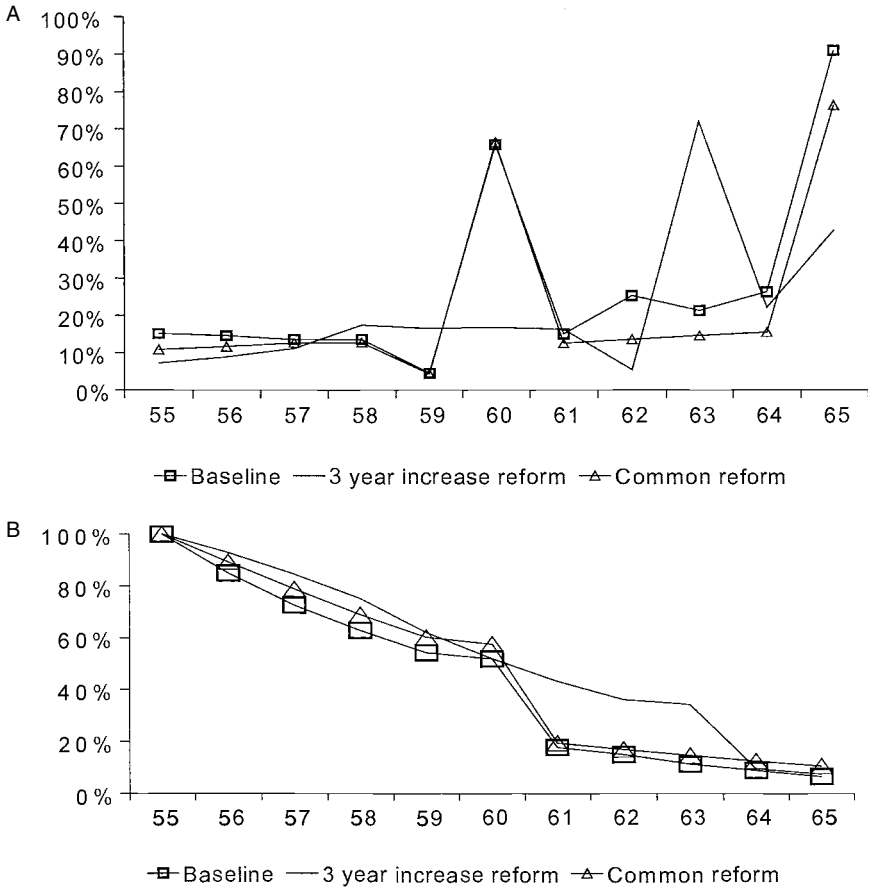


**Fig. 4.14** **S3 women: *A*, OV, hazard; *B*, OV, cumulative**

- Second, current behaviors strongly reflect demand-side effects on the labor market that our supply-side approach cannot capture. In particular, access to early retirement or unemployment schemes is very imperfectly modeled.

Nonetheless we performed various regressions that provide a quite satisfactory description of the behaviors observed in our sample. Sensitivity analysis (through the simulation of alternative rules for the computation of pensions) showed that the OV model (which accounts not only for the pure SSW, but also for the wage component of incentives) seems more appropriate to simulate policy changes. The simulation of individual behaviors under such changes showed a relatively important sensitivity to policy

changes since, for example, an increase by three years of all important parameters (minimum age to claim SS benefits and tenure required to get the full rate) could induce an increase by between one and two years of the average retirement age (results obtained with the OV specification).

## Appendix

### *Wage Projections*

As stated above, our only requirement for wages is their extrapolation at later ages, starting at age fifty-five. This is done through the estimation of wage equations. Even if the analysis will only apply to cohort 1930, wage equations have been estimated using all the information available, that is, data taken from DADS for all cohorts of the EIR (1926, 1930, 1932, 1934, 1936, 1938, 1940, and 1942): This corresponds to 207,433 observations (33,535 individuals) over the time period 1985–1996 (with one missing point in 1990).

Of course, wage equations are estimated on annualized wages, not on the basis of wages effectively earned by people belonging to these cohorts (to avoid the downward bias that would result from exits from the labor force during the year). This is done by dividing wages effectively earned by duration of pay and remultiplying the result by 360. This does not avoid a certain number of imperfections: Some people go on receiving very small wages at later ages, sometimes after the liquidation of their pensions (this is allowed within rather narrow limits). When the duration of pay is poorly registered (for instance, when it is declared to be 360 days while it is obviously less), this method leads to a very low level of the annualized wage which is going to bias the estimation of wage equations.

To avoid these imperfections, a somewhat arbitrary test is applied: Observations with an annualized wage lower than 90 percent of the annual minimum wage (salaire minimum interprofessionnel de croissance; SMIC) for a full-time job have been dropped from the sample. Once this is done, there remains 175,109 observations (29,483 individuals), that is, a sample size reduced by 15.6 percent.

Estimations are then performed on 1985–1995: This reduces once more the size of the sample, which is now composed of 165,530 observations. Observations for 1996 are left for out-of-sample tests of the accuracy of projections, the criterion for these tests being the mean or median squared error.

Four alternative methods have been attempted for the projection of wages.

Method A1 is a simple extrapolation of the last known wage. It is assumed that wages are constant in real terms (i.e., a 2 percent increase in nominal terms between 1995 and 1996).

Method A2 estimates wage equations without individual fixed effects. Wages are then projected, at the individual level, by applying the variation predicted by wage equations to the last known wage for 1995. Two subpossibilities have been explored for the estimation of wage equations: Method A21 estimates the wage equation on first order differences; and Method A22 estimates on levels (using logs).

Method B estimates wage equations on levels but with individual fixed effects. The estimated average age profile is flattened after age fifty, and individual effects are added to this profile to give expected wage profiles for individuals after this age.

Method C is a variant of the simple method A1 and the extrapolation of the average wage over the last three years.

The equations adjusted for methods A21, A22, or B are for the models in levels

$$Y_t = F(X_t, \text{age}, \text{agesq}, Y_{t-1}, Y_{t-2}, Y_{t-1} \cdot \text{age}, Y_{t-2} \cdot \text{age}, Y_{t-1} \cdot \text{agesq}, Y_{t-2} \cdot \text{agesq}, \text{time}_t),$$

or for models on differences

$$\Delta Y_t = F(X_t, \text{age}, \text{agesq}, \Delta Y_{t-1}, \Delta Y_{t-2}, \Delta Y_{t-1} \cdot \text{age}, \Delta Y_{t-2} \cdot \text{age}, \Delta Y_{t-1} \cdot \text{agesq}, \Delta Y_{t-2} \cdot \text{agesq}, \text{time}_t),$$

with $Y_t$ being the log of wages, $X_t$ a set of explanatory variables including a dummy for people living in or around Paris, a dummy for the socioprofessional group in four groups, and a dummy for the kind of activity (in sixteen groups). Equations have been estimated separately for each gender.

A problem is that the estimations of these equations require the knowledge of four successive years if the model is in differences, or three successive years if the model is in levels. Four successive years are also needed with method C. Yet many individuals are not observed during four consecutive years. In particular, cohort 1930, the one to which the model is going to be applied, is not observed before age fifty-five. Of course, at least when the model is in differences, the knowledge of past wages is not absolutely necessary if we want to use the model for projections, since we can limit ourselves to applying the age profile derived from the equation. But it is nevertheless a problem to drop people with short wage records from the sample: It may bias results since these people are less likely to have had good performances in terms of wage progression.

Models first have been estimated as initially proposed (on a subsample of people working three consecutive years), and then reestimated by pro-

gressively dropping variables related to past wages. For instance, for the model in levels, we have successively estimated

$$Y_t = F(X_t, \text{age}, \text{agesq}, Y_{t-1}, Y_{t-1} \cdot \text{age}, Y_{t-1} \cdot \text{agesq}, \text{time}_t),$$

and

$$Y_t = F(X_t, \text{age}, \text{agesq}, \text{time}_t).$$

Table 4A.1 shows the resulting quality of wage predictions for all five methods with a varying number of lags (irrelevant cases are left empty). Results are given both for the total population, and for full-time workers only.

The simplest of all methods, method A1 does not perform so badly. Its variant method C does not add any improvement. Method B does not perform very well, especially for men. It is difficult to compare methods A21 and A22. Wage equations estimated on levels perform significantly better if the criterion if the median of squared errors. Another criterion for selection is the examination of resulting age profiles for wages. The profiles are

**Table 4A.1 Out of Sample Wage Projections for 1996**

| | Men (no. of lags) | | | Women (no. of lags) | | |
|---|---|---|---|---|---|---|
| | 0 year | 1 year | 2 years | 0 year | 1 year | 2 years |
| | *All Workers* $\geq 55$[a] | | | | | |
| A1 (last wage) | 0.1450 | | 0.0959 | | | |
| | 0.0037 | | | 0.0018 | | |
| A21 (wage equation, differences) | 0.1454 | 0.1230 | 0.1206 | 0.0956 | 0.0813 | 0.1011 |
| | 0.0054 | 0.0056 | 0.0059 | 0.0034 | 0.0028 | 0.0045 |
| A22 (wage equation, levels) | 0.1447 | 0.1447 | 0.1443 | 0.0953 | 0.0928 | 0.0904 |
| | 0.0036 | 0.0052 | 0.0040 | 0.0021 | 0.0042 | 0.0017 |
| B (wage equations, with fixed effects) | 0.1465 | 0.1520 | 0.1436 | 0.1031 | 0.0937 | 0.0931 |
| | 0.0241 | 0.0133 | 0.0083 | 0.0125 | 0.0039 | 0.0041 |
| C (average wage of last 3 years) | | | 0.1510 | | 0.1380 | |
| | | | 0.0042 | | 0.0029 | |
| | *Full-Time Workers* $\geq 55$[b] | | | | | |
| A1 (last wage) | 0.1246 | | | 0.0899 | | |
| | 0.0026 | | | 0.0014 | | |
| A21 (wage equation, differences) | 0.1239 | 0.1005 | 0.1010 | 0.0885 | 0.0785 | 0.0984 |
| | 0.0053 | 0.0051 | 0.0048 | 0.0030 | 0.0023 | 0.0039 |
| A22 (wage equation, levels) | 0.1235 | 0.1257 | 0.1260 | 0.0888 | 0.0865 | 0.0859 |
| | 0.0032 | 0.0041 | 0.0029 | 0.0015 | 0.0042 | 0.0020 |
| B (wage equations, with fixed effects) | 0.1177 | 0.1333 | 0.1179 | 0.0953 | 0.0892 | 0.0785 |
| | 0.0189 | 0.0132 | 0.0068 | 0.0018 | 0.0031 | 0.0037 |
| C (average wage of last 3 years) | | | 0.1365 | | | 0.1322 |
| | | | 0.0031 | | | 0.0023 |

*Note:* Estimation period: 1985–1995, 1990 missing. Blank cells indicate that data is not relevant.

[a]Mean squared errors.

[b]Median squared errors.

convex and rapidly increasing when differences are modeled. They look more satisfactory when wage equations are estimated on levels. On the whole, the choice is between methods A1 and A22. The same conclusion can be reached if we restrict ourselves to the subsample of full-time workers. Method A22, without lagged income, is the one which has been finally preferred.

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