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# The PROMESS model

## MESO PROJECTION OF AGES FOR CEASING EMPLOYMENT AND RETIRING

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# INTRODUCTION

The PROMESS model (MESo PROjection of the Retirement System) is a projection model developed by the DREES during the first semester of 2010 to estimate the age distribution in people ceasing employment, ceasing the validation of quarters and the first time receiving a retirement benefits for those in the generations currently on the labour market. It allows us to make projections until the horizon of 2030 as to the different indicators deducting from these distributions: the amount of the retirees, seniors' employment rate, etc. This working paper details the model's main hypotheses and characteristics. Moreover, the annexes present a few specific technical points, examples of application as well as comparisons to exterior administrative sources and to other simulation and projection models.

PROMESS is a model covering all retirement schemes and the entire population: it applies to the ensemble of the population, to those born in France or abroad, without distinguishing people according to the schemes to which they are affiliated over the course of their careers. It is based on two sources of inter-scheme statistical data from administrative records: the inter-scheme retirement sample (*échantillon interrégimes de retraités - EIR*) and the inter-scheme contributor sample (*échantillon interrégimes de cotisants - EIC*).

The model was created to study and modelize the trajectories of those exiting employment and commencing retirement beginning at age 54, taking into account the entitlements already accumulated through the model's base year and the legislation applied to each generation. This base year is defined by the EIC date used, i.e. currently 2005 EIC, which covers the generations born through 1974. For the generations born in 1949 or before, the actual observed accumulated entitlements are only considered up to age 54 and the model was made according to the end of the career after age 54. This could therefore differ from that which has already been observed in reality for these generations.

The PROMESS model is qualified as meso[1] in the sense that its building blocks are categories of people, defined by their generation, their gender, their country of birth (France / abroad), their validated career length at age 54, their wage level quartile and their retirement insurance scheme at the end of their career[2]. It thus distinguishes itself from a macro model as the categories are very small and very numerous (almost 10,000 for each generation). It also distinguishes itself from a micro model since it incorporates all the individuals with similar characteristics relevant to retirement behaviour into homogenous categories. Furthermore, PROMESS distinguishes itself from a simulation model (or a meso-simulation model) due to the fact that it does not aim to simulate a determined retirement age for each building block in the model through a random drawing, but rather it models the entire distribution of possibilities associated with every possible retirement age for each building block. The choice of this modelization implies smoother results than those of most other micro-simulation models as there is no noise associated with random simulation[3].

Two advantages of this model deserve to be highlighted. On the one hand, the parameters of PROMESS are defined by the legislation applied to each generation as concerns the number of validated quarters necessary to have the right to full-rate retirement benefits, the minimum age at which they are eligible for retirement benefits and the age at which full-rate retirement benefits are automatically applied. These parameters thus enable us to easily create a model of the consequences, in terms of age, of the reforms concerning one or more of these

[1] It is thus included in the category of cell-based or matrix models.

[2] That is the last retirement scheme in which rights have been validated just before age 54, grouped into three categories: Public (State Civil Service and CNRACL), Special (SNCF, RATP, CNIEG, ENIM and CANSSM) and Private (general scheme, aligned schemes – MSA and RSI –, and schemes for the independent workers – CNAVPL, CAVIMAC and CNBF). We hypothesize that it is within this scheme that the person will terminate their career.

[3] Nevertheless, a sampling risk remains, due to the fact that the PROMESS parameters are based upon statistical EIR data from 2004 and EIC data from 2005, which are samples taken from the entire population of retirees and future retirees.

dimensions. On the other hand, PROMESS makes separate models of the age for receiving benefits and the age at which one ceases employment, taking into account specific effects pertaining to seniors' employment before the minimum age at which they are eligible for full-rate retirement benefits. This enables us to quantify potentially different impacts of retirement reforms on receiving benefits, and hence on the number of retirees, and on ceasing employment and hence on the number of employed seniors.

In practice, the modelization results from connecting three independent steps, which are detailed later in this paper:

- The first step aims to complete the distribution of career length observed in the 2005 EIC so as to make models of the distribution of the population according to defined categories, as well as by generation, gender, country of birth (France / abroad), by the number of quarters validated up to age 54[4], the wage level quartile and the retirement scheme at the end of career.
- The second step aims to make a model of the possibilities of ceasing employment, ceasing to validate quarters and of receiving benefits at each quarterly age between ages 54 and 66, taking into account the characteristics known at the end of step 1 and the legislation as applicable to each generation. This step actually links several distinct sub-steps according to the end of career insurance scheme (public or private) and according to the age brackets (before or after the minimum age for receiving benefits).
- A third step finally enables moving from age distributions, generation by generation, to the number of retirees and seniors employed or in the validating system. This step thus links the results from the second step with the demographic data (mortality, migrations after the EIC observation date, etc.).

The model's limitations are, finally, evoked in the last section of this working paper. In particular, PROMESS was conceived of to study the legislation based on parameters of required number of validated quarters and age. It is not, on the other hand, adapted to study reforms that essentially affect other parameters, modifications in tax rate discounts or premium schedules or complex reforms that would substantially change the link between the number of validated quarters and age in relation to the current situation. Moreover, in the retirement models, a decisive role is given to having reached full-rate retirement benefits, even though this factor is clearly not the only determiner considered. This choice assumes there is consistent retirement behaviour. It is only justified within a regulatory framework that remains relatively close to the current framework, where the 'search for full-rate retirement benefits' behaviour has actually been observed. In contrast, the model's projections are presumably becoming more uncertain as we move further from the current regulatory framework, for example in simulations of a very high increase in the minimum age at which full-rate retirement benefits are granted or in the cancellation of the reduced-rate benefits. Finally, the effects of the economic conjuncture, or, more generally, all the potential determiners in seniors' employment other than those linked to legislation on the number of validated quarters and age, are not parameterized, which signifies that their role in the model is merely implicit. Thus, PROMESS does not allow us to study the consequences of modifications affecting these other factors.

[4] The age of 54 was thus retained as the pivotal age at which the leaving employment model is created, that is, the probability of having permanently ceased employment of any kind, of having ceased validating quarters and of having received a first retirement benefit payment at each age (quarter by quarter) after age 54. This choice was based upon observing employment rates per age. Such as were observed, for instance, in the INSEE Labour Force Surveys, they remained relatively stable and at a high level until 54 years of age, then began to decline starting at age 55, for both men and women. This observation thus seems to prove that it is during the last 5 years of employment before the minimum age for having access to full retirement benefits that the end of career transition period occurs.

# MODELIZATION OF CATEGORIES AT AGE 54

The PROMESS model's first building block is the category at age 54, defined by the intersection of several variables:

- socio-demographic variables: generation, gender and country of birth (France / abroad);
- variables summarizing the career until age 54: the number of quarters validated up to age 54 (in the sense of quarters validated in all retirement insurance schemes); quartile of revenue in the field of employment or average annual wage in all retirement schemes between ages 50 and 54 (a specific modality identifies the unemployed at these ages); end of career retirement scheme (public, private or special).

Although the socio-demographic variables are invariable over time and observable in the 2005 EIC, this is not the case for variables summarizing the career. The first step in the model thus consists of modelizing the career, and notably the acquisition of quarters up to age 54 within each generation's total population in order to enable estimating the weight associated with each category at age 54 within the total population of each generation. The chosen method consists in beginning with the distribution by category of the number of quarters validated and the wage level quartile (at this stage, the retirement insurance scheme is not taken into account) observed in the 2005 EIC data at the age reached by each generation in 2004[5], then estimating the transitions between categories, that is, the probabilities associated with each change in category, and doing so every four years up to age 54. The four-year step chosen corresponds to the fact that one generation in four is observed in the EIC.

For the modelization of retirement, it is also necessary to break down the categories at age 54 into smaller subcategories, by type of retirement insurance scheme at the end of the careers. This division is carried out in a subsequent stage, once the categories of number of quarters validated and wage level quartile at age 54 have been modelized.

## Modelization of number of quarters validated up to age 54

The Category at Age 54 can only be observed in the EIC for generations born in 1950 (those aged 55 in 2005) and before (generations 1942 and 1946). For these generations, the weight of each category simply corresponds to the proportion of individuals in each category in the sample. The Number of Validated Quarters at Age 54 category is measured as the sum of the quarters validated each year in all of the retirement insurance schemes (after capping the annual sum of all retirement insurance schemes to 4 quarters per year) up to and including the calendar year in which they turn 54, and the 'wage level quartile' is defined using the average annual revenue for the field of employment from age 50 to up to and including age 54. The upper and lower quartile limits are calculated separately for men and women: the 'feminine' and 'masculine' quartiles are thus not interpreted in the same way (see Box 1).

For generations born after 1950, the Category at Age 54 cannot be observed, but the categories can be defined in a similar manner as those for lower ages: Category at Age 50 (number of quarters validated in all retirement insurance schemes up to the end of the calendar year in which they turn 50 and the employment field revenue for all retirement insurance schemes between ages 46 and 50), at age 46, at age 42, etc. For each generation, the categories are observable up to a certain age and their weight in the population can be calculated using the number of individuals in the Category in the EIC: the Category at Age 50 is thus known for those generations born before 1954, the Category at Age 46 for those born before 1958, etc. For the youngest generation in the 2005 EIC, only the Category at Age 30 is known (generation born in 1974).

[5] EIC data relative to the year 2005 was not used. This follows the choice of age 54 (reached by the generation born in 1950) as the pivotal age for the model.

### *Box 1: Career Data processing*

The weight of the diverse categories constituting the PROMESS model's building blocks are initially estimated as proportions among individuals sampled in the 2005 EIC. It is therefore necessary to dispose of, for all the individuals in this sample, values for all of the variables effecting the definition of the categories, notably for the number of quarters validated and the wage level or the employment revenue. In some cases, imputations are necessary so as to compensate for missing data and omitted variables.

The number of validated quarters in all retirement insurance schemes at a given age includes quarters validated in the paying of dues, quarters of old age insurance for validated by stay-at-home parents full-time caregivers of a disabled, dependent relative (assurance vieillesse des parents au foyer, AVPF) and the diverse so-called "assimilated" quarters (unemployment, sick leave, maternity leave, pre-retirement, etc.). The duration also includes quarters validated during military service for men. The 2005 EIC has some data pertaining to these latter, they were subject to imputation when there was data missing. These quarters were levelled off to 4 per year, then summed up for the entire career. Some quarters validated by people sampled in the EIC can, however, not be identified in the sample. That is generally the case when the number of quarters is only known upon receiving retirement benefits: quarters assimilated for uncompensated unemployment, periods validated abroad, etc. The latter were not subject to imputation, and thus there is a possibility that the number of quarters validated were slightly underestimated for some individuals.

There was an imputation made for the number of children a woman has. A probability is associated with each number of children between 0 and 5 (10% for 0 children, 20% for 1 child, 40% for 2 children, 20% for 3 children, 7% for 4 children and 3% for 5 children), identical for every generation. The imputation is made by selecting a random variable risk and comparing it to the probabilities for each woman in the EIC. Quarters validated in accordance with the Increased Period of Insurance (majoration de durée d'assurance, MDA) for children are then allocated to the fund scheme validating the most quarters knowing the scheme at age 54. This notably allows us to differentiate the number of quarters allowed per child in private retirement insurance schemes (8 quarters per child) and public retirement insurance schemes (4 quarters per child). Thus, a woman contributing to a private retirement insurance scheme at age 54 will benefit from 8 quarters per child. The MDA reform in the Civil Service sector for children born after 2004 was not modelized. This approximation nevertheless has a lesser impact as the most recent generation that will be 60 before the end of the model's projection (the generation born in 1970 that will be 60 in 2030) was already 34 in 2004. Similarly, the 2009 MDA reform in the general retirement scheme was not specifically taken into account and we hypothesize that the MDA quarters are allocated to women and only to women.

Moreover, the wages and employment revenue were not systematically input into the EIC. In particular, no wages are available for those affiliated with the Civil Servants' CNRACL scheme. Starting in 1984, the wages can be found in the DADS panel database, which is coupled with the EIC. For the generations and years prior to this date, the wages were estimated beginning with the first wages observed after 1984 to which average growth rates were digressively applied by age for the 1962 and 1966 generations.

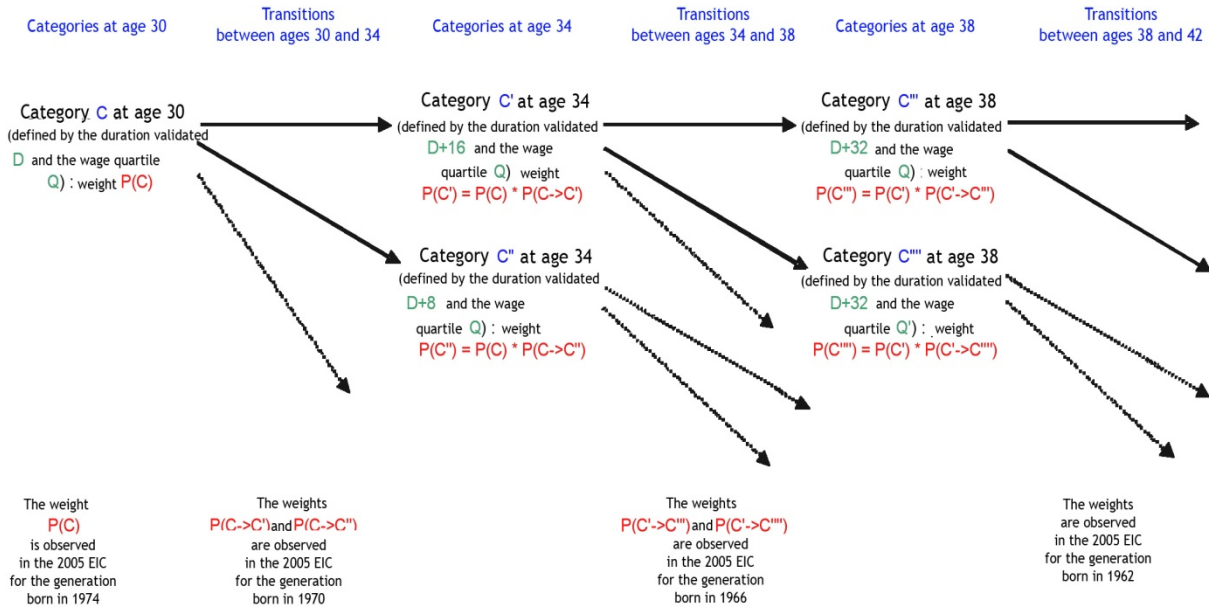
Distributing the population by wage level quartile (or employment revenue) was done as follows. First, the lower and upper limits of the wage level quartiles or employment revenue were estimated using individuals for whom the wages or employment revenue were known, and this was done separately for men and women. These individuals can then easily be classified into the corresponding quartile. Then, individuals working in the Civil Service for whom there was no wage information or for whom such information could not be reconstructed were randomly placed in quartiles 2 and 3. Individuals from other schemes with no wages but who had validated quarters in the form of paying employment retirement insurance dues were also randomly placed in one of the four quartiles. Finally, a 5th 'quartile' was created for the individuals with no wages and no validated quarters for employment retirement insurance. The modality 5 will thus be used to identify those persons with no employment in a given age bracket. In particular, persons situated within this modality for the Category at 54 (persons having no employment between ages 50 and 54) were considered to have definitively ceased employment before age 50.

The probabilities associated with category transitions between two successive quadrennial ages can also easily be measured using proportions in the 2005 EIC. For example, the probability associated with the transition between category *C* at age *A* and category *C'* at age *A+4* can be estimated by the proportion, in the 2005 EIC, of individuals in category *C'* at age *A+4* among those who were in category *C* at age *A*. The categories are defined by both a number of quarters validated and an employment revenue quartile. The passage from category *C* to category *C'* is thus due both to the validation of quarters between ages *A* and *A+4* and to an eventual change in the employment revenue quartile between these two ages.

In the PROMESS model, the most recent generation available is used to estimate the transitions at each quadrennial age. Thus, the observations of the generation born in 1970 are used to estimate the probabilities associated with category transitions between ages 30 and 34 and those from the generation born in 1966 for transitions between ages 34 and 38, etc. This choice signifies that all the empiric proportions observed correspond to transitions that occurred during the 2000-2004 period. Thus, implicitly, the PROMESS model hypothesizes that the projected labour market (i.e. beginning in 2004) will conserve the average characteristics it had over the period

from 2000 to 2004[6]. This period covers both a sub-period of expansion (the high point in the economic cycle was reached in 2000) and a sub-period of lesser activity (the low point was reached in 2003).

The weight associated with the diverse categories at 54 for all the generations could be projected by linking, every four years, the weight of each category at the age observed in the 2005 EIC and the probabilities associated with transitions between the corresponding categories. The following simplified schema illustrates this connection for the youngest generation, born in 1974.



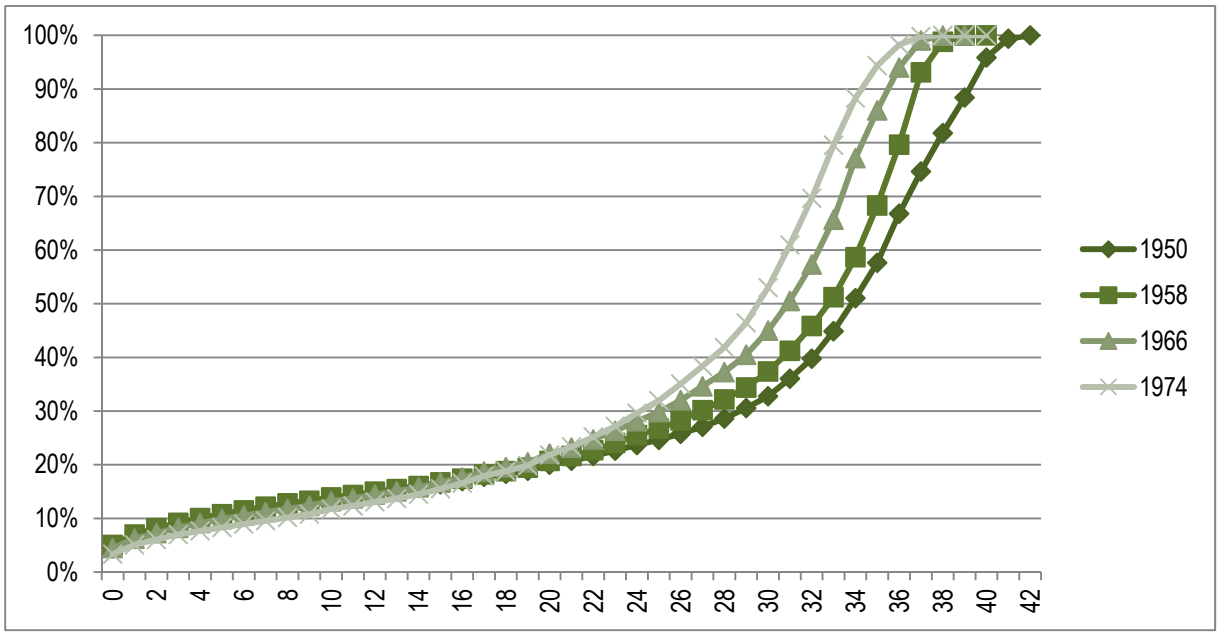

As the EIC is a sample and not an all-comprehensive database, some empiric proportions cannot be observed. So we use the proportions observed in the closest category, this is defined by a same wage quartile and the closest possible number of validated quarters. If, for example, we want to estimate the probability of the transition between ages 30 and 34 for the category defined by a duration (number of quarters) *D* validated at age 30 and a wage level quartile *Q*, and if we cannot observe any individuals in the 2005 EIC born in 1970 with these characteristics, we will then use the empiric proportions associated with transitions observed for individuals born in 1970 and who, at age 30, are in the category defined by the duration validated *D+1* (or *D-1*) and quartile *Q*. The number of quarters validated four years later will be increased or decreased in the gap between the number of validated quarters at age 30 (-1 if we use the duration validated *D+1* from generation 1970, and *+1* if we use the duration *D-1*).

Linking the proportions every four years enables us to calculate the proportions associated with the diverse Categories at Age 54 for each EIC generation. The corresponding distribution for the number of years they validated having retirement insurance at age 54 is represented in the graphs below. For men, we project proportions relatively similar from one generation to another as concerns validations of a low number of quarters, but the proportions decrease from generation to generation as concerns validations of a large number of quarters. This result shows the progressive increase of the age for entering the labour market observed from the mid-1950s through the mid-1990s. In particular, the generations born after 1954 are clearly distinguished from the generation

[6] This is true for the labour market as experienced up to age 54 by the individuals in the categories modelized by PROMESS. After age 54, the hypothesis is distinct since the modelization is completely different. For the private sector, notably, the end of career trajectories are calibrated using observations from generations 1934 through 1942: they thus correspond more to the state of the labour market as observed in the 1990s, albeit with one important detail: this "state of the labour market" for seniors can only be interpreted here without the effects of the retirement reforms. These latter are modelized endogenously so as to truly correspond to future effects and not to the effects observed on average in the 1990s.

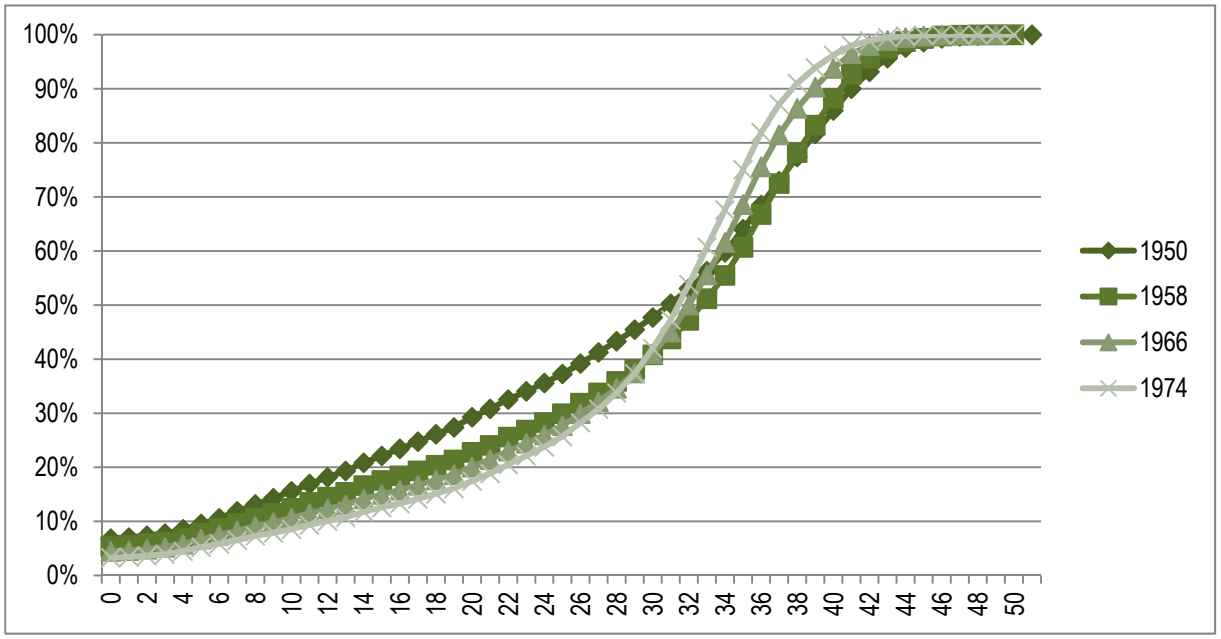
born in 1950, notably as concerns a great number of quarters validated, due to the obligation of remaining in school until age 16 for generations born after 1953. Among the women, we observe a similar drop in the proportion of persons having a great number of validated quarters at age 54. On the other hand, contrarily to men, the proportion of persons having very few validated quarters is also clearly dropping, demonstrating a regular increase in women's participation in the labour market.

**Graph 1: Distribution (cumulated frequency) of the number of years validated at age 54, projected for each generation**
**- Men –**




NOTE: AT THIS STAGE OF MODELIZATION, THE CORRECTIONS FOR LATE MIGRATIONS FOR THOSE BORN ABROAD ARE NOT TAKEN INTO ACCOUNT

**Graph 2: Distribution (cumulated frequency) of the number of years validated at age 54, projected for each generation**
**- Women –**




NOTE: AT THIS STAGE OF MODELIZATION, THE CORRECTIONS FOR LATE MIGRATIONS FOR THOSE BORN ABROAD ARE NOT TAKEN INTO ACCOUNT

The proportions associated with each category are expressed within each of the subpopulations defined by generation, gender and country of birth. To be expressed in terms of numbers, they will be multiplied by the number in each of the subpopulations using civil records data.

A portion of the population does not validate any quarters throughout their lives and thus will not have the right to any retirement benefits. This portion is measured using the proportion of individuals taken from the French National Directory for Identifying Individuals (*Répertoire National d'Identification des Personnes Physiques, RNIPP*) used to build the 2005 EIC, living as of 31 December 2005, but who had not accumulated any entitlement to retirement benefits. For the generations 1954 through 1974, the transitions by category every 4 years enable us to project the numbers concerned up to age 54. These numbers are then excluded from the projection model.

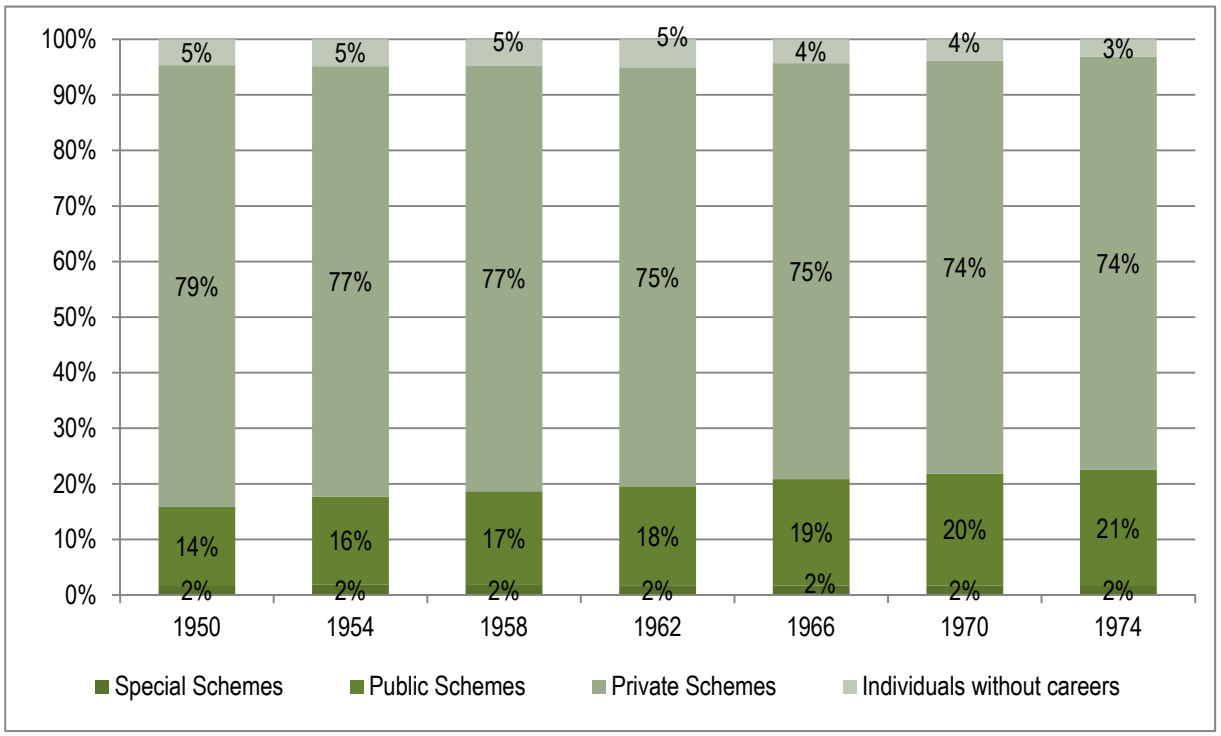
Moreover, the method described hereunder enables us to calculate the proportions for the generations observed in the 2005 EIC, i.e. one generation in four born between 1942 and 1974 (the data from the 2005 EIC for the generations born in 1934 and 1938 are not used in PROMESS due to problems in completness). The proportions for the intermediate generations can, however, be estimated through simple linear extrapolation. For example, the weight of a category *C* for the generation born in 1971 is estimated through the weighted average for the weight of this category for the generation born in 1974 (weighted 1/4) and that for the generation born in 1970 (weighted 3/4).

## Division by type of retirement scheme

Within the Categories at Age 54, the observations of the 2005 EIC for the generation born in 1950 allow us to estimate the proportion by type of regime: Private (employees affiliated with the general scheme or with MSA - agricultural employees, and independent workers), Public (Civil Service and employees affiliated with the National Pension Fund for Employees of Local Administrations - *Caisse Nationale de Retraite des Agents des Collectivités Locales, CNRACL*) and Special Schemes (employees affiliated with schemes at the SNCF - French Railways, CANSSM - miners, ENIM - sailors, CNIEG - electric and gas workers, etc.) These proportions conditional to Categories at age 54 are extrapolated to posterior generations.

The following graph illustrates the proportion of each type of scheme, for the ensemble of the population, by year of birth of the persons (see graph 3). From one generation to another, the proportions only evolve due to a composition effect. The increase in the percentage of people ending their careers in the public scheme (14.3% among those born in 1950, 21% among those born in 1974) thus should only be seen as a mechanical consequence of the increase in the weight of the categories in which the proportion of employees in public schemes is highest. In fact, Civil Servants are under-represented amongst the very long career durations, and thus over-represented in the shortest durations. The decrease in the weight of these long duration careers over the generations, notably due to a later entry to the labour force, thus mechanically increases the average proportion of Civil Servants in the ensemble of the population, since the weight of the duration categories in which they are most represented have increased.

**Graph 3: Distribution of the population by type of main retirement scheme at age 54, by generation**




NOTE: AT THIS STAGE OF MODELIZATION, THE CORRECTIONS FOR LATE MIGRATIONS FOR THOSE BORN ABROAD ARE NOT TAKEN INTO ACCOUNT

Finally, in order to modelize first receiving retirement benefits for persons terminating their careers in a public retirement insurance scheme, we distinguish the individuals according to the subcategory: agents classified as "active", agents classified as "sedentary" (or assimilated for special schemes) are able to retire with full-rate benefits at age 60 and must retire at age 65. The "active[7]" agents (to which most employees terminating their careers in one of the special schemes are assimilated) and "others". The "sedentary" agents (or assimilated for special schemes) can retire at 60 and must retire by 65. The "active" agents (to which are assimilated most employees terminating their careers in one of the special schemes) can retire at age 55 and must retire by age 60. Finally, the "other" kind of departures concerning those due to disability, parents of three children, early retirement due to handicap or long career and agents having been employed in a position classified as un-healthy[8]. In the case of departures due to disability (or reform retirement benefits in the SNCF) or due to the parents of three children, there is no age condition for receiving full-rate retirement benefits. Thus, a portion of retirement benefits is paid before age 50: the number of retirees under age 50 in the Civil Service and special retirement schemes was estimated to be 120,000 in 2005 and 110,000 in 2008. These numbers are mainly split between ex-military pensions (64,000 in 2008), departures with no age limitation in the Civil Service (30,000 in 2008), special retirement schemes (3,000 in 2008) and the disabled (10,000 in 2008).

In practice, each Category at Age 54 considered in the PROMESS model (category defined by generation, gender, number of quarters validated at age 54, etc.) for which the end of career retirement scheme is a public scheme is thus divided among three subcategories of "sedentary", "active" or "other" individuals.

The proportions corresponding to each subcategory are calibrated, for each of the Categories at Age 54, using the types of departures observed in the EIR for the generations 1938, 1940 and 1942. However, the data used here is not from the 2005 EIC, but from provisional files sent by the public retirement sector for the creation of the

[7] These agents have spent at least 15 years working in a position classified in the active category.

[8] These types of positions allow full-rate retirement before age 55, generally at age 50. It does not appear to be expedient to apply a typical 'search for full-rate retirement benefits' departure model to this category of agents, as the full-rate is very rarely reached before the age limit.

2008 EIR (civilian and military *FPE, CNRACL, SNCF, CNIEG, RATP, CANSSM, ENIM, Banque de France, FSPOEIE*). For those holding direct entitlement retirement schemes in several different schemes in the public sector, the main scheme is determined by retaining the highest principal advantage. Moreover, when there is no other category in the PROMESS model with the same characteristics as a Category at Age 54 in the data observed for the generations 1938 to 1942, we attribute the characteristics from the closest category and vary the number of validated quarters at age 54.

In projection, the method causes the proportions of active, sedentary and other individuals among former Civil Service employees to evolve uniquely, from generation to generation, due to composition effects. In fact, insomuch as the proportion associated with each sub-category is assumed to be constant within each Category at Age 54, only the evolution of the weight of the Categories at Age 54 within the entire population will make the weight of the sub-categories evolve.

The portion of individuals in the public sector retirement schemes thus increases with the generations (see graph 3). This increase mainly results in a rise in the number of sedentary agents and, to a lesser measure, active agents. The proportion of sedentary agents is 43% in the generation 1950 as compared to 49% for the generations 1938 to 1942 within the public sector.

**Table 1: Population distribution according to the main retirement scheme and public sub-category**

| category | generation 1950 | generation 1974 |
|---|---|---|
| *private* | 79% | 74% |
| *public - sedentary* | 7% | 12% |
| *public - active* | 4% | 5% |
| *public - other* | 5% | 5% |
| *No validated quarters* | 5% | 3% |

SOURCES: DREES, 2004 EIR, 2005 EIC, AND THE PROMESS MODEL
NOTE: THE "PUBLIC" CATEGORY GROUPS TOGETHER THOSE INDIVIDUALS HAVING A PUBLIC OR SPECIAL RETIREMENT SCHEME AT AGE 54.

**Table 1: Distribution of sub-categories within the public sector**

| | gen 1938-1940-1942 (2008 EIR) | generation 1950 (projection) | generation 1974 (projection) |
|---|---|---|---|
| *public - sedentary* | 49% | 43% | 53% |
| *public - active* | 26% | 28% | 24% |
| *public - other* | 25% | 30% | 23% |

SOURCES: DREES, 2008 EIR AND THE PROMESS MODEL
NOTE: THE "PUBLIC" CATEGORY GROUPS TOGETHER THOSE INDIVIDUALS HAVING A PUBLIC OR SPECIAL RETIREMENT SCHEME AT AGE 54

# CEASING EMPLOYMENT AND BEGINNING TO RECEIVE RETIREMENT BENEFITS

The second step of the model aims to estimate, at each age, the proportion of the population that has definitively ceased any employment (excluding employment within the framework of bridge jobs combined with retirement), that has definitively ceased validating quarters, and that has begun to receive retirement benefits. These proportions are estimated in each category from the first step, defined by the intersection generation * gender * country of birth * wage quartile at age 54 * number of quarters validated at age 54 * end of career sector. The estimate is made using simple employment exiting models, conditional upon the variables that define the categories and those alone. The proportions will then be reaggregated in a later step and will be expressed as averages for the entire population.

Three different models are considered, depending upon the situation of the individuals at the end of their careers (i.e. between ages 50 and 54):

- A 'private sector' model for those individuals ending their careers in the general retirement scheme, in an aligned scheme (MSA – farm employees – or RSI – independent workers), or in a scheme for independent workers (MSA farm owners, CNAVPL – self-employed, CNBF - lawyers). This model is calibrated using observations on the employment exiting behaviour of former wage-earners in the private sector. We thus hypothesize that the retirement of former independent workers is similar to that of former private sector wage-earners.
- A 'public sector' model for individuals terminating their careers in a Civil Service or special employees' retirement scheme (CNIEG – gas and electrical workers, RATP – transportation system workers, SNCF – French Railroad employees, *Banque de France*, CANSSM - miners, ENIM –sailors).
- A specific model for those persons having definitively ceased all employment before age 50 (notably women and foreigners).

We thus consider that it is the retirement scheme with which the person is affiliated at the end of their career that will determine their end of employment behaviour. The 'public sector' model is thus, for example, applied to people who paid into more than one retirement scheme and who may have begun their careers in the private sector.

## Persons terminating their careers in the private sector (employees and independent workers)

In the private sector, the ceasing employment model connects two sub-models:

- Firstly, a definitively exiting employment and definitively ceasing all validating systems[9] model is estimated: this consists of estimating, at each age up to the minimum age for receiving retirement benefits (i.e. age 60 currently), the probabilities associated with these events, conditional upon being employed (or being in a validating system) at the considered age. The case of early retirement due to a long career is considered specifically: we consider that every person eligible for this measure retires as soon as they have met the requirements.
- Secondly, we estimate a model on first retirement benefit payments at each quarterly age between the minimum age for receiving retirement benefits (age 60) and the automatic age for receiving full-rate retirement

[9] That is, employment and assimilated periods (unemployment, preretirement, disability, sick leave...).

benefits (age 65). Here, this means estimating the probabilities associated with each age for receiving benefits, conditional upon certain characteristics of the person at the age at which they can receive benefits (notably the number of missing validated quarters required for receiving full-rate benefits and whether or not they are still employed). The probabilities are constrained to make their sum equal to 1. Moreover, as is standard, we consider that all retirement benefit payments after the automatic full-rate benefit age are received at age 66 (or the automatic full-rate benefit age increased by one year when the reforms staggering this limit are considered).

These models are estimated using people employed (exclusively) at the CNAV after age 50, born in 1934, 1938 or 1942 (for the modelling of ceasing employment before age 60) or in 1934 and 1938 (for the modelling of receiving benefits after age 60).

In projection, the exiting employment model for persons terminating their careers in the private sector is applied to employees and independent workers. Implicitly, we hypothesize that the employees affiliated with a retirement scheme other than the CNAV (MSA employees) and that independent workers (artisans, storekeepers, self-employed and non wage earning agricultural workers) have the same ceasing employment age distributions and retirement ages as employees in the general retirement scheme.

## Ceasing employment before the minimum age for receiving retirement benefits

Here we estimate the *instantaneous* probabilities of definitively exiting employment on the one hand and the validating system on the other hand. Between ages 54 and 59 (*i.e.* at ages *a* such as *53<a<60*), the probability of exiting employment is defined as the probability that the year when age *a* was reached was the last year in which the periods of employment were observed, with the condition that the periods of employment were observed up to said year. The definition is similar for definitively exiting the validating system, by replacing the 'periods of employment' with 'periods of employment or assimilated'.

The two ages of 53 and 60 are particular. 'Exiting employment at age 53' means the person validated quarters after (and including) age 50, but they did not validate any more as of the year they turned 54. Officially, this does not mean exiting at age 53, but between ages 50 and 53. Moreover, 'exiting employment' at age 60 means retiring *before the age at which they are eligible for retirement benefits*, that is, before their 60th birthday in the current context. Concretely, we consider this to be retirement at age 60 if the number of quarters validated in the year they turn 60 is strictly inferior to the number of quarters potentially able to be validated in the year (that is, the number of civil quarters before the date they first receive retirement benefits).

In practice, we estimate for each age *a* (*a=53 to 60*) the instantaneous probabilities of *not* exiting employment $P_a^{employed}$ or a validating system $P_a^{validating}$ [10]. The probabilities of still being employed or in a validating system at a given age are then obtained by combining the instantaneous probabilities up to said age. For example, for a person having validated quarters after age 50, the probability of still being employed at age 60 are obtained as follows:

$$P(\text{still employed at age } 60 / \text{validating after age } 50) = P_{53}^{employed} * P_{54}^{employed} * \ldots * P_{59}^{employed} * P_{60}^{employed}$$

[10] The probabilities are estimated annually. For the projection, the results are then quartered so as to present the distributions at the age of exiting employment quarter after quarter. This quartering is simply done by considering that the quarterly probabilities (of exiting employment or a validating system) are equal to the fourth root of the annual probabilities.

## *Box 2: Discrepancy Change in probabilities of exiting employment in case of discrepancy an increase in the minimal age at which the person is eligible for claiming benefits*

In projection, in scenarios in which the minimum age at which people are eligible for retirement benefits is shifted, we hypothesize that, for the instantaneous probabilities of exiting employment, that the five years preceding this age are analogous to the five years between ages 55 and 60, and that the years preceding this age are analogous to that of age 54. For example:

$$P(\text{still employed at age } 62 / \text{validating after age } 50) =$$

$$P_{53}^{employed} * (P_{54}^{employed} * P_{54}^{employed} * P_{54}^{employed}) * P_{55}^{employed} \ldots * P_{59}^{employed} * P_{60}^{employed}$$

For the first wage quartile, we retain the probability observed at age 55 and not that observed at age 54, for replicated years. This corresponds to the age at which the rate of definitively exiting employment is the lowest.

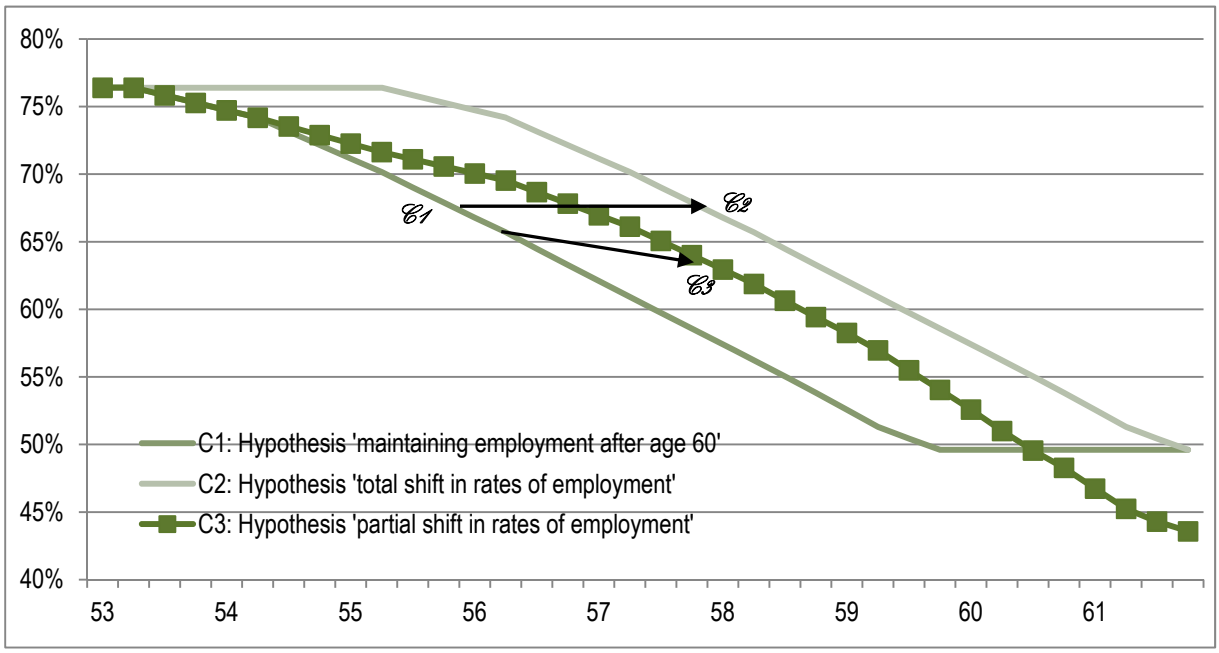
This modelization is really shifting the instantaneous probabilities so as to maintain the distance to the minimum age for receiving retirement benefits constant. In effect; the hypothesis consists of considering, for example, that the instantaneous probability of definitively exiting employment at age 59 'becomes', all else being equal ceteris paribus, the instantaneous probability of definitively exiting employment at age 61 when the minimum age for receiving retirement benefits is raised from age 60 to age 62. However, the shift is not absolute as concerns the probability of being employed at a certain age (that is, the rate of employment) or the average age for exiting employment, being that shifting the instantaneous probabilities of exiting employment according to the distance to the minimum age for receiving retirement benefits does not signify that we shift the rate of employment and the average ages in the same way. For these indicators, the shift is in effect attenuated due to the replication, as many times as there are years shifted, of the annual instantaneous probability of exiting employment.

Furthermore, the shift is not absolute for the instantaneous probabilities of exiting employment, being that it is only true all other things being equal ceteris paribus: and the characteristics of individuals evolving with age (as in the case of the example below, between ages 59 and 61), and notably the number of quarters validated, which, in the model, is one of the main determinants for maintaining employment.

The model thus corresponds to a hypothesis of imperfect elasticity in the distribution of ages for exiting employment when the minimum age for receiving retirement benefits is raised. The situation is thus intermediary between the age where the elasticity is null (since, at a given age between 55 and 59, the probability of being employed – that is, the rate of employment – is slightly higher when the minimum age for receiving retirement benefits is later) and the age at which the elasticity is perfect (since, at a given distance from the age at which one is eligible for retirement benefits, the probability of being employed is slightly lower when the age at which one is eligible for retirement benefits is higher).

The following graph (see graph 4) illustrates these polar hypotheses on the elasticity of employment when the minimum age for receiving benefits is raised. The C1 curve represents the rate of employment under the hypothesis that the reforms have no effect before age 60 (the rate of employment before age 60 is thus equal to its level in the absence of reform), but all persons still in employment at this age will remain so until the new age for receiving retirement benefits is reached (age 62). Due to this, the rate of employment between ages 60 and 62 remains constant with the level observed at age 60 in the absence of reform. This type of case corresponds, for example, to the hypothesis of projection retained by the general retirement scheme in the projection exercise carried out by the Retirement Orientation Counsel (Conseil d'orientation des retraites) in 2010. The curve C2 corresponds to the hypothesis of a total shift in rates of employment, of the same scope as the shift in the minimum age for being eligible for retirement benefits. This hypothesis consists of considering that the rate of employment will remain invariable in function to the given distance remaining until the minimum age for receiving retirement benefits: the rate of employment at age 60 on curve C2 rigorously corresponds, for example, to the rate of employment at age 58 on curve C1. As in the hypothesis of maintaining employment after age 60, the total shift hypothesis considers that the rate of employment remains constant in one window of a given age, but that this window is before the age classes for which the rate of employment diminishes, and not after (in the graph, the rate of employment is constant between ages 53 and 55 in curve C2, not between ages 60 and 62 as in curve C1). Finally, curve C3 corresponds to the hypothesis of a partial shift in the rate of employment, as the one modelized by PROMESS. This curve cannot simply be deduced using translations or other transformations of curve C1, being that the rates of employment are re-estimated at each age using new hypotheses on legislation and the interaction of diverse mechanisms leading to numerous deformations of the curve. The shift is qualified as partial being that, at a given age, the rate of employment is superior to that which it would be in the absence of the effect of the reforms on seniors' employment (see comparison of the curve C3 to the curve C1 before age 60), but that, at the distance to the given age at which one becomes eligible for retirement benefits, the rate of employment is inferior to that which it would be under the hypothesis of a total shift (see comparison of C3 and C2).

**Graph 4: Three hypotheses for modelizing the employment rate of seniors between 53 and 62 years of age, in a scenario in which the minimum age for receiving retirement benefits is raised from age 60 to age 62**




Moreover, the choice of the probability observed at age 54 as the probability of remaining employed replicated for all the new years appearing in the window between age 54 and the age at which one is eligible to begin receiving retirement benefits when it is shifted corresponds to an important hypothesis in the model. This choice was made based on the idea that definitive exiting of employment at age 54 can be mainly attributed to the effects of labour demand, insomuch as measures for leaving employment early (preretirement, unemployment with chômage en DRE – when elderly persons are unemployed and it is deemed unlikely they will find work, they are dispensed with searching for employment, etc.) are not generally available at this age. On the other hand, exiting of employment observed between ages 55 and 59 can also presumably stem from effects of labour supply and not only labour demand. It would thus have been difficult to hypothesize that these effects will remain the same at the same ages being that they are linked to the existence of measures likely to evolve if the minimum age for being eligible for retirement benefits shifts.

Finally, to modelize scenarios in which the minimum age for being eligible for retirement benefits is raised, a scalability hypothesis is forwarded in the PROMESS model. We consider that the generations who had already reached age 55 in 2010 could not have anticipated a possible reform. Their employment is thus assumed to be impervious to a possible rise in the minimum age for being eligible for retirement benefits, hence the modelized impact of this measure is very low in the short term. The sensibility of seniors' employment to such a rise would only begin in the generations born after 1956 (generation that was 55 in 2011).

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The probabilities $P_a^{employed}$ and $P_a^{validating}$ are conditional upon a certain number of *X* determinants. In practice, we use values predicted by a logistic model (SAS PROC LOGISTIC) $\hat{P}_a^{employed}(X)$ and $\hat{P}_a^{validating}(X)$, estimated separately for each gender, and where *X* includes :

- average annual wage quartile dummies from age 50 up to and including age 54,
- the unemployment rates observed over the year, and
- a dummy equal to 1 if a duration longer than or equal to the required duration was validated over the course of the year considered.

The impact of the reforms increasing the duration required to be eligible for full-rate retirement benefits when exiting employment before the minimum age at which retirement benefits are granted is thus portrayed by this last dummy variable, being that, in practice, we observe that maintaining employment or a validating system is significantly lower when this indicator is equal to 1 (see Aubert, 2009).

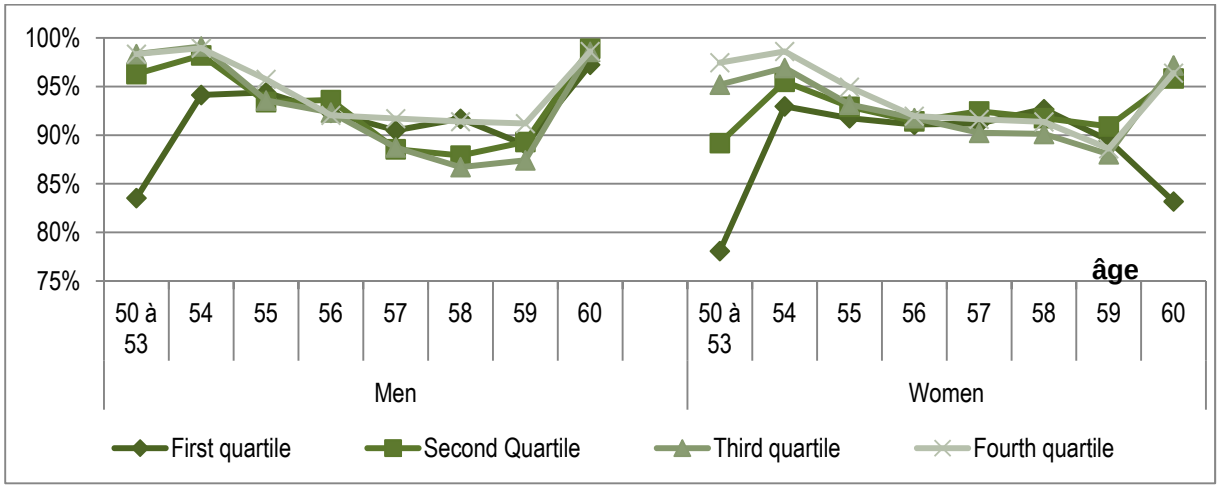
As previously indicated, the models are estimated using individuals observed in the EIR and EIC, born in 1934, 1938 or 1942, having had employment requiring affiliation with the CNAV between ages 50 and 54, and validating quarters only at the CNAV over the year in which they turned 54. The number of quarters validated at age 54 is

estimated as the difference between the number of quarters validated in all schemes that the CNAV gave the EIR ('DAS' variable) and the sum of the number of quarters validated in the EIC ('NTTV' variable) between the year in which the person turns 55 and the date they collect their first retirement benefits. The age at which employment is definitively ceased is defined as the highest age being employed is observed (quarters employment retirement scheme dues were paid or the presence of a wage revenue or employment was recorded.) The age at which a person definitively ceased validating quarters is, similarly, defined as the highest age observed at which at least one quarter was validated (for employment period or assimilated period).

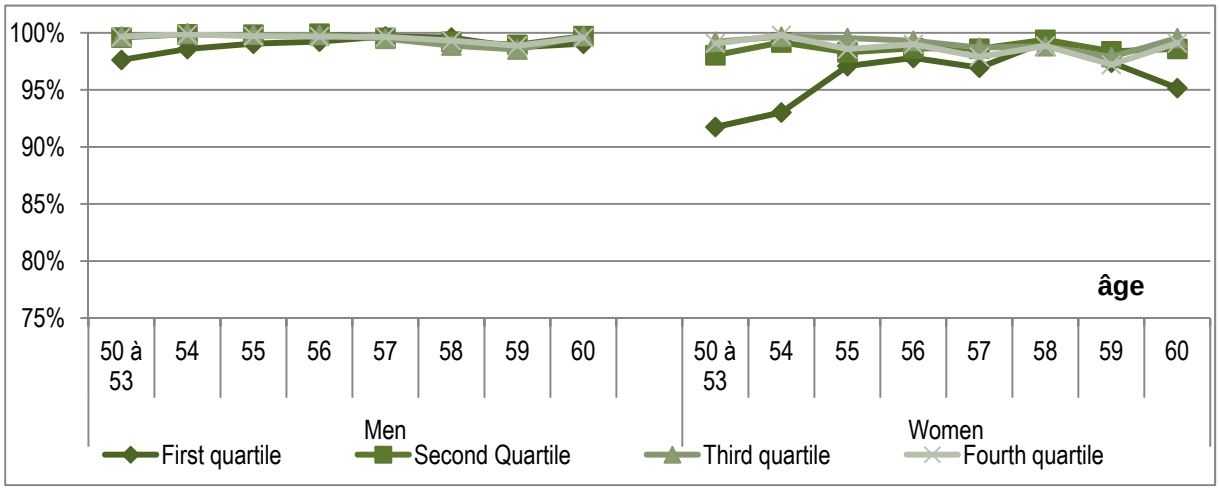
The graphs below (graph 5) present, for each age, the instantaneous probabilities estimated for people with diverse profiles (according to gender, average annual wage quartile between ages 50 and 54, and whether or not they have a sufficient number of quarters validated for full-rate retirement benefits).

**Graph 5: Diverse examples of probabilities estimated, at each age before 60, according to gender and wage quartile between ages 50 and 54**

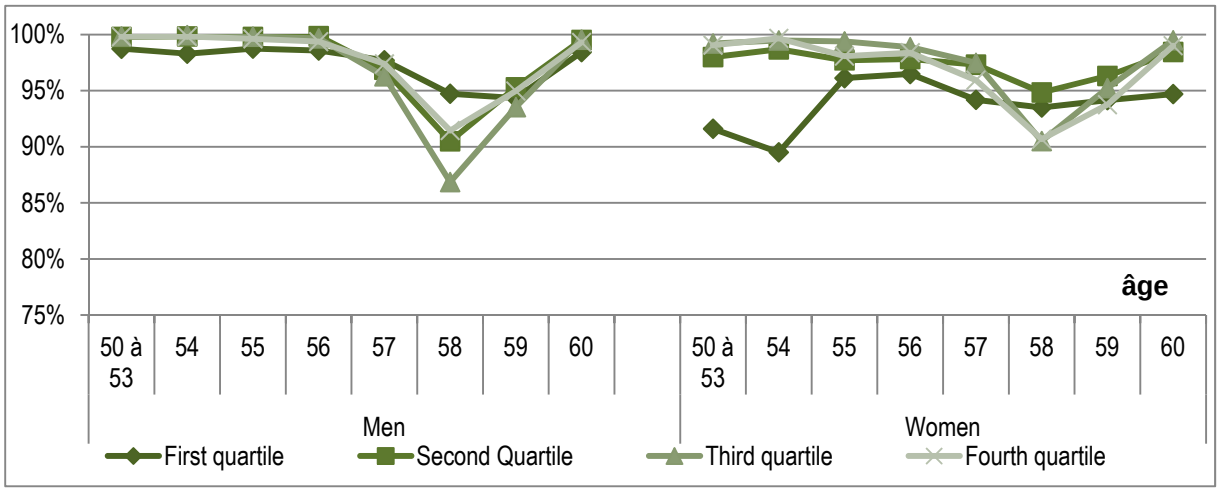
Example 1: Instantaneous probability of maintaining employment for those without sufficient validation duration for full-rate retirement benefits




Example 2: Instantaneous probability of maintaining a validating system for those without sufficient validation duration for receiving full-rate retirement benefits



Example 3: Instantaneous probability of maintaining a validating system for those with a sufficient validation duration for full-rate retirement benefits



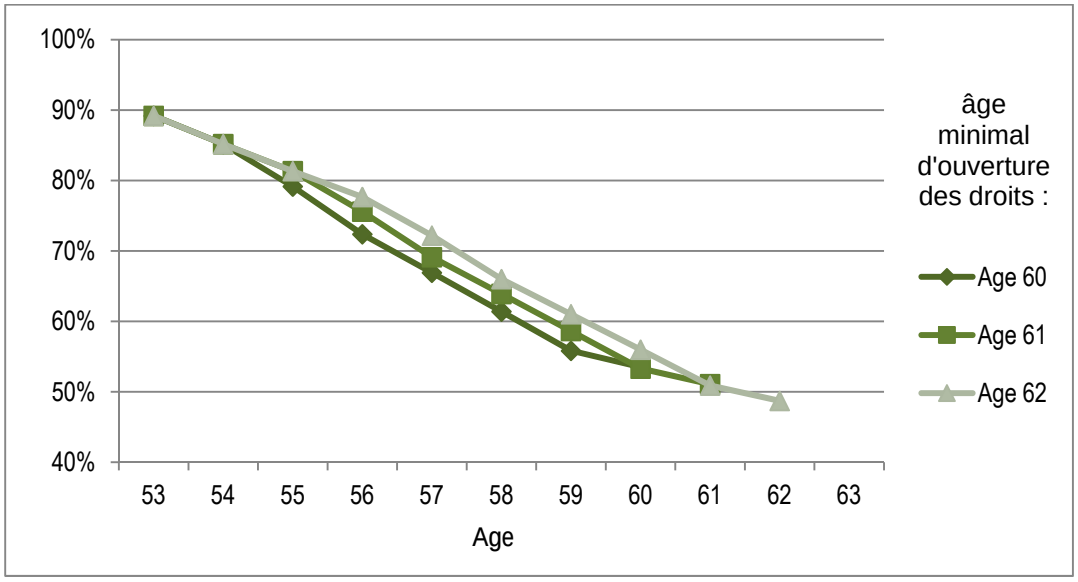

We can highlight the following results. Firstly, the probability of maintaining oneself in a validating system is systematically higher than the probability of maintaining employment, which is natural due to the existence of legal measures for exiting employment (unemployment, preretirement, disability, etc.).

Secondly, the probabilities of maintaining employment and maintaining oneself in a validating system, in general, become higher as the wage quartile increases. This is, however, not the case between ages 57 and 59, when the intermediate quartiles (2 and 3) exit employment and validating systems more than the lower wage quartile (quartile 1), and notably do so when the persons already have a sufficient number of quarters validated to receive full-rate retirement benefits. This result could be explained by the access to *préretraites maisons* (a custom preretirement scheme when companies suspend or break work contracts for the entire period of preretirement), which are more frequent in large corporations where wages are generally higher. Moreover, it is more than natural that the result is above all observed in persons having already validated a sufficient number of quarters to be eligible for full-rate retirement benefits: they have more reason to accept exiting employment through a *préretraite maison* scheme being that it does not affect their ability to begin receiving full-rate retirement benefits as soon as they reach age 60. These observations give us an opportunity to highlight that which should be seen as an implicit hypothesis of the model, the fact that completely private measures enabling preretirement several years before the minimum age for being eligible for retirement benefits (often between one and three years before said age), such as the *préretraite maison* schemes, will continue to exist in the future (with a possible age shift, insomuch as, in the variants consisting of raising the minimum age for being eligible for retirement benefits, we have chosen to shift the probabilities observed empirically).

Moreover, let us note that the generations on which the models on exiting employment are estimated were not concerned by the measures relating to early retirement due to long careers. Thus this measure cannot be calibrated using real observations. For the projections, a specific approach is taken, based on the hypothesis that all persons eligible for the early retirement measure collect their retirement benefits as soon as they can within this framework.

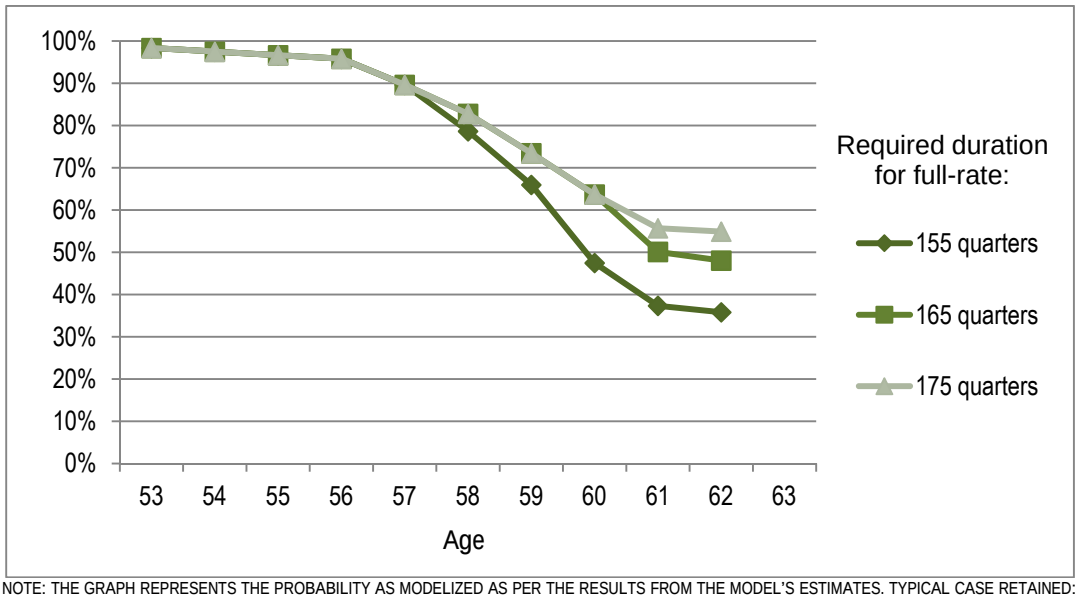
Finally, the graphs below illustrate several examples of modelized probabilities of still being employed at each age, under different legislation hypotheses. Here, this concerns chain rule probabilities for maintaining employment and not instantaneous probabilities. Graph 6 allows us to illustrate the fact that, if the minimum age for receiving benefits is raised, the proportion of individuals still employed immediately preceding this age is generally lower as the age for being eligible for benefits is higher (in this example, 53% of women are still employed immediately preceding a minimum age of 60 for being eligible for benefits, but 49% are immediately preceding a minimum age of 62 for receiving benefits). This is true even if, at each age, the modelized proportion of persons still employed is higher when the minimum age for receiving benefits is later. Graph 7 allows us to illustrate the fact that the modelized probability of remaining employed is significantly higher when the required duration for receiving full-rate benefits is greater.

**Graph 6: An example of modelized probability of maintaining being in employment until the minimum age for being eligible for retirement benefits (age 60, 61 or 62 depending on the case)**




READING: WHEN THE MINIMUM AGE FOR BEING ELIGIBLE FOR RETIREMENT BENEFITS IS SET AT AGE 62, 49% OF THOSE WHO WERE EMPLOYED AFTER AGE 50 STILL ARE AT AGE 62.
NOTE: THE GRAPH REPRESENTS THE PROBABILITY AS MODELIZED AS PER THE RESULTS FROM THE MODEL'S ESTIMATES. TYPICAL CASE RETAINED: WOMAN, FROM THE SECOND WAGE LEVEL QUARTILE (BETWEEN AGES 50 AND 54), WHO WOULD HAVE ATTAINED THE REQUIRED DURATION FOR FULL-RATE BENEFITS AT AGE 59 WITH THE LEGISLATION BEFORE THE 1993 REFORM. THE REQUIRED DURATION FOR FULL-RATE BENEFITS HERE IS 150 QUARTERS.

**Graph 7: An example of modelized probability for maintaining of being in employment until the minimum age for being eligible for retirement benefits (age 62), for different possible values of the required duration for receiving full-rate benefits (155, 165 or 175 depending on the case)**




NOTE: THE GRAPH REPRESENTS THE PROBABILITY AS MODELIZED AS PER THE RESULTS FROM THE MODEL'S ESTIMATES. TYPICAL CASE RETAINED: MAN, FROM THIRD WAGE LEVEL QUARTILE (BETWEEN AGES 50 AND 54), WHO WOULD HAVE ATTAINED THE DURATION REQUIRED FOR FULL-RATE BENEFITS AT AGE 57 WITH THE LEGISLATION BEFORE THE 1993 REFORM (I.E. WITH A REQUIRED DURATION OF 150 QUARTERS).

## A specific case: early retirement due to long career

The generations observed in the EIR and EIC up to their complete retirement did not have the early retirement due to long career measure, which prevents making a model of the impact of this measure on exiting employment based on estimations stemming from observed data.

To ensure the realism of the projections, we consider the possibilities of early retirement with a simplified modelization consisting of considering that all persons becoming eligible for early retirement immediately exit employment and begin receiving their retirement benefits.

Nonetheless, this hypothesis cannot be directly applied. In fact, the model functions by considering that the categories for which only the duration of validated quarters (including increases in the duration of retirement insurance) is known, while eligibility for early retirement also includes a condition of age at the beginning of the career. In order to judge the real eligibility for this measure, we thus apply a probability that the conditions of required insurance payment duration and age at beginning of career are met on the condition that the required number of validated quarters is met. This probability $P_a^{DRA}$ is calibrated using the EIC observations from generations 1946 and 1950, for each category of gender and number of quarters validated at age 54. It takes different values at each age *a* (hypothesizing that the person validates all quarters between age 54 and age *a*) and for each possible modality of the criterion required for being eligible (total number of validated quarters required, required length of retirement insurance payments and age at the beginning of career).

Finally, for the age *a* when a person becomes eligible for early retirement, we replace the probability of remaining employed $P_a^{employed}$ with the smallest of the probabilities between $P_a^{employed}$ and the probability of not being eligible for early retirement $(1 - P_a^{DRA})$.

## First receiving retirement benefits after the minimum age for receiving benefits

Beginning with the minimum age for being eligible for retirement benefits, PROMESS uses a model for the probability of receiving retirement benefits at each (quarterly) age. At these ages, no distinction is made between the age at which employment is ceased and the age at which retirement benefits are received: the model hypothesizes that those persons still employed at the minimum age for being eligible for retirement benefits work until they reach the age at which they are eligible to receive retirement benefits and cease working when they first receive their benefits. Employment within the framework of combining bridge jobs and retirement are therefore not taken into account, which could lead to the modelized rates of employment and average ages for ceasing employment being slightly lower than they are in reality.

The situations are distinguished according to the state immediately preceding the minimum age for being eligible for retirement benefits:

- If the person has definitively exited employment but has maintained themselves in a validating system, they receive their first benefits either when they have attained the required validation duration for receiving full-rate benefits (hypothesizing that the person maintains themselves within the same system for validating quarters after age 60, and does so until the date they retire), or as of the minimum age at which they become eligible for retirement benefits (and do so even if they have not validated a sufficient number of quarters) with a certain probability, which takes into consideration the possibility of receiving benefits due to incapacity or previous disability. This probability is calibrated using observations of generation 1938 from the EIR and EIC[11].
- If the person is still employed, we estimate a model of probability of first receiving benefits for each quarterly age between this minimum age and the age at which they are eligible for full-rate benefits (age 65), as well as after this age (i.e. a total of 21 probabilities were estimated). As is usual, in the projections we consider that

[11] The probability is thus 24% for males born outside of France, 29% for females born outside of France, 17% for males born in France and 27% for females born in France.

benefits received (strictly) after the age at which one is eligible for full-rate benefits are received on the day of their 66th birthday (or one year after the age for automatically acquiring full-rate benefits if this age is raised). Moreover, the probabilities estimated for each age are repositioned so their sum is always equal to 1. We also consider that the person has definitively exited employment and the validating systems once they have received retirement benefits. Hypothetically, there is no combination of bridge jobs and retirement.

- Finally, if the person has completely exited the validating systems, we consider that they received benefits at the minimum age for receiving benefits as soon as they have validated a sufficient number of quarters to be eligible for full-rate benefits. If the number of quarters validated is insufficient, the person can receive benefits at each of the ages from the minimum age for receiving benefits up to the age at which full-rate benefits are automatically obtained (age 65), with a certain probability. This probability aims to take into account receiving benefits due to incapacity or previous disability. A probability is calculated for each of the ages because, even though most of those exiting employment due to incapacity or previous disability do so at the age at which they become eligible for benefits, exiting employment for this reason can also occur at a later age. As in case (1), the probabilities are calibrated using the EIR and EIC observations for generation 1938.

For those persons still employed at age 60 (case 2), the probabilities of receiving benefits at each age (measured as the number of quarters after the minimum age) are estimated using a logistic model (SAS PROC LOGISTIC), separately for each gender. The explanatory variables *X* include:

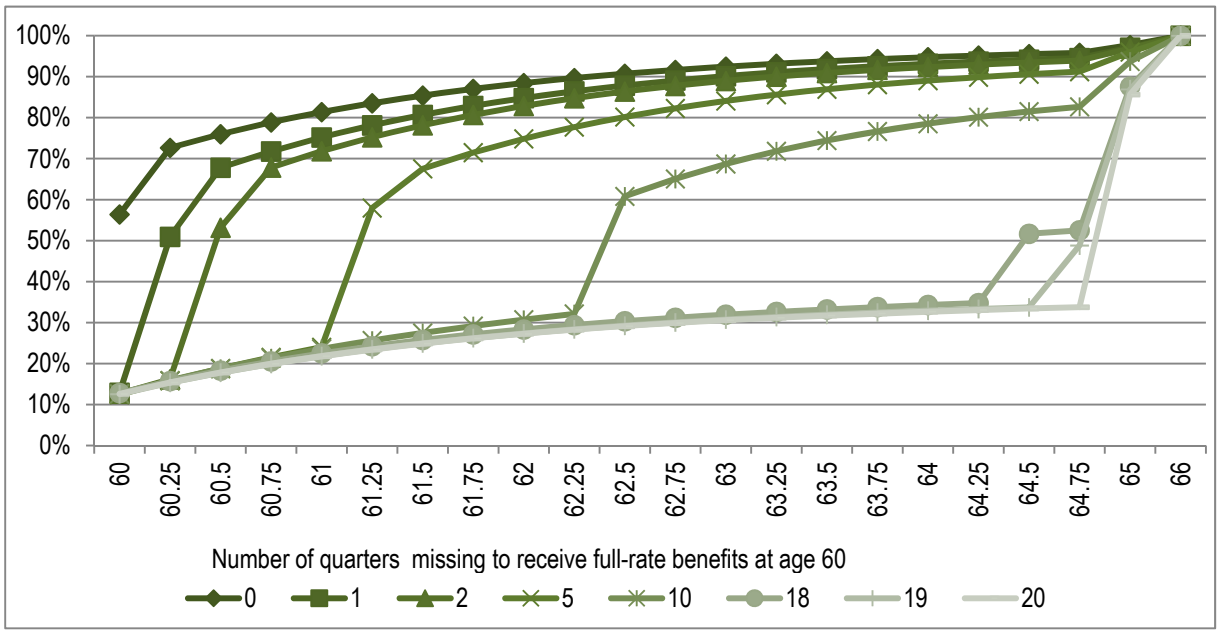
- a wage level quartile dummy variable (wage or revenue observed between ages 50 and 54)
- an *EgalTrimsuppl* dummy variable, equal to 1 when the required number of quarters for full-rate benefits is reached at exactly the age considered
- a *Plus1* dummy variable, equal to 1 if the required number of quarters for full-rate benefits is exceeded by (exactly) 1 quarter
- a *DepasseTrimsuppl* dummy variable, equal to 1 when the required number of quarters required for full-rate benefits is exceeded

The model is estimated jointly for the 21 ages and each explanatory variable contained in the model is included both alone and multiplied by the age. The hypothesis is therefore that the effect of each variable (on the subjacent variable in the logistic model) is a linear function of the age. For the wage quartiles, specific constants are also added to take peaks in receiving benefits at the key ages of 60 and 65 into account. In other terms, rather than estimating $\beta_a$ coefficients specific to each age *a* (*a*=0 at 21) for each explanatory variable in the model, these coefficients are constrained to be expressed as $\beta_a = \tilde{\beta}.a + \beta_0.1_{a=0} + \beta_{1-19}.1_{1\le a\le 19} + \beta_{20}.1_{a=20} + \beta_{21}.1_{a=21}$. The wider specification would clearly have been more satisfactory, but, taking the low number of available observations for this estimate in the EIR and EIC data into account, parsimonious specification had to be chosen in order to ensure the robustness of the coefficients estimated at each age.

The models for receiving benefits are estimated using persons observed in the EIR-EIC, born in 1934 or 1938, holding employment requiring affiliation with the CNAV and not validating any quarters for assimilated periods throughout the year in which they turn 60. The number of quarters validated in all schemes is estimated as the difference between the number of quarters validated in all schemes as reported by the CNAV in the EIR ('DAS' variable) and the sum of the number of quarters validated in the EIC ('NTTV' variable) between the 60th birthday and the date of receiving retirement benefits.

In practice, having reached a sufficient number of validated quarters to be eligible for full-rate benefits is a major determinant for going into retirement. The probabilities of having received benefits at each age, modelized using the model's estimates, therefore show a significant departure at the age at which a sufficient number of quarters validated for receiving full-rate benefits can be reached, taking the number of quarters missing at age 60 into account (see graph 8).

**Graph 8: Modelized probability of having received benefits (cumulative function) at each age, in function to the number of quarters missing to receive full-rate benefits at age 60, for those still employed at age 60**




READING: AT AGE 60, THE PROBABILITY OF HAVING ALREADY RECEIVED FIRST RETIREMENT BENEFITS IS 56% FOR THOSE PERSONS ALREADY DISPOSING OF A SUFFICIENT NUMBER OF QUARTERS TO RECEIVE FULL-RATE BENEFITS (0 MISSING QUARTERS) AND 13% FOR THOSE PERSONS MISSING BETWEEN 1 AND 20 QUARTERS.
NOTE: THE GRAPH REPRESENTS THE PROBABILITY AS MODELIZED FROM THE RESULTS OF THE MODEL'S ESTIMATES. TYPICAL CASE RETAINED: AVERAGE OF PROBABILITIES MODELIZED ON EIGHT CATEGORIES OF GENDER * WAGE LEVEL QUARTILE.

## Persons terminating their career in the public

Exiting employment and first receiving retirement benefits are most often close together in Civil Service and special schemes: the gap between the average age of exiting employment and the average age of first receiving retirement benefits was thus three months in the Civil Service in 2008[12]. We thus hypothesize that these individuals exit employment, cease validating quarters and begin to receive retirement benefits simultaneously.

Moreover, the temporal hindsight is still too small to estimate the actual retirement behaviour in the public sector after the implementation of the 2003 reforms. This is even truer for the retirement behaviour of those in special retirement schemes following the 2008 reform. Contrary to the private sector cases, the modelization of ceasing employment in the public sector within the framework of PROMESS could therefore not be calibrated using observations of past generations: the modelization retained herein is thus *ad-hoc.*

In order to modelize first receiving retirement benefits, we distinguish those individuals impacted by the 2003 reform from the 'others', and, among those impacted, the 'active' agents from the 'sedentary' agents. Employees of special schemes are most often assimilated with public employees in the 'active' category, except when they can benefit from a motive for retirement strictly before age 55, in which case they are assimilated with the 'other' agents in the Civil Service. Furthermore, let us remember that, these 'other' types of retirement concern disabled, parents of three children, early retirement due to handicap or long career, those agents having been employed in positions classified as unsanitary and the military. Among retirees belonging in the category 'other', a portion was able to cease their employment in the public sector before age 50 and then begin to be employed in the private sector. If those individuals are still employed in the private sector after age 50, then in the PROMESS model, they are included in the modelization when they definitively cease employment.

[12] See *Rapport annuel sur l'état de la fonction publique - Faits et chiffres 2008-2009* (Annual report on the state of the Civil Service - Facts and figures 2008-2009), volume 1, page 547, DGAFP.

For those individuals impacted by the reform (active and sedentary),we hypothesize that they first received retirement benefits when the required number of quarters for receiving full-rate benefits was attained, when they reach the minimum age for receiving benefits at the earliest, and at the upper age limit at the latest. Possible prolongations beyond the upper age limit were not taken into account.

For the sub-category 'other', we replicate the distribution in the age at which retirement benefits were first received as observed in generations 1938, 1940 and 1942 for similar categories (see table 3).

**Table 3: Structure of retirement ages in the sub-category 'other'**

| Retirement age | gen 1938-1940-1942 | generation 1950 | generation 1974 |
|---|---|---|---|
| *Before age 54* | 38% | 42% | 56% |
| *Year of the 54th birthday* | 8% | 13% | 5% |
| *Year of the 55 birthday* | 14% | 17% | 12% |
| *Year of the 56 birthday* | 8% | 7% | 6% |
| *Year of the 57 birthday* | 6% | 6% | 5% |
| *Year of the 58 birthday* | 5% | 3% | 4% |
| *Year of the 59th birthday* | 5% | 3% | 4% |
| *Year of the 60th birthday and over* | 17% | 9% | 9% |

READING: 12% OF THOSE BORN IN 1974, ENDING THEIR CAREER IN A PUBLIC RETIREMENT SCHEME BELONGING TO THE CATEGORY 'OTHER' (THAT IS, OTHER THAN SEDENTARY AND ACTIVE) RETIRE IN THE YEAR THEY TURN 55. THE PROPORTIONS ARE, IN REALITY, CALCULATED FOR EACH SPECIFIC CATEGORY AT AGE 54: THE DIFFERENCES FROM ONE GENERATION TO ANOTHER IN THIS TABLE THUS UNIQUELY RESULT FROM COMPOSITIONAL DIFFERENCES ACCORDING TO THESE SPECIFIC CATEGORIES.

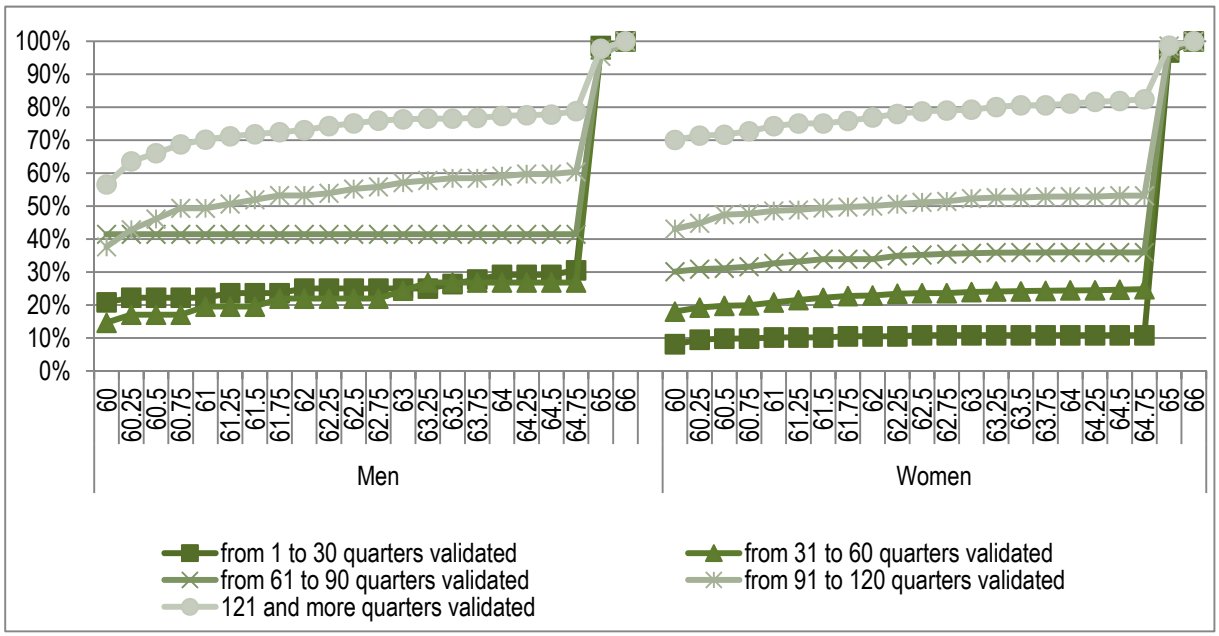
## Persons definitively ceasing employment before age 50

Persons definitively ceasing employment before age 50 are not all identical: one portion thereof actually continues to validate quarters in the form of assimilated periods (sick leave, incapacity, unemployment, etc.) after said age. Moreover, some of them begin receiving benefits as of the minimum age for being eligible for retirement benefits, notably in cases of incapacity or previous disability, while others do not retire before the age at which one automatically obtains full-rate benefits, i.e. age 65. A specific modelization is thus applied to those persons having ceased employment before age 50 so as to completely take their heterogeneity into account.

This modelization actually consists in applying the end of validation age distributions and the age at which they first receive retirement benefits within the EIR-EIC observations for those persons born in 1938 conditional on gender, country of birth (France/abroad) and the number of quarters validated up to age 54, grouped into 6 sections (0 quarter; 1 to 30 quarters validated; 31 to 60 quarters; 61 to 90 quarters; 91 to 120 quarters; 121 and more quarters).

As an example, the graph below (graph 9) represents the probabilities of having already received retirement benefits in function to the age (age expressed in number of quarters after age 60), for men and women born in France.

**Graph 9: Probability of having received a first retirement benefit at each age for those persons having definitively ceased all employment before age 50, in function to the number of quarters validated over the course of a career**




READING: AT AGE 61, 49.3% OF MEN BORN IN FRANCE AND HAVING VALIDATED BETWEEN 91 AND 120 QUARTERS BEFORE AGE 54 (CATEGORY 91-120) HAVE ALREADY RECEIVED RETIREMENT BENEFITS.

# AGGREGATION AND WEIGHTING

After the second step (see *above*), the PROMESS model modelized the proportion of persons still employed, those still using a validating system and those having retired for each generation and each quarterly age. The numbers corresponding to these states on the labour market can thus be easily obtained, at a given date, by multiplying these proportions by the total number of persons in the generation still living at the chosen observation date, then adding the numbers for all generations[13].

This requires knowing the total number of persons still alive in 2005, the modelization base year, then projecting the evolutions from year to year of these numbers for each gender and each generation, taking into account migrations of those born abroad as well as the mortality at each age.

An additional correction is applied so as to take into account those persons who collect their entire basic retirement benefits in the form of unique lump sum payments (*versements forfaitaires uniques - VFU*), and who must not, therefore, be counted among the number of retirees.

## Total numbers in 2005: calibrated using civil data from the French national records

The total number of persons alive at the age reached in 2005 for each gender, country of birth (France / abroad) and generation is taken from the French national civil records: France metropolitan section (s*ection métropole, SM*) and Outside France section (s*ection hors métropole, SHM*) in the National Directory for the Identification of Individuals (*répertoire national d'immatriculation des personnes physiques*, *RNIPP*). This choice is coherent, insofar as the PROMESS model is based on the inter-scheme retiree (EIR) and contributor (EIC) samples that are sampled in the RNIPP. The numbers from this directory thus represent the total population, of which the PROMESS model's categories are supposed to be representative.

For each category in the PROMESS model, the number is obtained by simply multiplying the total number from the RNIPP by gender, country of birth and generation with the proportion, within the ensemble defined by these variables, associated with each wage level quartile, end of career retirement scheme and number of quarters validated at age 54 (expressed as the closest quarter).

## Total numbers after 2005: migrations

A correction was made, so as to take into account, for the total number of persons born abroad, the entries into France (and thus the entries into the RNIPP) after 2005, at which date the numbers were observed in the RNIPP for the PROMESS model.

Please note that, with the PROMESS study, we only took an interest in those entering France potentially associated with the acquisition of retirement benefits, and not those exiting France. In fact, leaving the territory does not affect the retirement entitlements accrued during the period of residence in France, and the model aims to estimate the total number of retirees in all French schemes, regardless of their country of residence.

[13] The PROMESS model can be used for generations born beginning in 1942, for which we have sufficiently complete information on their careers in the EIC data (information on the generations born in 1934 and 1938 are also available in the EIC, but sizeable collection holes have been observed in certain schemes). To project a total number of retirees, the number of retirees for the generations born before 1942 as per observations made from 2005 to 2008 in DREES' annual survey on retirement funds (EACR), to which the mortality coefficients per generation, age and gender are then applied. This leads to the hypothesis that those generations aged 67 and over in 2008 were almost entirely all retired at that date.

The method retained to make this correction is based on the 2005 EIC observations. We estimate for each age *A* the rate of increase between *A* and *A+4* of the number of persons having validated at least one quarter since their birth. This rate is not null for those born in France (a person residing in France can never have validated a quarter before age *A*, and begin to do so between *A* and *A+4*), but it is, at every age, superior for those born abroad. We consider that the differential rate of increase between those born in France and those born abroad can be attributed to the increase in the population of those born abroad due to immigration. We thus use these differential rates that we check every 4 years so as to estimate the cumulative impact of immigration, and which we interpolate for the intermediate years.

*Example: for generation 1970, the number of persons born abroad having validated at least 1 quarter before age 35 is 4% superior to the number of persons born abroad having validated at least 1 quarter before age 31; for those born in France, the difference is only 1% => we consider that the increase between 31 and 35 is equal to +2,97%=(1+4%)/(1+1%)-1*

The choice of using information from the EIC to calibrate the hypotheses on migration after 2005 stems from a concern for coherency in the sources of the PROMESS model, being that this model is essentially calibrated using EIR and EIC data. A second method was nonetheless tested to judge the robustness of the hypothesis. This method uses data from the French Labour Force Surveys (*enquête Emploi en continu*) (average 2003T1-2009T3) to calculate, for each age and gender, the proportion of persons who did not arrive in France within the past year (and who had lived in France for over one year) among the ensemble of persons born abroad. The inverse of this proportion is interpreted as being the rate of increase of the population born abroad, due to immigration, at a given age. It is then sufficient to chain these rates of increase for all the ages (starting with the initial given age *a*). In the end, the two methods give rather similar results, although as a whole, the method using the data from the Labour Force Surveys shows a higher rate of immigration than does the method using the EIC data (especially at younger ages, before 30).

## Total numbers after 2005: correction for mortality

Mortality is taken into account by applying mortality coefficients for each gender, age and year to the 2005 RNIPP numbers modelized in the 2005 Insee population projections.

This notably implies that mortality is assumed to be orthogonal in all dimensions other than those linked to gender and the date (i.e. the age and the generation). In particular, no differential mortality is considered in the model, according to the wage level quartile, the end of career sector, the number of quarters validated or the age at the end of employment and first receiving retirement benefits.

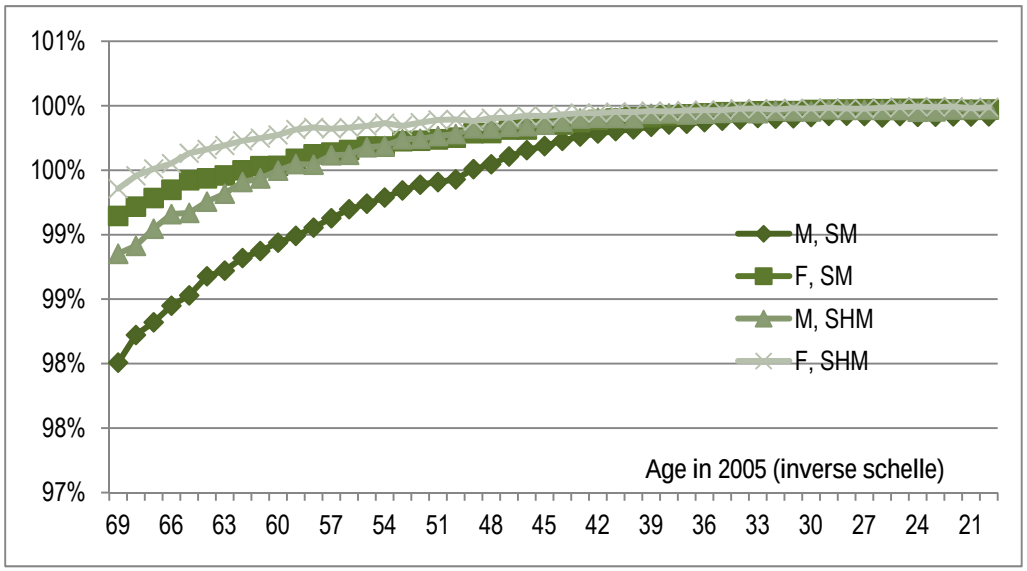
Moreover, a specific correction for mortality before 2005 was made as concerns those persons born abroad in the RNIPP (outside of France section, *section hors métropole – SHM*). This correction aims to take into account the fact that mortality could have been underestimated, being that information pertaining to the deaths of persons having left France is not systematically received. In fact, if we observe the mortality from year to year (i.e. for a given extraction of the RNIPP, the percentage of living persons in a given year who are not living the following year), the mortality coefficients are lower for those born abroad (outside of France section, *section hors métropole – SHM*) than for those born in France (France metropolitan section, s*ection métropole, SM*) (see graph 10).

We can consider that this observed differential mortality is uniquely due to the fact that the information pertaining to some deaths is not received by the RNIPP-SHM, as the mortality rate for those born in France and those born abroad should be similar for a given age and gender. For those born abroad, we thus correct the number of those living in 2005 by applying a coefficient equal to the differential mortality (in relation to those born in France) cumulated between age 20 and their age in 2005. For example, for those persons who were age 40 in 2005 (generation 1965):

$$\text{Population(corrected)}_{1965}^{\text{born abroad}} = \text{population(RNIPP} - \text{SHM)}_{1965}^{\text{born abroad}} * \frac{\text{Mortality rate}_{20}^{SM} * \text{Mortality rate}_{21}^{SM} * \ldots * \text{Mortality rate}_{40}^{SM} *}{\text{Mortality rate}_{20}^{SHM} * \text{Mortality rate}_{21}^{SHM} * \ldots * \text{Mortality rate}_{40}^{SHM}}$$

where $Mortality\ \ rate_{20}^{SHM}$ represents (for example) the mortality observed between 2004 and 2005 for those born outside of France (SHM) and who were age 20 in 2005. The quotient correction is always less than 1, being that, at each age, the mortality observed in the RNIPP is higher for the France metropolitan section than for the outside of France section: $\text{Mortality rate}_a^{SM} < \text{Mortality rate}_a^{SHM} \ \forall \ \text{age a}$.

**Graph 10: Survival rate by age between 2004 and 2005 of persons recorded in the RNIPP in 2005**




READING: IN THE 2005 RNIPP, 98% OF MEN BORN IN FRANCE (M, SM ) IN 1936 (AGED 69 IN 2005) AND LIVING AS OF 31/12/2004 WERE STILL LIVING AS OF 31/12/2005.

# LIMITS AND COURSES FOR EVOLUTION

As does every projection model, PROMESS makes a certain number of hypotheses and simplifications that, while they are legitimate and presumably have a small margin of error within a defined framework of use, can make the use of this model problematic for certain other uses. Some of these simplifications are linked to structural modelization choices. Others are due to available data. Enumerating the main ones enables us to implicitly describe the limits in using the model and to highlight the most promising courses for evolution.

Before this, we must also restate that, for robustness purposes, it is always preferable to privilege the analysis of results expressed as relative magnitudes (for example the proportions within each generation or gaps between a central scenario and a reform scenario), rather than absolute results (for example, the total number of retirees). The uncertainty linked to errors in modelization actually has a cumulative impact in the second case, while it is more likely to be constant in time, or even neutralized, in the first case.

## Conceivable parametric improvements

Processing the data relative to careers in PROMESS only uses a part of the incredible amount of information contained in the EIC. In particular, the completion of careers up to age 54 is founded only upon the total number of quarters validated in all retirement schemes and the wage level quartile for each quadrennial period. It does not, on the other hand, use other, potentially decisive dimensions, such as the scheme to which one is affiliated (public/private) or the type of periods validated (employment; unemployment, sick leave, old age insurance for stay-at-home parents - *assurance vieillesse des parents au foyer, AVPF*...). It is, of course, impossible to take all of these considerations into account at the same time, insofar as the EIC is a sample of the total population and thus cannot be precise about categories defined too specifically. But at least one of the dimensions should be taken into account in later versions of the model. It has been highlighted that PROMESS modelizes an increase in the proportion of persons ending their career in the public sector, which is technically only attributable to compositional effects, yet we cannot determine whether or not there is a real increase in this proportion. Taking the scheme to which one is affiliated over the course of their career into account; at least in a simple public/private dichotomy, should improve this aspect.

In the same vein, this model assumes that independent workers have the same retirement benefit collection behaviour as employees in the private sector. This hypothesis is linked to the low number of observations in the EIR and EIC data, which does not allow us to estimate a specific model for collecting retirement benefits for independent workers, or even specific models for each of the main categories among the independent workers (agricultural workers, storekeepers, artisans, the self-employed). Such an estimate could, nonetheless, become possible in the future, notably thanks to an increase in the size of the 2008 wave of EIR samples. Generally speaking, the next wave of samples (2008 EIR and 2009 EIC) should allow us to update and improve the estimates of the parameters of the end of career models. The end of career model for Civil Servants could also be refined when the temporal hindsight will be more substantial in relation to the 2003 reform.

Finally, a certain number of validated quarters remain unknown in the EIC data (periods validated abroad, bonus time granted by some schemes, some quarters assimilated for uncompensated unemployment and quarters recognized as equivalent, etc.) These data collection holes could lead to an underestimation of the number of quarters validated for some persons, and thus to a bias in the distribution of quarters validated up to age 54 in the population, which notably determines the weighting associated with each category in PROMESS. An improvement of the model could thus consist of imputing the corresponding quarters, just as the increases in the length of insurance for children and the quarters missing due to military service are already subject to imputation.

## The model's structural limitations

Some modelization choices are structural and limit the framework in which the model can be used. Firstly, the modelization for ceasing employment gives a primordial place to the age at which one becomes eligible for full-rate retirement benefits. In the private sector, this is a decisive factor, although it does not prevent retirement at other ages from occurring. It is even more so in the public sector, where, due to a lack of sufficient temporal hindsight since the 2003 reform, we hypothesize that retirement occurs upon attaining full-rate benefits. Hypotheses on behaviour imply that the PROMESS projections are pertinent in the study of retirement reforms that remain close to those occurring currently: for example, a modification of the number of quarters validated required for full-rate retirement benefits, a shift in the retirement age or the age at which full-rate benefits are automatically acquired[14]. Inversely, the model, in its current form, was not designed to study reforms greatly deviating from the current regulatory framework (for example, a huge increase in the age limits[15]), affecting parameters other than the required number of quarters and age (for example, a modification of the discounted rates or premiums[16]) or structurally modifying the conditions for receiving benefits (for example, commencing distinct ages for receiving benefits according to criterion other than generation and number of quarters validated or, more radically, transitioning to a notional account scheme).

Moreover, PROMESS was designed to study the consequences of retirement system reforms. It does not make explicit models and specific parameters of other determiners in senior employment cannot be defined, such as economic conjuncture, public measures relating to unemployment and preretirement, etc. These determiners are however not ignored: they appear implicitly in estimated parameters of the models for ceasing employment. But this implicit consideration implies that this model makes the strong hypothesis that these determiners will remain similar to their current level[17] throughout the projection period. This signifies that, firstly, the model does not enable us to study the reforms of one of the determiners other than retirement systems, and secondly, that any modification to the balance of the senior labour market in relation to the current balance is an additional factor of uncertainty on the projections.

Finally, PROMESS is a model interested in the ages (for ceasing employment and receiving retirement benefits), but which does not aim to and does not enable studying the amount of the benefits. These amounts would be difficult to integrate into the model due to an indirect consequence of having chosen a meso approach, i.e. aggregated by category of affiliations to retirement schemes. The age approach, in fact, only allows consideration of the total number of quarters validated accrued up to age 54, being that only the total duration matters for full-rate benefits, and thus only to disaggregate the total population into a moderate number of categories. An approach enabling an estimation of the retirement benefit level would, necessitate considering, moreover, all the heterogeneity linked to the complete chronicle of annual employment revenue, which is not possible within the framework of an approach aggregated by categories. In this case, a micro-simulation approach would be preferable[18]. This would not be an evolution of the PROMESS model, it would entail moving to a structurally different model, which is not within the framework of this working paper. Nevertheless, using some modules of PROMESS within the framework of a micro-simulation exercise could be conceivable: this use is less satisfying than creating

[14] The parameters of the model are defined so as to take into account these types of reforms, which can thus be very easily implemented. Some other retirement reforms can also be modelized, but need much more programming. This is the case, for example, of reforms modifying the conditions of eligibility for early retirement measures due to long careers.

[15] Contrary to the following examples, this scenario does not pose technical implementation problems to the model, but it raises questions as to the pertinence of the results. In fact, the model on retirement implies, for example, that a person having validated a sufficient number of quarters for full-rate benefits at the minimum age for receiving benefits has the same probability of remaining employed after said age (and thus to benefit from a premium), regardless of the age. If this hypothesis remains plausible so long as the minimum age for receiving benefits remains close to age 60, it is less so when this age is greatly raised after age 60.

[16] It is, for this reason, not very suitable for specifically studying the impact of the 2003 reform on civil servants.

[17] More precisely at their level at the end of the 1990s and the beginning of the 2000s, being that the parameters for the ceasing employment models were estimated using observations from those years.

[18] This notably implies that PROMESS' meso approach is not adapted for ceasing employment behaviour motivated by a desired amount of retirement benefits or replacement rate instead of by an age objective (such as the age at which full-rate benefits are attained). A Stock and Wise model would thus not make sense within the framework of PROMESS.

a complete micro-simulation model, but it could be an acceptable transitional solution. As a case in point, PROMESS' module on ceasing employment could be used to simulate the end of careers for persons whose careers were almost entirely observed in the EIC (at least up to age 54). Scheme changes and wage evolutions are, in fact, rare at the very end of a career, and the PROMESS modelization thus enables a very acceptable simulation.

# BIBLIOGRAPHY

Aubert P. (2009), "Allongement de la durée requise pour le taux plein et âge de départ en retraite des salariés du secteur privé : Une évaluation de l'impact de la réforme des retraites de 1993", Document de travail du Crest n°2009-21

Coudin E. (2007), « Projections de population active à l'horizon 2050 : des actifs en nombre stable pour une population âgée toujours plus nombreuse », *Économie et statistique* n°408-409, pp.113-136

DGAFP, « Rapport annuel sur l'état de la fonction publique – Faits et chiffres 2008-2009 », volume 1

DREES, « Les retraités et les retraités en 2008 », Collection Études et Statistiques

Vallin Jacques et Meslé France, 2001. – Tables de mortalité françaises pour les XIXe et XXe siècles et projections pour le XXIe. - Paris, INED, 102 p + CD-Rom (Données statistiques n 4-2001).

# Annexe 1. Comparison PROMESS – EACR

A comparison exercise was carried out between the number of retirees projected by the PROMESS model and those observed in DREES' Annual Retirement Fund Scheme Survey (EACR). Firstly, an estimate of the number of 'all scheme' retirees was created using data from the EACR by generation for the years 2005 to 2008. This estimate was then compared to those obtained by PROMESS to refine the calibration of the model, notably pertaining to the scalability for early retirement due to long careers after 2004, and to correct the number of retirees for those receiving benefits as a unique lump sum payment (VFU) or who never receive their retirement benefits.

## Number of 'all scheme' retirees from the EACR

The EACR furnishes the number of retirees as of 31 December of each year for all of the main French retirement funds. These numbers were consolidated into the number of retirees from all retirement schemes using a method similar to that used for the annual estimate of the number of all scheme retirees published each year by the DREES[19]. However, it only concerns retirees aged 50 and over in a basic scheme, and is carried out by generation for all generations between ages 50 and 65. Those retirees only having benefits in a supplemental scheme are excluded, as is also the case in the PROMESS model.

Data from the CNAV, aligned basic schemes, the CNRACL and the State Retirement Department (Service des Retraites de l'État) were used. The coverage rate per number of pensions as well as the average number of pensions per retiree was calculated using the 2004 EIR and the 2008 EIR. They were then calculated for the years 2005 to 2007 using linear extrapolation.

## Correction for unique lump sum payments (*versement forfaitaire unique*)

The number of retirees in PROMESS was corrected for those persons receiving all of their benefits in basic schemes as a VFU (unique lump sum payment) (for example, those individuals who spent most of their careers abroad). As is standard, also included among these persons are those who never claim their benefits, which can be the case when they are extremely low. The correction consists of diminishing by 7% the value obtained by multiplying the total number of retirees in the RNIPP by the probability of having received retirement benefits in a basic scheme. This proportion is calculated using the ratio between the number of retirees actually observed in the EACR and the number present in the RNIPP for generations 1932 to 1941: 85% of the RNIPP numbers are retirees. Among the remaining 15%, 8% corresponds to persons who are not affiliated with any retirement schemes (proportion estimated using the EIC). The remainder, i.e. 7%, is considered to represent those persons who receive a unique lump sum.

The correction is only applied to the number of retirees aged 65 and up. We thus hypothesize that all persons receiving VFU (unique lump sum payments) do so at age 65. The justification thereof is that benefits received in this manner are very low, corresponding to incomplete careers, thus full-rate benefits are rarely reached before age 65.

[19] See « Les retraités et les retraités en 2008 », Collection Études et Statistiques, DREES.

## Comparison with the PROMESS numbers

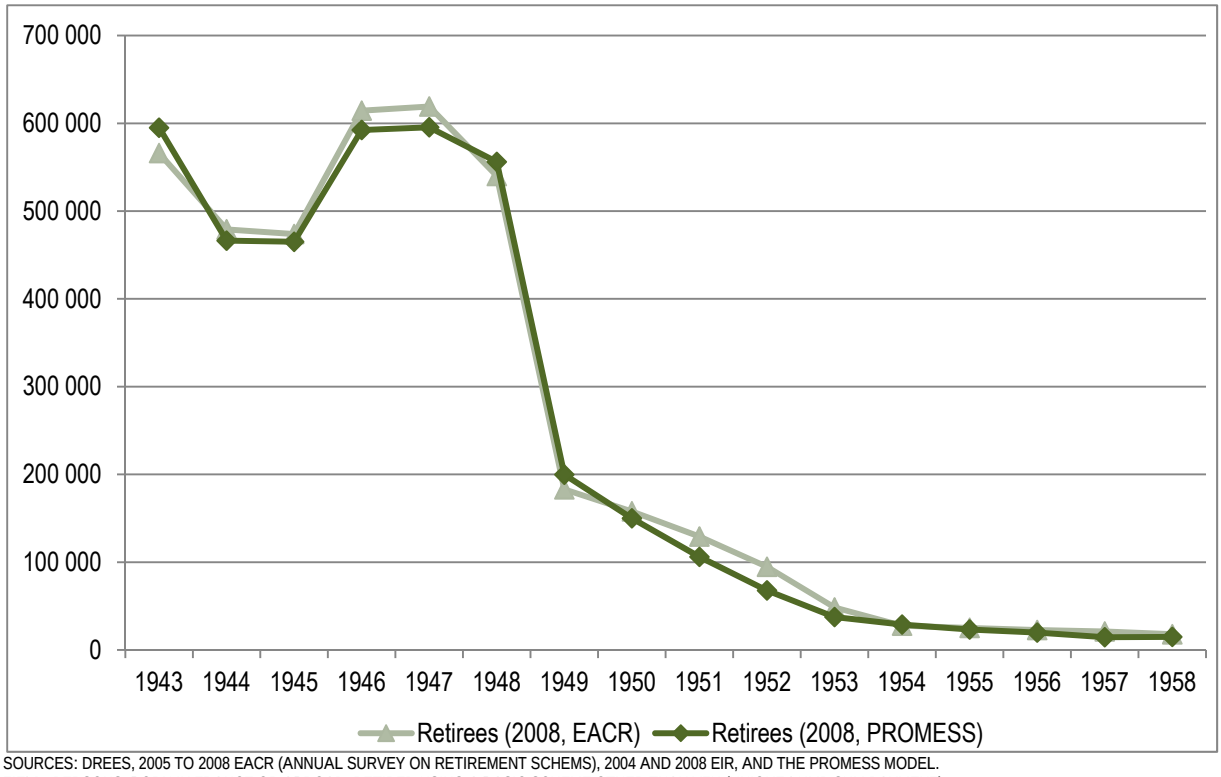
The gaps between PROMESS and the corrected all scheme estimates come from gaps in the forecasting of retirement influx per age, notably at ages 56 and 57, which correspond to early retirements due to long careers: PROMESS underestimates early retirement. Between 2005 and 2008, most such retirements occurred before age 59, which has repercussions on the gaps in the following years

### Table 4: Comparison of the number of retirees by year and by age class

| Number of retirees (in thousands) | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|
| *PROMESS* | 13.187 | 13.612 | 14.084 | 14.537 |
| *EACR (basic retirement schemes, retirees age 50 and up)* | 13.157 | 13.660 | 14.193 | 14.611 |
| *Total gap* | 30 | -48 | -109 | -74 |
| *Gap ages 50-54* | -13 | -13 | -13 | -13 |
| *Gap ages 55-59* | 47 | -15 | -85 | -52 |
| *Gap age 60* | 23 | 17 | 11 | 16 |
| *Gap ages 61-64* | -26 | -37 | -53 | -67 |
| *Gap age 65* | 0 | 0 | 32 | 29 |
| *Gap age 66* | 0 | 0 | 0 | 14 |

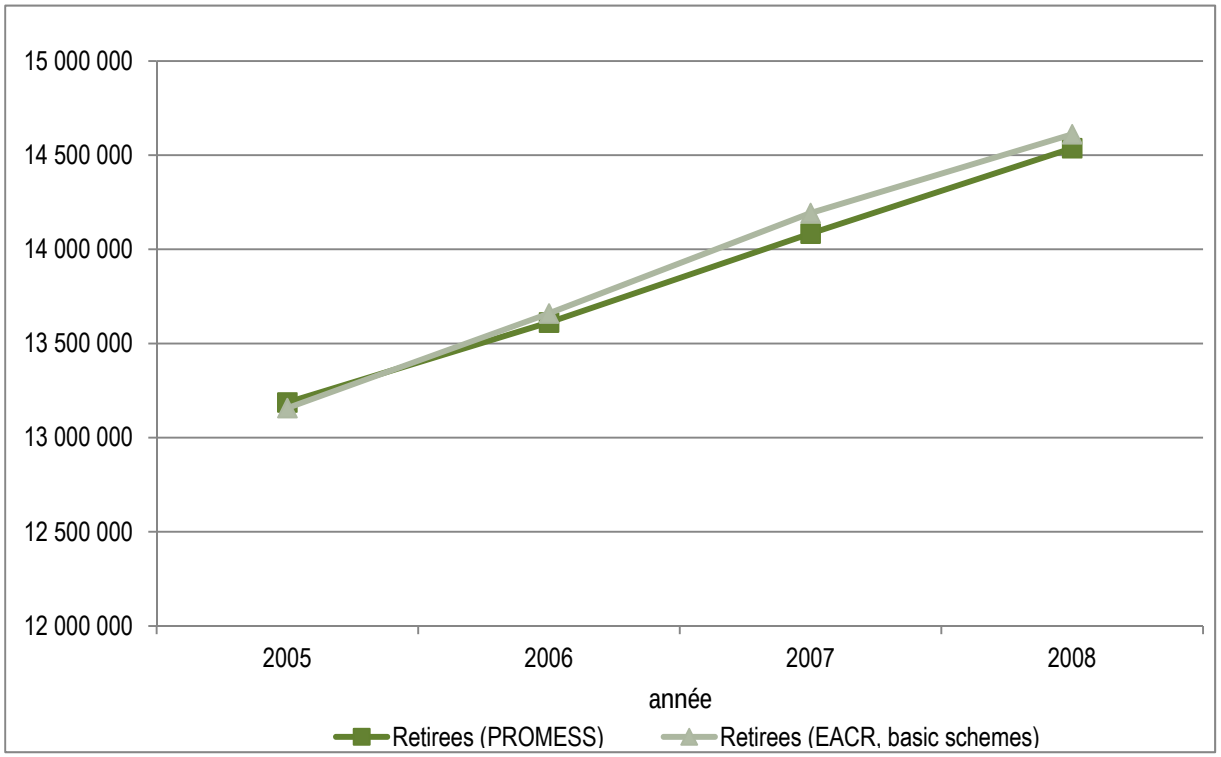
SOURCES: DREES, 2005 TO 2008 EACR (ANNUAL SURVEY ON RETIREMENT FUNDS), 2004 AND 2008 EIR, AND THE PROMESS MODEL.
FIELD: PERSONS, BORN IN FRANCE OR ABROAD, RETIRED USING A BASIC SCHEME OTHER THAN VFU (UNIQUE LUMP SUM PAYMENT).

### Graph 11: Number of retirees aged 50 to 65 by generation in 2008




SOURCES: DREES, 2005 TO 2008 EACR (ANNUAL SURVEY ON RETIREMENT SCHEMS), 2004 AND 2008 EIR, AND THE PROMESS MODEL.
FIELD: PERSONS, BORN IN FRANCE OR ABROAD, RETIRED USING A BASIC SCHEME OTHER THAN VFU (UNIQUE LUMP SUM PAYMENT).

**Graph 12: Comparison of total number of retirees – 2005-2008**




SOURCES: DREES, 2005 TO 2008 EACR (ANNUAL SURVEY ON RETIREMENT SCHEMES), 2004 AND 2008 EIR, AND THE PROMESS MODEL.
FIELD: PERSONS, BORN IN FRANCE OR ABROAD, RETIRED USING A BASIC SCHEME OTHER THAN VFU (UNIQUE LUMP SUM PAYMENT).
NOTE: FOR THE TOTAL NUMBER IN THE PROMESS MODEL, THE NUMBER OF RETIREES IN THE GENERATIONS BORN IN 1941 AND BEFORE ARE THOSE REPORTED IN THE EACR.

## Annexe 2. Modelized effects of the 1993 and 2003 reforms

Many recent econometric studies aimed to estimate the impact of the 1993 and 2003 retirement reforms, notably the increase in the required number of validated quarters required for receiving full-rate benefits, on the ages for receiving benefits or ceasing employment. These studies generally show that, for those persons really affected by these reforms, the increase in the number of required quarters has a statistically significant impact on the age of retirement.

These estimates based on econometric studies have the advantage of representing 'all else being equal' ceteris paribus results. They really correspond to the impact of the reforms and not compositional effects or evolutions that could occur concurrently with yet independently from said reforms. Estimates of microeconomic studies, on the other hand, have the inconvenience of not being able to be easily interpreted as a global effect of the reforms on the entire population and of not being directly comparable to the usual magnitudes such as the average age for receiving benefits or ceasing employment.

The PROMESS model's projections allow us to compensate for this inconvenience. The model is, in fact, calibrated using estimates that take into consideration the effect of the retirement reforms and it is also designed to modelize the average effects for the entire population, taking into account the composition of this population according to its diverse components.

In this annex, we thus illustrate the impact of the 1993 and 2003 reforms on the generations born between 1950 and 1974, on diverse simple indicators estimated using the PROMESS model. This exercise is, of course, theoretical, being that it ignores retirement reforms after 2003, notably that of 2010. Nevertheless, although such reforms modify future evolutions, it is interesting to study the results of the projection of the only reforms implemented on a relatively distant horizon, so as to observe both the short and long term consequences of these past reforms.

For those generations currently at retirement age, the 1993 and 2003 reforms resulted in a lowering of the retirement age as they included measures for early retirement due to long careers that enabled receiving retirement benefits as of age 56. The average age for receiving retirement benefits would thus be age 60.8 for men born in 1950 (except those terminating their career in a Civil Service scheme or a special scheme), while it would have been age 61.3 with the legislation prior to the 1993 reform (see graph 13).

The conclusion is, however, different in the long term, due to the fact that recent generations have entered into the labour market at later ages. On the one hand, practically no one in the generations born after 1970 has accumulated the conditions for early retirement due to long careers, on the other hand, due to the observation of fewer validated quarters in the beginning of the career, a large proportion of these persons do not have, at age 60, a sufficient number of validated quarters for receiving full-rate retirement benefits: many are thus forced to retire after this age.

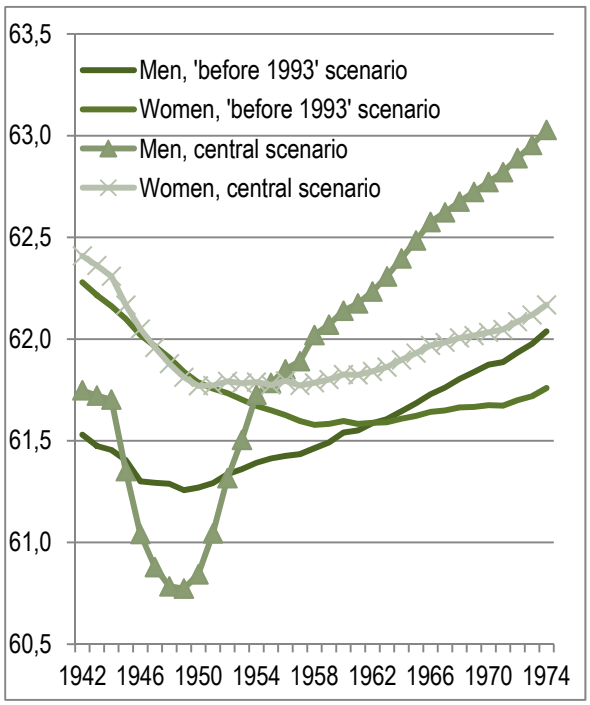
By 2030 (for those generations born beginning in the 1970s), the increase in the number of validated quarters required for full-rate benefits resulting from the 1993 and 2003 reforms would, in the absence of additional reforms, have had the effect of delaying the average retirement age 12 months for men (1 year) and 5 months for women (0.4 years).

Let us note that, in public and special schemes, the reforms are too recent to correctly estimate their impact at this time, so that modelization for these schemes is unsatisfactory in the PROMESS model. For this reason, the average ages for receiving benefits and ceasing employment presented in graphs 13 and 14 were calculated using a field excluding those employees terminating their careers in the Civil Service or special schemes (SNCF, RATP, CNIEG, CANSSM, ENIM).

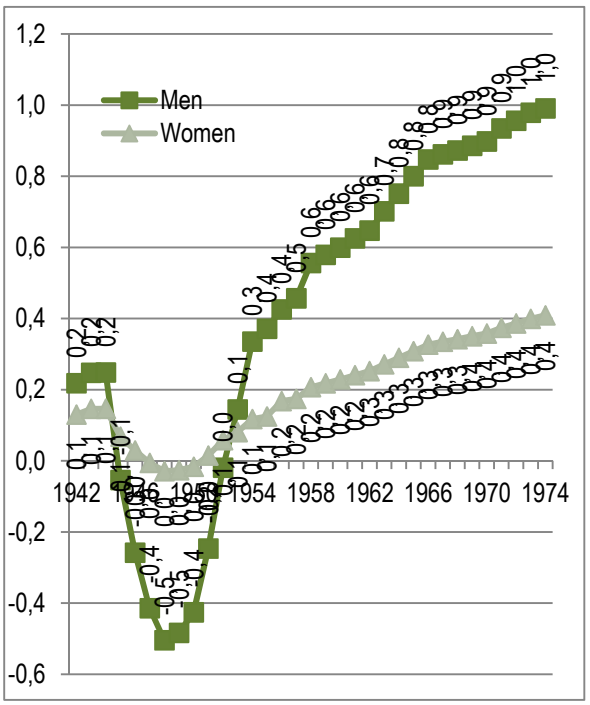
It should also be noted that the results presented herein stem from a modelization and thus are valid only if the hypotheses formulated for the projection actually occur. In the present case, the long term impact modelized will correspond to the actual impact of the reforms if the 'search for full-rate benefits' behavior observed in those generations that have recently retired and that is inherent to PROMESS modelization remains the behavioural model for the future generations.

**Graph 13: Average age for first receiving retirement benefits, by generation**

Average age for first receiving benefits




Gap between the central scenario (1993 and 2003 retirement reforms) and the scenario with legislation prior to 1993



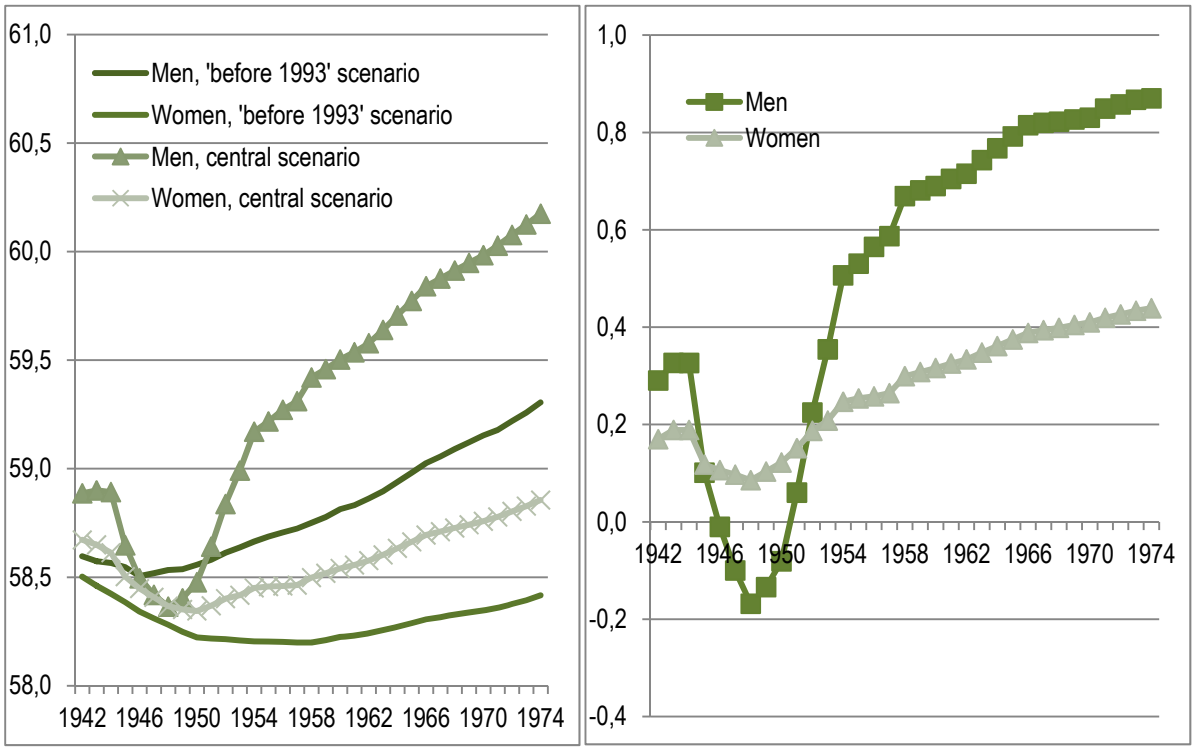

SOURCES: DREES, 2005 EIC AND PROMESS MODEL.
FIELD: PERSONS BORN IN FRANCE OR ABROAD WHOSE LAST RETIREMENT SCHEME IN THEIR CAREER WAS A PRIVATE SCHEME (I.E. EXCLUDING CIVIL SERVICE -FPE AND CNRACL- AND SPECIAL SCHEMES (SNCF, CNIEG, RATP, ENIM AND CANSSM)).

The impact is of the same magnitude, albeit slightly attenuated, on the age for definitively ceasing employment for those persons still employed after age 50 (see graph 14). For the generation born in 1974, it will thus be age 60.2 (instead of 59.3) on average for men and age 58.9 (instead of 58.4) for women. The comparison of the impacts on the age for ceasing employment and the age for receiving benefits must, however, be interpreted carefully, due to the difference in fields: the first indicator is calculated on a more limited field, excluding those persons having definitively ceased employment before age 50. The age for receiving benefits is generally not very affected by reforms because they are often received at either age 60 for incapacity or previous disability or at age 65.

### Graph 14: Average age for definitively ceasing employment

Average rate for definitively ceasing employment

Gap between the central scenario (1993 and 2003 retirement reforms) and the scenario with legislation prior to 1993

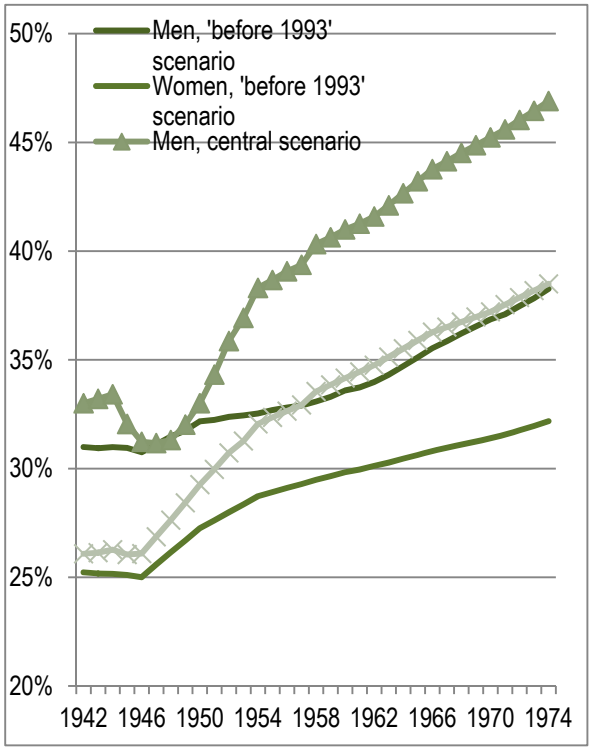



SOURCES: DREES, 2005 EIC AND THE PROMESS MODEL.
FIELD: PERSONS BORN IN FRANCE AND ABROAD STILL EMPLOYED AFTER AGE 50 AND WHOSE LAST RETIREMENT SCHEME IN THEIR CAREER WAS A PRIVATE SCHEME (I.E. EXCLUDING CIVIL SERVICE -FPE AND CNRACL-, SNCF, CNIEG, RATP, ENIM AND CANSSM)).
NOTE: IN THE PROMESS MODEL, WE HYPOTHESIZE THAT PEOPLE DEFINITIVELY CEASE EMPLOYMENT WHEN THEY BEGIN RECEIVING RETIREMENT BENEFITS. EMPLOYMENT WITHIN THE FRAMEWORK OF A COMBINATION OF HAVING A BRIDGE JOB/ ETIREMENT ARE THUS NOT TAKEN INTO ACCOUNT IN THE ESTIMATE OF THE AGE FOR DEFINITIVELY CEASING EMPLOYMENT.

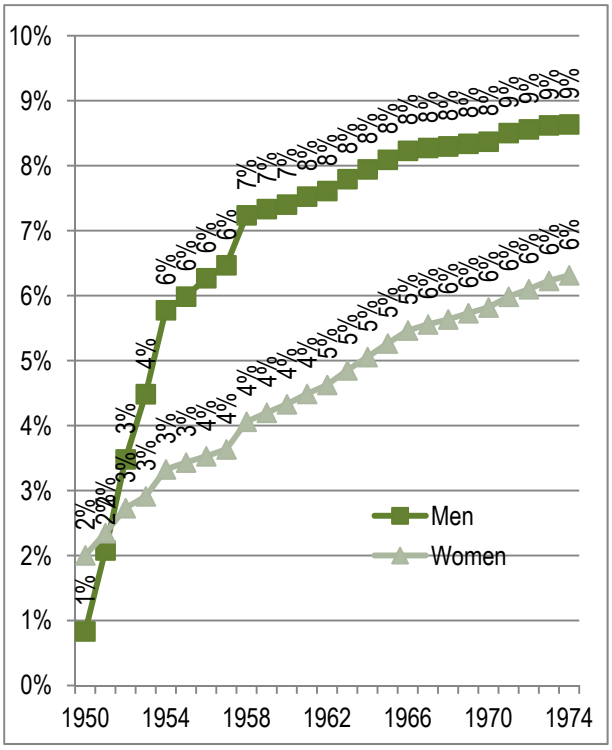
The rates of employment between ages 55 and 64 would be from 6 to 9 points higher in the long term due to the 1993 and 2003 reforms (see graph 15). They would reach close to 47% for men and 38% for women for those persons born in 1974. Due to conceptual differences, these rates cannot be directly compared to the rates of employment 'in the sense of the International Labour Office (ILO)' generally published by the INSEE using its Labour Force Survey. The rate of employment by generation is also not comparable to the annual rate of employment, which is also made with results from PROMESS in the following annex. The levels remain close, differing by only a few percentage points regardless of the concept, so that the impact of the reforms should very likely have the same magnitude on employment rates in the ILO sense.

### Graph 15: Average rates of employment between ages 55 and 64, by generation

Average rate of employment between ages 55 and 64




Gap between the central scenario (1993 and 2003 retirement reforms) and the scenario with legislation prior to 1993

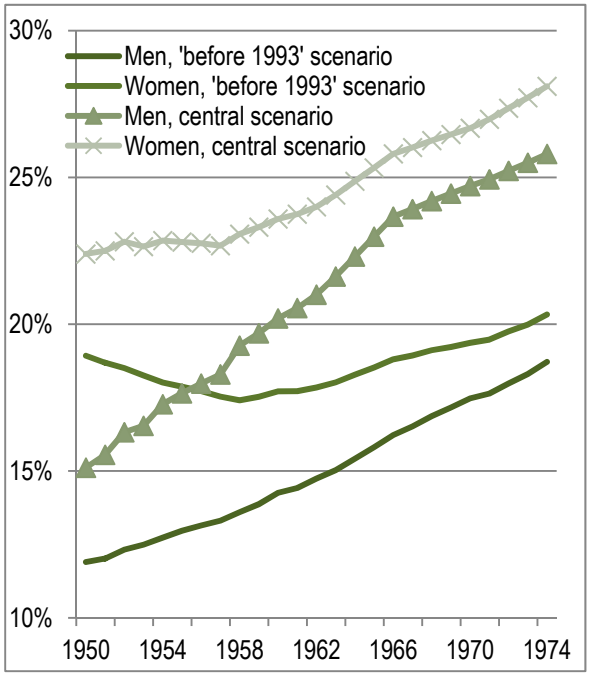



SOURCES: DREES, 2005 EIC AND THE PROMESS MODEL.
FIELD: PERSONS RESIDING IN FRANCE WHEN THEY RETIRE.
NOTE: THE RATES OF EMPLOYMENT PRESENTED IN THIS GRAPH ARE NOT DIRECTLY COMPARABLE TO THE ANNUAL EMPLOYMENT RATES FOR THOSE AGED 55-64 ESTIMATED USING THE LABOUR FORCE SURVEY AND PUBLISHED BY THE INSEE. FIRSTLY, THESE ARE RATES BY GENERATION AND NOT BY YEAR (MIXING PERSONS FROM MANY GENERATIONS); SECONDLY, THE CONCEPT OF EMPLOYMENT DIFFERS. THE FACT OF BEING EMPLOYED IS APPROACHED BY THE FACT THAT THE AGE IS INFERIOR TO THE AGE FOR DEFINITIVELY CEASING EMPLOYMENT, WHICH IS DEFINED BY RECORDING A PERIOD OF EMPLOYMENT WITH ADMINISTRATIVE SOURCES. THIS CONCEPT DIFFERS FROM EMPLOYMENT IN THE SENSE OF THE INTERNATIONAL LABOUR OFFICE (ILO), OBSERVED OVER ONE GIVEN WEEK OF REFERENCE, USED BY THE INSEE FOR ITS PUBLICATIONS.
MOREOVER, THE ESTIMATE ON THE FIELD OF PERSONS RESIDING IN FRANCE IS AN APPROXIMATION, MADE BY ASSIGNING PERSONS BORN ABROAD WITH A WEIGHT OF LESS THAN 1, EQUAL TO THE PROBABILITY OF RESIDING IN FRANCE WHEN RETIRING, TAKING GENDER AND VALIDATED CAREER LENGTH INTO CONSIDERATION.

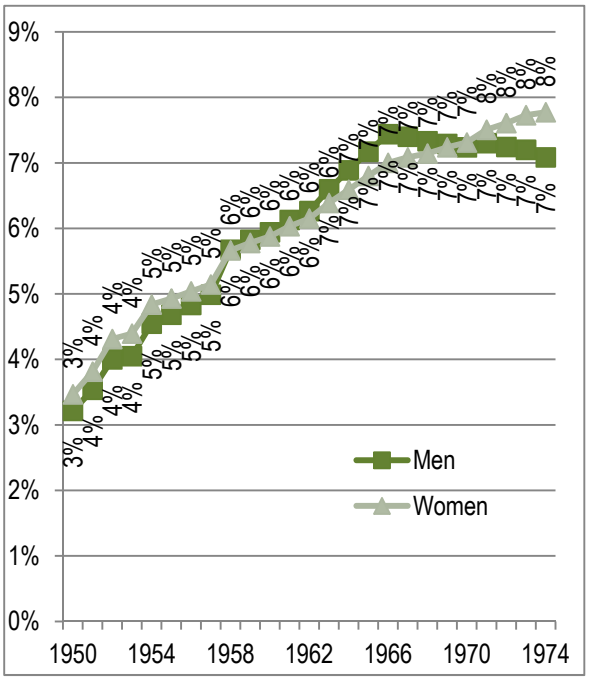
Finally, with the increase in the number of validated quarters required for full-rate benefits, an increasing proportion of the population reaches age 60 with a number of validated quarters inferior to this legal length. Some people delay the date at which they cease employment, or they wait until they reach the age at which full-rate benefits are automatically acquired (age 65), but not all. A larger portion of the population thus begins receiving benefits at a discounted rate, or through a measure such as incapacity or previous disability. In the absence of reforms, the proportion of persons in this situation would have been approximately 20% of the population born in 1974 (see graph 16), for both men and women. Under the effect of the 1993 and 2003 reforms (and without the effect of later reforms), this proportion would have increased by 7 points and would range between 25 and 30% of the population.

## Graph 16: Proportion of each generation not receiving full-rate benefits for number of quarters validated or age

Proportion, by generation




Gap between the central scenario (1993 and 2003 retirement reforms) and the scenario with legislation prior to 1993




SOURCES: DREES, 2005 EIC AND THE PROMESS MODEL.
FIELD: PERSONS RESIDING IN FRANCE WHEN THEY RETIRE.
NOTE: THIS GRAPH REPRESENTS THE PROPORTION OF PERSONS RECEIVING BENEFITS BEFORE THE AGE AT WHICH THEY ARE AUTOMATICALLY ELIGIBLE FOR FULL-RATE BENEFITS (AGE 65) WITH A NUMBER OF VALIDATED QUARTERS INFERIOR TO THE NUMBER REQUIRED FOR FULL-RATE BENEFITS (150 QUARTERS IN THE 'BEFORE 1993 SCENARIO', BETWEEN 162 AND 164 QUARTERS IN THE CENTRAL SCENARIO UNDER THE EFFECT OF THE 1993 AND 2003 REFORMS). THESE PERSONS THUS BEGAN RECEIVING BENEFITS DUE TO INCAPACITY OR PREVIOUS DISABILITY OR THEY RECEIVED DISCOUNTED BENEFITS.

## Annexe 3. Comparison with the rates of employment observed in the Employment Study Labour Force Survey

This annex aims to compare the results of the PROMESS model with the series of rates of employment by seniors' gender and age observed in the Insee's Labour Force Surveys, on the one hand, and the series of rates of the labour force modelized in the labour force projections carried out in 2006 by the Insee[20], on the other hand. This double comparison enables us to judge the model's adequacy with the observations on recent years and to explain the possible differences with the projections used elsewhere (notably the COR - Retirees Advisory Council - projection of the number of retirees in all schemes).

The comparison is not immediate, however. The PROMESS model is based on an approach by generation and uses the field of all persons affiliated with French retirement schemes (residing in France or abroad), whereas the Insee series are annual series, all generations together, and on a field of resident population. PROMESS' results were processed so as to facilitate the comparison.

### Calculation of the annual rate of employment using PROMESS

Moving from an approach by generation to an approach by year is easily done, insomuch as the probabilities of being employed or unemployed for each generation in the PROMESS model are calculated at each age, thus for each year. The annual number of persons employed in the age brackets considered are calculated by multiplying the total population in each generation by this probability of being employed.

The population residing in metropolitan France cannot, however, be directly appreciated using EIR and EIC data, on which the PROMESS model is based. An approximation was therefore made here, consisting of considering, for each given year, that all persons employed and in a validating system (unemployment, incapacity, sick leave, pre-retirement) reside in France, but only a given proportion of retirees and other unemployed non-retirees reside in France. This proportion was calibrated using the probability of residing in France upon retiring for generation 1938 in the EIR data, conditional upon the country of birth (France / abroad), the gender, the fact of still being on the labour market after age 50 and the number of quarters validated before this age (grouped into 5 categories). It is valued at 100% for all persons born in France and between 10 and 100%, depending on the case, for those born abroad.

Some conceptual differences nonetheless remain between the results of the PROMESS model and the series from the Labour Force Surveys. PROMESS is this based on a total population (including 'unordinary households') whereas the Labour Force Survey's field is ordinary households. Moreover, the concept of employment is different. In the Labour Force Survey, the concept is that of the International Labour Office (ILO). The fact of being employed is calculated using one reference week and the rate of employment published is an average of the 52 weeks in the year. In PROMESS, we modelize the age of definitively ceasing employment, which is defined as the highest age for which a period of employment (wage or employment revenue posted to an account, length of employment) is observed in the administrative files of at least one retirement scheme. This period can possibly be inferior to 1 year or correspond to remunerations that are very low. Persons are considered to be employed so long as their age is inferior to the age for definitively ceasing employment, even if they go through transitory periods of unemployment, which could lead to overestimating the rate of employment. Inversely, we consider that there is no more employment once retirement benefits are first received. The combination bridge job/ semi-

[20] For seniors (ages 55-59 and ages 60-64), these projections are mainly based on the impact of retirement reforms modelized by the Insee's DESTINIE model, as well as on an ad-hoc consideration of retirement within the framework of the early retirement due to long career measure (see Coudin, 2007).

retirement is thus not considered as employment, which has the effect of under-estimating the real rate of employment.

Finally, the concept of age is different. In the calculations made for this annex using PROMESS, a quarterly base was retained. Each generation was broken down into four equal groups that are considered to have been born uniformly over the course of each of the year's four quarters. The age retained thus corresponds to a common concept of age. This concept is similar to that retained by DARES for its senior employment indicators, but not the concept of age as of 31 December used in the 2003 labour force projections. The concept of age can have a significant impact on the results concerning seniors, since defining age brackets by current age rather than the age as of 31 December amounts to considering persons aged 6 months older on average.

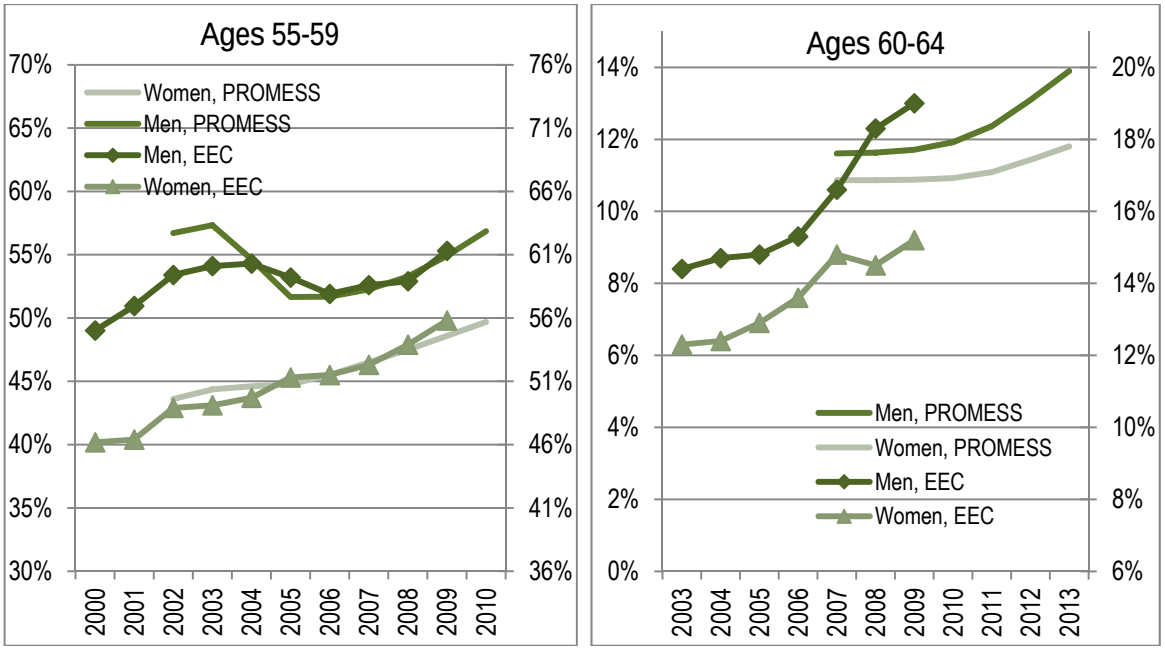
These differences in the concept of age make the comparison of levels in the two series irrelevant: hereafter, we will thus comment mainly on the differences in evolution.

### Comparison with the observed rates of employment

In evolution, PROMESS model seems to conform to the reality observed for those aged 55-59. For women in this age bracket, over the course of the 8 years for which a comparison is possible (2002 to 2009), PROMESS modelized a continuous and regular increase in the rate of employment over this period of approximately 0.7 points per year. This is comparable, albeit slightly lower, to the increase of approximately 1 point per year observed in the Labour Force Surveys. For men, a decrease in the rate of employment was observed beginning in 2004, the year the early retirement due to long career measure was implemented. This decrease was interrupted beginning in 2006 and was not completely offset until after 2009.

For those aged 60-64, the comparison is more difficult, insofar as it is only possible over a period of 3 years (2007 to 2009). Over this period, PROMESS gives very comparable results to the series observed for women (stability of rates of employment over three years), but not for men (stability of rates of employment according to PROMESS, whereas an increase of 2.5 points in the rate of the labour force was observed).

**Graph 17: Rate of employment observed in the Labour Force Surveys and modelized by PROMESS**




SOURCES: DARES, SENIOR EMPLOYMENT INDICATORS (AS PER INSEE'S LABOUR FORCE SURVEYS) AND DREES, PROMESS MODEL.
NOTE: DUE TO CONCEPTUAL DIFFERENCES, THE LEVEL OF THE RATES OF EMPLOYMENT ARE NOT DIRECTLY COMPARABLE WITH THE PROMESS MODEL AND DATA FROM THE LABOUR FORCE SURVEYS (*ENQUÊTES EMPLOI EN CONTINU, EEC*). SO AS TO FACILITATE THE COMPARISON, THE SCALES WERE SHIFTED BY 5 PERCENTAGE POINTS (PROMESS MODEL: LEFT SCALE, EEC SERIES: RIGHT SCALE).

The difference could come from a significant impact of premiums on retirement between 2006 and 2009. The PROMESS model does not, in fact, include specific retirement behaviour reaction to the establishment of a premium and the modification to the discount rate scale[21]. It thus does not enable us to modelize a possible scalability of these measures in the years following 2004, if it is indeed this phenomenon that explains the increase in the rate of employment for men aged 60-64 in the Labour Force Survey data.

However, the rates of employment of men over 60 greatly increased as of 2010 in the PROMESS model. The gap could thus merely describe a temporal shift in the scalability of the effects of the reforms.

### Comparison with the rates of the labour force modelized in the 2006 labour force projections

As in the previous section, the level of rates of employment modelized using the PROMESS model cannot be directly compared with the rates in Insee's labour force projections. Added to the difficulties inherent in defining a field of residents in France in the PROMESS model here is the fact that the indicator is different (rate of the labour force and not rate of employment) and the difference in the concept of age (age reached at the end of the year for the labour force projections, age at the date of observation for PROMESS). Nevertheless, if we hypothesize that the seniors' rate of unemployment will remain globally stable in the future, the evolutions in the series of the two projections could be compared.

For those aged 55-59, the PROMESS projections and those projections from labour force projections are similar in the short term. The rate of employment for women increases continually and with a comparable rhythm in both exercises over the 2002 - 2008 period.

For men, the rate of employment shows a slack of approximately 5 percentage points beginning in 2004, the year in which the early retirement due to long career measure was established, and this is the case in both projections. This slack was not reabsorbed until the beginning of 2010, with a return to the average level observed prior to 2003. The recovery of the rate of employment is more rapid in PROMESS than in the labour force projections (return to the 2003 level in 2010 in the first case, and in 2013 in the second). We must, however, bear in mind that this recovery is linked to two factors: first, mandatory school until age 16 for those born beginning in 1953 (who were 56 in 2009), which means these persons never meet the eligibility criterion for the early retirement due to long career measure before age 59; second, the toughening of the access conditions in 2009, decided upon within the framework of the 2009 Social Security Financing Law (Loi de Financement de la Sécurité Sociale, LFSS). By design, Insee's 2006 labour force projections do not integrate this second effect, which explains the fact that the disappearance of the early retirement measure is slower in these projections.

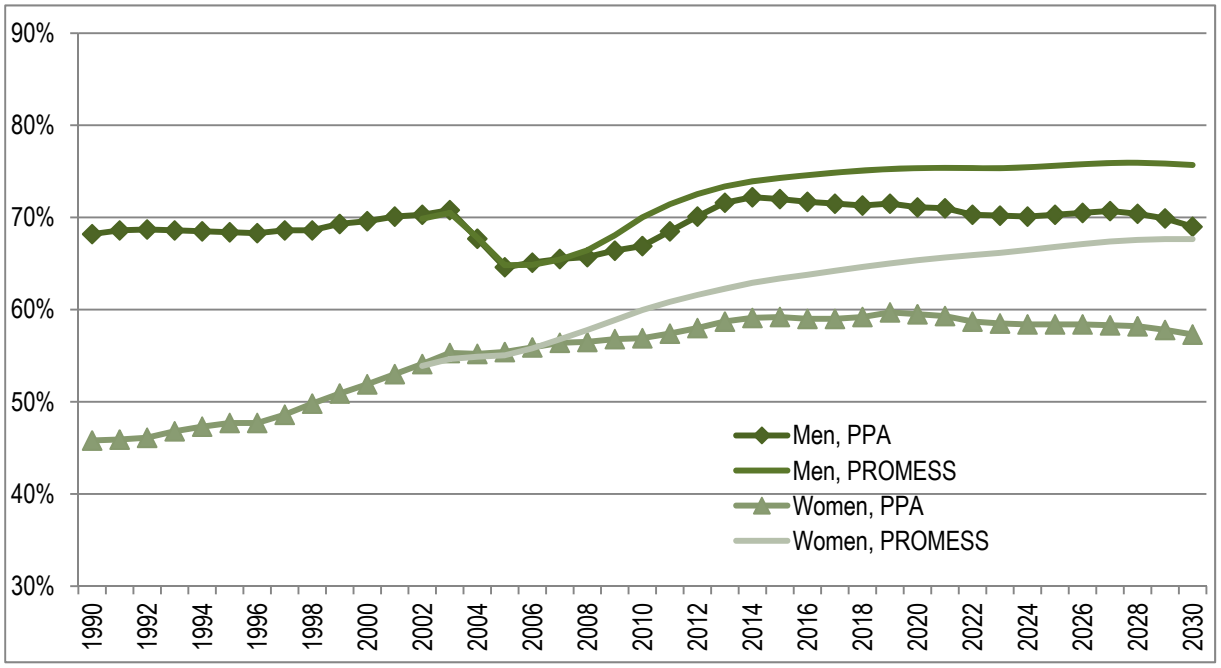
In the long term, however, the conclusions of the two projection exercises differ. PROMESS modelizes an increase in the rate of employment for those aged 55-59 until 2020 for men and until 2030 for women, whereas the rates remain stable or even decrease slightly beginning in 2015 in the labour force projections. By 2030, the variation of the rate of employment since 2005 is thus 6 points higher for men and 11 points higher for women in the PROMESS model.

[21] The hypotheses of modelizing retirement mainly correspond to a sensitivity to the required number of quarters validated for being eligible for full-rate benefits and, if need be, to the minimum age for receiving benefits. We must therefore assume that retirement with a premium would have occurred in any case, at the same age, even if the premium had not been established.

**Graph 18: Labour force rates for ages 55-59 modelized in Insee's labour force projections (2006) and rates of employment modelized by PROMESS**

*In % of the population residing in France*

Please note: so as to facilitate the comparison of the curves, the series from the PROMESS model were shifted by a few percentage points (see reading note). The comparison is thus only valid as an evolution, not as a level.




SOURCES: INSEE, 2006 LABOUR FORCE PROJECTIONS; DREES, PROMESS MODEL.
NOTE: DUE TO CONCEPTUAL DIFFERENCES, THE LEVELS OF THE RATE OF EMPLOYMENT IN THE PROMESS MODEL ARE NOT DIRECTLY COMPARABLE TO THE LABOUR FORCE PROJECTIONS (PPA). SO AS TO FACILITATE A COMPARISON, THE RATES OF EMPLOYMENT MODELIZED BY PROMESS WERE THUS SHIFTED BY SEVERAL PERCENTAGE POINTS, SO AS TO MAKE THE AVERAGE EQUAL OVER THE 2002 - 2010 PERIOD (+13 POINTS FOR MEN AND +10 POINTS FOR WOMEN)

This difference in dynamics could be explained by a hypothesis of a greater impact of retirement reform on employment before age 60 in PROMESS than in the labour force projections. In PROMESS, the impact mainly passes through two channels. Firstly, the model on retirement for Civil Service and special schemes (SNCF, RATP, CNIEG) is a model for full-rate retirement[22] . For employees in active categories for whom eligibility for retirement benefits occurs at age 55, the impact of lengthening the number of validated quarters required for full-rate benefits combined with raising the age for entering into the labour force thus is significant for generations 1960-1970. Under the retained hypothesis, these employees retire massively at the age at which the discounted benefit rate is cancelled, i.e. age 60, being that they never attain the number of quarters validated required for full-rate benefits before this age[23] . Secondly, for employees and independent workers in the private sector, the retirement model at each age between 55 and 60 includes an indirect effect of retirement legislation. This effect is reflected in the fact that those persons not yet disposing of a sufficient number of validated quarters for receiving full-rate benefits have, at each age, a significantly higher probability of maintaining employment than do those who already dispose of a sufficient number of validated quarters. The increase in the number of validated quarters required for full-rate benefits and the rise in the age for entering the labour force have the effect of increasing the proportion of the population in this situation, and thus impact the increase in the seniors' rate of employment.

This latter mechanism implies that even the natural evolution of the rate of employment or the rate of the labour force for ages 55-59, in the absence of the 1993 and 2003 retirement reforms, leads to gaps between the PROMESS model and the labour force projections. In the Insee projections, the DESTINIE modelization is only

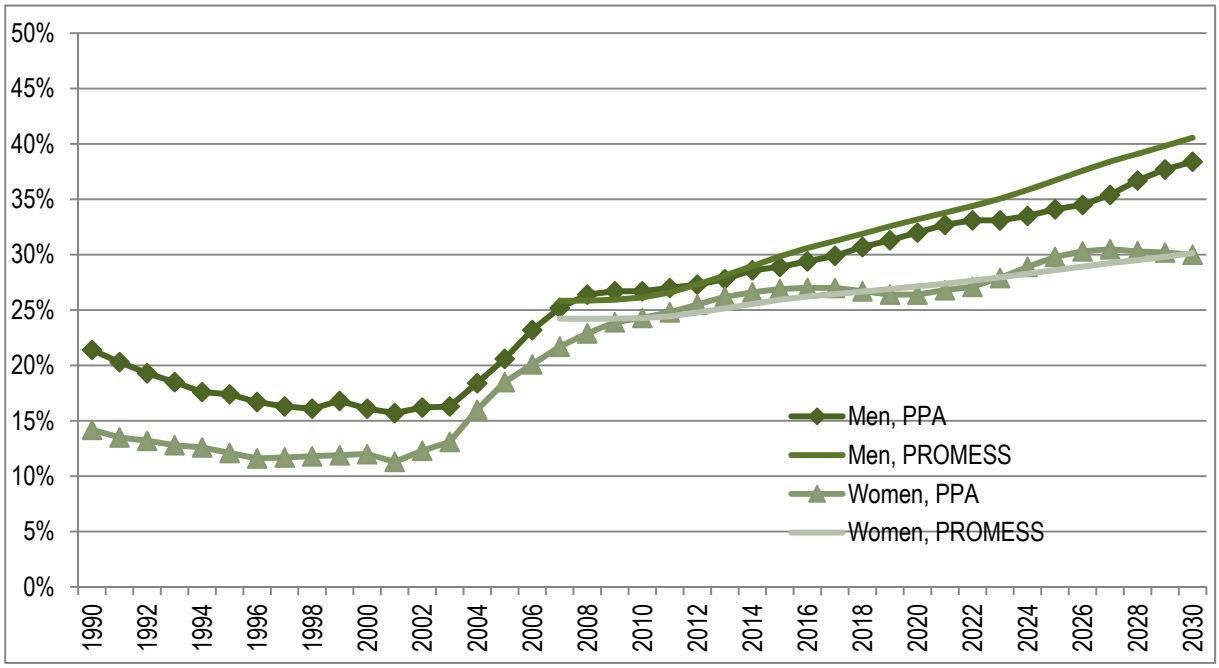
[22] With the exception of a portion of the population composed of the armed forces, the disabled and parents of three children, for whom the age for retirement (or ceasing employment due to incapacity) is assumed to be inelastic to the modification of the number of validated quarters required for full-rate benefits.

[23] Note that PROMESS does not include modelization of the bonuses for the number or quarters validated accorded by some schemes that could, in practice, allow some people to attain a sufficient number of validated quarters for full-rate benefits before age 60.

used in differential between a scenario based on the legislation applied before the 1993 and 2003 reforms and a scenario of legislation integrating the effects of these reforms. Excluding this differential impact, the evolution of the rate of the labour force is modelized via estimating the parameters of a logistical function, which in practice leads to the estimate of a stable global rate in the future. Inversely, in the PROMESS modelization, the rise of the age for entering the labour force over generations leads to an increase in the rate of employment as of ages 55-59 between 2010 and 2030, even in the absence of retirement reform effects.

**Graph 19: Labour force rates for ages 60-64 modelized in Insee's labour force projections (2006) and rates of employment modelized by PROMESS**

*In % of the population residing in France*
Please note: so as to facilitate the comparison of the curves, the series from the PROMESS model were shifted by a few percentage points (see reading note). The comparison is thus only valid as an evolution, not as a level.




SOURCES: INSEE, 2006 LABOUR FORCE PROJECTIONS; DREES, PROMESS MODEL.
NOTE: DUE TO CONCEPTUAL DIFFERENCES, THE LEVELS OF THE RATE OF EMPLOYMENT IN THE PROMESS MODEL ARE NOT DIRECTLY COMPARABLE TO THE LABOUR FORCE PROJECTIONS. SO AS TO FACILITATE A COMPARISON, THE RATES OF EMPLOYMENT MODELIZED BY PROMESS WERE THUS SHIFTED BY SEVERAL PERCENTAGE POINTS, SO AS TO MAKE THE AVERAGE EQUAL OVER THE 2002 - 2010 PERIOD (+14 POINTS FOR MEN AND +13 POINTS FOR WOMEN).

For ages 60-64, the rhythm of the increase in the rate of employment in PROMESS is similar to the rhythm of the increase of Insee's rate of the labour market projections: approximately +13 points environ for men and +6 points for women between 2010 and 2030.

As previously indicated, only the evolutions can be compared here, not the levels. The apparent concordance between the evolutions modelized in PROMESS and in the labour market projections (mainly coming from the DESTINIE model for ages 60-64) could be qualified by the fact that they include a sharp increase in the rate of the labour market over the period 2003-2008 (+10 points in 5 years), a period for which it is unfortunately not possible to judge the adequacy with the PROMESS modelization, being that the generations concerned are older than those taken into consideration in the model (generations previous to that born in 1942).

## Annexe 4. Comparison with the results projected by the CNAV's PRISME model

In this annexe, we compare the retirement ages modelized by PROMESS and by PRISME for the years 2008-2030. The simulations from PRISME were done by the CNAV in the springtime of 2010 and correspond to the results published by the COR in May, 2010 (see eighth COR report Retirees: Perspectives updated in the medium and long term in view of the 2010 appointment - Retraites : Perspectives actualisées à moyen et long terme en vue du rendez-vous de 2010 from 14 April 2010 and documents 2 and 3 from 11 May 2010). We will refer to these documents for a presentation of the modelization hypotheses retained by the CNAV.

The PRISME model relates to the field of those affiliated only with the general scheme, whereas the PROMESS model is an all-scheme model (even though it distinguishes, for modelization needs, between private, public and special schemes). By design, it is therefore not possible to compare the results of the two modelizations on rigorously equivalent fields. This limitation must be kept in mind while interpreting the results. So as to make the fields as comparable as possible, all of the PROMESS results presented in this note relate only to those persons finishing their careers in a private scheme. In particular:

- the influx of people receiving benefits in PROMESS includes all persons having retirement benefits in agricultural schemes or independent schemes (RSI - independent workers, MSA - farmers, CNAVPL - the self employed, etc.), some of which were never affiliated with the CNAV,
- inversely, it does not include those persons terminating their careers in a public scheme (State or CNRACL - agents of the local collectivities) or in a special scheme (SNCF - French Railroads, CNIEG - gas and electrical workers, Banque de France, ENIM - disabled sailors, CANSSM - miners, etc.), even if they could have been affiliated with the general scheme in the beginning of their careers, and, as such, belong to the influx of those receiving benefits from the CNAV.

Moreover, the PROMESS model refers to the first time receiving retirement benefits. In the case of persons with multiple retirement schemes in the general scheme, this date could be distinct from the CNAV's date for receiving benefits, if the diverse benefits are not received at the same time.

Graph 20 represents the average ages of new annual retirees, modelized by PRISME and by PROMESS[24] using the hypothesis of a Fillon type legislative scenario, i.e. with the simple application of the measures provided for in the 2003 retirement reform (lengthening of the number of validated quarters required for full-rate benefits to 41.5 years by 2020).

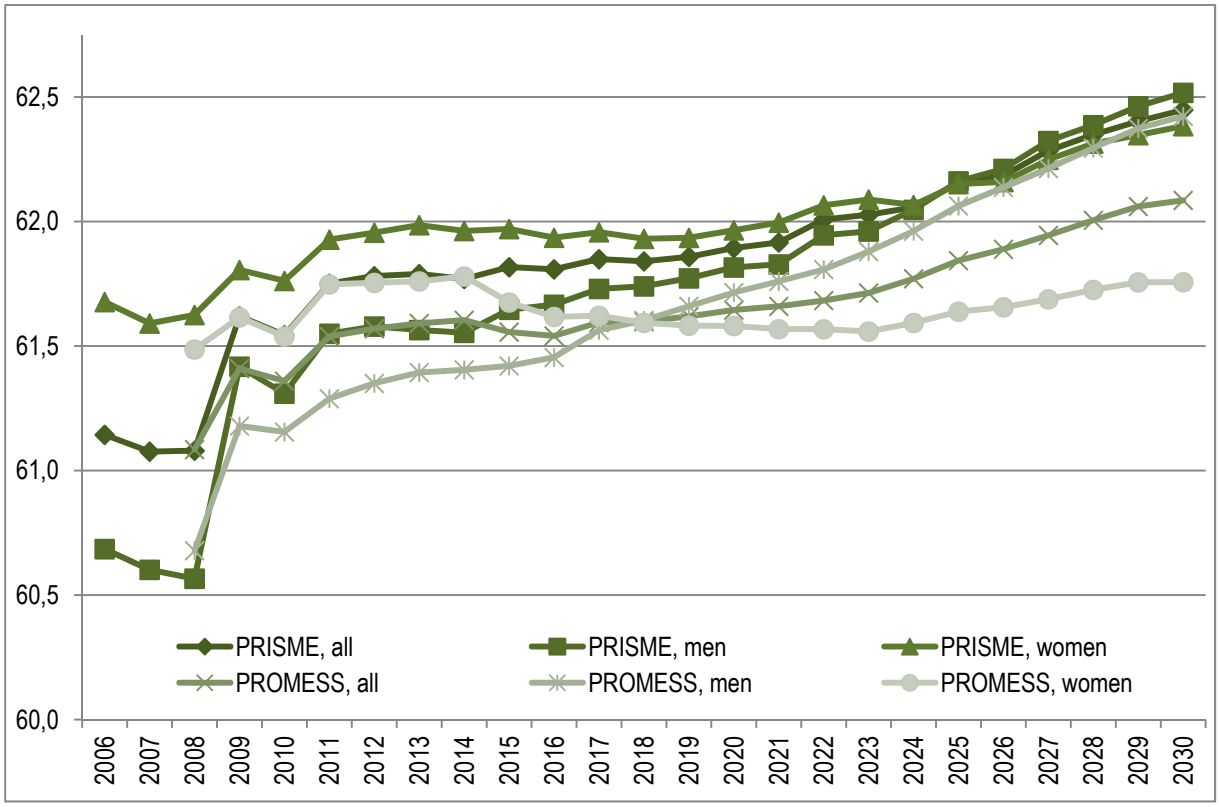
The levels are somewhat different between the two modelizations, the average age of new retirees are slightly lower (by approximately 0.2 years) in PROMESS. This difference is mainly due to the aforementioned field differences. Moreover, PROMESS hypothesizes that retirement is at age 66 maximum, whereas PRISME hypothesizes that retirement can occur up to age 69. This hypothesis, in itself, explains a difference in level of 0.1 years.

The average age of new retirees evolves in a globally similar manner in the two models, except as concerns women between 2010 and 2020, for whom the average age for receiving benefits will remain stable according to PRISME, whereas it decreases slightly by 0.2 years according to PROMESS. In the long term, the average age also increases slightly more for men in the PROMESS modelization as compared to that of PRISME, which

[24] PROMESS modelizes, for each generation, the probabilities of having received a first retirement benefit at each quarterly age (situation at the end of the quarter). To construct an annual influx of benefit receptors, we considered that the persons from each generation were born in a uniform manner over all the days in the year.

means that, overall, the average age for receiving benefits (both men and women together) increases at, in a parallel manner in the two models.

**Graph 20: Average age of new retirees, by year**




SOURCES: DREES, PROMESS MODEL; CNAV, PRISME MODEL.

The variation between 2008 and 2009 must be considered on its own. Between these two years, the age for receiving benefits clearly increases more abruptly in the PRISME modelization, notably for men. The increase in itself is linked to the toughening of accessing early retirement due to long careers as of 2009. The gap between the two models stems, in reality, from a gap in the estimate of said early retirements: it is marked in 2008, the year in which these retirements are numerous, but is much less so in 2009, insofar as early retirements due to long career represent a much lower portion of the influx of new retirees.

The modelization of early retirement, between 2004 and 2008, is very difficult insofar as, to take advantage of it, many employees adjust periods that were not recorded in retirement funds' administrative files when they receive benefits. PRISME explicitly modelizes these adjustments so as to calibrate the influx of early retirement observed up to 2008[25] . On the other hand, PROMESS is based on the number of quarters validated as per the 2005 EIC, with no imputation of periods adjusted after the fact. In practice, if we compare the numbers of retirees aged 56 to 59 in 2007 and 2008 modelized by PROMESS and observed in the EACR (enquête annuelle auprès des caisses de retraites - Annual Retirement Fund Scheme Survey), early retirement due to long career appears to be under-estimated in PROMESS over the course of these two years. Insofar as the phenomenon is but transitory, no specific correction was added to the model, the underestimation is only an issue in the short term.

Table 5 presents the evolutions in the age for receiving benefits between 2008 and 2030 and between 2009 and 2030. As explained below, the comparison of the 2008-2030 evolutions is of little interest, due to the gaps specific to the year 2008. It is thus all the more important to retain the gaps between the 2009-2030 evolutions so as to

[25] The concern for specific consideration is linked to the fact that the PRISME model is also used to make short-term projections, which is not the case for the PROMESS model.

judge the gaps between the two models. The gap in the ensemble of new retirees is but 0.2 year. As previously mentioned, this proximity nonetheless hides disparities between men and women, the lower shift in the age at which women receive benefits in PROMESS being compensated by a higher shift in the age at which men receive benefits.

Let us note that this proximity, observed for a Fillon type legislative scenario, is not necessarily ensured in the simulations of scenarios raising the minimum age for receiving benefits or for the automatic acquisition of full-rate benefits (results not represented herein). The shift in the average age of new retirees is in fact greater according to the PROMESS model than to the PRISME model, and all the more so when the increase in the minimum age is greater. This result is actually natural and is explained by the different modelization hypotheses: on the one hand, PROMESS is a model based on the distance to full-rate benefits, with no specific effect linked to age (in particular, at a given distance to full-rate benefits, the number of years until the actual age for receiving benefits will be the same regardless to the age at which this distance is 'seen'); on the other hand, for the 2010 projection exercise, the CNAV hypothesized that the policy holders retiring upon attaining full-rate benefits in the scenario of reference (the Fillon scenario) were seeking to conserve this rate while remaining as close as possible to their original retirement date (with a possible loss in the premium). This hypothesis tends to greatly attenuate postponing the age for receiving benefits in the scenarios in which the minimum age for first receiving benefits is raised.

**Table 5: Shift in the average age of new retirees**

| | **CNAV (PRISME model)** | | | **PROMESS, average age of influx of benefit receivers (end of career in the private sector)** | | | |
|---|---|---|---|---|---|---|---|
| | All | Men | Women | All | Gap | Men | Women |
| *2008 to 2030* | **1.4** | 2.0 | 0.8 | **1.0** | *0.4* | 1.7 | 0.3 |
| *2009 to 2030* | **0.8** | 1.1 | 0.6 | **0.7** | *0.2* | 1.2 | 0.1 |

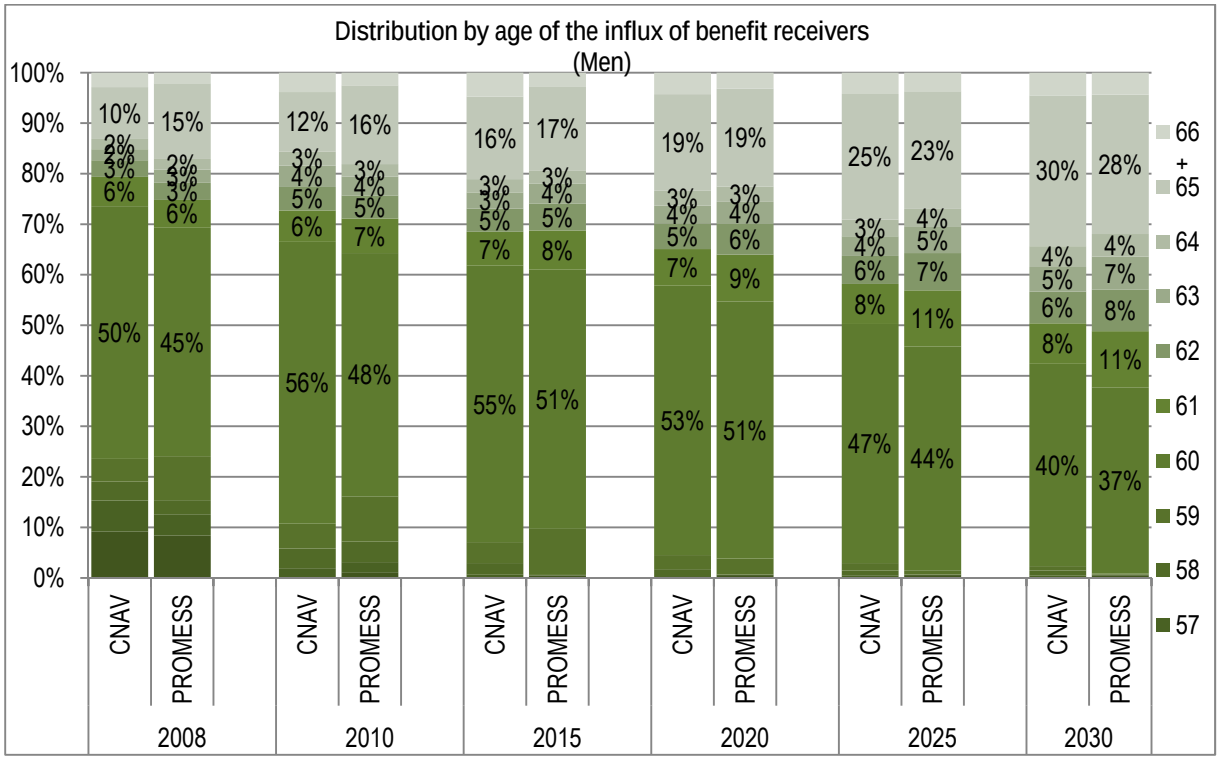
SOURCES: DREES, PROMESS MODEL; CNAV, PRISME MODEL.
READING: UNDER A FILLON LEGISLATION SCENARIO, THE AVERAGE AGE OF NEW RETIREES WOULD INCREASE BY +.8 PER YEAR BETWEEN 2009 AND 2030 ACCORDING TO THE PRISME MODEL, AND BY +0.7 OVER THE SAME PERIOD ACCORDING TO THE PROMESS MODEL (FOR THOSE PERSONS TERMINATING THEIR CAREERS IN A PRIVATE SCHEME).

Finally, the following graphs complete the analysis, by presenting distributions by age of the year's new retirees for men and for women under the Fillon scenario.

These graphs confirm the observations made previously. For men in 2008, the PROMESS model underestimates early retirements due to long career at age 58 or before (19% of the influx according to PRISME as compared to 15% according to PROMESS). This difference is, however, compensated for by more numerous early retirements at age 59 in the PROMESS model. Moreover, it disappears for previous years, with the toughening of the access conditions to this measure.

In 2010, the proportion of those receiving benefits at age 60 and under is close in the two models (approximately 66% of the total influx, with a 2-points gap between the two models), but this gap is amplified subsequently and the proportion is 5 percentage points higher according to PRISME by 2030. PROMESS, however, modelizes a greater increase in the portion of persons receiving benefits between ages 61 and 64 in the influx of newly retired men.

**Graph 21: Distribution by age of the year's newly retired men, under the Fillon scenario**




SOURCES: DREES, PROMESS MODEL; CNAV, PRISME MODEL

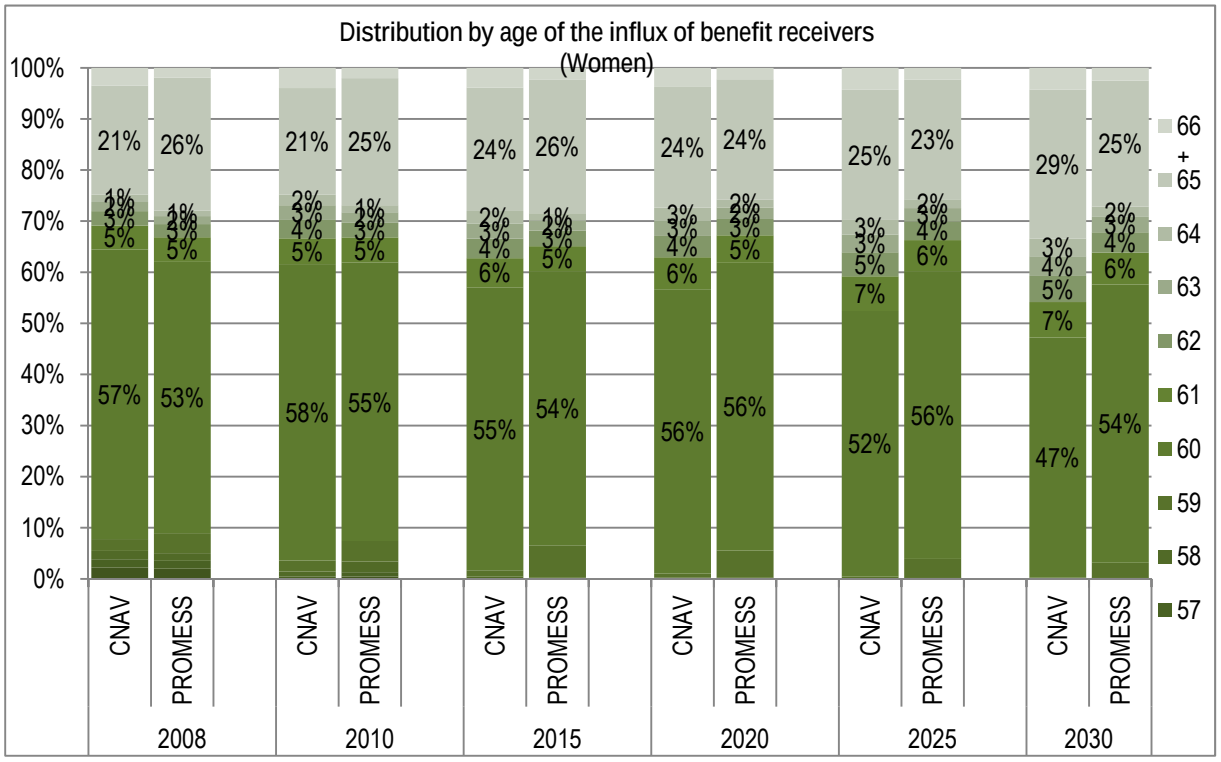
For women, the proportion of age 60 and under among the new retirees decreases significantly more according to the PRISME model. While these proportions are practically equal in 2010, they will be close to 10 points lower by 2030 according to PRISME.

Early retirement represents a portion of the gap. These retirements will practically disappear for women beginning in 2020 in the PRISME modelization, while they will still represent 3% of new retirees according to PROMESS. This gap nonetheless remains small and is only mentioned herein for information[26] .

For the rest, the differences observed between the two models cannot easily be linked to a specific and readily identifiable modelization hypothesis. They could, in part, be linked to hypotheses on employment before age 60. PROMESS takes into consideration specific retirement reform effects on the employment of persons aged 55-59: as a result, women could be employed more often and could validate more quarters therein than in PRISME. But other phenomenon could play a role. For example, PRISME hypothesizes that a larger and larger proportion of the population will be covered by the general scheme (i.e. the hypothesis that an increasingly higher proportion of the population will receive benefits according specifically to the general scheme). This adjustment could lead to a phenomenon of demographic composition that is difficult to understand but that could explain some of the differences between PRISME and PROMESS.

[26] The explanation could be as follows: the possibilities of early retirement due to long career are subject to a triple condition of the total number of quarters validated, the length of time contributions were made and the age upon entering the labour force. However, only the total number of quarters validated is modelized in PROMESS. The two other conditions are in fact taken into consideration by the model by applying a probability of satisfying the three conditions for those persons already satisfying the condition of the number of validated quarters. In projection, this probability is assumed to be constant (its different values, defined for each category of gender and number of quarters validated at age 54 are calibrated on the observations born in 1946 or in 1950), whereas in reality, it could decrease, which would explain the difference with the PRISME modelization (which explicitly takes the three conditions into consideration).

**Graph 22: Distribution by age of the year's newly retired men, under the Fillon scenario**




SOURCES: DREES, PROMESS MODEL; CNAV, PRISME MODEL.

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