Pension schemes and participation rates of older workers

A microsimulation of pension reforms in France

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Introduction

In all industrialised countries, it is now rare to be still working after the age of 65. Today, many workers even exit the labour market as young as 55, particularly in France. In the mid-1990s, less than 17% of men in the 60-64 age group were in the labour force; in 1970, this proportion reached almost 70%. For men in the 55-59 age group, the participation rate has fallen from 83% to 68% in 30 years. For women, trends are less clear since the downward tendency in participation at older ages is partly offset by the generalization of female participation.

Although all worker age-groups were affected by the deterioriation of labour-market conditions, the elderly were the most hit. Since the end of the 1970s, many of them have stopped working well before claiming their old-age pensions. Today, in France, private sector wage earners exit the labour market 2 years on average before claiming their old-age pensions. The number of people aged over 55 benefiting from early-retirement programs rose sharply in the late 70's, reached a peak of 700,000 in 1984, then declined to fluctuate around 500,000 since the mid-90's. These pre-retirement systems, as well as the lowering of the statutory retirement age to 60 in 1983, provide the main explanation for the decline in the participation rate over 55.

By 2050, if present demographic trends persist, there will be in France eight people aged over 60 for ten people between 20 and 59, compared with a current proportion of four to ten. The very low participation rate of older workers is a source of concern for the financial viability of old-age pension systems. In order to limit the impact of ageing on the funding of pensions, one solution would be to favour higher participation rates over 55. Changing pension rules to make work financially more attractive could be one step into this direction.

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In the French pension system for private sector workers, people are entitled to public pensions as soon as they are 60. However they face strong incentives to postpone their retirement until they reach either the age of 65 or 40 years of contributions[2] ('full rate'). The penalties associated with retirement below the 40 years target of contributions are high. Conversely the pension accrual rate if the worker continues working after he gets the full rate is very low. The distribution of the retirement age has therefore a familiar two peaked shape: wage earners with long careers claim old-age benefits as soon as they can (ie. at 60) whereas short careers (mainly women) wait until 65 in order to get the full rate of pension.

Reforms of the pension system allowing more flexibility in the choice of the retirement age or increasing the contribution period required to get the full rate of pension are currently under debate in France (Charpin 1999, Taddei 2000). For instance, the Charpin Report published in Spring 1999 suggested to reduce the penalties associated with early withdrawal in order to get closer to actuarial adjustement. The drop in the level of SS benefits per year missing to reach the full rate could be fixed around 7% instead of 10-12.5% today. To alleviate the consequences of demographic trends on the pension system in the years to come, the report also proposed to shift progressively to 42.5 years (instead of 40) the length of the contribution period required to get the full rate.

In order to assess the effects of pension reforms on the participation rate, a supply-side modelling of the retirement decision, in the line of Stock-Wise (1990), is introduced in the dynamic microsimulation model Destinie developed at Insee. The main idea of the model is that people choose their retirement age by comparing over the life cycle the utility of retirement at different dates. This modelling implicitly assumes that the individual choice is not constrained by the demand on the labour market which may be a rather strong assumption today in France. After discussing methodological issues in implementing such a modelling, we simulate several reforms of pension schemes and assess their impact on participation of older workers. Simulations are performed on cohorts that will retire around 2005-2015 (cohorts born between 1945 and 1954). For these cohorts, simulations indicate that the reforms could have significant but limited effect on participation rates given the high proportion of individuals that have contributed more than 40 years before the minimum age of 60.

The paper is organized as follows. A first section briefly describe the basic features of French pension system for private sector workers. A second section specifies the modelling of the retirement decision and explores the sensitivity of the results to the parameterization. A last section simulates several reforms of the pension system: enforcement of more actuarial adjusted schemes ; 3-year increase in the contribution period required to get the full rate of pensions ; combination of the two reforms.

[2] This target corresponds to the so-called 'full rate' (*taux plein*) and this is the term we will use in the rest of the paper.

1. The French pension system for private sector workers

The French pension system is composed of a wide range of pension schemes that provide quite different old-age benefits. About 65 % of workers (most wage earners in private firms) fall under the *Régime Général*, whereas civil servants, farmers or self-employed people have specific schemes (Blanchet-Pelé 1999). In our microsimulation model, all workers are assumed to fall under the *Régime Général* for pensions. For these workers, the pension system is a two pillar scheme: the first one provides basic pensions (the so-called *Régime Général*); the second one includes complementary old-age benefits (ARRCO and AGIRC). The rules that determine the level of pensions are detailed below.

Basic pensions

The computation of the basic pension is rather complex. It depends on three terms: the reference wage, the pension rate and a so-called 'proratization' variable. The formula may be simplified as follows:

$$B_B = \tau . w_{ref} . Min\left(1, \frac{d}{150}\right) \qquad (1)$$

where τ is the pension rate, d is the number of quarters of contribution, and w_{ref} is the reference wage.

- Since the major 1993 reform, for people born after 1948, the reference wage w_{ref} is computed as the average gross wage of the 25 best years of the career[3] (the earnings are truncated to the social security ceiling that prevailed that given year and then reevaluated[4]).

- The pension rate τ has a maximum value of 50% (*'full rate'*) that is automatically reached when people retire at 65. Nonetheless, one can retire from 60. In this case, τ equals 50% only if the total number of contributing quarters is greater than 160 (for people born after 1942). Otherwise it decreases by 1.25% for each quarter missing to reach either the age of 65 or 160 contributing quarters. If a person retires at age *a* (in quarters) after *d* contributing quarters τ writes:

$$\tau = 0.5 - 0.0125\ Max\left[0, Min(260 - a, 160 - d)\right]$$

  This rule implies strong penalties for people claiming SS benefits before the full rate. Their amount ranges from 10% to 12,5% per year missing depending on the length of the contribution period. This level of penalty is one the highest among the SS pension systems around the world (Gruber-Wise 1997). *A contrario* the system provides no accrual rate in basic pensions if retirement occurs beyond the full rate.

[3] For people born between 1934 and 1948, the number of years on which the reference wage is computed is progressively increased from 10 to 25 (one year per generation).
[4] In 2000, the monthly SS ceiling amounted to FF 14 700 - about 2240 Euros. The 25 best wages entering the computation of the reference wage are reevaluated using a consumption price index.

- The last term in (1) states that the amount of pensions is cut by about 0.7% for each quarter missing to reach the contribution period of 150 quarters.

Complementary pensions

Beside the basic pension benefit, two mandatory complementary systems exist for wage earners in private firms: the ARRCO regime that applies to everybody and the AGIRC regime exclusively for executives. Non executive workers pay contributions to the ARRCO on their whole wage. Executives pay contributions to the ARRCO on the part of the wage below the social security ceiling, and to the AGIRC on the part of the wage above the ceiling.

In the microsimulation model, the school leaving age is the only proxy for the occupational status. Therefore, one cannot separate executives from non executives. We thus assume in the model that every person that earns more than the ceiling is an executive and pays contributions to the AGIRC on the fraction of the wage above the ceiling.

People receive each year a number of units ('*points*') proportional to their contributions ; the amount of their complementary benefit equals:

$$B_c = N_p . v_p \quad ,$$

where N_p is the total number of units they have accumulated since the beginning of their career and v_p is the current value of the unit ('*valeur du point*'). This value roughly follows the consumption price index. Both systems (ARRCO and AGIRC) are financed through pay-as-you-go mechanisms. People may enjoy complementary old-age pensions before being entitled to the full rate of 50 % for basic pensions: in that case they get a downward adjustment that cuts their pension by 4% for each missing year.

2. The modelling of the retirement decision

2.1. The choice to retire: theoretical background

In order to model the retirement decision, an assumption has to be made on the functioning of the labour market. Most existing models rely on the assumption that the retirement is an individual choice based on the comparison over the life cycle of the gains to retire at different dates. This supply side approach implicitly assumes that the individual choice is not constrained by firms' demand on the labour market. In low unemployment countries like the United States, this assumption may not seem too restrictive. It is certainly more in many European countries.

There exists a wide range of models of the retirement decision that mainly differ in the treatment of consumption over time and the specification of individual expectations about mortality risk and earnings uncertainty. One first class of models relies on utility-maximizing behaviour under non linear lifetime budget constraint (Burtless (1986)). It assumes that individuals jointly determine the optimal age of retirement and consumption path. This approach rests on the restrictive assumption that individuals have a perfect information on their future earnings and social security entitlements. It thus makes no allowance for updating of information about future opportunities as the individual ages.

Another line of research relaxes the assumption of perfect foresight on future income flows. It allows an updating of the decision to retire to account for unexpected changes in variables such as annual earnings (Stock-Wise 1990 ; Rust-Phelan 1997). Conversely, given the burdensome computational requirements of such models, consumption equals income for each period. This no-saving assumption may be more restrictive for individuals on high earnings.

The common limit of these models is to assume that the individual is the appropriate unit of analysis for modelling the retirement decision. The withdrawal from the labour market should be indeed analyzed at the household level. The decision to claim SS benefits is likely to be strongly related to the spouse's occupational situation and income. This is particularly true for housewives. However, including the spouse as a second decision-maker requires additional information on the spouse's employment status and earnings which increases the computational burden in an exponential way. Hence empirical studies generally restrict to the retirement behaviour of male heads of household or at best focus on both male and female from an individual point of view.

2.2. The retirement decision in the microsimulation model Destinie

A supply-side approach may seem restrictive in the French institutional context. It is well known for example that employers are allowed to breach the labour contract as soon as their employee is eligible to the full rate. Given the current employment context -and the relatively large wage gap between elder and younger workers- it is quite likely that firms will make a large use of this possibility[5]. This opportunity raises some doubt on the ability of a wage earner to work today above the full rate even if he has a low valuation of leisure. As a consequence, the observed spike of retirement at the age of the full rate may be interpreted as demand-side as much as supply-side effects. Nonetheless, since the scope of our model is the long run, it seems appropriate to select a supply side approach in the line of Stock and Wise (1990)[6].

As it is commonly done in retirement models, the individual level will be privileged here. Such an assumption is clearly not sustainable for non-working people (mainly housewives) whose decision to claim SS benefits is in principle highly dependent on the spouse status. However, since we want to focus on people moving directly from work to retirement, the scope of our analysis will be restricted to individuals who are still on the labour market at 59. We thus assume that people decide simultaneously to withdraw from the labour market and to claim old-age pensions[7].

The basic idea of the model is that the decision to retire depends on a trade-off between the utility workers can expect if they retire now and the one they can get if they defer their

[5] There is no statistical information on the scope of constrained withdrawals from the labour force at the full rate age.
[6] Such an assumption is consistent with the fact that the expected decline of the working population from 2010 may lead to a change in firms behaviour towards older workers as well as a reduction in pre-retirement programmes.
[7] Today, this choice is open to less than 40% of workers : in 2001, the employment rate at 59 is 39%. Older workers in unemployment or pre-retirement programmes at the end of their working life are de facto excluded from our sample.

withdrawal[8]. Working for an additional year has three main consequences: first, a welfare loss due to work penibility or lower leisure; second, an instantaneous financial gain since the wage is higher than the old-age pension; third, a deferred financial gain related to the increase in pension rights as long as as the individual continues working.

Pension rules influence the decision to retire through the last two channels. First the pension replacement rate gives the size of the opportunity cost of continuing working. Second, the pension accrual rate as a function of the retirement age determines the increase in social security wealth that can be expected if the individual postpones his withdrawal.

Beyond the financial incentives embedded in pension rules, other parameters influence the decision to retire. The expected earning profile as well as the valuation of leisure play a crucial role in the individual trade-off between income and time. Choices will be also influenced by risk aversion (given the mortality risk, workers may never benefit from their old-age pension if they defer retirement too long), the discount rate and life expectancy.

When there is no uncertainty on preferences, the decision rule is quite straightforward. Let us consider an individual still in the labour force at age *t*. If he retires at age *r*, he can expect a flow of earnings of $(Y_t,...Y_{r-1})$ until retirement and then a flow of old-age pensions $(B_r(r),B_{r+1}(r),...,B_s(r),...)$. It is assumed that this individual derives an indirect utility U_w from his earnings and an indirect utility U_r from old-age benefits. Time discounting occurs at rate β. For an age at retirement equal to *r*, the expected utility at age *t* is therefore:

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

with:

$$U_w(Y_s) = \frac{Y_s^{1-\gamma}}{1-\gamma}$$

$$U_r(B_s) = \frac{\left[kB_s(r)\right]^{1-\gamma}}{1-\gamma}$$

where γ denotes the risk aversion and *k* the preference for leisure. Note that this specification does not consider the possibility of smoothing income through private savings.

Since retirement is irreversible and uncertainty affects most variables of the model (mainly mortality and earnings prospects), postponing retirement by one year allows the individual to base his decision on a larger set of information. However solving a program that incorporates all sources of uncertainty requires dynamic programming techniques that would be excessively time consuming in our microsimulation context. As a consequence, our modelization does not assume any updating of the individual’s expectations. In particular, people expect their wages to remain unchanged in real terms until retirement. These assumptions ignore the value of waiting

[8] The complexity of pension rules in the private sector (in particular the mix of basic and complementary pensions) may raise doubt on the ability of people to have perfect foresight of what they can gain by delaying their retirement decision. However, this does not seem to be such a strong assumption for people very close to the retirement age. When wondering about retirement, most of elder workers benefit from advices of their pension fund regarding their pension rights.

associated with any irreversible decision and therefore should lead to slightly underestimate the optimal age of retirement (Mahieu-Sédillot 2001).

Hence, we assume that the individual decides to retire at date t if the resulting expected utility is higher than the maximum value of utilities expected for all other possible choices *r>t*. If we write

$$G_t(r) = E_t V_t(r) - E_t V_t(t)$$

the individual chooses to work for one additional year if $\exists\, r^* \geq t+1 \;/\; G_t(r^*) > 0$.

At this stage, the only sources of uncertainty are the mortality risk and the wage evolution. We assume that each year for which people consider retirement, they base their decision on the survival probabilities given by the mortality tables by cohort, sex and school leaving age of the year considered. The survival probabilities in 1991 are extrapolated from the INSEE mortality tables by age, sex and socio-professional status for the 1980-1989 period and from the distribution of the school leaving age by socio-professional status derived from the 1991 Financial Assets Survey. For the following years, the mortality tables are extrapolated using the INSEE prospective mortality tables by sex and age as a benchmark. The distributions of the age of death conditional on survival at 55 for the 1945 generation and three values of the school leaving age are depicted in figures 1-2 for men and women.

FIGURE 1:
DISTRIBUTION OF THE AGE OF DEATH CONDITIONAL TO THE SURVIVAL AT 55 FOR MEN AT 14-22-30 SCHOOL LEAVING AGE

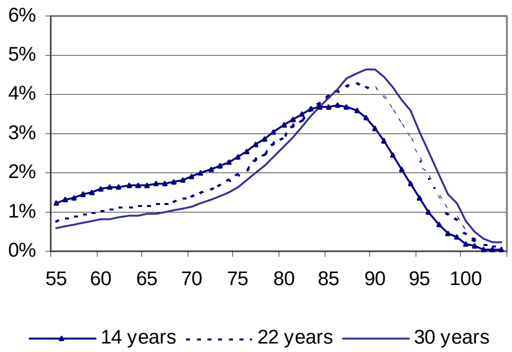
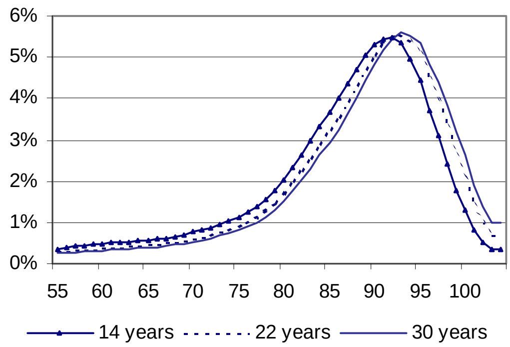


FIGURE 2:
DISTRIBUTION OF THE AGE OF DEATH CONDITIONAL TO THE SURVIVAL AT 55 FOR WOMEN AT 14-22-30 SCHOOL LEAVING AGE



We assume myopic expectations as regards earning profiles: the individual believes that his wage will remain unchanged until retirement. This expectation can be very different from the wage he will actually receive if he continues working given both the deterministic growing trend and the random shocks in our modelling of the wage equation. Our assumptions regarding the preferences parameters are detailzd in the next section.

3. Simulating the retirement decision under current rules

3.1. Calibrating preferences

The parameters of the utility function need to be calibrated in order to simulate the retirement decision. Risk aversion, discount rate or preference for leisure are a *priori*, fairly heterogeneous among the population and may vary over time. Moreover, it is very difficult to have structural estimates of preferences parameters on French data. The only available data source is the *'Echantillon Inter-régimes des Retraités'* from the Ministry of Social Affairs that collects administrative data on old-age pensioners in 1997. This data provides information on the retirement year and the end of the earning profiles (wages perceived since 1985). The beginning of the career needs to be simulated which create a first source of uncertainty. Another difficulty for structural estimations stems from the extreme concentration of retirement at the full rate age, given pension rules incentives. This makes it difficult to perform an accurate and robust estimation of structural parameters of the utility function, notably the preference for leisure. Some estimations on French data of the Stock and Wise model indicate a strong sensitivity of the estimated preference for leisure to the selected sample (Blanchet-Mahieu, 2000). A final source of trouble is that the estimated parameters may not provide a good measure of individual preferences if observed behaviours are partly constrained by labour-maket conditions.

Given these difficulties, we calibrated preferences in order to roughly replicate the strong accumulation on the full rate under current rules. However, our purpose was not to adjust perfectly the share of people claiming SS benefits at the full rate to the one observed for the 1930 cohort. As was mentioned earlier, part of this accumulation may reflect demand side effects not considered in the model. Risk aversion γ and time discounting β were fixed to $\gamma = 0.95$ and $\beta = 0.97$. This implies a moderate risk aversion and 3% time discounting. These values are broadly consistent with the Blanchet-Mahieu estimation on French data (Blanchet-mahieu 2000).

We allowed some heterogeneity in the preference for leisure. More precisely, the preference for leisure *k* is supposed to be heterogeneous in the population but not affected by shocks over time. *k* is randomly distributed in the population with a mean value equal to 3 and a standard error of the random residual σ equal to 0.2. We also explored the case where the preference for leisure randomly varies over time. This is more complicated to implement and did not yield a more satisfactory adjustment to actual behaviours.

To understand what means such a *k* value, let us consider an individual expecting to live 20 years with probability 1 and whose pension is increased by 10% for each additional year of work (which corresponds approximatively to the current penalties in the *Régime Général*). Under our assumption of 3% time discounting, this individual will decide to withdraw immediately from the labour market only if his replacement rate is greater than 144% (see appendix 2 for a derivation of the replacement rate required for immediate withdrawal).

In all simulations, we state that the age of retirement cannot exceed 65. This assumption is consistent with current behaviours displaying participation rates above 65 close to zero. However this may result from SS incentives (Gruber-Wise, 1997) as well as demand-side effects on the labour market. Fixing 65 as an upper bound for retirement may be less valid if the situation on the labour market improves or if new pensions rules were implemented.

3.2. The retirement decision under current rules

The simulations of the retirement decision were performed for people born between 1945 and 1954 and still employed at 59. We focused on these generations because they are the first ones on which the requirement of a contribution period of 40 years to get the full rate fully applies.

The simulated proportion of individuals retiring at the full rate is high: more than 60% of wage earners claim SS benefits when they reach the full rate (figure 3)[9]. Our simulation generates a relatively high number of people retiring just one year after the full rate (19%): most of them already had 40 years of contributions at 60 and chose to retire at 61 following a negative shock on their wage. Hence, the distribution of the retirement age displays a peak at 60 but also a relatively high share of people quitting at 61.

To assess the sensitivity of our results to the value of the preference for leisure, we simulated the distribution of the retirement age under the assumption k=2. Such a value corresponds to quite a higher critical replacement rate: 216% instead of 144% for the illustrative example given above. The lower value of the preference for leisure implies that people stay longer on the labour market. This value clearly does not fit the data as well as before: too many persons decide to claim SS benefits after the full rate (figure 4).

FIGURE 3:
SHARE OF INDIVIDUALS RETIRING
BELOW/AT/ABOVE THE FULL RATE

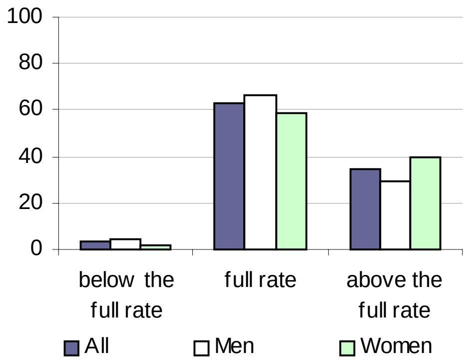
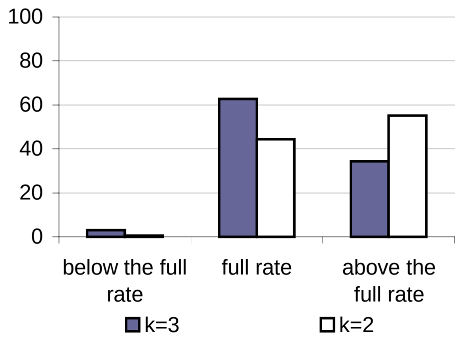


FIGURE 4:
SHARE OF INDIVIDUALS RETIRING
BELOW/AT/ABOVE THE FULL RATE: K=2/K=3



4. Simulating pension reforms

The growing concern on the consequences of aging on the financing of pensions leads to consider reforms with more incentives to work longer. In this prospect, the constraints embedded in pension schemes on the retirement choice may be alleviated.

[9] However this share remains 20 points lower than the one observed in administrative data for the 1930 cohort (figure 3).

Several reforms could encourage workers to remain longer on the labour market : significant accrual in old-age pensions if workers continue to work after they reach the full rate; lengthening of the requested contribution period to get the full rate ; combination of these two reforms.

To illustrate the effects of pension rules reforms on participation behaviour, three types of reforms are successively investigated.

1. Implementing more flexible pension schemes

Basic features of the new pension scheme

In order to give more weight to individual preferences, a first reform *('40 years with more flexibility')* assumes that the penalties associated with early withdrawal are lowered while a positive pension accrual rate is introduced for people working after the full rate age. More precisely:

- the cut in the basic pension for each quarter missing to reach the full rate is reduced from 1.25% to 0.6%
- the length of contribution period in the 'proratization' term is increased from 150 to 160
- the basic pension is increased by 0.3% for each quarter of contribution above 160 quarters after the age of 60. As will be discussed below, this scheme aims at partly neutralizing the income effect that would derive from the increase in the replacement rate for long careers workers if a bonus was given on each quarters of contribution above 160. Indeed, with this reform, a worker retiring currently at 60 with 41 years of contribution would face no increment in his old-age pension if he does not change his retirement age ; conversely, his SS benefit would increase by 2,4%, for one additional year of work (he would then retire at 61). To be effective this reform requires that employers are no longer allowed to breach the labour contract when the worker reaches the full rate[10].

The new formula that determines the level of pension writes:

$$B_B = \tau . w_{ref} . Min\left(1, \frac{d}{160}\right)$$

where the pension rate is

$$\tau = 0.5 - 0.006 Max[0, Min(260 - a, 160 - d)] + 0.003 Max[0, Min(d - 160, a - 240)]$$

with *a* the retirement age (in quarters) and *d* the contributing quarters.

[10] Note that the new pension accrual rate remains lower on average than a pure actuarial adjustment: the increase in the level of pension does not balance the gain induced by the lower length of pension coverage.

Expected effects of more flexible pension schemes on retirement decisions

The lowering of the penalties associated to early withdrawal reduces the opportunity cost of leisure (the decrease in the replacement rate if the individual claims SS benefits before the full rate is lower). This decrease in the relative price of leisure provides a strong incentive to quit earlier ('substitution effect'). An 'income effect' may strengthen this former effect: wage earners who previously claimed SS benefits below the full rate enjoy a higher level of pension if their behaviour remains unchanged. The combination of these two effects leads to an unambiguous prediction of earlier retirement.

Conversely, allowing pensions to increase above the full rate has more uncertain effects. On the one hand, the substitution effect increases the value of waiting (the opportunity cost of leisure is higher); on the other hand, wage earners who previously claimed SS benefits above the full rate enjoy a higher level of pension if their retirement age remains unchanged, which increases the demand for leisure. If an increase in the level of pension was granted for all the contributing years over 40, this latter effect would be rather important for generations entered early on the labour market. Truncating the bonus to the sole periods worked after 60 helps to partially neutralize the income effect.

2. Increasing the contribution period required to get the full rate pension

The previous reform aims at alleviating the constraints on the age of retirement embedded in current rules but is not expected to generate huge financial gains for the regimes. Other reforms may tackle the future expected financial imbalances due to aging by increasing the contribution period requested to get the full rate of pension. Two types of reforms are investigated. The first one simulates the effect of a 3-year lengthening in the contribution period necessary to get the full rate: 43 years instead of 40 ('*43 years' reform*). A second reform combines this 3-year lengthening with the implementation of a more flexible pension scheme in the line of the first reform (*'43 years with more flexibility' reform*).

- ***The '43 years' reform***

In this reform, the requested contribution period for reaching the full rate in the General Regime is lengthened to 43 years instead to 40 and the contribution period in the proratization term is increased from 150 to 172.

- ***The '43 years with more flexibility' reform***

Beside the *'43 years'* reform, the penalty associated with early withdrawal is reduced from 1,25% to 0,6% for each quarter missing to reach the full rate and the basic pension is increased by 0.3% for each quarter of contribution above 160 quarters after the age of 60.

The formulas that determine the level of pension is:

$$B_B = \tau.w_{ref}.Min\left(1, \frac{d}{172}\right)$$

where in the first case: $\tau = 0.5 - 0.0125 Max[0, Min(260 - a, 172 - d)]$

in the second case:

$$\tau = 0.5 - 0.006 Max[0, Min(260 - a, 172 - d)] + 0.003 Max[0, Min(d - 172, a - 240)]$$

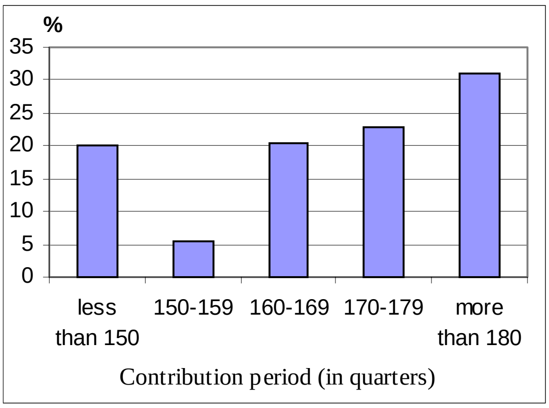
where *a* is the retirement age (in quarters) and *d* the contribution quarters.

The impact of these reforms is simulated on a sample of individuals born between 1945 et 1954[11] and still in the labour force at 59. We assume that people willing to work longer can find a job. We thus deliberately ignore the current difficulties faced by workers at the end of their working life.

Effect of the 3 reforms on the age of retirement

The results of the 3 reforms are the following. The *'40 years with more flexibility'* reform leads to a significant increase in the participation rate. Most of the workers in the sample have a contribution period long enough at 60 to benefit from the pension accrual if they decide to work over 60 : 76 % have contributed at least 40 years at 60[12] (figure 5). Indeed, 32 % workers postpone their retirement, following the reform (figure 6). Very few individuals choose to claim their old-age pension earlier than before (less than 3% of the sample). Between 60 and 65, participation rates they are 10 to 16 points higher (figure 7). The average age of retirement is delayed by 8 months. On the whole, this reform leads to a greater dispersion of the retirement age (figure 8).

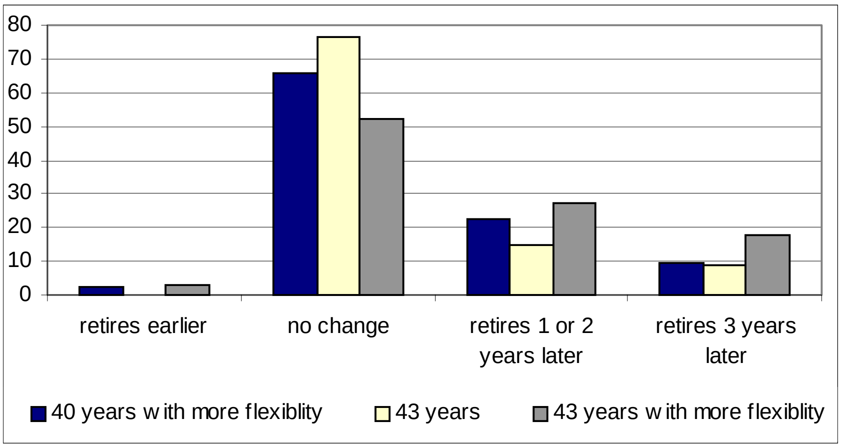
FIGURE 5 :
DISTRIBUTION OF THE CONTRIBUTION PERIOD AT 60*
(including the bonuses for children)



Source : Destinie microsimulation, Insee
**Private sector workers born in 1945-1954 still employed at 59*

[11] We ignore here the pratical implementation of such reforms that would require a precise calendar. For instance, the Charpin report suggested a progressive increase in the length of the contribution period, the target of 42.5 years being reached for generations born after 1959.
[12] Since we focus on individuals still employed at 59, the spell of working life est longer than what would be observed for the population as a whole. In particular, women who stopped working early are ignored.

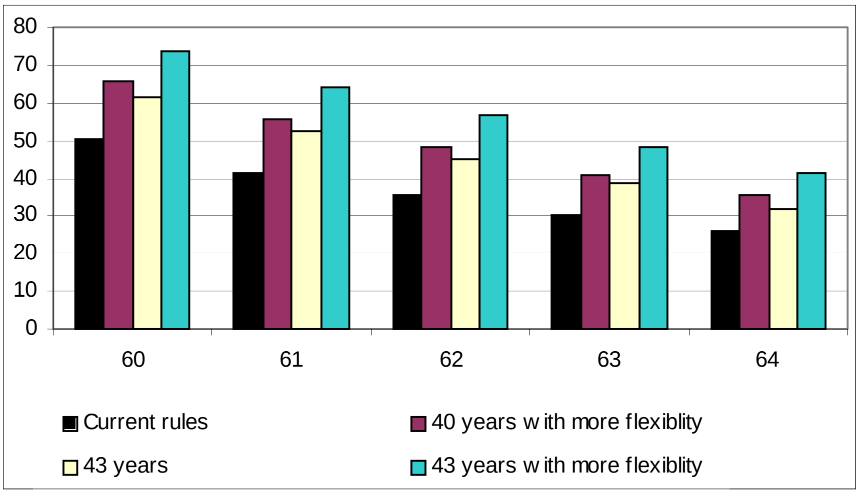
FIGURE 6 :
CHANGE IN THE RETIREMENT DECISION FOLLOWING THE REFORMS



Source : Destinie microsimulation, Insee

The 3-year increase in the period of contribution required to get the full rate *('43 years' reform)* is primarily targeted towards workers reaching 40 years of contribution between 60 and 62. This reform has no effect on retirement decision of workers with very long or short carrers. For short carreers, 65 remains after like before the reform the age of retirement necessary to get the full pension. For very long carrers[13] (at least 43 years of contribution at 60), the reform does not affect the replacement rate if the retirement age remains unchanged. Given the distribution of the contribution period in the sample (figure 5), the '43 reform' concerns only a small proportion of workers : 77 % do not change their retirement behaviour (figure 6). The increase in the participation rates following the reform is significant but not huge: participation rates are 6 to 12 points higher in the 60-65 age group (figure 7). The average age of retirement is increased by 7 months.

FIGURE 7 :
EFFECT OF THE 3 REFORMS ON PARTICIPATION RATES
(as a pourcentage of the population)

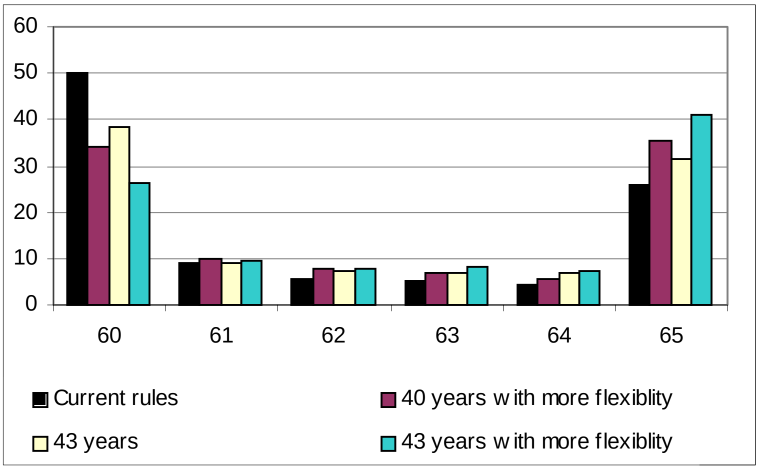


Source : Destinie microsimulation, Insee

[13] or for women with long careers and several children

Introducing more flexibility around the 43 years target of contribution period *('43 years with more flexibility' reform)* has a stronger effect on the participation rate after 60 : 73 % of workers choose to remain in employment at 60 after the reform. The number of individuals that pospone their retirement is twice as large as with the previous reform (figure 6). Following the reform, the average age of retirement is one year higher that what would prevail with current rules.

FIGURE 8 :
DISTRIBUTION OF THE AGE OF RETIREMENT



Source : Destinie microsimulation, Insee

Concluding remarks

According to our simulations, implementing more actuarially adjusted pension schemes or increasing the contribution period necessary to get a full rate pensoin would encourage workers to delay their age of retirement. However, the average impact remains limited as long as the 60-65 age constraint keeps on binding.

The simulations apply to a sample of private sector workers born between 1945 and 1954 and still employed at 59. These workers began their working life early and most of them have more than the 40 years target of contribution period at 60. The effect of the reforms could be slightly different on younger generations. Given the gradual lengthening of schooling and the difficulties faced by young people to enter the labour market, men born after 1955 should have, on average, fewer years of contribution at 60. For women, the average period of contributions at 60 should continue to increase, allowing a generalization of female participation. For future generations, short careers and very long careers should be less frequent. This evolution should reduce the impact of the first reform. On the opposite, a 3-year increase in the contribution period necessary to get the full rate of pension could have stronger effects.

Of course, the simulated effects remain sensitive to the value of the preference parameters, in particular the valuation for leisure on which very few information is currently avalaible. The preference for leisure reflects individual tastes but may also be influenced by labour-market conditions that can change over time (a high risk of unemployment or bad working conditions makes early withdrawal more attractive).

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Appendix 1 :

The dynamic microsimulation model Destinie: a brief overview

This appendix gives a brief overview of the structure and of the main assumptions of the microsimulation model Destinie. A more detailed description can be found in the INSEE working paper (Insee 1999).

The main purpose of the model is to simulate the evolution of old-age pensions in the long run accounting for the heterogeneity of careers and the change in the demographic structure. The model is based on individual data derived from the 1991 Financial Assets Survey. The initial sample is composed of 15,000 households i.e. about 37,000 individuals. Each person is characterized by demographic and economic information such as age, income (wages, pensions...), relatives, labour participation. In order to follow this population year by year from 1992 to 2040, different kinds of events are simulated:

- A demographic module simulates events like death, birth, immigration, departure from parents' home, marriage (this step requires a matching process), divorce.

- A labour market submodule provides information on the age at which people leave school and on transitions on the labour market.

The school leaving age is one of the main variables of the model. It sums up all the heterogeneity in term of social status, socioprofessional group and qualification. The individual school leaving age is related not only to the average one of his cohort but also to his father's and mother's. This latter assumption accounts for some kind of 'social replication'.

To model transitions on the labour market, six states are distinguished: employment, unemployment, school, inactivity (mainly housewives), early retirement and retirement. The labour market module is organized in two stages. The first one simulates the participation whereas the second determines if a participating individual is employed or unemployed. Transition probabilities are estimated on the 1991 Employment Survey. The probabilities are treated as a first-order Markovian process and depend on sex, age, school leaving age, and, for women, the number and the age of children. For each person who is no longer in school and not yet retired, the model randomly determines, given his transition probabilities, whether his labour force status changes. The parameters of the transition equations are adjusted to account for the increasing labour force participation of women and to allow for changes in the macroeconomic environment. Two levels of unemployment rate are considered in the long run: 9 % ('base case') and 6 % in 2020.

- The income submodule allows us to simulate wages and pensions.

  The annual wage is the sum of a deterministic component and a stochastic one. The first one is econometrically adjusted, for each sex, to the school leaving age and the total tenure on the labour market. The stochastic component includes an individual fixed effect and an autocorrelated residual. In the central scenario, the career mobility is close from the one observed in mid-eighties. Given the regular increase in the school leaving age, the wage equations induce an increase by about 1 % per year in individual wages. To allow for productivity gains related to technical progress, we add an additional 1 % increase each year. Hence, individual wages annually grow by 2 % in average with a growth slightly smaller at the end of the period.

In the model, all unemployed (respectively early retired) persons receive unemployment (respectively early retirement) benefits. Once a person retires, his pension benefit is indexed on price inflation. The model also simulates survivor pension benefits and the old age minimum benefit (*minimum vieillesse*).

Appendix 2: Preference for leisure and replacement rate

Let us consider an individual who may retire at *t* or at any later period. Her wage is assumed not to change over time. Besides, he will enjoy an *x*%-year increase in his SS benefits if he chooses to postpone retirement.

Let $V(s)$ be the intertemporal utility derived from retirement at *s* ($s \geq t$).

$$V(s) = \sum_{i=t}^{s-1} \beta^{i-t} p_t(i) \frac{w^{1-\gamma}}{1-\gamma} + \sum_{i=s}^{T} \beta^{i-t} p_t(i) \frac{\left[kB(1+x)^{s-t}\right]^{1-\gamma}}{1-\gamma}$$

where $p_t(i)$ is the survival probability at i conditional to survival at t, B the pension benefits if he retires at t, *k* the preference for leisure, γ the constant relative risk aversion and β the time discounting factor.

The additional utility the individual gets if he retires at s instead of t writes:

$$V(s) - V(t) = \sum_{i=t}^{s-1} \beta^{i-t} p_t(i) \frac{w^{1-\gamma}}{1-\gamma} + \sum_{i=s}^{T} \beta^{i-t} p_t(i) \frac{\left[kB(1+x)^{s-t}\right]^{1-\gamma}}{1-\gamma} - \sum_{i=t}^{T} \beta^{i-t} p_t(i) \frac{[kB]^{1-\gamma}}{1-\gamma}$$

For small values of *x*, a first-order development in x leads to:

$$V(s) - V(t) \underset{x \to 0}{\cong} \frac{w^{1-\gamma}}{1-\gamma}\left[\sum_{i=t}^{s-1} \beta^{i-t} p_t(i)\right] + \frac{[kB]^{1-\gamma}}{1-\gamma}\left[\sum_{i=s}^{T} \beta^{i-t} p_t(i)\big(1+(1-\gamma)(s-t)x\big) - \sum_{i=t}^{T} \beta^{i-t} p_t(i)\right]$$

$$V(s) - V(t) \underset{x \to 0}{\cong} \frac{w^{1-\gamma}}{1-\gamma}\left[\sum_{i=t}^{s-1} \beta^{i-t} p_t(i)\right] + \frac{[kB]^{1-\gamma}}{1-\gamma}\left[(1-\gamma)(s-t)x\sum_{i=s}^{T} \beta^{i-t} p_t(i) - \sum_{i=t}^{s-1} \beta^{i-t} p_t(i)\right]$$

The individual does not retire immediately if there exists at least one period s such that he can expect a greater utility by delaying his departure until s ($s \geq t$). This writes:

$$V(s) - V(t) \geq 0 \Leftrightarrow \frac{[kB]^{1-\gamma}}{1-\gamma}\left[\sum_{i=t}^{s-1} \beta^{i-t} p_t(i) - (1-\gamma)(s-t)x\sum_{i=s}^{T} \beta^{i-t} p_t(i)\right] \underset{x \to 0}{\leq} \frac{w^{1-\gamma}}{1-\gamma}\left[\sum_{i=t}^{s-1} \beta^{i-t} p_t(i)\right]$$

,

For small values of x, a second first-order development in *x* leads to:

$$V(s)-V(t)\geq 0 \Leftrightarrow \frac{B}{w} \underset{x\to 0}{\leq} \frac{1}{k}\left[1+(s-t)x\frac{\sum_{i=s}^{T}\beta^{i-t}p_t(i)}{\sum_{i=t}^{s-1}\beta^{i-t}p_t(i)}\right]$$

which yields a critical value for the replacement rate:

$$\frac{\hat{B}}{w} \underset{x\to 0}{\cong} \underset{s\geq t+1}{Max}\left(\frac{1}{k}\left[1+(s-t)x\frac{\sum_{i=s}^{T}\beta^{i-t}p_t(i)}{\sum_{i=t}^{s-1}\beta^{i-t}p_t(i)}\right]\right)$$

If the replacement rate (in case of immediate retirement) exceeds this critical value, the individual retires immediately ; otherwise he continues working.

If the individual dies at T with probability 1 and if he does not discount time, the formula is straightforward for small values of x:

$$\frac{\hat{B}}{w} \underset{x\to 0}{\cong} \underset{s\geq t+1}{Max}\left(\frac{1}{k}\left[1+(T-s+1)x\right]\right)=\frac{1}{k}\left[1+(T-t)x\right] \quad (1)$$

The results are rather intuitive:

- The critical value for the replacement rate rises with *x*, which corresponds to the increase in pension the individual may expect if he postpones retirement. The value of waiting is higher if *x* is large.
- The value of waiting is lower if the individual has a shorter life expectancy: the increase in pension will benefit for a shorter time. He will thus be less willing to delay his retirement for a given x (the critical replacement rate is lower).
- The individual will request a lower replacement rate to quit the labour market if his preference for leisure is high

The table below provides some estimates of the critical replacement rate at 60 for different values of *k* and *x,* under the assumption that the individual dies at 80, $\gamma = 0.95$ and $\beta = 0.97$ (for x=5% and x=10%, the first-order approximations are no longer valid and the critical replacement rate is simulated).

T=80	x=0%	x=5%	x=10%
k=2	50%	105%	216%
k=3	33%	70%	144%
k=4	25%	53%	108%