Does Increasing Contribution Length lead to Higher Retirement Age ? Evidence from the 1993 French Pension Reform[*]

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Abstract

This paper offers the first *ex post* evaluation of the incentive effects of the 1993 French pension reform. This private sector reform was meant both to reduce replacement rates and to increase retirement age. In order to induce later retirement, the government increased the number of quarters of contribution necessary to obtain a full rate pension from 150 to 160 quarters. We use both the Echantillon Interrégime des Retraités (EIR 2001) and the exhaustive administrative data from the CNAV (1994-2003) in order to estimate the elasticity of retirement age to the length of contribution necessary to obtain the full rate. We take advantage of the fact that different groups were affected differently by the reform (depending both on birth year and contribution length at age 60) in order to identify precisely the behavioral impact of changing incentives, using a difference-in-difference approach. We find that one additional quarter of necessary contribution led to an average increase of 2 months in retirement age, corresponding to an elasticity of 0.7. This fairly high response of French workers should be put in perspective with the high level of penalty associated with early retirement in the French pay-as-you-go scheme. In light of this high penalty, most authors in the literature assumed that the elasticity of retirement age should be equal to 1. Moreover we show that, when possible, workers used other possibilities to leave at 60 either by making efforts in producing evidence of longer carriers (thereby "manipulating" their contribution length at age 60) or by more often asking for a disability pension. The net impact of the 1993 reform should therefore be significant but lower than so far expected, with an elasticity around 0.5-0.7. These behavioral parameters suggest that the impact of the 2003 reform (which further extends the full-rate contribution period) on retirement age will be lower than official predictions. (*JEL* H55, J26)

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1 Introduction

One key issue in pension reform debates is the labor supply elasticity of old-age workers. To what extent are old-age workers able or willing to work longer careers as full-rate retirement age and marginal incentives to work increase ? In this paper, we estimate this parameter using the 1993 French pension reform as a natural experiment and draw implications for the likely impact of ongoing reforms.

To face the now approaching demographic shock (the baby boomers are expected to start re-tiring in 2005 and life expectancy increases currently at a rate of a quarter a year), governments have only three ways to secure the solvency of the public pension schemes:[1] lower pensions levels, increase contribution rates, increase retirement age. The 1993 pension reform, which was imple-mented by Edouard Balladur's government, is the first reform in France aiming at restricting the conditions to get a full rate pension. It was designed first to reduce the amount of pensions, by increasing the spell taken into account to compute the reference wage (from the best 10 years to the best 25 years). But it was also supposed to give incentives to delay retirement, by increasing the length of contribution necessary to get the full rate (from 150 to 160 quarters, ie from 37.5 to 40 years).

The fiercest opponents to the 1993 reform (and to the 2003 one) have put forward the possible contradiction between leading workers to retire later while there is still large unemployment and while the post-55 years old job market is almost non existent. More precisely some of them have predicted that the low labor demand at older age would lead the reform to have no net effect: workers would just remain longer in unemployment or in early retirement schemes. Another argument was that most workers were unable to work past 60 and would be physically forced to leave at 60 with a lower pension. As a result, they stressed that increasing contribution length would just lead to lower pension and not to a higher retirement age. So in the current debate, still raging with the 2003 reform, accurate estimates of behavioral parameters are key elements. It will definitely help predict the actual impact of current and future reforms and give clearer directions for the public debate concerning the choices that still have to be made.[2]

As regards the academic debate, this reform is a great opportunity to confirm or invalidate results concerning the impact of Social Security on labor force participation that have been largely discussed. Our goal is not to do here a survey of a very large literature as it has already been done brilliantly[3] but to remind the reader of the elements prone to discussion. To summarize this literature, studies with cross-sectional data (Gruber and Wise (2004), Johnson (2000) and Duval (2003)) show a strong correlation between the development of Social Security programs and the decrease in labor force participation at older age. Conversely, studies on panel data that use exogenous changes in Social Security wealth show very little or no impact of Social Security on labor force participation (Krueger and Pischke (1992), Costa (1998), Baker and Benjamin (1999)) and they stress alternative explanations like the secular increase in income, the development of a society based on leisure, or the low labor demand at older age. Baker and Benjamin (1999)

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[1] In a rare show of consensus all government reports since the nineties have agreed on this "triangle of solutions". See The White Book of Pension (1991), Charpin report (1999) and the report of the newly created Pensions Advisory Council - Conseil d'Orientation des Retraites (2002).

[2] The 2003 reform leaves two-third of the financial gap for the next reforms. The estimate of this gap is also clearly dependent on the labor supply elasticity.

[3] See Lumsdaine and Mitchell (1999), Bommier, Magnac and Roger (2001), Krueger and Meyer (2002).

underline the differentiated impact that reforms can have on the retirement age and on the labor market. They thus show that the introduction of early retirement in Canada has had a considerable impact on the retirement age but almost none on the labor market: the individuals who retired earlier would otherwise have had limited labor participation. The true variable of interest for the economist, as well as for the decision-maker, is the elasticity of labor supply (and labor demand) to the incentives of Social Security. This literature had rightly stressed the fundamental problem of identification of the true impact of Social Security when all the reforms (which consisted, in the seventies and eighties, in expanding the generosity of Social Security) were collinear with the secular trend of increasing income and leisure time (Krueger & Pischke 1992). Worse, the pension reforms of the time had all chances to be endogenous: with higher income, voters would push to expand the generosity of the pension system, as they wanted, in all cases, to retire earlier. Another identification problem underlined by Krueger and Pischke is the fact that the Social Security benefits are a non-linear function of past earnings and retirement behavior is likely to be correlated with past earnings, thereby creating simultaneity issue difficult to disentangle. The reforms that have tended to restrict access to pension programs are still quite recent and few studies have had enough retrospect to take advantage of those legal changes opposite the secular trend. Krueger and Pischke (1992) provided an evaluation of the Social Security Notch[4] but showed no reversal in the decline of labor supply while others (Snyder & Evans 2002) have suggested that this natural experiment could have led to increased post-retirement work. Johnson (2000) put forward the case of New-Zealand to show that the recent reform led to a significant increase in labor force participation at older age.

Concerning the 1993 French pension reform, there has been, to this date, no *ex post* empirical study. The only papers that are available are microsimulation studies developed around the model DESTINIE (INSEE 1999). In the first versions (Pelé & Ralle 1997, Pelé & Ralle 1999), simulations are conducted with the assumption of a unitary elasticity.[5] They stress therefore that only a fraction of the French workers are affected by the 1993 reform and that more will be as new cohorts begin to retire.[6]

Recent simulations (Mahieu and Sedillot (2000), Bardaji, Sedillot and Walraet (2002, 2004)) adopt a more sophisticated approach by assuming that people choose their retirement age following a Stock and Wise (1990) model : they choose the date that maximizes expected utility of income and pension benefits in function of their own preferences (preference for leisure, risk aversion and preference for the present). To calibrate preferences in the model, the authors use the parameters that can best replicate current behaviors of retirement. These micro-simulations must use as inputs hypothesis concerning behavioral preferences. The authors of the model are well aware of the reliance of their results on the quality of previous studies. Until now, the best estimate of preferences of French individuals concerning retirement comes from the study of Mahieu and Blanchet (2001, 2004) who estimated an option value model following Stock and Wise (1990). They remained, however, cautious about the robustness of their results as they had data on only one generation (the 1930 cohort). Their estimates are dependent on the low variations within a

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[4]The 1977 amendments to the Social Security Act in the United-States created a substantial reduction (10 %) in Social Security wealth for individual born after 1916.

[5]Individuals retire from labor force as soon as they get the "full rate", so any increase in the length of contribution results automatically in the same increase of the retirement age.

[6]Recent cohort have started their career later due to increased schooling and are more likely to be affected by an increase in the required length of contribution.

generation that are the results of the strength of current incentives. In particular, they have no data allowing them to use the changes of behaviors introduced by the 1993 reform.

One last study is worth to mention (Hairault, Langot & Sopraseuth 2003) which models retirement decision including saving behavior. Although they offer a very sophisticated model of retirement decision, ultimately they calibrate their model using preference parameters that are not related to the retirement decision.[7]

Our goal, in this paper, is to use the variations introduced by the 1993 reform to identify more precisely the incentives of the French pension system and to estimate *ex post* the impact of the 1993 reform on the retirement age. Our identification strategy relies on the progressive implementation of the reform which creates many control groups not affected by the reform. The interaction between the generation and the length of the career at 60 identifies perfectly the impact of the reform on the retirement age. We find that one additional quarter of necessary contribution led to an increase of 2 months of the age of retirement, corresponding to an elasticity of 0.7. Moreover we show that, when possible, workers used other possibilities to retire at 60 either by making efforts in producing evidence of longer carriers (thereby "manipulating" their contribution length at age 60) or by more often asking for a disability pension. The net impact of the 1993 reform should therefore be much lower, around 0.5 and 0.7, than so far expected.

This paper offers one of the first estimate of the elasticity of labor supply relative to the key parameter of length of contribution. It confirms for the first time with micro data the strong correlation between Social Security parameters and labor force participation displayed with cross-country data. However our results underline also the fact that a large minority of the population prefers, even with high penalty, to leave early the labor force.

We will first recall the features of the 1993 pension reform (section 2) and offer some suggestive graphical evidence of the likely impact of the reform (section 3). We shall then describe our identification strategy (section 4) and present afterwards the empirical estimates in section 5. The net impact of the 1993 French pension reform will then be assessed in section 6. Section 7 concludes.

2   The 1993 French pension reform

The French pension system is quite complex and is characterized by numerous schemes with different ways of computing pensions.[8] To simplify, one has to make a distinction between the self-employed who have their own scheme, the civil-servants whose pensions are paid by the state budget, the workers in special public services (train, subway, electricity...) who benefit from special and very generous schemes and finally the majority of wage earners in the private sector (68 % of French workers in 2002) who contribute to the *régime général* and receive pensions from the Caisse Nationale d'Assurance Vieillesse (CNAV). The 1993 reform aimed only at the *régime général*.[9] Beside these basic pension schemes, there is a second pillar which consists in mandatory

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[7]They use general estimates of the leisure preference available in the literature.

[8]See Blanchet and Pelé (1999), Dupuis and El Moudden (2002) and Bozio (2004) for an history of the legal changes of French Social Security, unemployment programs for older workers and early retirement programs.

[9]To be more precise, one has to note that besides the *régime général* of the CNAV, the wage earners of the agricultural sector (MSA), the self-employed of industry and trade (ORGANIC) and the craftsmen (CANCAVA) were also affected by the 1993 reform. These specific schemes joined the *régime général* in 1973 and 1974 and follow the same rules for the contributions paid after 1973.

complementary schemes: for the private sector, ARRCO and AGIRC (for non-executives and executives) are financed in a pay-as-you-go way. They were affected by the reform as the full rate in the complementary schemes is conditioned on obtaining the full rate in the basic pension scheme of the CNAV.

Before going into the details of the reform, a brief overview of the previous rules to compute pensions in the *régime général* ought to be helpful.

2.1 Rules before the 1993 reform

The French pension system of the *régime général* dates back to 1945 but the rules prevailing to compute pensions were changed quite a number of times, increasing the complexity of the formula. The two main reforms of the post-WWII era are the 1971 Boulin reform which increased the replacement rate and the 1983 reform which reduced the retirement age from 65 to 60. The basic formula to compute pensions in the *régime général* was nonetheless always based on three terms: τ the pension rate, PC the proportionality coefficient and W_{ref} the reference wage. The level of the pension cannot fall below a floor MIN and is truncated by a ceiling MAX.

$$P = \tau * PC * W_{ref} \tag{1}$$

with $MIN \leq P \leq MAX$

2.1.1 The pension rate τ

The rule defining the pension rate τ is rather complex following the 1983 reform. The only constant rule was to be equal to 0 % before age 60.[10] Between 1946 and 1971, the pension rate was fixed at 20 % at age 60 and was increased by 4 percentage points for each year of contribution after 60 (without limit). Thus, at age 65, τ was 40 % and at age 70 it was 60 %. After 1971, the pension rate at 60 was increased to 25 % and each year after 60 brought 5 percentage points to τ. Thus it was 50 % at age 65 and 75 % at age 70. At that time, it was independent of the length of contribution and only age-related.

The 1983 reform, commonly but inaccurately refereed as the lowering of the legal retirement age from 65 to 60,[11] was in fact a change in the pension rate τ formula. The reform increased the full pension rate at age 60 to 50 % but introduced a required length of contribution and a penalty for each missing quarter of contribution. This penalty was quite high at 10 % for each year of missing contribution (or 5 percentage points) or for each year before the individual reaches age 65. The most advantageous solution for the pensioner is then chosen. The pension rate did not increase anymore once it had reached the full rate of 50 % and everyone had the right to claim it at age 65. We can summarize this rule by the following formula:

$$\tau = 0.50 * \left[1 - \delta * \max \left\{ 0, \min \left[(65 - AGE), \frac{N_1 - D_1}{4} \right] \right\} \right] \tag{2}$$

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[10]This was changed by the 2003 reform which allowed for very long careers early retirement at 56.
[11]One could leave at 60 since 1946, but with a low replacement rate.

with δ the penalty, fixed at 10 % as soon as 1971,[12] N_1 the "necessary length of contribution in all schemes" (37.5 years) and D_1 the length of contribution in all schemes or also named "length of career".[13]

In practice, this rule of a penalty either relative to quarters of contribution or to age 65 offers a minimum rate τ at 60 of 25 %, whatever the length of contribution. An exemple will help the reader figure out how the formula really works: a person aged 61 with a career of 140 quarters (35 years) needs 10 additional quarters to reach N_1 (at 150) but needs 16 quarters before turning 65. If this person decides to retire at age 61, she will compute her penalty by multiplying $\frac{10}{4}$ by 5 %, so 12.5 %. So she obtains a pension rate of 37.5 %. If that same person worked one more year, she would get a pension rate of 42.5 %.

2.1.2   The proportionality coefficient PC

The proportionality coefficient PC depends on the length of contribution solely to the *régime général* D_2 and on the "proportion length" N_2 (the required contribution length solely to the *régime général*)[14] to obtain the full rate.

$$PC = \min\left\{1, \frac{\widetilde{D_2}}{N_2}\right\} \tag{3}$$

Between 1983 and 1993, the "proportion length" N_2 was equal to the "necessary length of contribution" N_1. The 1983 reform introduced a change in the computation of D_2 after age 65, under the name "corrected contribution length" $\widetilde{D_2}$. Between 1945 and 1982, $\widetilde{D_2} = D_2$. It was designed to allow workers without the necessary quarters of contribution at age 65 to obtain more quickly a unitary proportionality coefficient. The idea was also to avoid having people working after age 65. So for each year after age 65, individuals would see their length of contribution increase by 10 % until they reach the necessary 150 quarters. This can be sum up by the following formula:

$$\widetilde{D_2} = \min\left[N_2, D_2 * \left\{\max\left(AGE - 65, 0\right) * \frac{10}{100}\right\} + D_2\right] \tag{4}$$

To give an example, a person aged 66 and 3 months with 34 years of career (136 quarters) would have needed an extra 3.5 years of work to obtain an unitary proportionality coefficient PC. With the correction introduced, 5 quarters after 65 increase her contribution length by 12.5 % which gives 153 quarters. That person can thus retire without more delay with a full pension.

2.1.3   The reference wage W_{ref}

The reference wage was defined between 1946 and 1971 as the average wage of the last 10 years truncated to the ceiling and weighted to reevaluate past nominal wage. The 1971 Boulin reform changed it to the ten best years.

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[12]This 10 % penalty is also designated in the literature as a 5 percentage points penalty. One can simply write the formula (2) in the following way: $\tau = 0.50 - \delta_2 * \max\{0, \min[(65 - AGE), \frac{N-D_1}{4}]\}$ with $\delta_2 = 0.5 * \delta = 5$ %.

[13]D_1 includes all the quarters worked in the *régime général* but also all quarters worked in other regimes, such as public sector or as self-employed or even in periods of work outside France.

[14]The distinction between N_1 and N_2 was introduced in 1993.

The weights are meant to compensate for monetary depreciation and are published by the government. During the seventies, they were higher than the actual monetary depreciation and were a way of increasing the generosity of the system. Since 1987 the coefficients used have only offset inflation. The ceiling is the so called social security ceiling. Above it, contributions are paid to the mandatory complementary schemes.

2.1.4 Floor and ceiling, MIN and MAX

Although there exists in France an old-age benefit scheme since 1956, a floor was introduced in the contributive *régime général* scheme in 1983. Since, a minimum pension is available for workers who fall below this floor and succeed in reaching the full rate. This minimum (€ 542 monthly from January 1st 2004) is therefore available provided one has contributed N_1 quarters.

The pension ceiling is defined as 50 % of the Social Security ceiling[15] save for complementary provisions (increase for children or spouses).

2.1.5 Complementary schemes

As the pensions from the CNAV could not be higher than 50 % of the SS ceiling, mandatory complementary schemes have been later introduced. It was first directed at executives through the regime of the "Association Générale des Institutions de Retraite des Cadres" (AGIRC), created in 1947 and then for all workers with the "Association pour le Régime de Retraite Complémentaire" (ARRCO) created in 1962. Contribution to ARRCO became mandatory only in 1972 and in 1974 for AGIRC.

The complementary schemes are unfunded defined contribution pension plans. Workers accumulate points on an account that give entitlements to a pension at retirement age. The pension R is equal to the number of points NP multiplied by the value of the point V. The number of points corresponds to the product of the wage W by the contribution rate CR and divided by the reference wage fixed by the scheme P which is a sort of price of the point. It is possible to receive a full pension at age 65 and a lower one at age 55 with a quasi-actuarial penalty $C(age, quarters)$ which depends either on the age until 65 or the quarters until N_1. We can summarize this rule with the following formulae:

$$R = NP * V * C(age, quarters) \tag{5}$$

$$NP = \frac{(W * CR)}{P} \tag{6}$$

The history of the parameters can be found in Bozio (2004). Here it is sufficient to note that the penalty is lower than in the basic pension of the CNAV, being closer to actuarial fairness.

2.2 The 1993 reform

In July 1993,[16] the government introduced a reform of the *régime général* which consisted in three changes of the parameters, thus not affecting the pension formula.

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[15]From January 1st 2004 onwards the SS ceiling is € 29'712 - which represents twice the full time minimum wage - and the maximum pension in the basic scheme of the *régime général* is therefore € 14'856 (so € 1238 monthly payment).

[16]Law 93-936 of July 22nd 1993; decree 93-1022 of August 27th 1993; decree 93-1024 of August 27th 1993; circular CNAV 103/93 of December 30th 1993.

The first one was to increase the "length of contribution necessary to obtain the full rate" N_1 from 37.5 years to 40 years (or from 150 quarters to 160 quarters). In other words, one needs 40 years of contribution to get the full rate, but only 37.5 years in the *régime général* (N_2) to get the unitary proportionality coefficient PC.

The implementation of the reform has been phased in with one additional quarter per generation, from 1934 to 1943. As a result, individuals born in 1933 or before only need 150 quarters to get the full rate, whereas the 1934 generation needs 151 quarters, the 1935 152 quarters, and the workers born in 1943 and after need 160 quarters. Therefore the reform is fully phased in in January 1st 2003, as it is impossible to retire prior age 60. The fact that the reform was phased in by generation and not by year of retirement is a key element of our identification strategy and is worth stressing here.

The second decision was to change the computation of the reference wage, W_{ref}. The 1993 reform defined it as the best 25 years of wages instead of the best 10 years. This measure is also phased in with one additional year in the reference wage by generation from the 1934 generation to the 1948 generation. Therefore, the individuals born in 1933 or before compute their reference wage with their best 10 years, while the 1934 cohort uses the best 11 years, the 1935 cohort the best 12 years, and the 1948 generation the best 25 years. This reform is thus fully phased in in January 1st 2008.

The third and last step of the 1993 reform was to increase pensions each year with inflation and not according to wage growth. This measure legalized a practice existing since 1987.

The direct impact of the new way to compute the reference wage is to lower pension levels. Indeed, the average of the 25 best years has to be lower than the average of the 10 best years. The amount of the decrease depends on the steepness of the wage curve. The CNAV (2002) has computed pensions with the rules pre-reform and post-reform in order to evaluate the decline in pension. It amounts between 1 % and 6 % for the generation 1934 to 1940.[17]

The implementation of the change in the reference wage concerned all the individuals of each generation whatever their retirement age. This means for example that within the 1934 cohort everyone was affected by the change of the reference wage[18] and we will then be able to take advantage of the variations introduced by the change in the necessary length of contribution.

The change of N_1 in the pension formula did not affect everyone uniformly. The reform being phased in, it creates a differentiated impact according to the generation and to the number of quarters of contribution at age 60. The two dimensions of the variations introduced by the reform are the year of birth (cohort effect) and the age of entry in the labor market at the quarter level (length of career or length of contribution in all schemes).

To summarize, the cohorts born in 1933 and before will never be affected by the reform. Individuals with less than 130 quarters of contribution and those with more than N_1 at 60 will also never be affected by the reform, whatever their date of retirement. The wage earners concerned by the increase in N_1 belong to the 1934 generation and have between 131 and 150 quarters of contribution, to the 1935 generation with 131 to 151 quarters of contribution, to the 1936 generation with 131 to 1942 quarters of contribution and so on. Tables 1 and 2 describe for generations 1934 and 1936 the drop in the replacement rate to the reference wage ($\tau * PC$) due to

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[17]This double computing does not take into account the possible behavioral changes so it is an approximation of the decline induced by the change in computation of the reference wage.

[18]Save the few persons who have less than 10 years of contribution.

the 1993 reform for different quarters of contributions. Section 4 will describe the identification strategy but these tables give a clear insight on which group was affected by the reform and which one is going to be the control group.

At first, let us consider the data available and the graphical evidence of the 1993 pension reform.

3   Some suggestive graphical evidence of the impact of the 1993 reform

3.1   The data available

Two arguments are usually given to explain the lack of data available to evaluate the 1993 reform. First, data concerning retirement in France are relatively scarce. Usual surveys like the INSEE Labor Force Survey do not have any information on the key variable to compute pensions that is the length of contribution.[19] Moreover the information available on retirees themselves is very scarce: we cannot even identify in which pension scheme the retiree is in.[20]

The commonly used data set available to date to study retirement in France is a specific panel, the *Echantillon Interrégime de Retraités* (EIR).[21] This panel has selected a sample of 20,000 people based on their date of birth (the first 10 days of October of each generation) and has gathered all the information about their pension entitlements in their various pension schemes, using administrative data from the basic schemes (*régime général*, public pension schemes) and from more than 180 different complementary schemes. The drawbacks of the EIR are to be limited to some generations (one out of two in the more recent file), to have finally few observations for each cell and to have a rather long periodicity, once every four years.[22] In the 2001 version the only generation entirely affected by the 1993 reform is the 1934 generation. This one saw an increase in N_1 of only 1 quarter (Coeffic 2003).

In this paper we use another database (which to our knowledge has never been used by economists), namely the administrative and exhaustive data collected by the CNAV while managing the files of every will-be pensioner of the private sector pension scheme.[23] Since 1977, the CNAV has produced files on the retirees in the *régime général*. Starting in 1982, length of contribution was added to the basic variables of the file and starting 1994 the year of birth of the retirees was also added. The data is based on tabulations made by the CNAV each year on the incoming retirees. The tabulations of the CNAV give the exact number of pensioners in each pos-

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[19]We know nonetheless the end of study age which is used in microsimulations to forecast the length of contribution.

[20]We don't know whether the retiree had work in the public sector or the private sector. For the few retrospective information available, they are usually considered not reliable.

[21]The panel has been developed by the Direction de la Recherche, des Etudes, de l'Evaluation et des Statistiques (DREES), a statistical and research unit under the supervision of both Ministry for Social Affairs and Ministry of Health. In its simpler version it is based on information provided by all the French pension schemes; a matching is also possible with annual wage returns filed by firms (DADS) and the unemployment files of UNEDIC.

[22]There exists an EIR for the years 1988, 1993, 1997 and 2001. The next one will be realized in 2005 and won't be available for researcher before the end of 2006.

[23]The data we use comes from the so called ACTIV5 files that are available on request at the Actuariat Statistique of the CNAV. They are published officially in a less detailed manner in the CNAV circular letters, the last one being the CNAV circular letter n°2003-26 and some of their statistics are published under the yearly CNAV Statistical Book, *Recueils Statistiques*.

sible cell[24] and we have turned those tabulations into a simple database. The data is perfunctory concerning the number of variables available (gender, type of pension, length of contribution, year of submission of the retirement demand, age of retirement, year of birth), but it has the enormous advantage of being exhaustive, annual and very recent. Thus we have information on all pensioners in the private sector who have retired until December 31st 2003.[25] With this data set the generations that have completely retired[26] are those born in 1934, 1935, 1936 and 1937. Those born in 1938 can also be used as they have already reached 65, the second peak of retirement in France. Another advantage of this data set is that age is coded at the quarter unit (60, 60.25, 60.5...) and not in an annual way as usual. The only drawback of the base is that it is impossible to use generations before the reform as control groups.[27] To do so will require nonetheless the use of the EIR data. On the complete generations from 1934 to 1937, the 1993 reform increased N_1 from 1, 2, 3 to 4 quarters.

Before developing our identification strategy of the 1993 reform, we shall first present some graphical evidence of the likely impact of the 1993 French pension reform. Two empirical facts ought to be stressed : 1/ Labor force participation rates have declined constantly at older age to end up in the lower tail of the European distribution. 2/ The administrative data on the average retirement age show a constant decline until 1994 and then a modest increase.

3.2   The secular decline in labor force participation rate at older age

The secular decline in labor force participation at older age was well studied by Marchand and Thélot (1997) over long period, by Blanchet and Marioni (1996) over the last decades, and by Bommier, Magnac and Roger (2003) for the more recent period.[28] Figure 1 is based on data from all the series of Labor Force Survey with the same methodology used in those articles until 2002. We note easily that the labor force participation of the 60-65 age group dropped considerably in the beginning of the period to stabilize itself in the eighties. The lowering of the retirement age in France in 1983 was only the legalization of a pre-existing trend caused by early retirement schemes. Those schemes were put in place from 1972 onwards and were generalized in 1977 for workers 60 years old and above. As soon as 1977 one can see some early retirement schemes available for the 55 and older in some sector like the steel industry and for all in 1980, before a strong halt in 1984. In the more recent period, one can note an increase of labor participation of the 55-60 group in the years 1988-1991 which corresponds to a period of growth of the French economy and a fall of unemployment at all ages. The same increase happens in 2000-2002 during the last period of growth where jobs have been created. If this rough description is well-known to all, the causalities at stake are still a hot debate within economists.

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[24]For example, there is a cell, female, aged 60.25, who retired in 1995 with 149 quarters of contribution on a disability pension and who was born in 1934.

[25]We have in this data set all the French private sector wage earners, who have retired between 1994 and 2003, 1'241'400 different observations which correspond to information on exactly 5'273'827 retirees.

[26]At age 66, 98 % of the private sector wage earner of one generation have retired.

[27]The generation 1933 is the data set is a truncated generation because only those who have retired starting 1994 are in the base. The 1934 generation is also truncated as those who have asked in 1993 to be able to retire in 1994 are not in the base either.

[28]The last two articles use the Labor Force Surveys of INSEE.

3.3 The recent increase in the average retirement age

The next set of information concerns official series of average retirement age from the *régime général* that are reproduced in figure 2. This annual series is the one easily available for the public. Although one has to be careful when using it,[29] it is clear that average age at retirement has declined until 1994 and reached then a floor. However it is impossible to draw very firm conclusions concerning the increase since 1994 of the average retirement age as this increase might be due to purely demographic changes.

A more suggestive evidence of the 1993 reform is the fact that average age at retirement by generation has declined constantly until generation 1932 when it stabilized and then slightly increased. Figure 3 shows this statistic using the EIR 2001 data until generation 1934 and then uses the CNAV data set.[30] The small increase in the average retirement age since generation 1934 does not give hints for a large impact of the 1993 reform (around 0.03 increase in the average age). But one has to keep in mind that the counterfactual hypothesis is one of a secular decline in the average retirement age (with longer careers for women). Doubts on the possible influence of the business cycle are possible but it is also in line with the progressive implementation of the reform.

Last but not least are the distribution of the length of contribution by generation. Figures 4 and 5, respectively from EIR 2001 data and from the administrative data of the CNAV, are actually more dramatic to reckon the impact of the 1993 reform. The figures depict simple histograms with the distribution of length of contribution at retirement for the various generations concerned. With EIR 2001 it is obvious that older generation (born before 1933) show a huge peak at 150 quarters of contribution, the exact number required to receive a full rate pension. The peak moves to 151 quarters for the 1934 generation, to 153 for the 1936 generation and to 1955 for the 1938 generation, following exactly the way the reform was phased in. With the CNAV data the same pattern is easily noticeable for every single generation until the 1940 generation where the peak is at 157 quarters.[31]

At the light of those figures, there is no doubt that the 1993 reform has had some impact on the retirement age of wage earners in the private sector. We shall then describe in the next section our identification strategy to estimate a proper elasticity of labor supply to the required length of contribution.

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[29]If a smaller generation start retiring at age 60, then this particular year, the average age of retirement will increase in a mechanical manner, and conversely for bigger generations (Givord 2002). Thus the average age of the 60-65 years old group in Labor Force Surveys change considerably with the effect of the age group depleted by low birth rate during World War I (between 1975 and 1985). Besides, there exists a discontinuity in 1994 in the way the average age is computed by the CNAV. Before 1993, the CNAV computed age in yearly units and after in quarter units. The gap between the two series is estimated around 0.25 year in 1994.

[30]We exclude persons who have retired after age 66 to allow fair comparison between the different cohorts. The CNAV data for the generations 1935 to 1937 are somehow different from the EIR data as they give information on all the persons who have retired and not (as in EIR 2001) those who are alive in 2001. Differential mortality can then play a role for older generation in overestimating the average age.

[31]One has to note that the statisticians of the CNAV acknowledge the fact that once a person is over 65 the true number of quarters of contribution is not searched extensively as this person will get the full rate in all cases. However there is no reason to think that for those particular cases the number of contribution was arbitrary set to N_1.

4 Identification strategy

The first part of the analysis consist in applying a difference-in-difference methodology using the different impact of the reform for the persons who were just above and just under the moving threshold of N_1 (150, 151, 152...) quarters of contribution. It is the application of a regression-discontinuity design estimate.[32] Then we will describe how the the generalization of this methodology to a fixed effect regression can make the best use of all the variations within the data.

4.1 First difference in difference approach

In order to estimate the impact of increasing the length of contribution on retirement age, one faces an identification problem, as the increase is collinear with a reduction in the replacement rate and with the secular trend in declining replacement rate. To differentiate simply by the time trend would lead to biased estimates of the elasticity. The progressive implementation of the 1993 reform offers a double variation to identify the pure impact of the reform which depends on both year of birth and quarters of contribution. The strategy of the difference in difference approach relies simply in instrumenting the variation in length of contribution by an interaction between date of birth and quarters of contribution at 60. One can thus consider the following data generating process for the retirement age:

$$AGE_{ijk} = \alpha + \beta_j GEN_j + \gamma_k QUA_k + \eta GEN_j * QUA_k + \nu_i + \epsilon_{ijk} \tag{7}$$

Ideally we would have liked to have the variable giving the number of quarters of contribution at the date of the reform. As we do not have such a variable, we use as proxy the number of quarters of contribution at age 60 computed supposing that all the quarters between 60 and the retirement age have led to quarters of contribution.[33] To identify the 1993 reform we have to make the hypothesis that it has had no effect on the number of contribution at age 60. If this hypothesis would be true, we can then estimate a difference in difference regression between the individuals born in 1934 with 151 and 152 quarters of contribution at age 60 and those born in 1935. With 151 and 152 quarters of contribution at 60, those born in 1934 can retire with the full rate at 60. On the other hand, those born in 1935 and who have only 151 quarters of contribution at 60 must wait one quarter to retire with the full rate.

We can write down the estimates of the difference in difference regression:

$$DD_{\text{estimates}} = \left[E[AGE_{ijk}|\text{j=1935 \& k=151}] - E[AGE_{ijk}|\text{j=1935 \& k=152}] \right]$$
$$- \left[E[AGE_{ijk}|\text{j=1934 \& k=151}] - E[AGE_{ijk}|\text{j=1934 \& k=152}] \right] \tag{8}$$

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[32]Technically, this method is only valid if the contribution variable is really continuous (Hahn, Todd & Van der Klaauw 2001). However, we posit that the unity of a quarter of year is sufficiently small at a life-time horizon to consider it continuous.

[33]Unemployment and early retirement lead to quarters of contribution, but this is not true for inactivity. So we miss here the true length of contribution for those who are inactive after 60 and before retiring. Mostly women are in this case and they are very likely to retire at age 65. Thus we underestimate length of contribution in the lower range (less than 131 quarters at 60).

Using equation 11, one can rewrite the DD estimates in the following way:

$$DD_{\text{estimates}} = \left[(\alpha + \beta_{1935} + \gamma_{151} + \eta_{1935,151}) - (\alpha + \beta_{1935} + \gamma_{152})\right] \\ - \left[(\alpha + \beta_{1934} + \gamma_{151}) - (\alpha + \beta_{1934} + \gamma_{152})\right] \tag{9}$$

$$DD_{\text{estimates}} = \eta_{1935,151} \tag{10}$$

Thus we get the true impact of the increase of length of contribution for the 1935 cohort which had only 151 quarters of contribution at age 60. The same methodology can be replicated for the cohorts 1935-1936 with 152-153 quarters at 60, for cohorts 1936-1937 with 153-154 quarters at 60. . .

To benefit from more control groups within one cohort, one can estimate a larger double difference. When considering tables 1 and 2, it is obvious that the individuals with less than 131 quarters of contribution at 60 or more than N_1 will never be affected by the reform. They constitute a nice control group while the $131 - N_1$ are the treated. We will call this estimate the "global estimate" to differentiate it from the "local estimate" from above.

4.2 Framework for the general regression

Although the difference in difference estimate is fairly straightforward, the phasing in of the 1993 pension reform gives more elements to precise our estimate: later generations are not only affected by the reform at higher contribution length (up to 160) but also, they are affected in a varied intensity. For example, an individual with 150 quarters of contribution at age 60 would need to delay retirement by one quarter if she were born in 1934 and 5 quarters if born in 1938. The generalization of the DD regression would be as follows:

$$AGE_{ijk} = \alpha + \sum_{j=1935}^{1937} \beta_j GEN_j + \sum_{k=1}^{220} \gamma_k QUA_k + \sum_{j=1935}^{1937} \sum_{k=1}^{220} \eta_{jk} GEN_j * QUA_k + \nu_i + \epsilon_{ijk} \tag{11}$$

This fixed effect regression has however two immediate drawbacks: first it is a black box and secondly it does not allow to distinguish the effect of the 1993 reform by its intensity. To face 1 or 10 quarters of necessary contribution to reach the full rate should obviously lead to different delays of retirement and possibly to different elasticities.

So we rewrite the variable $\sum_{j=1935}^{1937} \sum_{k=1}^{220} \eta GEN_j * QUA_k$ in a more explicit way concerning the intensity of the reform. To make it clear: a person born in 1936 with 152 quarters at 60 is affected by the reform with 1 quarter; with 151 quarters at 60 she is affected by 2 quarters and if she has between 133 and 150 quarters she is affected by 3 quarters. So we create a dummy variable RB_i which takes the value 1 if the individual has to postpone retirement of i quarters to have the full rate and thus because of the reform.

We can then estimate the following equation:

$$AGE = \alpha + \sum_{j=1935}^{1937} \beta_j GEN_j + \sum_{i=1}^{4} \gamma_i RB_i + \delta LC60 + \epsilon \tag{12}$$

with AGE the retirement age, GEN_j generation j and LC60 the length of contribution at age 60.

5 Empirical estimates

5.1 Baseline estimates

We first report the double difference estimates in table 3 with the case where all pensions are included and the case where we have restricted the sample to normal pensions (excluding disability pension). With figures 6, 7 and 8 the corresponding histograms are depicted. The result is that the 1993 reform has had a dramatic impact on the retirement age: it increases between 3 and 6 months for the persons concerned by the reform. And yet in these double differences, only an increase of one quarter of N_1 was at stake. Elasticities corresponding to the interaction coefficients were also reported in table 3: they are almost always above 1 and almost close to 2.

Then we estimate "global" double differences: we use all the persons affected by the reform as the test group (those who have at 60 between 131 and 152 quarters for the 1935 generation) and all the rest as the control group (those with less than 131 and more than 152). Figure 9 depicts the corresponding graph for the 1934-35 generations. For every pair of generations, we can estimate similar double differences whose results are summarized in table 4. The coefficients are generally lower than in the previous table but still give very high elasticities (between 0.7 and 1.6). It is worth noting here that the true elasticity should be estimated on normal pensions only as they are the only ones really concerned by the reform. Disability pensions give the right to a full rate pension at age 60 whatever the length of contribution. In that last case, elasticities are all above 1.

For the general regression of equation (12), we suggest in table 5 three specifications: the first one corresponds exactly to the above description of RB_i. It is the sheer effect of the reform for various intensity of the reform. As expected we find that coefficients are higher for those who faced a larger part of the increase in N_1. In the second specification, we normalize RB_i by i to allow easy comparison of coefficients per additional quarter. The elasticies we get with this specification are all below 1, at around 0.8. The only exception is the coefficient of RB_1 which is very close to 1. We finally suggest a last specification where we suppose a linear effect in order to give a base line estimate of the general effect of the reform.

5.2 Why such a strong effect ?

How are those high elasticities possible ? One can take a closer look at histograms of figures 6, 7 and 8 which represent the first set of double differences. We notice that effectively a large number of people concerned by the reform delay their retirement by one quarter. But there is also a certain number of people who do not delay their retirement and prefer retiring at age 60 with a penalty on their pension rate. So, logically, we should find elasticities between 0 and 1, and closer to 1 than to 0. So why do we find higher elasticites ? The number of observations was reported next to the titles of the subfigures. A short look will convince the reader that there are much less observations for the 1935 generation with only 151 quarters of contribution and a lot more for those who have just the quarters of contribution necessary. The simple explanation of this fact is

that the number of quarters of contribution at 60 is not independent from the 1993 reform and that all our double differences estimates are thus biased upward.

Three explanations can be given for this fact: first people might just have worked more before 60 to retire at 60 with full rate. This would be indeed a strong positive effect of the reform. However, this hypothesis is not very credible knowing that the first generation concerned has had only a small amount of time to start working again and that the job market for 58 and older is close to non existent. The second possibility is that the number of quarters of contribution can be fairly easily manipulated, at least in the margin: to receive its pension one has to submit a file with all the proofs of the necessary quarters of contribution. Before the reform, a would-be pensioner would not care to look for early age career if he had already 150 quarters of contribution with his main career. With the reform the same person has high incentives to spend a weekend to find the small piece of paper proving that he has done, at age 14, an internship during 3 months. This could bring him as much as a 2.5-3 % increase of its pension.

Finally, another bias in these estimates can explain these high results: the possible impact of the reform on disability pensions or unfitness for work pensions. In this case, the true group affected by the reform would not be only those who have retired with normal pensions but all pensioners. We report in table 6 all interaction coefficients with elasticities to summarize the previous results. If the reform influences the type of pensions then the coefficients with all pensioners (still biased) are closer from the true coefficients.

One point we would like to make at this stage is that the manipulation of the quarters of contribution is more likely to have taken place at the margin, for one quarter of contribution. Those who had less than 150 quarters, had all chances to have already tried hard to look for some additional quarters to be validated. Hence the regressions of table 5 are *de facto* less concerned by the manipulation bias which is concentrated on a small part of the people affected by the reform (those at the margin). That does not mean however that they are free from the bias related to disability pensions.

In the next subsection we will address the question of disability pensions and then we shall suggest a method to correct for the manipulation in the length of contribution.

5.3   Impact of the reform on disability pensions

In theory, pensions granted for disability or unfitness for work should not be influenced by the 1993 reform. The fact to be deemed unfit for work or to be disabled is based on a medical investigation and is independent from the number of quarters of contribution.[34] We can notice in table 7 that disability pensions are much more granted to individuals affected by the reform. In this table we have realized the same double difference as before using as dependent variable the fact of having been granted a disability pension or not. The impact is quite strong and very significant for the people affected at the margin by the reform: their probability to have disability pensions or pensions for unfitness is from 11 to 13 % higher. On all the persons affected by the reform the impact is smaller but still 3 to 4 % higher. As a group of control of this effect, we can use the pensions granted to former prisoners of concentration camps, former resistance fighters, former prisoners of war or mothers working in factories. The possibility to ask for such pensions is

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[34]However for pensions granted for unfitness to work the number of quarters of contribution has to play a role as people who can have the full rate have no incentives to ask for such a type of pension.

much more reduced and it is likely that even with more than N_1 quarters of contribution former prisoners or resistance fighter would have asked to be granted such types of pension. The effect is then generally non significant, and when one can see one, it is very small (around 0.05 % and 0.1 %).

In table 8, we estimate an equation similar to equation (12) with the dependent variable being a dummy for disability pensions and pensions for unfitness. In the first specification, which distinguishes the effect according to the intensity of the reform, we show that the reform has increased the likelihood to receive a disability/unfitness pension from 10 to 13 %, allowing these people to retire at full rate at age 60. The effect is slightly increasing with the intensity of the reform. This fact might be explained by the lack of other means to avoid delaying retirement (it is harder to find additional quarters of contribution as one has already tried hard to do so) for those who have shorter careers. In the second specification we make the linear hypothesis to get an average effect of 11.6 % on those affected by the reform. The third column presents the results of a control experiment with a dummy variable for pensions granted to former prisoners of war and resistance fighters. The effect is significant and positive but very small (around 0.2 %). Contrary to equation (12), these regressions control for gender, which might in itself influence the fact of receiving a disability pension or a pension for unfitness.[35]

Once this impact of the reform on disability pension is well identified, we can suggest a correction to equation (12) in introducing additional control variables.

We thus estimate the following equation:

$$AGE = \alpha + \sum_{j=1935}^{1937} \beta_j GEN_j + \sum_{i=1}^{4} \gamma_i RB_i + \delta DIS + \sum_{k=1}^{4} \zeta_k RB_i * DIS + \eta LC60 + \epsilon \qquad (13)$$

where DIS is a dummy variable which takes the value 1 if the pension is a disability pension or a pension for unfitness and 0 otherwise and where $RB_i * DIS$ are interactions of this variable with the intensity of the reform. We estimate this equation with the same three specifications as previously and the results are to be found in table 9. Coefficients are all lower than in table 5 and give elasticities around 0.72 and 0.81; in the linear specification, controlling for disability pensions, the elasticity drops to 0.75.

If a large part of the previous bias has disappeared, there is still the manipulation of the length of contribution to account for, which is a more tricky problem.

5.4 How to correct for the manipulation of contribution length ?

To be clearer about the problem we face, it is worth well understanding what this manipulation is all about: there is no massaging in the sense that we think individuals can cheat or invent quarters that in reality did not lead to contribution. The reform leads the individuals affected to reveal all the possible quarters of contribution, as previously they had no incentives to spend time to find more quarters then necessary. So the true contribution length is the one observed after the reform, *ex post*, for the one affected. Unfortunately, it is impossible to have any idea of the

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[35]It would have been, on the other hand, a mistake to include gender in the equation (12) as the reform does not play a role on the retirement age by gender, unless through the differences in length of contribution, much lower for women.

true contribution length of those not affected by the reform. Therefore the only possibility left to account for this bias is to correct it toward the *ex ante* length of contribution.

Thus, if one takes another look at figure 6, one realizes that a perfectly fair hypothesis would be to posit that the proportion of individuals born in 1935 who have 152 quarters at 60 is the same for those born in 1934.

$$p(\widetilde{QUA_{152}}|j = 1935) = p(QUA_{152}|j = 1934) \tag{14}$$

So we compute new weights for each natural experiment by subtracting to the 1935-152 group who retired at 60, the number of individuals necessary to make this proportion with the 1934 cohort equal. We then increase the weights of the 1935-151 group by a similar amount. We suggest two possible distributions of this correction: one will be the lower bound, ie all the correction is distributed to the 1935-151 group who retire at 60 (as they have in practice retired at 60 - see equation 15). The upper bound distribute the correction between those who retire at 60 and those who retire at 60.25 in the same proportion as observed in the data (see equation 16).

$$p(\widetilde{AGE_{151,1935}} = 60) = p(AGE_{151,1935} = 60) + p(QUA_{152,1935}) - p(\widetilde{QUA_{152,1935}}) \tag{15}$$

$$p(\widetilde{AGE_{151,1935}} = 60) = p(AGE_{151,1935} = 60) + p(QUA_{152,1935}) -$$
$$p(\widetilde{QUA_{152,1935}}) * \frac{p(AGE_{151,1935} = 60)}{p(AGE_{151,1935} = 60 \text{ or } 60.25)} \tag{16}$$

The table 10 shows the results of the double difference estimates using this correction. Column (2) is the lower bound correction and column (3) the upper bound. The second specification is our favorite estimate as the actual age of retirement is not changed. It gives elasticities between 0.6 and 0.7. In table 11 we present the global regression correcting for invalidity pensions and for the manipulation bias. The coefficient of RB_1 drops to 0.64 as a result of the correction.

Before summarizing the effect of the 1993 reform, we will present a complementary analysis with data of the EIR 2001.

5.5 Controls and complements with Echantillon Interrégime de Retraités (EIR 2001)

Although imprecise (small sample, retirement age in years) and rather old for our purpose (in 2001 only the 1934 generation is complete to test the impact of the 1993 reform), the EIR 2001 allows us to do the control experiments that were lacking with our previous estimates on the administrative data of the CNAV.

In tables 12 and 13, we use the same double difference methodologies as with CNAV regressions. We can thus exhibit more convincing control experiments on previous generations, like 1930-1932. The interaction coefficients that show a positive effect are quite imprecise. Because of the lack of precision in the data the coefficient ought to be smaller than in the CNAV data set. So if we find coefficients close to our estimates after correction for the bias, it might just be pure coincidence. What is not however a coincidence is the fact that in control experiences we find a null or non significant effect.

In table 14, we report results of the estimate of the following equation:

$$AGE = \alpha + \beta_i GEN_i + \gamma QUA + \delta QUA * Affected\ Generations + \zeta QUA * Trend + \epsilon \qquad (17)$$

with AGE the retirement age, GEN the generation and QUA the dummy variable which takes the value 1 if the person has at 60 between 131 and 152 quarters of contribution and 0 otherwise. We do not try here to estimate the impact of the reform for each generation but its global impact. The QUA*trend variable controls for a possible trend specific to the test group. We report the results in column 1 of table 14. The interaction coefficient is very close from the one in table 12, which was expected as we have just introduced new control variables.

Another way of estimating the effect of the reform is to define a variable $R93_i$ which is equal to the number i of additional quarters the individual must delay retirement to have the full rate. Contrary to the similar estimate with CNAV data we have here only two generations 1934 and 1936 (as the people born in 1936 are aged 64 in early 2001, we have to restrict the sample to those who have retired at 64 or earlier) and mostly 1 and 3 additional quarters for $R93_i$. The equation (18) is just the generalization of this estimate:

$$AGE = \alpha + \beta GEN + \gamma QUA_1 + \delta QUA_2 + \zeta \sum_{i=1}^{10} R93_i + \zeta X + \epsilon \qquad (18)$$

The QUA_i variables are dummy variables which take the value 1 if the individual has at 60 a number of quarters of contribution that might make him affected by the reform. Results of the estimate of equation (17) for the sample of the individuals born between 1930 to 1936 are reported in column 2 of table 14. The coefficients, between 0.11 and 0.17 give elasticities around 0.4 and 0.7. These results are similar to the double difference estimates but should be taken carefully. One should prefer the CNAV estimates after correction for the biases.

The really important result coming from the use of EIR data is to show control experiments that give more credits to our own estimate of the true impact of the reform. In the next section we are going to give a global vision of the impact of the 1993 reform on the retirement age.

6 Summing up : The net Impact of the 1993 Pension Reform

Before coming back to our evaluation of the reform, it is worth recalling who was actually affected by the reform and what was expected from it. The 1993 reform only changed the pension formula of the wage earners of the private sector (68 % of French workers) and within this group only changed incentives to retire for those who had at age 60 between 131 and 160 quarters of contribution (25 % of a generation). To sum up, the 1993 reform[36] affects only 15 % of the French workers.

Among those affected, some have been granted disability pensions or pensions for unfitness to work, some have tried and succeeded in finding the additional quarters of contribution to receive a full rate pension, some have preferred a lower pension and have retired at 60 and some have

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[36]We mean here the increase of N_1 necessary quarters of contribution. The reduction in replacement rates by the change in computation of the reference wage affects everyone.

postponed their retirement. We take the risk to present rough estimates of the distribution of cases for those affected by the reform in table 15. The reform was more effective at encouraging those who already had to face penalty if they retired at 60 (the 131-150 quarters of contribution at 60 group). We estimate at 72 % the proportion of those who postponed retirement. For those affected at the margin by the reform (the 151-160 quarters of contribution at 60 group) the net effect is much lower as possibilities to retire with a disability pension or to find additional quarters of contribution were still at their disposal. So we get an estimate of 51 % only for those who actually postpone retirement.

Finally one has to understand those numbers with the possibility that individuals unemployed or in early retirement schemes can also have postponed their retirement. That would lower considerably the true net impact of the 1993 reform. According to previous studies (Colin, Iéhlé & Mahieu 2000) 34 % only of the wage earners in the private sector were working just before retirement and 47 % (either unemployed or in early retirement schemes) had the possibility to get additional quarters of contribution by remaining in those schemes. It is hard, with the available information to give estimates of the proportion of those who have postponed retirement who might actually be in those schemes. We do not know for certain the likelihood of unemployed or people in early retirement schemes to be affected by the reform. We know that a large number of them (being manual workers, or workers in industry) should have very long career (much more than 170 quarters of contribution at 60) and would therefore not have been concerned by the 1993 reform. Therefore to assume that they are affected by the 1993 reform in the same proportion as the rest of the population gives a lower estimate of the reform, at 0.36. A more realist assumption would be that only half of the proportion are affected by the 1993 reform, leading to a low elasticity of 0.51.

7   Conclusion

This paper offers the first *ex post* evaluation of the incentive effects of the 1993 French pension reform. This private sector reform was meant both to reduce replacement rates and to increase retirement age. In order to induce later retirement the government increased the number of quarters of contribution necessary to obtain a full rate pension from 150 to 160 quarters. We use both the Echantillon Interrégime des Retraités (EIR 2001) and the exhaustive administrative data from the CNAV (1994-2003) in order to estimate the elasticity of retirement age to the length of contribution necessary to obtain the full rate. We use the fact that different groups were affected differently by the reform (depending both on birth year and contribution length at age 60) in order to identify precisely the behavioral impact of changing incentives, using a difference-in-difference approach. We find that one additional quarter of necessary contribution led to an average increase of 2 months in retirement age, corresponding to an elasticity of 0.7. This fairly high response of French workers should be put in perspective with the high level of penalty associated with early retirement in the French pay-as-you-go scheme. In light of this high penalty, most authors in the literature assumed that the elasticity of retirement age should be equal to 1.

Moreover we show that, when possible, workers used other possibilities to leave at 60 either by making efforts in producing evidence of longer carriers (thereby "manipulating" their contribution length at age 60) or by more often asking for a disability pension. The reform has increased the probability to retire with a disability pension by 11 % according to our estimates and 26 % of the people affected at the margin by the reform have succeeded in producing evidence of longer career.

The net impact of the 1993 reform should therefore be lower than so far expected, with an elasticity around 0.5-0.7. The fact that people in unemployment or early retirement schemes account for a large part of the would be retirees suggests that the net estimates might even be lower than those presented here. In another paper, we will present simulations of the 2003 reform with those behavioral estimates.

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Table 1: Changes in the replacement rate ($\tau * PC$) following the 1993 reform - Generation 1934.

Retirement Age / Quarters of contribution	60	61	62	63	64	65
125	0	0	0	0	0	0
126	0	0	0	0	0	0
127	0	0	0	0	0	0
128	0	0	0	0	0	0
129	0	0	0	0	0	0
130	0	0	0	0	0	0
131	-1.09 %	0	0	0	0	0
132	-1.10 %	0	0	0	0	0
133	-1.11 %	0	0	0	0	0
134	-1.12 %	0	0	0	0	0
135	-1.12 %	-1.12 %	0	0	0	0
136	-1.13 %	-1.13 %	0	0	0	0
137	-1.14 %	-1.14 %	0	0	0	0
138	-1.15 %	-1.15 %	0	0	0	0
139	-1.16 %	-1.16 %	-1.16 %	0	0	0
140	-1.17 %	-1.17 %	-1.17 %	0	0	0
141	-1.17 %	-1.17 %	-1.17 %	0	0	0
142	-1.18 %	-1.18 %	-1.18 %	0	0	0
143	-1.19 %	-1.19 %	-1.19 %	-1.19 %	0	0
144	-1.20 %	-1.20 %	-1.20 %	-1.20 %	0	0
145	-1.21 %	-1.21 %	-1.21 %	-1.21 %	0	0
146	-1.22 %	-1.22 %	-1.22 %	-1.22 %	0	0
147	-1.22 %	-1.22 %	-1.22 %	-1.22 %	-1.22 %	0
148	-1.23 %	-1.23 %	-1.23 %	-1.23 %	-1.23 %	0
149	-1.24 %	-1.24 %	-1.24 %	-1.24 %	-1.24 %	0
150	-1.25 %	-1.25 %	-1.25 %	-1.25 %	-1.25 %	0
151	0	0	0	0	0	0
152	0	0	0	0	0	0
153	0	0	0	0	0	0
154	0	0	0	0	0	0

NOTE: This table reads as follows: following the 1993 pension reform, the replacement rate of workers born in 1934 retiring at age 64 with 150 quarters of contribution was cut by 1.25 percentage point, from 50 % to 48.75 %.

Table 2: Changes in the replacement rate ($\tau * PC$) following the 1993 reform - Generation 1936.

Retirement Age Quarters of contribution	60	61	62	63	64	65
125	0	0	0	0	0	0
126	0	0	0	0	0	0
127	0	0	0	0	0	0
128	0	0	0	0	0	0
129	0	0	0	0	0	0
130	0	0	0	0	0	0
131	-1.09 %	0	0	0	0	0
132	-2.20 %	0	0	0	0	0
133	-3.32 %	0	0	0	0	0
134	-3.35 %	0	0	0	0	0
135	-3.37 %	-1.12 %	0	0	0	0
136	-3.40 %	-2.27 %	0	0	0	0
137	-3.42 %	-3.42 %	0	0	0	0
138	-3.45 %	-3.45 %	0	0	0	0
139	-3.75 %	-3.75 %	-1.58 %	0	0	0
140	-3.50 %	-3.50 %	-2.33 %	0	0	0
141	-3.52 %	-3.52 %	-3.52 %	0	0	0
142	-3.55 %	-3.55 %	-3.55 %	0	0	0
143	-3.57 %	-3.57 %	-3.57 %	-1.19 %	0	0
144	-3.60 %	-3.60 %	-3.60 %	-2.40 %	0	0
145	-3.62 %	-3.62 %	-3.62 %	-3.62 %	0	0
146	-3.65 %	-3.65 %	-3.65 %	-3.65 %	0	0
147	-3.67 %	-3.67 %	-3.67 %	-3.67 %	-1.22 %	0
148	-3.70 %	-3.70 %	-3.70 %	-3.70 %	-2.47 %	0
149	-3.72 %	-3.72 %	-3.72 %	-3.72 %	-3.72 %	0
150	-3.75 %	-3.75 %	-3.75 %	-3.75 %	-3.75 %	0
151	-2.50 %	-2.50 %	-2.50 %	-2.50 %	-2.50 %	0
152	-1.25 %	-1.25 %	-1.25 %	-1.25 %	-1.25 %	0
153	0	0	0	0	0	0
154	0	0	0	0	0	0

NOTE: This table reads as follows: following the 1993 pension reform, the replacement rate of workers born in 1936 retiring at age 64 with 150 quarters of contribution was cut by 3.75 percentage point, from 50 % to 46.25 %.

Table 3: Average retirement age - difference in difference

Generations	All pensioners			Normal pensions		
Panel A : Natural experiment 1						
	Length of contribution at 60			Length of contribution at 60		
Cohort	151	152	Difference	151	152	Difference
1935	60.546	60.207	0.338	60.675	60.218	0.456
	(0.016)	(0.009)	(0.015)	(0.019)	(0.010)	(0.018)
1934	60.295	60.275	0.019	60.316	60.297	0.018
	(0.011)	(0.010)	(0.014)	(0.012)	(0.011)	(0.016)
Difference	0.251	-0.067	**0.319**	0.358	-0.078	**0.437**
	(0.018)	(0.012)	(0.021)	(0.021)	(0.014)	(0.024)
Elasticity			**1.004**			**1.748**
Panel B : Natural experiment 2						
	Length of contribution at 60			Length of contribution at 60		
Cohort	152	153	Difference	152	153	Difference
1936	60.475	60.218	0.257	60.576	60.218	0.358
	(0.013)	(0.009)	(0.015)	(0.016)	(0.010)	(0.017)
1935	60.208	60.258	-0.051	60.219	60.274	-0.055
	(0.009)	(0.009)	(0.012)	(0.009)	(0.010)	(0.013)
Difference	0.267	-0.040	**0.307**	0.357	-0.056	**0.413**
	(0.014)	(0.012)	(0.019)	(0.017)	(0.013)	(0.021)
Elasticity			**1.228**			**1.652**
Panel C : Natural experiment 3						
	Length of contribution at 60			Length of contribution at 60		
Cohort	153	154	Difference	153	154	Difference
1937	60.462	60.557	-0.095	60.553	60.605	0.051
	(0.013)	(0.014)	(0.013)	(0.016)	(0.016)	(0.028)
1936	60.218	60.689	-0.403	60.218	60.766	-0.548
	(0.008)	(0.014)	(0.018)	(0.009)	(0.016)	(0.022)
Difference	0.243	-0.132	**0.376**	0.335	-0.162	**0.497**
	(0.014)	(0.024)	(0.030)	(0.016)	(0.027)	(0.035)
Elasticity			**1.504**			**1.988**

NOTE: Computations with administrative data of the CNAV. We exclude individuals who have retired after 69 for the first experience, after 67 for the second one, and after 66 for the third one. Standard errors are reported in brackets and interaction coefficients in bold. Computation of the elasticity corresponds to the coefficient of double difference divided by 0.25 (one quarter).

Table 4: Average retirement age - difference in difference

| Generations | All pensioners | | | Normal pensions | | |
| | Length of contribution at 60 | | | Length of contribution at 60 | | |
	Affected	Control group	Difference	Affected	Control group	Difference
Panel D : Natural experiment 4						
1935	61.426	61.314	0.112	62.018	61.635	0.383
	(0.007)	(0.002)	(0.009)	(0.009)	(0.004)	(0.012)
1934	61.302	61.406	-0.104	61.751	61.766	0.014
	(0.007)	(0.003)	(0.009)	(0.008)	(0.004)	(0.012)
Difference	0.124	-0.092	**0.216**	0.267	-0.131	**0.397**
	(0.010)	(0.004)	(0.012)	(0.012)	(0.006)	(0.017)
Elasticity			**0.864**			**1.588**
Panel E : Natural experiment 5						
1936	61.445	61.335	0.11	62.016	61.642	0.373
	(0.006)	(0.003)	(0.009)	(0.009)	(0.004)	(0.012)
1935	61.261	61.327	-0.066	61.710	61.658	0.050
	(0.007)	(0.003)	(0.008)	(0.008)	(0.004)	(0.011)
Difference	0.184	0.008	**0.176**	0.306	-0.016	**0.322**
	(0.009)	(0.004)	(0.012)	(0.012)	(0.005)	(0.016)
Elasticity			**0.704**			**1.288**
Panel F : Natural experiment 6						
1937	61.412	61.296	0.117	61.959	61.588	0.370
	(0.007)	(0.003)	(0.009)	(0.009)	(0.003)	(0.011)
1936	61.286	61.347	-0.060	61.724	61.663	0.061
	(0.006)	(0.003)	(0.008)	(0.008)	(0.004)	(0.011)
Difference	0.126	-0.051	**0.177**	0.235	-0.074	**0.309**
	(0.009)	(0.004)	(0.012)	(0.012)	(0.005)	(0.016)
Elasticity			**0.708**			**1.236**

NOTE: Computations with administrative data of the CNAV. We exclude individuals who have retired after 68 for the fourth experience, after 67 for the fifth one, and after 66 for the sixth one. An individual is considered affected by the reform if she has between 132 quarters of contribution at 60 in experience 4, between 133 and 153 quarters in experience 5 and between 134 and 154 quarters in experience 6. Standard errors are reported in brackets and interaction coefficients in bold. Computation of the elasticity corresponds to the coefficient of double difference divided by 0.25 (one quarter).

Table 5: Impact of one additional quarter - normal pensions

Variable	(1) Coefficient (Std. Err.)	(2) Coefficient (Std. Err.)	(3) Coefficient (Std. Err.)
Cohort 1935	-0.061*** (0.015)	-0.061*** (0.015)	-0.071*** (0.015)
Cohort 1936	0.058*** (0.015)	0.058*** (0.015)	0.048*** (0.015)
Cohort 1937	0.048*** (0.015)	0.048*** (0.015)	0.020 (0.015)
RB linear			0.801*** (0.006)
RB_1	0.961*** (0.030)	0.961*** (0.030)	
RB_2	1.667*** (0.032)	0.834*** (0.016)	
RB_3	2.471*** (0.034)	0.824*** (0.011)	
RB_4	3.049*** (0.037)	0.762*** (0.009)	
LC60	-0.154*** (0.000)	-0.154*** (0.000)	-0.154*** (0.000)
Intercept	267.992*** (0.021)	267.992*** (0.021)	268.007*** (0.020)
N		1505101	1505101
R^2		0.497	0.497
F $_{(8.1505092)}$		185805.487	297267.56

Significance levels : ∗ : 10%   ∗∗ : 5%   ∗ ∗ ∗ : 1%

NOTE: Computation with administrative data of the CNAV. We exclude from the sample observations where retirement age is above 66 and we keep only people born from 1934 to 1937. The dependent variable, age at retirement, is in quarters. RB_i variables are defined as the number i of quarters necessary to get the full rate after the reform. For instance RB_2 equals 1 if the individual is born in 1935 with 132 to 150 quarters of contribution at 60, those born in 1936 with 151 quarters of contribution at 60 and those born in 1937 with 152 quarters of contribution.

In specification (1), RB_i variable are simple dummy variable. In specification (2) we normalize by i, ie $RB_i = i$. In specification (3) we suppose a linear effect. LC60 is the number of quarters of contribution at 60. Standard errors are reported in brackets.

Table 6: Coefficients of interaction variable in double differences regressions. Retirement age is the dependent variable.

Local	Pensioners of the *régime général*	
	All pensioners	Normal pensions
1934-35 ≤ 68 years	0.319 (0.021) **1.004**	0.437 (0.024) **1.748**
1935-36 ≤ 67 years	0.307 (0.019) **1.228**	0.413 (0.021) **1.652**
1936-37 ≤ 66 years	0.376 (0.030) **1.504**	0.497 (0.035) **1.988**
1937-38 ≤ 65 years	0.416 (0.028) **1.664**	0.572 (0.032) **2.288**

Global	Pensioners of the *régime général*	
	All pensioners	Normal pensions
1934-35 ≤ 68 years	0.216 (0.012) **0.864**	0.397 (0.017) **1.588**
1935-36 ≤ 67 years	0.176 (0.012) **0.704**	0.322 (0.016) **1.288**
1936-37 ≤ 66 years	0.177 (0.012) **0.708**	0.309 (0.016) **1.236**
1937-38 ≤ 65 years	0.226 (0.011) **0.904**	0.389 (0.015) **1.556**

NOTES: Computations with administrative data of the CNAV. In the local cases, double differences are realized with 2 quarters of contribution, for example 151 and 152 for the generations 1934-35. In the global case, we use all possible contribution length and "are affected" by the reform those with between 131 and 152 quarters of contribution. Standard errors are reported in brackets and elasticities in bold.

Table 7: Impact of the reform on the probability to retire with disability pensions or pensions for unfitness.

	Effects on disability or unfitness		Effect on war related pensions	
	Local	Global	Local	Global
1934-35	0.125	0.043	0.0015	0.0005
≤ 68 years	(0.010)	(0.002)	(0.0008)	(0.0002)
1935-36	0.121	0.034	-0.0006	0.0006
≤ 67 years	(0.009)	(0.002)	(0.0007)	(0.0002)
1936-37	0.135	0.033	0.0009	0.0000
≤ 66 years	(0.009)	(0.002)	(0.0008)	(0.0002)
1937-38	0.121	0.036	0.0001	0.0005
≤ 65 years	(0.009)	(0.002)	(0.0006)	(0.0002)

NOTES: Computation with administrative data of the CNAV. The dependent variable in the first two columns of the table is a dummy variable which takes the value 1 if the pension is a disability pension or a pension for unfitness to work and 0 otherwise. In the last two columns it takes the value 1 if it is pensions for former prisoners in concentration camps, former prisoners of war, former resistance fighter or mothers working in factories. The coefficients reported correspond to the interaction of double differences (with respect to quarters of contribution and to generations). Standard errors are reported in brackets.

Table 8: Impact of the reform on the probability to retire with disability pensions or pensions for unfitness.

Variable	(1) Coefficient (Std. Err.)	(2) Coefficient (Std. Err.)	(3) Coefficient (Std. Err.)
Cohort 1935	0.001 (0.001)	0.002*** (0.001)	0.000 (0.000)
Cohort 1936	-0.007*** (0.001)	-0.005*** (0.001)	0.000 (0.000)
Cohort 1937	-0.004*** (0.001)	-0.001 (0.001)	0.000 (0.000)
RB		0.116*** (0.001)	0.002*** (0.000)
RB_1	0.094*** (0.002)		
RB_2	0.109*** (0.002)		
RB_3	0.122*** (0.002)		
RB_4	0.131*** (0.002)		
LC60	-0.003*** (0.000)	-0.003*** (0.000)	0.00002*** (0.00000)
Gender	-0.019*** (0.001)	-0.018*** (0.001)	0.004*** (0.000)
Intercept	0.666*** (0.001)	0.664*** (0.001)	0.003*** (0.000)
N	2078241	2078241	2078241
R^2	0.083	0.084	0.002
F	$F_{(9,2078231)}$ 21000.767	$F_{(6,N)}$ 31745.26	803.997

Significance levels : $*$: 10% $**$: 5% $***$: 1%

NOTES: Computation with administrative data of the CNAV. We exclude from the sample observations where retirement age is above 66 and we keep only people born from 1934 to 1937. RB_i variables are defined as the number i of quarters necessary to get the full rate after the reform. For instance RB_2 equals 1 if the individual is born in 1935 with 132 to 150 quarters of contribution at 60, those born in 1936 with 151 quarters of contribution at 60 and those born in 1937 with 152 quarters of contribution.

In specification (1) and (2) the dependent variable is the fact to retire with a disability pension or pension for unfitness or for war related reasons. In specification (3) the dependent variable is the fact to retire with a war related pension. Standard errors are reported in brackets.

Table 9: Impact of one additional quarter - all pensioners

Variable	(1) Coefficient (Std. Err.)	(2) Coefficient (Std. Err.)	(3) Coefficient (Std. Err.)
Cohort 1935	-0.051***	-0.051***	-0.099***
	(0.013)	(0.013)	(0.012)
Cohort 1936	0.081***	0.081***	-0.004
	(0.013)	(0.013)	(0.012)
Cohort 1937	0.070***	0.070***	-0.061***
	(0.013)	(0.013)	(0.012)
RB linear			0.756***
			(0.006)
RB_1	0.816***	0.816***	
	(0.029)	(0.029)	
RB_2	1.513***	0.756***	
	(0.032)	(0.016)	
RB_3	2.324***	0.775***	
	(0.034)	(0.011)	
RB_4	2.906***	0.726***	
	(0.036)	(0.009)	
DIS	-8.267***	-8.267***	-8.162***
	(0.011)	(0.011)	(0.011)
$RB_1 * DIS$	2.523***	2.523***	
	(0.051)	(0.051)	
$RB_2 * DIS$	1.932***	0.966***	
	(0.053)	(0.027)	
$RB_3 * DIS$	1.159***	0.386***	
	(0.056)	(0.019)	
$RB_4 * DIS$	0.779***	0.195***	
	(0.059)	(0.015)	
RBL*DIS			0.429***
			(0.011)
LC60	-0.118***	-0.118***	-0.118***
	(0.000)	(0.000)	(0.000)
Intercept	263.004***	263.004***	263.005***
	(0.018)	(0.018)	(0.018)
N	2078241	2078241	2078241
R^2	0.413	0.413	0.412
F $_{(13,2078227)}$	112476.774	112476.774	F $_{(7,N)}$ 207975.464

Significance levels : $*: 10\%$ $**: 5\%$ $***: 1\%$

NOTE: Computation with administrative data of the CNAV. We exclude from the sample observations where retirement age is above 66 and we keep only people born from 1934 to 1937. The dependent variable, age at retirement, is in quarters. RB_i variables are defined as the number i of quarters necessary to get the full rate after the reform. For instance RB_2 equals 1 if the individual is born in 1935 with 132 to 150 quarters of contribution at 60, those born in 1936 with 151 quarters of contribution at 60 and those born in 1937 with 152 quarters of contribution. DIS is a dummy variable which takes the value 1 if the individual retires with a disability pension or a pension for unfitness. LC60 is the number of quarters of contribution at age 60. Standard errors are reported in brackets.

Table 10: Corrected coefficients of the interaction variable in double difference regressions. Retirement age is the dependent variable.

Local	Normal pensions		
	Without correction	(Low estimation)	(High estimation)
1934-35	0.437	0.174	0.222
≤ 68 years	(0.024)	(0.024)	(0.024)
	1.748	**0.696**	**0.888**
1935-36	0.413	0.179	0.226
≤ 67 years	(0.021)	(0.020)	(0.020)
	1.652	**0.716**	**0.904**
1936-37	0.497	0.156	0.203
≤ 66 years	(0.035)	(0.034)	(0.034)
	1.988	**0.624**	**0.812**
1937-38	0.572	0.151	0.207
≤ 65 ans	(0.032)	(0.031)	(0.031)
	2.288	**0.604**	**0.828**

NOTE: Computations with administrative data of the CNAV. The coefficient is the interaction between the contribution length at 60 and the generation variable. Standard errors are reported in brackets and elasticities in bold. The low estimation suggests the lower bound correction with the hypothesis that all those who have manipulated their quarters of contribution have retired at 60. The high estimation suggests an upper bound with the hypothesis that the proportion of the "manipulated" that retired at 60 or 60.25 is the same as the actual proportion. The hypothesis common to both correction is that the proportion of individuals with, for instance, 152 quarters of contribution at 60 born in 1935 is the same for those born in 1934.

Table 11: Impact of one additional quarter - with correction

Variable	(1) Coefficient (Std. Err.)	(2) Coefficient (Std. Err.)	(3) Coefficient (Std. Err.)
Cohort 1935	-0.065*** (0.013)	-0.065*** (0.013)	-0.101*** (0.012)
Cohort 1936	0.068*** (0.013)	0.068*** (0.013)	-0.003 (0.012)
Cohort 1937	0.057*** (0.013)	0.057*** (0.013)	-0.059*** (0.012)
RB linear			0.748*** (0.006)
RB_1	0.645*** (0.029)	0.645*** (0.029)	
RB_2	1.512*** (0.032)	0.756*** (0.016)	
RB_3	2.321*** (0.034)	0.774*** (0.011)	
RB_4	2.903*** (0.036)	0.726*** (0.009)	
DIS	-8.271*** (0.011)	-8.271*** (0.011)	-8.163*** (0.011)
$RB_1 * DIS$	2.685*** (0.050)	2.685*** (0.050)	
$RB_2 * DIS$	1.937*** (0.053)	1.937*** (0.053)	
$RB_3 * DIS$	1.164*** (0.056)	1.164*** (0.056)	
$RB_4 * DIS$	0.784*** (0.059)	0.784*** (0.059)	
RBL*DIS			0.437*** (0.011)
LC60	-0.118*** (0.000)	-0.118*** (0.000)	-0.118*** (0.000)
Intercept	263.017*** (0.018)	263.017*** (0.018)	263.006*** (0.018)
N	2078228	2078228	2078228
R^2	0.413	0.413	0.412
F	$F_{(13,2078214)}$ 112435.046	112435.046	$F_{(7,2078220)}$ 207895.797

Significance levels : ∗ : 10% ∗∗ : 5% ∗ ∗ ∗ : 1%

NOTE: Computation with administrative data of the CNAV with the correction for the "manipulation bias". We exclude from the sample observations where retirement age is above 66 and we keep only people born from 1934 to 1937. The dependent variable, age at retirement, is in quarters. RB_i variables are defined as the number i of quarters necessary to get the full rate after the reform. For instance RB_2 equals 1 if the individual is born in 1935 with 132 to 150 quarters of contribution at 60, those born in 1936 with 151 quarters of contribution at 60 and those born in 1937 with 152 quarters of contribution. DIS is a dummy variable which takes the value 1 if the individual retires with a disability pension or a pension for unfitness. LC60 is the number of quarters of contribution at age 60. Standard errors are reported in brackets.

Table 12: Average retirement age - double differences (EIR)

Generations	Length of contribution at 60		
	Affected	Non-affected	Difference
Panel A : Natural experiment			
1934-36	61.164	60.277	0.886
	(0.041)	(0.009)	(0.028)
1930-32	61.056	60.355	0.7
	(0.046)	(0.012)	(0.036)
Difference	0.108	-0.077	0.185
	(0.062)	(0.015)	(0.045)
			0.74
Panel B : Control experiment			
1930-32	61.056	60.355	0.7
	(0.046)	(0.013)	(0.036)
1926-28	61.239	60.515	0.724
	(0.063)	(0.019)	(0.05)
Difference	-0.183	-0.159	-0.023
	(0.078)	(0.021)	(0.062)
			-0.09

NOTE: Computations with data from EIR 2001. We have excluded the individuals who have retired after age 64. Our sample is restricted to individuals who have retired only through *régime général* schemes. A person is considered affected by the reform if she has at 60 between 131 and 152 quarters of contribution and non-affected otherwise. Standard errors are reported in brackets and elasticities in bold.

Table 13: Average retirement age - double differences (EIR)

| Generations | Length of contribution at 60 | | |
	Affected	Non-affected	Difference
Panel A : Natural experiment 1			
1934	61.676	61.498	0.178
	(0.066)	(0.027)	(0.087)
1932	61.476	61.501	-0.024
	(0.084)	(0.038)	(0.121)
Difference	0.199	-0.003	0.203
	(0.108)	(0.046)	(0.144)
			0.81
Panel B : Control experiment 1			
1932	61.476	61.501	-0.024
	(0.089)	(0.038)	(0.121)
1930	61.618	61.674	-0.055
	(0.095)	(0.039)	(0.129)
Difference	0.172	-0.159	-0.030
	(0.130)	(0.055)	(0.177)
			-0.12

NOTE: Computations with data from EIR 2001. We have excluded the individuals who have retired after age 66. Our sample is restricted to individuals who have retired only through *régime général* schemes. A person is considered affected by the reform if she has at 60 between 131 and 150 quarters of contribution and non-affected otherwise. Standard errors are reported in brackets and elasticities in bold.

Table 14: Dependent variable: retirement age - data EIR 2001

Variable	(1) Coefficient (Std. Err.)	(2) Coefficient (Std. Err.)
QUA*Generations affected	0.726*	
	(0.376)	
QUA	-0.264	
	(187.395)	
Trend*QUA	0.002	
	(0.097)	
$R93_1$		0.446**
		(0.204)
$R93_3$		0.695**
		(0.299)
QUA_1		3.597***
		(0.242)
QUA_3		-0.059
		(0.209)
Generation 1932	-0.458***	-0.111***
	(0.094)	(0.022)
Generation 1934	-0.528***	-0.122***
	(0.086)	(0.021)
Generation 1936	-0.603***	-0.158***
	(0.114)	(0.028)
Intercept	241.659***	241.644***
	(0.069)	(0.066)
N	13072	13072
R^2	0.091	0.11
$F_{(6.13065)}$	217.273	$F_{(7.13064)}$ 230.454

Significance levels : $*: 10\%$ $**: 5\%$ $***: 1\%$

NOTE: Computations with EIR 2001 data. We exclude individuals who retired at age 65 or older. Our sample is restricted to individuals who have retired only through *régime général* schemes. The dependent variable, age at retirement, is in quarters. QUA variable is equal to 1 if individuals have at 60 between 131 and 152 quarters of contribution and 0 otherwise. The trend is the year of birth. Variables $R93_1$ et $R93_3$ correspond to the number (1 or 3) of quarters of contribution necessary to obtain the full rate with the reform and variables QUA_1 and QUA_3 correspond to the fixed effect of quarters of contribution at 60. Standard errors are reported in brackets.

Table 15: Net impact of the 1993 reform on retirement age

Between 131 and 150 quarters of contribution at 60		Between 151 and 160 quarters of of contribution at 60	
	Net effect		Net effect
4 % disability	4 % disability	11 % disability	11 % disability
Of those remaining		Of those remaining	
manipulation ?	manipulation ?	26 % manipulated	23 % manipulated
75 % postponed	72 % postponed	58 % postponed	51 % postponed
25 % retire at age 60	24 % retire at age 60	16 % retire at age 60	14 % retire at age 60

Figure 1: Labor force participation rate French males by age group - INSEE *Labor Force Survey* 1969-2002

LEGEND: △ 46-50 years old ▽ 51-55 years old -+- 56-60 years old ○ 61-65 years old - ✳ - 66-70 years old
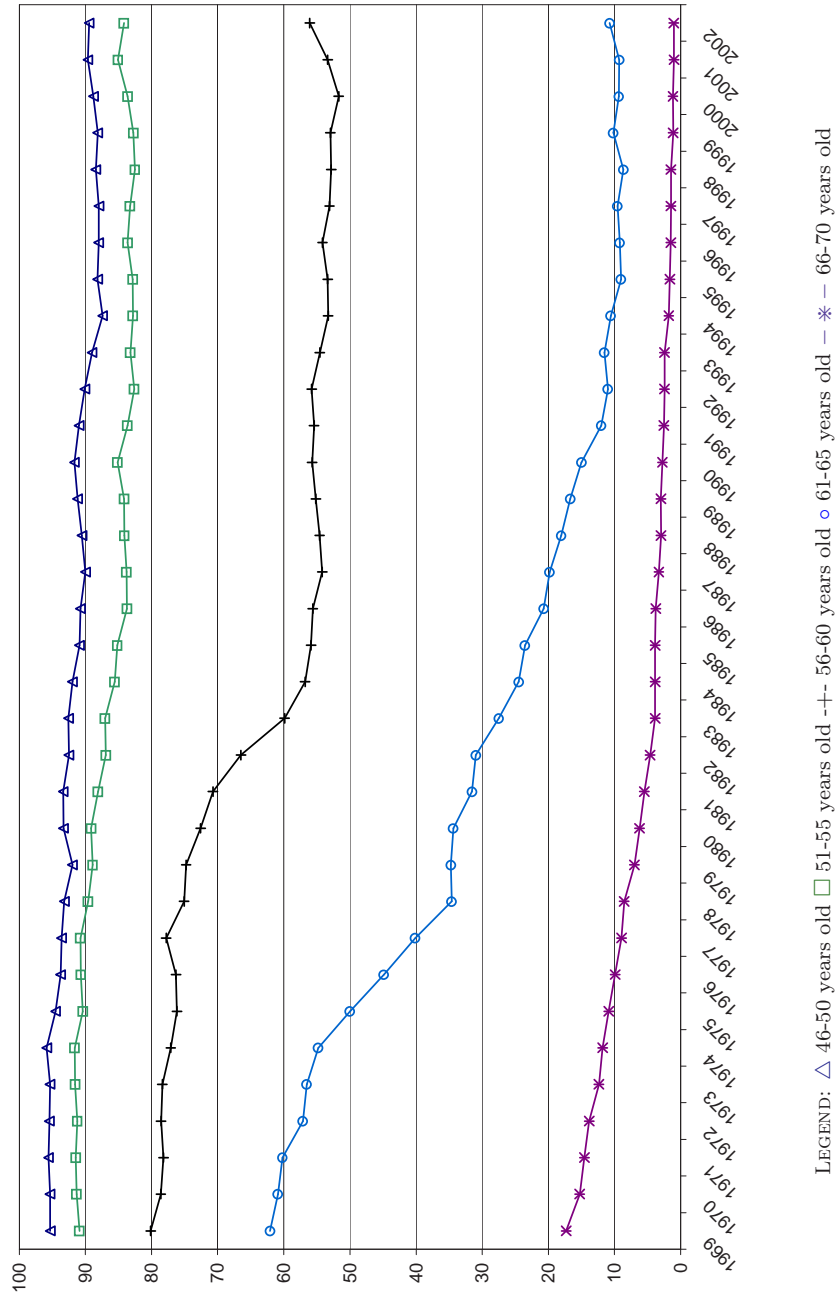
Figure 2: Average retirement age
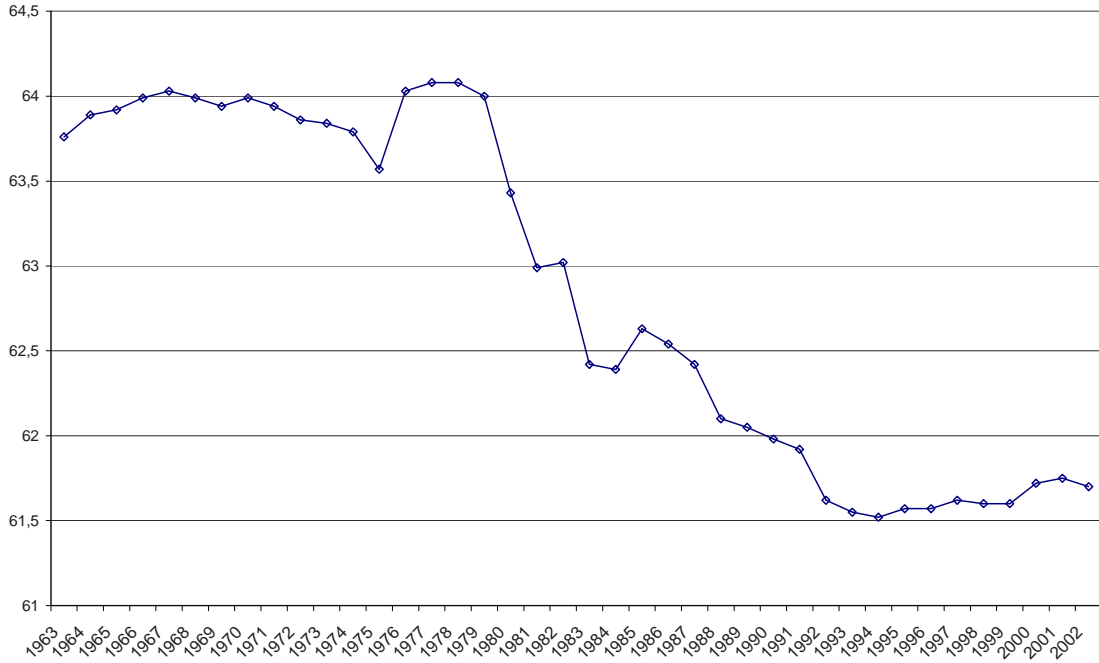
Figure 3: Average retirement age by generation
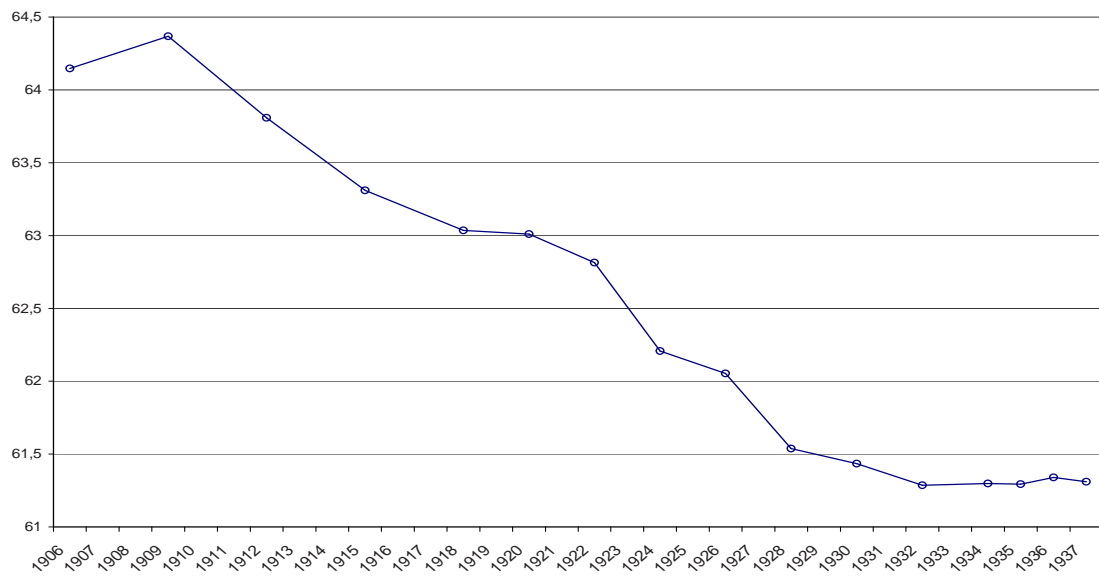
NOTE: We exclude the individuals who have retired after age 66. For the generations from 1909 to 1934, average retirement age was computed with EIR 2001 and for younger generation (1935 to 1937) with administrative data from the CNAV (1994-2003). The sample is not quite comparable in both data set as EIR 2001 has data only on the retirees alive in 2001. Differential mortality might play a role for older generations.

Figure 4: Distribution of the number of quarters of contribution at retirement by generation (pensioners of the "régime général").

(a) Generation 1924

(b) Generation 1926

(c) Generation 1928

(d) Generation 1930

(e) Generation 1932

(f) Generation 1934

(g) Generation 1936

(h) Generation 1938
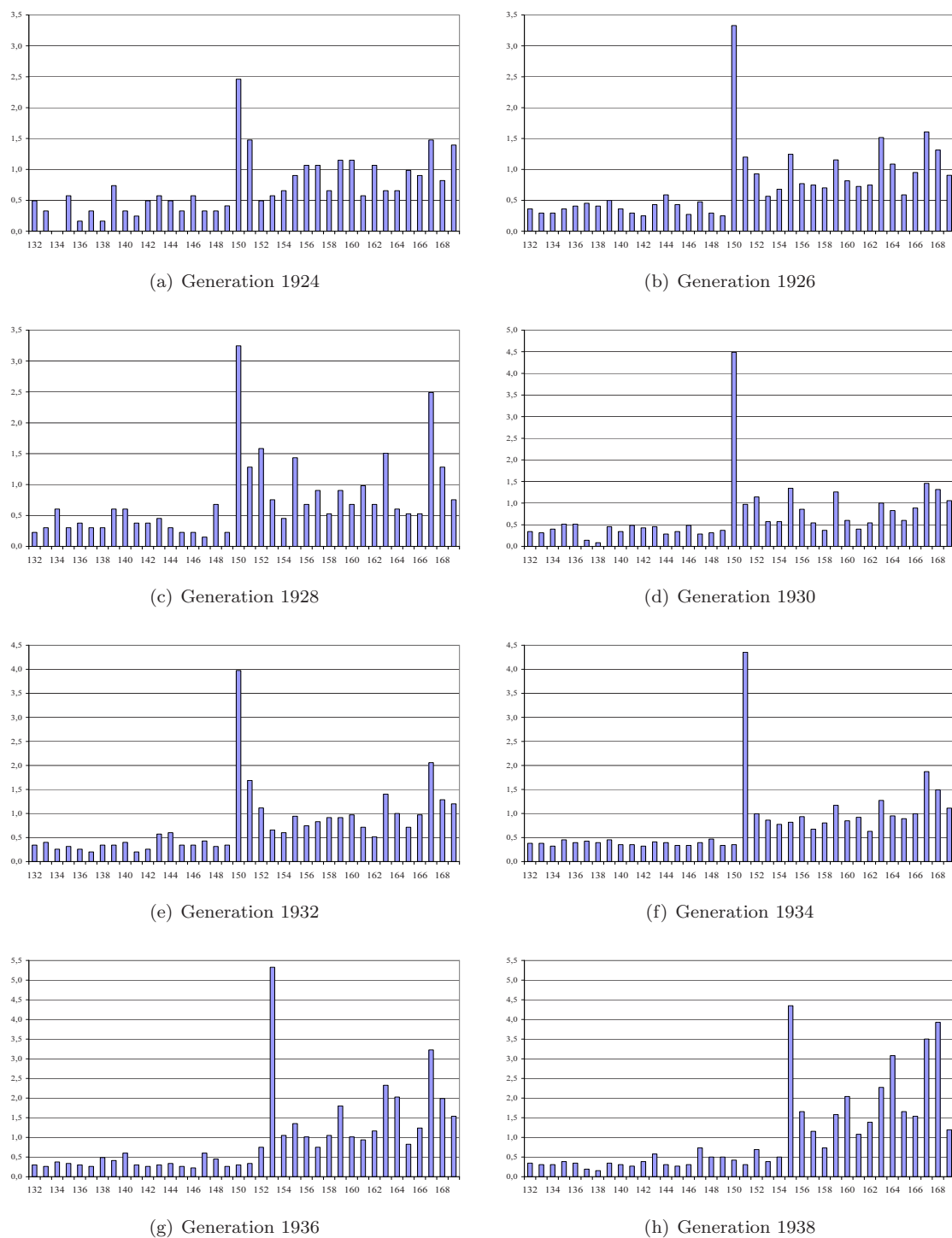
Source: Echantillon Interrégime de Retraités (EIR) 2001

Figure 5: Distribution of the number of quarters of contribution at retirement by generation (pensioners of the "régime général").

(a) Generations 1933 and before

(b) Generation 1934

(c) Generation 1935

(d) Generation 1936

(e) Generation 1937

(f) Generation 1938

(g) Generation 1939

(h) Generation 1940

SOURCE: Administrative date of the CNAV - All pensioners of the CNAV who retired between the 2nd semester of 1994 and December 31st 2003 (5'273'827 pensioners).
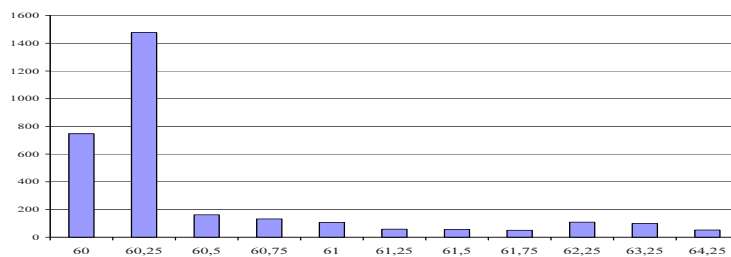
Figure 6: Distribution of the retirement age by generation and by the number of quarters of contribution at age 60. (normal pensions only).
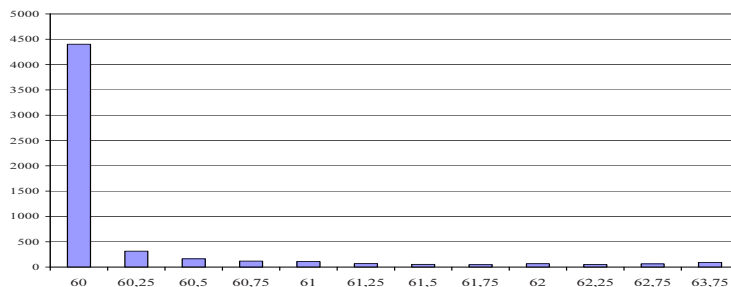
(a) Generation 1934 - 151 quarters at age 60 (5634 obs.)
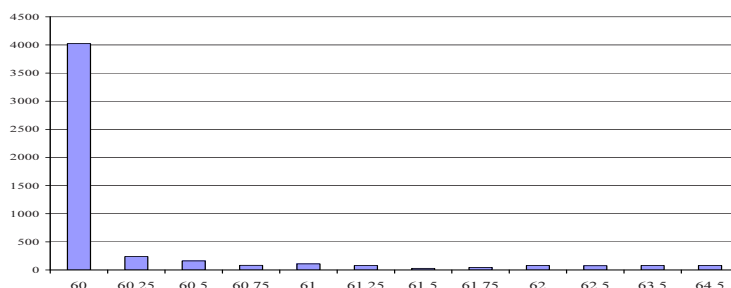
(b) Generation 1934 - 152 quarters at age 60 (5080 obs.)
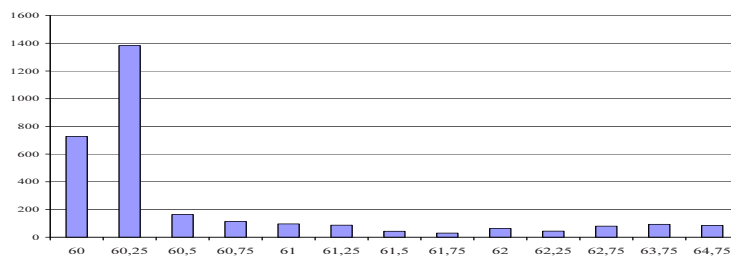
(c) Generation 1935 - 151 quarters at age 60 (3010 obs.)
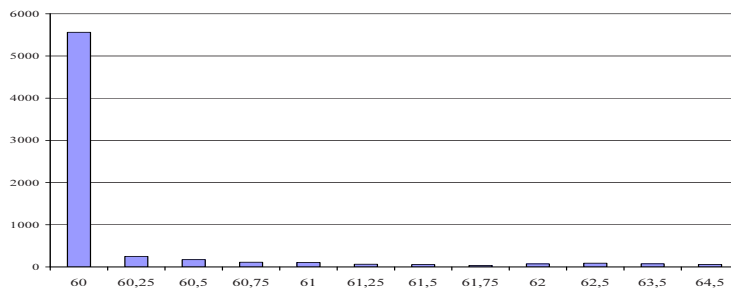
(d) Generation 1935 - 152 quarters at age 60 (6651 obs.)

Figure 7: Distribution of the retirement age by generation and by the number of quarters of contribution at age 60. (normal pensions only).
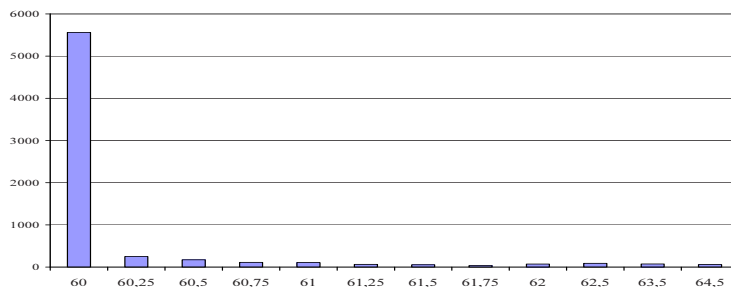
(a) Generation 1935 - 152 quarters at age 60 (6651 obs.)
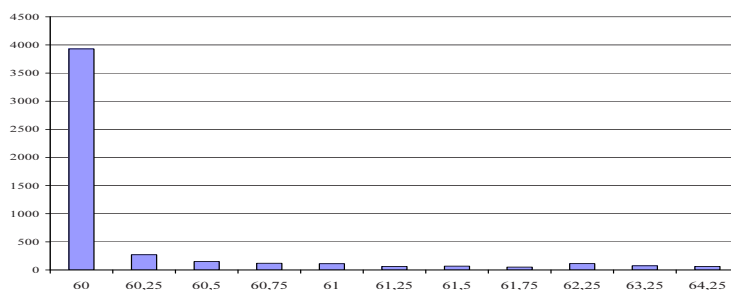
(b) Generation 1935 - 153 quarters at age 60 (5014 obs.)
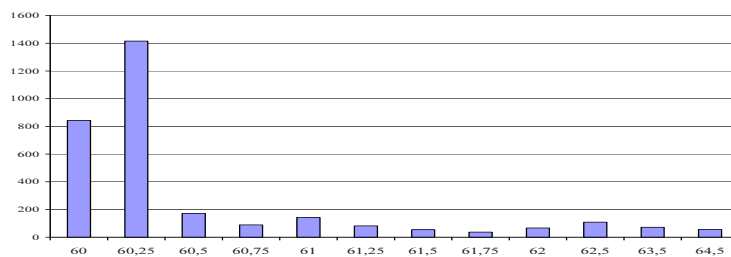
(c) Generation 1936 - 152 quarters at age 60 (3139 obs.)
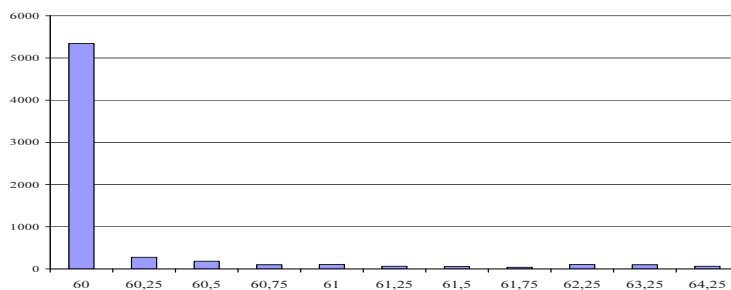
(d) Generation 1936 - 153 quarters at age 60 (6436 obs.)

SOURCES: Administrative data of the CNAV. The number of quarters of contribution at age 60 is computed from the number of quarters at retirement supposing that each quarter past 60 led to one quarter of contribution.

Figure 8: Distribution of the retirement age by generation and by the number of quarters of contribution at age 60. (normal pensions only).
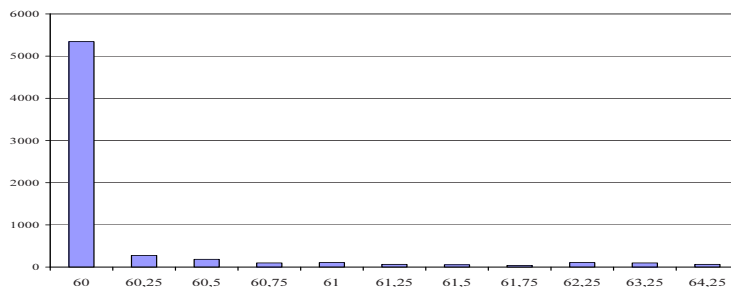
(a) Generation 1936 - 153 quarters age 60 (6436 obs.)
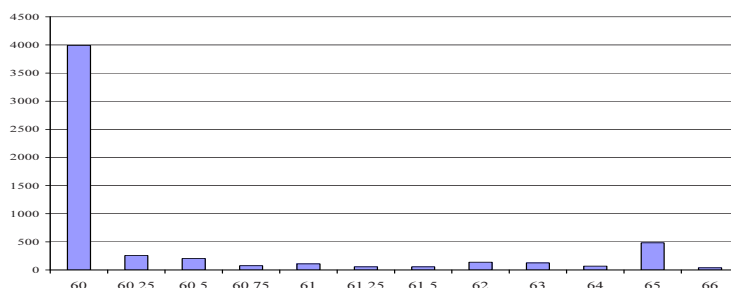
(b) Generation 1936 - 154 quarters age 60 (5598 obs.)

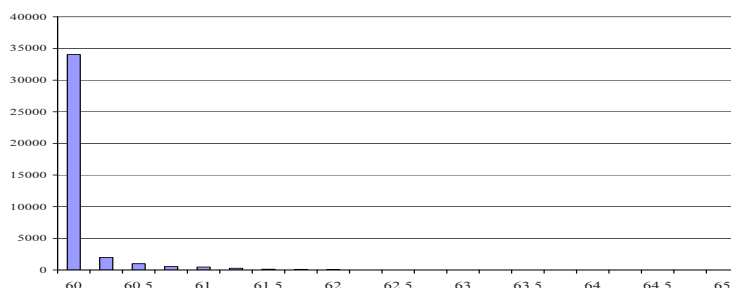(c) Generation 1937 - 153 quarters age 60 (3049 obs.)
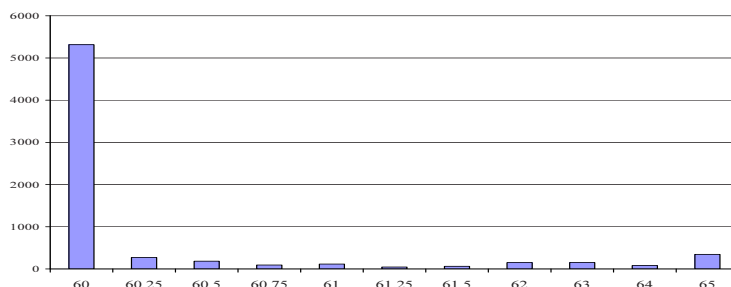
(d) Generation 1937 - 154 quarters age 60 (6814 obs.)

SOURCES: Administrative data of the CNAV. The number of quarters of contribution at age 60 is computed from the number of quarters at retirement supposing that each quarter past 60 led to one quarter of contribution.
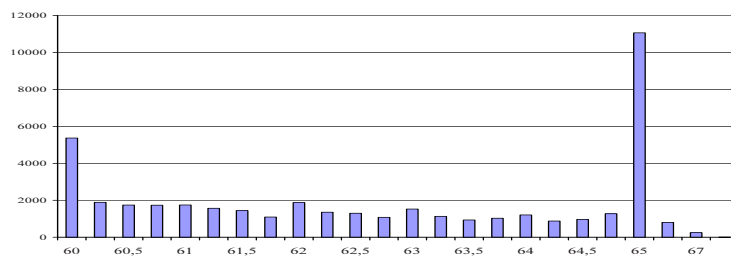
Figure 9: Distribution of the retirement age by generation and by the number of quarters of contribution at age 60. (normal pensions only).
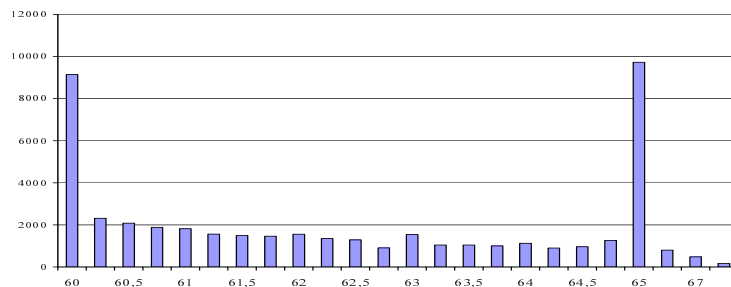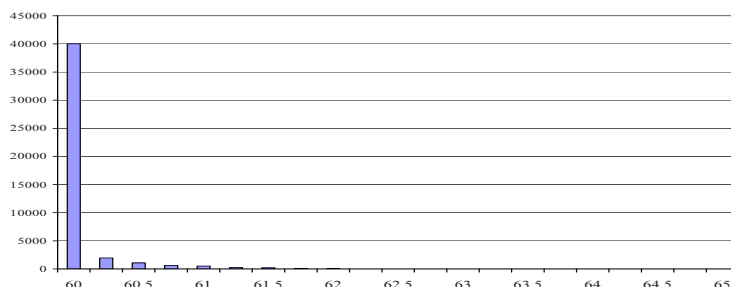

(a) Generation 1934 - 143 à 151 quarters (46875 obs.)

(b) Generation 1934 - 152 à 160 quarters (38596 obs.)

(c) Generation 1935 - 143 à 151 quarters (43245 obs.)

(d) Generation 1935 - 152 à 160 quarters (44789 obs.)

SOURCES: Administrative data of the CNAV. The number of quarters of contribution at age 60 is computed from the number of quarters at retirement supposing that each quarter past 60 led to one quarter of contribution.