Distance to Retirement and Older Workers' Employment: The Case For Delaying the Retirement Age

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Abstract

This paper presents empirical evidence and a theoretical foundation in favor of the view that the retirement age decision affects older workers' employment prior to retirement. To the extent that there are search frictions on the labor market, the return on jobs is determined by their expected duration: the time to retirement is then key to understanding older workers' employment. Countries with a retirement age of 60 are indeed characterized by lower employment rates for workers aged 55-59. Based on the French Labor Force Survey, we show that the likelihood of employment is significantly affected by the distance to retirement, in addition to age and other relevant variables. We then extend McCall's (1970) job search model by explicitly integrating life-cycle features with the retirement decision. Using simulations, we show that the distance effect in interaction with the generosity of unemployment benefits and the depressed demand for older workers explains the low rate of employment just before the eligibility age for the Social Security pension. Finally, we show that implementing actuarially-fair schemes not only extends the retirement age, but also encourages a more intensive job-search by older unemployed workers.

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1 Introduction

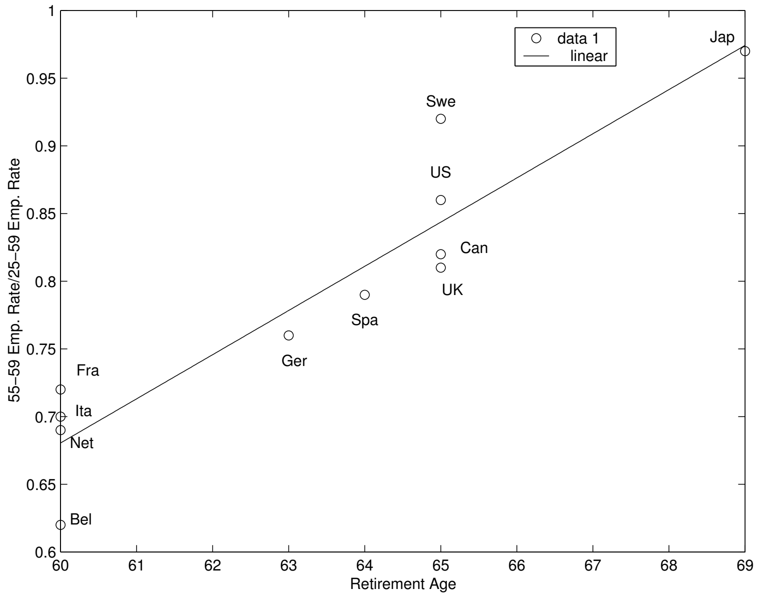
Ageing jeopardizes the sustainability of Pay-As-You-Go (PAYG) systems. Faced with this changing demographic trend, most developed countries have chosen to encourage the elderly to delay retirement by rewarding a longer working life with more actuarially-fair pensions. However, especially in some European countries, such a strategy could be weakened by the fact that a significant proportion of older workers are actually unemployed or entitled to specific assistance programs long before the current age at which benefits are first available. One often alleged reason is that technical progress makes older workers less employable[1]. Hence, trying to increase older workers' rate of employment seems to be an unattainable goal in a context where jobs available for them are scarce.

In this paper, we put forward the idea that the existence of a retirement date intrinsically creates a decrease in the employment rate just before this age. To the extent that there are search frictions on the labor market, the return on jobs is determined by their expected duration: the time to retirement is then key to understanding older workers' employment. The observed low employment rate of near-to-retirement people then cannot be considered as a reason for not postponing the retirement age. The reasoning is completely reversed: retirement postponement is actually likely to increase the employment rate of these workers, thereby contradicting the widespread view that the low employment rate of older workers makes any extension of the retirement age pointless.

We indeed observe in countries with a retirement age of around 60 (Belgium, France, Italy), that the employment rates for 55 - 59 year-old workers are the lowest in the OECD

[1] It is, however, a debated issue (Crépon et al. (2002), Hellerstein et al. (1999), Friedberg (2003), Aubert et al. (2006)). Technological and organisational innovations may be beneficial to older workers because they are more skilled and experienced. On the other hand, innovation accelerates skill obsolescence and requires adaptability. Whereas Borghans & TerWeel (2002) and Friedberg (2003) find no significant impact of technical changes on old workers' employment, Aubert et al. (2006) observe such an influence and emphasize both organizational and technological changes.

Figure 1: Older Worker Employment Rate and Retirement Age (Men, OECD, 1995)



countries (Figure 1)[2]. In contrast, Japan, and to a lesser extent Sweden, the US, Great Britain and Canada are characterized by the highest retirement ages and employment rates between the ages of 55-59. This suggests that the retirement age could affect the employment rate of older workers prior to this age: the later the retirement age, the higher the employment of older workers before 60. However, the existence of unemployment and disability programs for older workers in the first group of countries could disqualify this idea. These programs are often considered as an early retirement device before the official eligibility age for the Social Security (SS) pension (Gruber & Wise, 1999; Blondal & Scarpetta, 1998). They indeed correspond to an inactivity spell until retirement occurs. From our point of view, this situation must be distinguished from retirement stricto sensu[3] and viewed as a (non-)search decision of non-employed workers. Of course, the high generosity of these programs could amplify the retirement age feedback effect by giving unemployed people the means to wait for retirement without searching for a job. This is why a low retirement age associated with generous unemployment benefits could explain the low employment rate of older workers that prevails in some European countries such as Belgium, France or Italy.

[2] Figure 1 plots the scattered male employment rate of older workers aged 55 - 59 relative to the overall employment rate of those aged 25 - 59 against the retirement age, calculated for the country panel selected by Gruber & Wise (1999) in 1995.

[3] In the rest of the paper, the term "retirement" will be used with this strict meaning.

However, we agree that this interpretation must be considered with caution at this stage. In this paper, using individual data, we try to properly identify the effect of the distance to retirement on the labor market equilibrium before the early retirement age. We take advantage of the French Social Security system and its reform in 1993 to propose an original identification strategy based on the existing heterogeneity across individuals in terms of distance to retirement. Moreover, we also take advantage of the fact that the retirement age is quite independent of the current labor market status to cope with a potential reverse causation from unemployment to retirement. We then estimate a logit model on individual panel data (French Labor Force Survey, hereafter LFS) that measures how the distance to full pension age affects male employment probabilities. It appears that the shorter the distance to retirement, the lower the probability of being employed.

In order to rationalize the distance effect revealed on French individual data, we develop a modified version of McCall's (1970) model, in which unemployed workers look for a new job and choose an optimal search intensity, which will influence the average length of unemployment spells. Beyond the heterogeneity arising from the exogenous wage offer distribution, life cycle features are also considered. Following Ljungqvist & Sargent (2008), agents age stochastically. In addition, retirement choice is endogenous. Our originality is to investigate how the retirement decision, mainly driven by the tax on continued activity imposed by Social Security provisions, modifies the search behavior. The relative value of retirement compared to employment determines the job value for unemployed older workers.

Our streamlined model must be considered as a first attempt to model the interaction between retirement decisions and employment issues at the end of working life. In particular, it is clearly beyond the scope of the paper to explain the overall retirement age distribution. Especially, unlike Benitez Silva (2003), we leave aside the interaction between job search, health and wealth.[4] Moreover, it must be emphasized that this is only one way to interpret our empirical results. We are not able to say whether this distance effect affects labor demand or labor supply. The estimated variable is the equilibrium employment probability. However, as the retirement age and the unemployment search intensity are joint decisions for workers, we think that focusing on labor supply is a natural first step in the analysis of the interaction between retirement and pre-retirement labor market

[4] See Bettendorf & Broer (2003) for another search model with savings. However, with perfect insurance, they impose strong restrictions on search decisions.

decisions[5]. This is not to say that labor demand does not play any role in the decrease in the employment rate at the end of working life. We do take into account this dimension, but exogenously, by calibrating by age the wage distribution and the separation rate.

Our main contribution is then to quantify the importance of the distance effect in the observed decrease in the employment rate prior to the retirement age by calibrating the model on French data and simulating some counterfactual experiments. It appears that the distance effect plays a key role *in conjunction* with the generosity of unemployment benefits for older workers. We also show that the distance effect modifies pre-retired workers' search particularly when the separation rate is high. Time to retirement matters, but in conjunction with other factors such as higher unemployment benefits and depressed labor demand. We then illustrate the policy implication of this result by studying the impact of a Social Security reform that removes the tax on continued activity, thereby rewarding a longer working life with an actuarially-fair increase in pension. We show that such a policy does yield a double dividend: *(i)* workers are encouraged to delay retirement, which is the usual expected gain from this measure *(ii)* more unemployed older individuals are now willing to look for a job and accept job offers.

The distance effect has already been explicitly identified by Seater (1977) who theoretically stresses, in a life-cycle labor supply model, that the job search is age-dependent. Adopting a descriptive approach, Hutchens (1988) shows that hired older workers are less equally distributed across industries and occupation than both recently hired younger workers and all older workers. He interprets this empirical finding as suggestive of the fact that older workers are offered a smaller set of alternative job opportunities than younger workers because the latter have more years to devote to a job than the former. More recently, also using a labor supply approach, Ljungqvist & Sargent (2008) quantitatively show that the elasticity of job search intensity to unemployment benefits is greater for

[5] Chéron et al. (2006) show in the Mortensen-Pissarides general equilibrium framework that firms' firings and hirings are respectively higher and lower when the retirement age is getting closer. However, when the retirement age is endogenous, this interaction between workers' retirement choice and firms' hiring and firing decisions is not a simple extension of the distance argument, but a substantially different one. Indeed, in that case, the retirement age is private and asymmetric information. Firms must solve a potentially difficult problem to infer the expected retirement age for each individual, especially when the SS system is actuarially fair, i.e. when retirement age relies on individual preferences for leisure. The issue of the hiring, firing and bargaining decisions would then be much more complex in this context. Modelling the labor demand side when the retirement age is endogenous is an interesting issue, but it is left for future research.

older workers, leading to the view that the impact of labor market institutions can be age-dependent. However, they only briefly mention the distance to retirement effect, and even less do they aim at quantifying its contribution to the low employment rate of older workers. While they refer to "changes in economic turbulence", modelled as immediate loss of human capital at times of involuntary job displacements, we focus in our paper on the combination of the distance effect and generous pre-retirement plans. Although the distance effect has already been mentioned in other papers, ours is the first contribution that aims at quantifying it and deriving its implications for SS reforms by making both retirement and search decisions endogenous.

Our paper is organized as follows. We first investigate the empirical relevance of our intuition (Section 2). We then present our theoretical framework in order to propose an interpretation and a quantification of the distance to retirement effect and finally an evaluation of a policy that introduces more actuarially-fair pension adjustments (Section 3).

2 Empirical Evidence

In this section, we present some empirical evidence in favor of the view that there is a feedback effect of the distance to retirement on the employment rate of older workers. It is not the biological age (its absolute level) that matters in explaining the employment rate of older workers, but what can be called the social age (the age relative to the retirement age). More precisely, we measure the feedback effect of the retirement age on the chances of being employed using individual data. Our intuition is that, as individuals get closer to their pension age, they are less likely to be employed. The use of individual data enables us to control for other determinants of older workers' employment.

2.1 Data and Empirical Strategy

The distance to retirement is captured by the difference between the current age and the expected retirement age. The first problem is that the latter is unobservable. The second one is the risk of misinterpreting a reverse causation from unemployment to retirement, as the status on the labor market could affect retirement choices. Considering the French pension system allows us to cope with both problems. The retirement age is completely determined by the required number of contributive years to get the full pension rate, because of the huge tax on continued activity that prevailed in the French pension system prior to the 2003 reform: as stressed by Blanchet & Pelé (1997), in France, there are no incentives to delay retirement after the full pension age as no pension adjustments are made for any additional working year[6]. The retirement can then be approximated by the full pension age which is exogenous to their labor market status. Obviously, our proxy for the retirement age does not take into account incomplete careers. However, we believe that our proxy remains relevant as unemployment episodes in the French system are included in the number of contributive periods. Furthermore, non-continuous careers due to maternity leaves and family commitments could indeed make our proxy less accurate. To avoid this bias, we measure the impact of the retirement age on *male* employment only.

The retirement age is then computed by adding to the age at first job the required number of contributive years to qualify for full pension. The distance to retirement (D_i) for an individual i is equal to his age at first job (F_i) plus the legal number of contributive years to get the full pension (C) minus his current age (A_i): $D_i = F_i + C - A_i$. However, if a person enters the job market at a very young age, he cannot retire before the eligibility age for SS pension (60 years old) even though he has accumulated the required number of contributive quarters before this age. In this case, the expected retirement age is then set at 60. Finally, we take into account the fact that individuals aged 65 receive the full pension whatever their number of contributive years[7]. Finally, our distance to retirement is defined as: $D_i = Min[Max(60, F_i + C), 65] - A_i$. So, we have two subsets of individuals in our sample: individuals who are not constrained by the 60 or 65 bounds and those who are constrained, whose expected retirement age is either 60 or 65.

Tables A.1 - A.4 in the Appendix display the descriptive statistics of our sample. We consider variables that are widely used as key determinants of employment probabilities: age, age squared, education, marital status, number of children, size of city, sector, citizenship, education and occupational group. We add to these standard characteristics the number of years left before retirement. In the descriptive statistics, to summarize the impact of expected retirement on employment probabilities, distance to retirement is presented in dummies (11 years and more, 6 to 10 years, 3 to 5 years and less than 2 years). Table A.1 displays the expected number of years before retirement as a function of age for individuals of age 50 and older. Obviously, most individuals aged 58 and 59 (aged 55-57) have to wait for less than two years (between 3 and 5 years) before retiring. These

[6]This is why the expression "full pension" is used. Note that continued activity is highly rewarded before the full pension age.

[7]Note that we consider individuals who entered the labor market before 30 years old, so that we can consider that they get the full pension rate in their 65th year due to specific adjustments after this age.

statistics are consistent with the fact that the vast majority of French workers retire at the age of 60 (see Blanchard & Pelé, 1997). However, Table A.1 displays some heterogeneity in the distance to retirement at any age. The first lines of Table A.2 suggest that the number of years before retirement affect employment probabilities: employment odds fall as the individual gets closer to retirement. 63% of individuals who have to wait less than 3 - 5 years before drawing full pension are still working, while this proportion goes down to 37% for those who are 2 years away from retirement.

Where does this heterogeneity in the distance to retirement come from? First, as people start working at different ages, the retirement age is a heterogeneous individual characteristic. Provided we control for the level of education (and other individual characteristics), we believe that the heterogeneity in the age at first job explains the employment probability at the end of the working cycle through a distance to retirement effect. Secondly, the Balladur SS reform in 1993 provides another source of heterogeneity. The required number of contributive quarters before retirement amounts to 150 quarters for individuals born in 1933 or earlier, while the 1934 generation needs to contribute 151 quarters to Social Security, the 1935 generation 152 quarters and so on, and individuals born in 1943 or later, 160 quarters. As the required number of contributive quarters has gradually increased, considering data in the post reform era allows us to include in our sample individuals with heterogeneous distances to retirement. More precisely, we consider workers who are identical in all respects but for their number of contributive years depending on their year of birth. For an individual i born in year j, the distance to retirement is actually defined by: $D_{i,j} = Min[Max(60, F_i + C_j), 65] - A_i$.

Does this double source of heterogeneity in the distance to retirement significantly help explain the employment probability at the individual level? We first check whether this raw information has some explanatory power (Strategy I, Section 2.2). As one might be skeptical about the identification of the distance to retirement effect in this first stage, we then propose to show that the informational content specific to the distance to retirement does indeed matter for understanding the employment status at the end of the working life (Strategy II, Section 2.3). Finally, using difference-in-difference estimation, we will focus more specifically on the exogenous source of distance to retirement provided by the 1993 reform (Strategy III, Section 2.4).

Whatever the strategy implemented, we estimate logit models that measure how the distance to retirement age affects the chances of being employed. Estimating an unemployment duration model could be judged more appropriate. However, focusing only on unemployed people is too restrictive as non-employed older people are mainly outside the labor force, entitled to specific income programs. The dependent variable is the male probability of employment. It is coded as 1 when working, 0 otherwise, meaning unemployed or inactive (but not yet retired). The estimate is based on 13 successive waves of the French Labor Force Survey (LFS) (from 1990 through 2002). A third of the LFS sample is replaced each year. As a consequence, the LFS follows the same individual for only 3 consecutive years. Our sample is an unbalanced panel, which allows us to check the robustness of our results against events that are specific to each year, such as macroeconomic fluctuations. We implement random effect logit models that take advantage of the multi-period nature of the data and control for unobserved individual heterogeneity. Error terms then consist of random individual specific effects and unobserved individual characteristics that vary with time. A Hausman test confirms that a random effect logit is preferable to a fixed effect model.

2.2 Preliminary Investigation (Strategy I)

We first measure the effect of conventional explanatory variables (age, education, sector, etc.) on male employment probability before adding the distance to retirement in the estimated equation. The estimated coefficients of the model including only traditional variables without distance are displayed in the first column of Tables A.5 and A.6 the Appendix. The reference individual is a French blue-collar worker, with a low educational attainment, employed in the manufacturing sector, living with his spouse in the Paris area. He has no children. As far as standard characteristics are concerned, the estimates yield significant and expected results: higher skills (captured by the occupational group) and living in the Paris area increase employment probabilities. A high educational attainment, activities in the service sector and French citizenship also improve employment odds. Family characteristics affect employment status: compared with the reference individual, not having a spouse (respectively having 6 children or more) tends to reduce employment odds by 57% [8] (respectively by 35%). Notice that the coefficients on age are positive and negative on the quadratic term, thereby capturing the positive effect of age (as a proxy for experience) and the negative impact of human capital depreciation with age (quadratic term) on employment odds.

We add to the standard explanatory variables specific dummies on age (from the age

[8] $1 - e^{-0.8404}$

of 50 to 59). $age = k$ means that the dummy equals 1 if the individual is k years old, 0 otherwise. These variables capture the eligibility to programs specific to old workers, allowing them to withdraw from the labor force before the age of 60. From the age of 50 to 59, dummy variables appear negative and significant, which could be interpreted as the effect of the declining human capital and of older workers' specific programs.

Table 1 shows estimation results when the distance to retirement is introduced in the regression as an additional explanatory variable. Estimates on standard control variables are barely affected by the introduction of distance to retirement (second column of Tables A.5 and A.6 in the Appendix), which allows us to be confident that there is not much of a multicollinearity problem. We introduce distance to retirement in a non linear way. Two elements prompt us to adopt a non linear specification. First, for individuals who are far away from retirement, an additional year away from the retirement age is unlikely to influence their employment status. Another source of nonlinearity could arise from the existence of specific programs for workers over 50 years old. We then define the variable $dist \times (age = k)$ as the distance to retirement (in years) for an individual of age k, with $k = \{50, 51, ..., 59\}$, 0 otherwise. Distance to retirement could affect employment odds differently at each age k. This will be shown by the difference in the coefficients of the interaction terms.

First, notice in Table 1 that the distance to retirement appears significant with the correct sign: this confirms the view that older individuals' employment rate is affected by their expected retirement age. However, this is true only after the age of 56. This age appears as the threshold age at which distance to retirement begins to matter. It is interesting to note that, at these ages, generous income schemes are available to older workers[9], thereby suggesting a strong interaction between generous income plans and the expected retirement effect. Interestingly, age variables (age, age squared and age dummies from 50 to 59) remain significant, suggesting that distance to retirement negatively affects employment odds beyond the specific effect of age.

Secondly, the coefficient value on the distance variable increases from 0.082 at age 56 to 0.192 at age 59. As shown in Table A.1, at 55 (59), the heterogeneity in the distance to retirement ranges from 5 (1) to 10 (5) years. The noticeable increase in the coefficient associated with the distance and age interaction variable indicates that the distance effect

[9] Conditional on having already contributed the required number of quarters to Social Security, workers aged 55 are also eligible for specific older worker programs.

Table 1: Strategy I: Distance to retirement effect

	Coefficient	P value
Distance × (Age = 50)	-0.018	0.474
Distance × (Age = 51)	-0.028	0.278
Distance × (Age = 52)	0.020	0.446
Distance × (Age = 53)	-0.009	0.747
Distance × (Age = 54)	0.009	0.755
Distance × (Age = 55)	0.035	0.224
Distance × (Age = 56)	**0.082**	**0.003**
Distance × (Age = 57)	**0.125**	**0.000**
Distance × (Age = 58)	**0.186**	**0.000**
Distance × (Age = 59)	**0.192**	**0.000**

is particularly significant when individuals are sufficiently close to retirement [10]. For instance, for a worker aged 59, if the distance to the retirement age is increased by one year, this raises the employment odds by 21.1% - but only by 8.5% for a worker aged 56.

As one might argue that the age at first job actually captures the individual's education, thereby introducing a bias to our estimates. It is important to note that we control for educational attainment with a dummy variable. Individuals are either in the Low Education group (no degree to degrees obtained below the completion of High School, before Baccalauréat) or the High Education group (Baccalauréat and beyond). Table A.5 in the Appendix shows that this variable is significant and correctly signed in all our estimates. However, as the education variable cannot capture all the heterogeneity in the age at first job, the next section tries to identify the effect specific to the distance to retirement.

2.3 Experience or distance to retirement? (Strategy II)

By computation, the distance to retirement hinges upon the age at first job. The heterogeneity in the length of education in itself might actually account for the employment probability without recourse to the distance to retirement. Even though there are several ways of interpreting the role of the age at first job on the employment probability at the end of the working cycle (one could simply refer to unobserved heterogeneity), the most likely explanation is certainly the distance to entry or work experience (Benallah et al., 2008): for a given age, the lower the age at first job, the longer the experience, the lower the desire to be still at work (as if the disutility of working increased with the length of

[10] We checked that this conclusion remains relevant when the sample is reduced to individuals of age 50 and more.

the working life). The positive influence of the distance to retirement could actually come from the negative influence of experience (or the positive one of age at entry).

Here, we aim to isolate the informational content of experience and then identify the component specific to the distance to retirement. We take advantage of the French Social Security system which implies that experience and distance to retirement are not necessarily linked for individuals who are constrained by the 60 or 65 bounds. Indeed, on each constrained sub-population (the "60" and the "65"), at a given age, experience does not convey any information on the distance to retirement: for instance, 59-year-old people with more than 40 years of experience are all one year away from retirement, whatever their level of experience. On each sub-sample, there is no heterogeneity in the distance to retirement at any age. We can then identify the informational content of experience when distance to retirement does not matter. The distance variable is then omitted from the regression on each sub-sample[11]. Experience is introduced in conjunction with age: we can then measure, at each age between 50 and 59, the specific impact of experience on employment odds. Table 2 shows estimation results on individuals constrained by the 60 (column *i*) and 65 bounds (column *ii*). In both regressions, it appears that experience is never significantly negative as it should be to explain the positive effect of the distance variable in the first regression (Table 1).

We can go further by considering both distance and experience in the same regression over the whole sample (column *iii*, Table 2). Again, these variables are introduced in conjunction with age. The influence of the distance effect purged from the informational content of experience is still positive, and even higher than in Table 1. For a worker aged 59 (aged 56), if the distance to the retirement age is increased by one year, this raises the employment odds by 31% (by 10%). Distance to retirement is even significant at 55 at a 10% level. These results suggest that a distance effect is indeed at work when the retirement age is imminent.

2.4 The impact of the 1993 SS reform (Strategy III)

Another way to give more credibility to the influence of distance to retirement is to exploit the exogenous variation created in the number of contributing years by the 1993 reform[12]. Individuals with the same experience can have a different distance to retirement before

[11] We use the same set of control variables as in the first regression (age, age squared, education, citizenship, etc.). Estimates on these variables are displayed in Tables A.7 and A.8 in the Appendix.

[12] We thank an anonymous referee for suggesting this empirical exercise.

Table 2: Strategy II : Experience and distance to retirement

	Estimation *i*) Constrained population Minimum age 60		Estimation *ii*) Constrained population Maximum age 65		Estimation *iii*) All individuals	
	Coeff.	P value	Coeff.	P value	Coeff.	P value
Experience × (Age= 50)	-0.0493	0.005	0.0191	0.902	-0.0276	0.063
Experience × (Age= 51)	-0.0457	0.008	0.0432	0.767	-0.0289	0.057
Experience × (Age= 52)	-0.0324	0.058	-0.4808	0.044	-0.0101	0.497
Experience × (Age= 53)	-0.0072	0.659	-0.2546	0.322	0.0065	0.651
Experience × (Age= 54)	0.0053	0.745	-0.0127	0.959	0.0186	0.193
Experience × (Age= 55)	0.0161	0.307	-0.2182	0.352	0.0167	0.238
Experience × (Age= 56)	-0.0081	0.586	-0.2678	0.217	0.0069	0.605
Experience × (Age= 57)	**0.0213**	**0.125**	**-0.1752**	**0.413**	**0.0395**	**0.002**
Experience × (Age= 58)	**0.0003**	**0.982**	**-0.3391**	**0.150**	**0.0203**	**0.104**
Experience × (Age= 59)	**0.0169**	**0.240**	**-0.3411**	**0.120**	**0.0318**	**0.014**
Distance × (Age = 50)					-0.0809	0.053
Distance × (Age = 51)					-0.0938	0.028
Distance × (Age = 52)					-0.0033	0.938
Distance × (Age = 53)					0.0037	0.932
Distance × (Age = 54)					0.0491	0.250
Distance × (Age = 55)					0.0720	0.098
Distance × (Age = 56)					**0.0956**	**0.020**
Distance × (Age = 57)					**0.2183**	**0.000**
Distance × (Age = 58)					**0.2329**	**0.000**
Distance × (Age = 59)					**0.2698**	**0.000**

and after the 1993 reform. The gradual implementation of the reform implies that the additional contributing year depends on the cohort. In addition, there are individuals in our sample who are not affected by the reform. This offers a double variation that gives the opportunity to identify the effect of the increase in the distance to retirement due to the reform by using difference-in-difference estimation[13].

For instance, people who are 59 and have already experienced 38 years in the labor market, face different distances to retirement, depending on their birth date. Individuals born after 1939 are at more than one year to retirement (2 years at most for the 1943 generation), but just at one year for the previous generations. The workers aged 59 with 38 years' experience can then be considered as the treatment group and the 1939 generation (or equivalently the 1998 year) as the treatment date. As the reform is being implemented gradually, the treatment date is not the same, depending on the experience level considered. The treatment date is the 1935 generation for people aged 59 with 37 years of experience, and the 1934 generation for individuals aged 59 with less than 37 years of experience[14].

On the other hand, at each age, for different experience levels, some individuals are not affected by the reform. These individuals are constrained by the bounds of 60 and 65: individuals of 59 years old with a labor market experience of 39 years and more are all one year away from retirement; individuals of 59 years old with a labor market experience of 31 years and less are all 6 years away from retirement. At age 59, whatever the cohort, these individuals are not affected by the reform. They constitute the control group, which is not defined for each experience level because we want to use as much variance as possible in the additional distance to retirement introduced by the reform. In a nutshell, we have two control groups that we could use jointly or separately: those constrained by the 60 bound and those constrained by the 65 bound. We noticed that individuals constrained by the 65 bound have characteristics in terms of education and occupation closer to the treatment group. We will then favor this control group, even though its sample size is more limited.

We can then estimate the impact of the increase in the distance to retirement by using a difference-in-difference strategy. We focus here on individuals aged 59 with different

[13] This strategy has been already used by Bozio (2007) to evaluates ex-post the 1993 Social Security reform.

[14] Note that the calendar in the LFS implies the consideration of yearly levels of experience (and not quarterly as in Bozio, 2007).

levels of worker's experience E (33 years $< E <$ 38 years). We define a dummy "$Expe$" which is equal to 1 if the individual is in the treatment group, i.e. to have E years of experience, and 0 if he is in the control group, i.e. to have less than 32 years of experience. For a given experience E, the treatment date corresponds to a particular cohort D. We then define a dummy "D" which is equal to 1 for individuals belonging to the cohort D and to younger ones and 0 for older cohorts. We then consider the interaction variable "$Expe \times D$" in order to capture the impact of the exogenous increase in the distance to retirement due to the 2003 reform. In all estimates, we use the same set of explanatory variables as in the previous regressions in order to control for differences in observables between the control and treatment groups.

The results (not shown here) suggest that the reform has a positive influence on the probability of being employed, but not at a significant level. This result can be explained by the fact that all treated cohorts are not affected to the same extent by the gradual reform. Rather than a 0/1 binary variable for the treatment date, we finally consider a continuous variable "N" that takes the value of 0 for the cohorts younger than D and the value of N, the number of additional contributive years specific to the D cohort and older cohorts. We then consider the interaction variable "$Expe \times N$" which is equal to the number N of additional contributive years for the individuals affected by the reform (individuals of E experience years and of a cohort $\geq D$) and 0 otherwise.

Table 3 confirms the positive influence of the distance to retirement on the probability of being employed. Individuals who bear an exogenous increase in their distance to retirement have a higher probability of being employed at 59 years old. More precisely, whatever the experience level, the higher the number of additional contributing quarters (exogenously) introduced by the 1993 reform, the higher the probability of being employed. For an individual aged 59 with 38 years of work experience, an additional contributive year raises the employment probability by 35%. The distance variable is significant with the expected positive sign for $E = 36$ and 35 (Table 3). However, it is not significant at the 10% level for individuals with years of experience 38, 37, 34 and 33, even if the p-values are low, at 12%, 13% and 11% respectively, for $E = 38$, $E = 34$ and $E = 33$. The results are then fragile, even if they go in the right direction. The sample size is limited (around 165 individuals in the control and treatment groups). This constitutes a problem for the validity of our empirical strategy. In addition, if we repeat the same empirical exercise at ages 57 and 58, the interaction variable "$Expe \times N$" appears with the expected positive sign but is not significant. Again, at these ages, the sample sizes remain small.

Finally, all these convergent results suggest that the distance effect matters in the understanding of older workers' employment. The effect appears strongly nonlinear: employment odds are affected only when the distance is sufficiently close to the retirement age and only for workers between 55 and 59 years old, who are eligible for specific income programs.

3 The theoretical approach

The job search model appears as a natural candidate for a global approach to older workers' employment, provided life cycle features are taken into account. It must be considered as a first step to improving our understanding of the interaction between retirement and the employment rate of older workers. We choose to present a simple model in order to make the key mechanisms more transparent (Section 3.1). After a careful calibration (Section 3.2), we investigate and illustrate the mechanisms underlying the distance to retirement effect and its consequences on employment for older workers (Section 3.3). Finally, we evaluate the effect of introducing more actuarially-fair pension adjustments on the employment before and after the early retirement age (Section 3.4).

3.1 A job search model

The model is a modified version of McCall's (1970) model, in which unemployed workers look for a job and choose a search intensity which will influence the average length of unemployment spells. Beyond the heterogeneity arising from the wage offer distribution, life cycle features are also considered. Following here Castañeda et al. (2003) and Ljungqvist & Sargent (2008), agents age stochastically. In addition, retirement choice is endogenous. Upon death, households are replaced by other households so that the population is constant over time. Finally, we discard saving decisions in order to keep the model tractable. In each period, consumption equals income.

3.1.1 Population dynamics and employment opportunities

We first define the exogenous stochastic variables of the model, namely the households' age and their employment opportunities. These two stochastic processes are independent. A worker observes his new wage at the beginning of each period before deciding to accept a new wage offer, quit a job or choose a search intensity.

Table 3: Strategy III: Impact of the 1993 reform on the probability of being employed at 59

		N	$Expe$	$Expe \times N$	Number of observations
$E = 38$	Coeff.	-0.5607	-1.6051	**1.7365**	173
	P value	0.7060	0.0030	**0.1230**	
$E = 37$	Coeff.	-0.0079	-2.6595	**0.7347**	167
	P value	0.9920	0.0010	**0.2360**	
$E = 36$	Coeff.	-0.9375	-1.8795	**0.9582**	175
	P value	0.0800	0.0170	**0.0470**	
$E = 35$	Coeff.	-0.9706	-2.1505	**1.0664**	161
	P value	0.0780	0.0080	**0.0380**	
$E = 34$	Coeff.	-0.5666	-1.5578	**0.7446**	157
	P value	0.3080	0.0540	**0.1380**	
$E = 33$	Coeff.	-8.4129	-1.7228	**1.2562**	86
	P value	0.0000	0.1840	**0.1170**	

Population dynamics. In each period, some households are born and some die. We assume that the measure of the newly-born is constant over time. They are born as unemployed workers. Early retirement is endogenous.

We assume that the population can be divided into 6 age groups[15], denoted C_i for $i = 1, ..., 6$. These age groups are a stylized representation of the following life-cycle: if a worker enters the labor market at 20, his expected time in the labor market is 40 years, and his expected time as a retiree is 20 years. In order to take into account typical age-specific unemployment rates, we consider the following age groups. 20 - 34 year old individuals, in C_1, start working. Experienced individuals of age 35 - 49, in C_2, expect to be employed for a long time. People of age 50 - 54 in C_3 and especially 55 - 59 in C_4, expect that the duration of the job is short before retirement. Individuals in age group 60 - 64, in C_5, can choose to retire early or not. Finally, people aged 65 and more, in C_6, are all retirees as 65 is the mandatory retirement age. In our policy experiments, we will then be able to measure individuals' willingness to delay retirement following changes in pension schemes.

Each individual is born young. The probability for a worker of remaining in C_i (for $i = 1, .., 6$) the next period is π_i. Conversely, the probability of aging equals $1 - \pi_i$. In each period, a fraction $1 - \pi_6$ of new workers is born. They replace an equal number of dead workers, so that the measure of the population is constant. The matrix Π governing the age Markov-process is given by:

[15] More motivations are given in the calibration section (section 3.2.2).

		$t+1$					
		C_1	C_2	C_3	C_4	C_5	C_6
	C_1	π_1	$1-\pi_1$	0	0	0	0
	C_2	0	π_2	$1-\pi_2$	0	0	0
	C_3	0	0	π_3	$1-\pi_3$	0	0
t	C_4	0	0	0	π_4	$1-\pi_4$	0
	C_5	0	0	0	0	π_5	$1-\pi_5$
	C_6	$1-\pi_6$	0	0	0	0	π_6

Employment opportunities. Retirement age is endogenous and, in particular, depends on the SS pension p. After the early retirement age, individuals can choose to get retired conditionally to their current position on the labor market. An individual still in the labor force is either employed or unemployed. An unemployed worker receives an unemployment benefit b and chooses a job search intensity $s \geq 0$. The private incentive to increase the job search intensity is linked to the probability of getting a job offer in the next period. This probability $\phi(s)$ is an increasing function of s, and we assume that $\phi(s) \in [0, 1]$, for $s \in [0, \infty[$. This offer is drawn from an age-specific wage offer distribution $F_i(w)$, which denotes the probability of receiving a wage offer between the lower wage of the distribution $\underline{w}_i$ and $w_{i,t}$ ($F_i(w) = \text{Prob}(w_{i,t} \leq w)$). An unemployed worker observes his new age at the beginning of a period before choosing a job search intensity and deciding to accept or reject a new wage offer. Because the wage offer is age-specific, we consistently assume that the search effort of unemployed workers of age i (s_i) is devoted to find a job specific to the age i, i.e. the search process is segmented by age. Because ageing is a sequential process, unemployed workers visit each segment of the labor market only sequentially.

Let $\bar{w}_{i,t}$ denote the reservation wage above which the worker of age i accepts the wage offer $w_{i,t}$: if $w_{i,t} > \bar{w}_{i,t}$, he earns that wage in period t and thereafter for each period he has not been laid off and has not retired. The age-specific probability of being laid off at the beginning of the period is $\lambda_i \in [0, 1]$. Calibrating the exogenous variables $F_i(w)$ and λ_i by age can capture the potential bias against the demand for older workers, while keeping the model tractable[16].

[16]The sole issue of the interaction between retirement, labor market equilibrium and technological and organizational changes would deserve major theoretical work and is left for future research.

3.1.2 Labor market stocks and flows

Let $U_{t,i}$, $N_{t,i}$, $R_{i,t}$ and $P_{t,i}$ denote at the beginning of period t the number of unemployed workers, the number of employed workers, the number of retirees, and the total population of age i respectively. Let us define I_i^e (I_i^u) the indicator function which is equal to 0 if the employed (unemployed) worker of age i prefers retirement and 1 if he is still in the labor force. Unemployment rates at each age then obey the following laws of motion:

$$U_{t,1} = \underbrace{(1-\pi_6)P_{t-1,6} + \pi_1\lambda_1 N_{t-1,1}}_{\text{newly unemployed workers}} + \underbrace{\pi_1[\phi(s_1)F_1(\overline{w}_1) + (1-\phi(s_1))]U_{t-1,1}}_{\text{surviving unemployed workers}} \quad (1)$$

and, for $i = 2, 3, 4, 5$

$$\begin{aligned} U_{t,i} \quad = \quad & \underbrace{(1-\pi_{i-1})[\phi(s_i)F_i(\overline{w}_i) + (1-\phi(s_i))]I_i^u U_{t-1,i-1}}_{\text{unemployed workers coming from age } i-1} \\ + \quad & \underbrace{(1-\pi_{i-1})\lambda_i I_i^e N_{t-1,i-1}}_{\text{unvoluntary quits from age } i-1} \\ + \quad & \underbrace{(1-\pi_{i-1})(1-\lambda_i)G_{i-1}(\overline{w}_i)I_i^e N_{t-1,i-1}}_{\text{voluntary quits from age } i-1} \\ + \quad & \underbrace{\pi_i\lambda_i N_{t-1,i}}_{\text{newly unemployed workers}} + \underbrace{\pi_i[\phi(s_i)F_i(\overline{w}_i) + (1-\phi(s_i))]U_{t-1,i}}_{\text{surviving unemployed workers}} \end{aligned} \quad (2)$$

where $G_i(w)$ denotes the fraction of age i employed workers at wage w or less. The age-specific wage offers and separation rates imply that the transition between age $i-1$ and age i leads to voluntary quits if wages accepted at age $i-1$ are lower than the reservation wage at age i. For unemployed workers of age i who survive in the same age group, the age i-specific search effort s_i determines the probability of getting a job offer $\phi(s_i)$. Consistently with the age-directed search assumption, when the unemployed workers are coming from age $i-1$, their probability of getting a job offer does not depend on the search effort made at the initial age (s_{i-1}). These unemployed workers are assumed[17] to have instantaneously access to the contact probability of the unemployed worker aged i, namely $\phi(s_i)$.

[17] When unemployed workers age from $i-1$ to i between time $t-1$ and time t, their age-specific search at time $t-1$ should imply a probability of getting a job offer equal to zero at the time of the age transition. It would lead to a temporal (at time t) exclusion of the matching process. This can be viewed as an excessively restrictive implication of our age-specific search assumption. Assuming that the ageing worker has instantaneously access to the contact probability of the worker aged i allows us both to deal with this problem and to preserve the idea that search is a sequential process over the life cycle.

The mass of retired workers evolves as:

$$\begin{aligned} R_{5,t} &= \pi_5[R_{5,t-1} + \lambda_5(1 - I_5^e)N_{5,t-1}] \\ &+ (1 - \pi_4)[\lambda_4 + (1 - \lambda_4)G_4(\overline{w}_5)](1 - I_5^e)N_{4,t-1} \\ &+ (1 - \pi_4)[\phi(\overline{s}_5)F_5(\overline{w}_5) + 1 - \phi(\overline{s}_5)](1 - I_5^u)U_{4,t-1}\} \quad (3) \\ R_{6,t}^5 &= \pi_6 R_{6,t-1}^5 + (1 - \pi_5)R_{5,t-1} \quad (4) \\ R_{6,t}^6 &= \pi_6 R_{6,t-1}^6 + (1 - \pi_5)(P_{5,t-1} - R_{5,t-1}) \quad (5) \end{aligned}$$

where R_5 and R_6^5 denote respectively the number of retirees of age 5 and 6 who have decided to retire at age 5, and R_6^6 the newly retired workers at age 6.

3.1.3 Wage distribution

The dynamics of the wage distribution $G_{i,t}(w)$ is given by:

$$N_{1,t}G_{1,t}(w) = \pi_1\left[(1 - \lambda_1)N_{1,t-1}G_{1,t-1}(w) + \phi(s_1)\max\{0, F_1(w) - F_1(\overline{w}_1)\}U_{1,t-1}\right] \quad (6)$$

and for $i = 2, 3, 4, 5$

$$\begin{aligned} N_{i,t}G_{i,t}(w) &= \pi_i\left[(1 - \lambda_i)N_{i,t-1}G_{i,t-1}(w) + \phi(s_i)\max\{0, F_i(w) - F_i(\overline{w}_i)\}U_{i,t-1}\right] \\ &+ (1 - \pi_{i-1})\phi(s_i)\max\{0, F_i(w) - F_i(\overline{w}_i)\}I_i^u U_{i-1,t-1} \\ &+ (1 - \pi_{i-1})(1 - \lambda_{i-1})(1 - G_{i-1}(\overline{w}_i))I_i^e N_{i-1,t-1} \quad (7) \end{aligned}$$

3.1.4 Preferences

We assume that individuals derive utility from consumption and leisure. Leisure refers to the time not spent on labor or job search. Intertemporal preferences are given by:

$$E_0 \sum_{t=0}^{\infty} \beta^t u(y_t, T - z_t) \quad \text{where } z_t \equiv I^u A s_t + I^e(1 - A)h$$

where function u satisfies the usual Inada conditions, E_0 is the expectation operator conditional at time 0, $\beta \in [0, 1]$ the subjective discount factor and y_t the after-tax income from employment, unemployment compensation or pension. T is the total time endowment. If $A = 0$, then the worker is at work and has a constant disutility of labor denoted by h, whereas if $A = 1$ the worker is unemployed and has an endogenous disutility of job search.

3.1.5 Government policies

The government provides both a pension p and an unemployment benefit b. For the sake of simplicity, we assume that pensions and non-employment incomes are not linked to individuals' earning histories. In the benchmark case, we assume that the pension is not increased by additional years of working beyond the early retirement age; whatever the retirement age, the pension level is the same: $p_6 = p_5$. In contrast, an actuarially fair increase in pension ($p_6 > p_5$) will be analyzed as a policy experiment.

The government collects flat rate income taxes $\{\tau_p, \tau_b\}$ to balance the pensions and the unemployment benefits respectively. When the agent is employed, he pays both taxes, whereas unemployed workers are only taxed to finance the SS system.

3.1.6 Bellman equations

Let $V_i^e(w)$ be the value of the optimization problem for a worker of age C_i and paid w, V_i^u the value of the optimization problem for an unemployed worker of age C_i, and V^r the value of a retiree. Let $V_i(w)$ be the value of the optimization problem for a worker of age i who was employed in the previous period and has today the option to work at wage w

$$V_i(w) = \max\{V_i^e(w), V_i^u\} \quad \text{for } i = 1,..,5$$

Bellman equations can be written as:

for $i = 1, 2, 3$

$$\begin{aligned} V_i^e(w) &= u((1-\tau_p-\tau_b)w, T-h) + \beta\{\pi_i[(1-\lambda_i)V_i(w) + \lambda_i V_i^u] \\ &\quad +(1-\pi_i)[(1-\lambda_{i+1})V_{i+1}(w) + \lambda_{i+1}V_{i+1}^u]\} \qquad (8) \\ V_i^u &= \max_{s_i}\{u((1-\tau_p)b_i, T-s_i) \\ &\quad +\beta\left\{\pi_i\left[\phi(s_i)\int V_i(w)dF_i(w) + (1-\phi(s_i))V_i^u\right]\right. \\ &\quad \left.+(1-\pi_i)\left[\phi(s_{i+1})\int V_{i+1}(w)dF_{i+1}(w) + (1-\phi(s_{i+1}))V_{i+1}^u\right]\right\}\Bigg\} \qquad (9) \end{aligned}$$

for $i = 4$

$$\begin{aligned} V_4^e(w) &= u((1-\tau_p-\tau_b)w, T-h) + \beta\{\pi_4[(1-\lambda_4)V_4(w) + \lambda_4 V_4^u] \\ &\quad +(1-\pi_4)[(1-\lambda_5)\max\{V_5(w), V_5^r\} + \lambda_5\max\{V_5^u, V_5^r\}]\} \qquad (10) \\ V_4^u &= \max_{s_4}\{u((1-\tau_p)b_4, T-s_4) \\ &\quad +\beta\left\{\pi_4\left[\phi(s_4)\int V_4(w)dF_4(w) + (1-\phi(s_4))V_4^u\right]\right. \\ &\quad \left.+(1-\pi_4)\left[\begin{array}{c}\phi(s_5)\int\max\{V_5(w), V_5^r\}dF_5(w) \\ +(1-\phi(s_5))\max\{V_5^u, V_5^r\}\end{array}\right]\right\}\Bigg\} \qquad (11) \end{aligned}$$

At age 4, workers expect with a probability $(1-\pi_4)$ to have the right to retire: age 5 constitutes the eligibility age for retirement. Given the age at first job, age 5 is also the age of full pension. These equations highlight an important feature of the French Social Security system: the pension is not lowered by an unemployment spell. The value V_5^r of becoming retired in C_5 is the same for employed or non-employed workers. If all workers, whatever their employment status, choose to retire in C_5, employed and unemployed people in C_4 have the same expected value V_5^r in the near future (see equations (10) and (11)). This explains why the job value is weak when the retirement age is imminent.

<u>for $i=5$</u>

$$
\begin{aligned}
V_5^e(w) &= u((1-\tau_p-\tau_b)w, T-h) \\
&\quad +\beta\left\{\pi_5[(1-\lambda_5)\max\{V_5(w),V_5^r\}+\lambda_5\max\{V_5^u,V_5^r\}]\right. \\
&\quad \left. +(1-\pi_5)V_6^{r6}\right\} &(12)\\
V_5^u &= \max_{s_5}\left\{u((1-\tau_p)b_5, T-s_5)\right. \\
&\quad +\beta\left\{\pi_5\left[\phi(s_5)\int\max\{V_5(w),V_5^r\}dF_5(w)\right.\right. &(13)\\
&\quad \left.\left.\left. +(1-\phi(s_5))\max\{V_5^u,V_5^r\}\right]+(1-\pi_5)V_6^{r6}\right\}\right\} \\
V_5^r &= u(p_5,T)+\beta\left\{\pi_5 V_5^r+(1-\pi_5)V_6^{r5}\right\} &(14)
\end{aligned}
$$

Two retiree value functions must be distinguished in C_6, namely the already (in C_5) retired workers' value V_6^{r5} and the newly (in C_6) retired workers' value V_6^{r6}.

<u>for $i=6$</u>

$$
\begin{aligned}
V_6^{r5} &= u(p_5,T)+\beta\left\{\pi_6 V_6^{r5}\right\} &(15)\\
V_6^{r6} &= u(p_6,T)+\beta\left\{\pi_6 V_6^{r6}\right\} &(16)
\end{aligned}
$$

In the benchmark case, we assume that the pension is not increased by additional years of working beyond the full pension rate: $p_6=p_5$. This implies that the employment value does not increase if the agent decides to postpone retirement, leading to implicitly imposing a huge tax on continued activity. In contrast, an actuarially fair increase in pension $(p_6>p_5)$ can make the early retirement option undesirable for employed workers. In this case, employment is more valuable than any other options: there is now an employment surplus at the early retirement age, which conversely boosts the search intensity before this age.

The optimal decisions for search intensity are given by:

<u>for $i=1,2,3,4$</u>

$$u_2'((1-\tau_p)b_i, T-s_i) = \phi'(s_i)\beta\pi_i \left(\left[\int V_i(w)dF_i(w) \right] - V_i^u \right) \quad (17)$$

for $i = 5$

$$u_2'((1-\tau_p)b_5, T-s_5) = \phi'(s_5)\beta\pi_5 \left(\begin{array}{c} \left[\int \max[V_5(w), V_5^r]dF_5(w)\right] \\ -\max[V_5^u, V_5^r] \end{array} \right) \quad (18)$$

The marginal disutility of job search activity equals its expected return, which is captured by the increase in the probability of getting a wage offer times the expected surplus of employment. In the case of early retirement at 60, the right hand side of equation (17), given equations (10) and (11), states that, as the individual ages, the gap between discounted earnings (V_i) and unemployment benefits (V_i^u) narrows. Employed and unemployed people in C_4 expect to be in the same state in the near future. Decreasing the unemployment benefit is then a traditional solution to foster job search by creating an instantaneous gap between employment and non-employment value. In contrast, if the continued activity opportunity is sufficiently attractive after the early retirement age, the employment and the unemployment values converge later, only when the mandatory retirement (C_6) is imminent. The horizon of older workers just before the early retirement age is then broadened. By inspecting equations (5) to (8), it appears that this result can be reached by increasing the relative value of p_6 to p_5. This incentive policy is implemented in Section 3.4.

3.1.7 Equilibrium

The steady state equilibrium is characterized, for $i = 1, ...6$, by workers' occupational choices $\{A_i, I_i^e, I_i^u\}$, reservation wages $\overline{w}_i$ and search intensity s_i, value functions V_i^e, V_i^u and V_i^r, a set of stationary labor market aggregates $\{U_i, N_i, R_i, P_i, G_i(w)\}$ and a tax policy $\{\tau_b, \tau_p\}$. The stationary equilibrium is such that:

- Individual policy rules $\{s_i, \overline{w}_i, A_i, I_i^e, I_i^u\}$ are solution to the lifetime maximization programs (8)-(16).
- U_i, R_i and $G_i(w)$ are the stationary solution of equations (1)-(7) and P_i is the stationary distribution associated with the matrix Π. N_i then solves : $P_i = N_i + U_i + R_i$, $\forall i$.
- The tax rates τ_b and τ_p adjust to balance the budgets of unemployment insurance and social security respectively, given the exogenous levels of the unemployment

benefits b_i and of the pensions p_5 and p_6:

$$\begin{aligned}\tau_b \sum_{i=1}^{5} N_i \int w dG_i(w) &= \sum_{i=1}^{5} U_i b_i \\ \tau_p \sum_{i=1}^{5} N_i \int w dG_i(w) + \tau_p \sum_{i=1}^{5} U_i b_i &= R_6^6 p_6 + \sum_{i=5}^{6} R_i^5 p_5\end{aligned}$$

3.2 Specification and calibration of the model

Before investigating the interplay between the endogenous distance to retirement and individual job search decisions on the labor market, it is necessary to specify the utility function and calibrate parameters of the job search model. At this stage, we have two options: either to consider a theoretical setting that we could solve analytically at the expense of the robustness of our results or to calibrate a more general specification of the utility function and the wage distribution. We chose to follow the second route in order to quantify the economic mechanisms in a more general setting, even though we do not claim to encompass all dimensions of employment and retirement decisions.

3.2.1 Specification of the preferences

Let us consider the following utility function[18]:

$$u(c, T - z) = \frac{(c^{\nu}(T - z)^{1-\nu})^{1-\sigma}}{1 - \sigma}$$

The function that maps the job search intensity onto the probabilities of obtaining a wage offer is defined as follows:

$$\phi(s) = \gamma s \quad \text{where } s \in [0; 1]$$

In the literature (Mortensen, 2003; Postel-Vinay & Robin, 2004), the search effort is a concave function of employment surplus. This simple linear rate of the offer arrival function combined with our utility function ensures that this standard property holds.

Given these assumptions, the optimal search intensity is given by: for $i = 1, ..., 5$

$$s_i = T - \left\{ \frac{\gamma \beta \mathcal{S}}{(1-\nu)((1-\tau_p)b_i)^{\nu(1-\sigma)}} \right\}^{\frac{1}{(1-\nu)(1-\sigma)-1}} \tag{19}$$

$$\text{where:} \quad \mathcal{S} = \begin{cases} \pi_i \left[\int V_i(w) dF_i(w) - V_i^u \right] & \text{if } i = 1, ..., 4 \\ \pi_i \left[\int \max[V_i(w), V_5^r] dF_5(w) - \max[V_i^u, V_5^r] \right] & \text{if } i = 5 \end{cases}$$

Equation (19) shows that higher unemployment benefits increase the elasticity of the job search effort to a variation in $\mathcal{S}$, leading to a greater distance to retirement effect[19].

[18] This function is compatible with a balanced growth path.

[19] With this utility function, given the calibration of σ, a high non-employment income implies a decrease in the marginal utility of leisure.

Moreover, as this elasticity is decreasing with the value of $\mathcal{S}$ (s is a concave function of $\mathcal{S}$), higher separation rates and unemployment benefits by decreasing the job value $\mathcal{S}$ raise the importance of the distance effect.

3.2.2 Calibration

We base our calibration on the French Labor Force Surveys prior to the 1993 Balladur Reform (4 waves from 1990 to 1993). Indeed, given the simplicity of our model, we cannot pretend to be able to generate heterogeneous retirement ages. When computing the key elements to calibrate our model (unemployment duration, employment rates, separation rate, etc.) on the French micro data, we restrict our sample to low and middle wage workers. Indeed, these workers enter the job market at very young ages. Therefore, before the 1993 reform, they have accumulated the required number of contributive years before 60 years old which allows them to retire at 60. This fact encourages us to calibrate the model on pre-1993 data and on low and middle wage workers who constitute 85% of the labor force, because our stylized model can only capture this homogeneous retirement behavior[20].

We first discretize the working life cycle by choosing quite homogenous age groups. We have already provided some empirical or institutional arguments in favor of the discretization in the presentation of the model. In France, 60 is the eligibility age for retirement and 65 the maximum age. Between 60 and 65, agents have the choice of withdrawing their pension or not. It is then particularly important to distinguish the 60-65 and the 65+ groups. The expected age of death is set at 80. The working life cycle before the eligibility age for SS pension is split into four age groups. The first one, from 20 to 30, aims at taking into account the labor market entry process. We consider that all workers are first unemployed at 20. The employment rate is then growing with age as long as this entry process carries on. On French data, the employment rate becomes stable from the age of 30 onward. Until 50, the employment rate exhibits a great stability. From the age of 50 onward, the employment rate starts declining. It would have been useful to discretize all ages between 50 and 60. However, in order to keep the model within tractable bounds, we consider only two age groups, 50-54 and 55-59. The dividing age of 55 is natural as special income programs exist from this age to the eligibility age for retirement. In the pre

[20] In contrast, in our empirical investigation based on micro data, we needed heterogeneous distances to retirement to robustly identify our feedback effect. We thus chose to use Labor Force Surveys also after 1993.

and post 1993 periods, eligibility for old age specific programs is 55 years old for workers who have already contributed the required number of years to Social Security, which is the case for low skilled individuals. In contrast, eligibility for specific older worker schemes is unconditional for workers older than 57. In addition, the choice of age 55 is supported by our estimates : in Table 2, the distance effect matters at a 10% level from 55 through 59.

To sum up, the four age groups prior to the retirement periods are such that each individual has an expected duration of 10 years in the first class C_1, 20 years in C_2, 5 years in C_3 and 5 years in C_4: this leads to an expected duration of 40 years in the labor market. We assume that the expected duration is 5 years for C_5 and 15 years for C_6.

It remains to calibrate the other parameters of the model. Traditionally, the parameter calibration relies either on external information or on empirical targets that must be reached by the model. Our calibration strategy is to use as much external information as possible in order to use the employment rates by age as overidentifying restrictions. Most parameter values are indeed based on external information. This is the case for the discount factor, the relative preference for leisure, the risk aversion, the wage distribution and the separation rate by age. On the other hand, the search efficiency, the unemployment benefits and the pension are set in order to make the model's predictions consistent with French data.

External information: As we have set the model period to a month, the discount factor β equals 0.9967, which yields an annual interest rate of 4%. The parameters needed for the calibration of the utility function have been extensively studied in the literature (Prescott, 1986; Cooley & Prescott, 1995; Hansen & Imrohoroglu, 1992; Rios Rull, 1992; Huggett & Ventura, 1999). ν is set to the traditional value of 0.33, σ to 2. This implies that the value of the relative risk aversion $\widetilde{\sigma} = 1 - \nu(1 - \sigma)$ is equal to 1.33. This is close to the estimates provided by Attanasio et al. (1999).

We assume that the exogenous wage offer distribution $F_i(w)$ is a log-normal distribution. In order to replicate the wage increase with age, the wage offer distribution is assumed to depend on the worker's age. We then potentially take care of some general human capital accumulation in our setup. From the French LFS, we compute the mean and the standard deviation of the wage offer distribution over each age group. We only consider wages corresponding to job tenures of less than one year. In Table 4, we indeed observe a shift to the right of the wage offer distribution along the life cycle. As we have only a few observations after 60, we consider the same distribution as between 55 and 59.

Using the French LFS data set, we calibrate the job separation rate by age groups in order to capture the decrease in the labor demand for older workers. For middle-aged workers (C_2 age group), λ_2 is set to 0.0055. The separation rate at age 55-59 is two times higher than the one relative to the middle-aged workers, whereas the 50-54 year old workers display roughly the same value. Note that the separation rate is equal to 0.018 for the younger workers.

Targets: The unemployment benefits b for middle-aged workers are calibrated in order to match the observed average replacement rate of 37%, which is consistent with Blanchard and Wolfers'(2000) estimates. As a consequence, our results on employment rates by age will be consistent with a realistic calibration of unemployment benefits[21].

Given the legislation in the early nineties in France (Daniel, 1999), workers aged more than 50 years benefit from more generous unemployment compensations, especially non-employed workers aged 55-59 who are in specific programs characterized by a lower decrease in their benefits with the unemployment spell. Consistently with this legislation, we add a premium of 11.5% (6%) on the unemployment benefit for workers older than 55 (between 50 and 55), relative to the previous age group C_3 (C_2).

We now turn to the pension system calibration. We calibrate the pension level in order to match the observed replacement rate which equals 85% (Hairault et al., 2008) of the last wage for workers in our sample. Moreover, in our benchmark calibration, we consider an actuarially-unfair Social Security scheme as was the case until the 2003 reform in France[22]. We assume the pensions to be the same whatever the retirement age between 60 and 65: $p_6 = p_5$. No pension adjustment is taken into account in the case of delayed retirement.

As the parameter γ has no empirical counterpart, we choose to calibrate it in order to replicate the observed average unemployment duration for workers aged 30-55. Based on the French LFS, the average unemployment duration amounts to 15 months, which leads to $\gamma = 0.80$. The calibration is summarized in Table 4.

[21] Our model is not able to capture the specific problems of entry of young people on the labor market (high turnover, learning, etc.). As a result, we calibrate the unemployment benefits b_1 so as to reproduce the employment rate of workers aged 20-30. This generates a consistent initial condition to avoid distorting the employment rate of subsequent age groups. Our paper focuses on the distance effect that does not by definition affect this age group. A better understanding of the job entry is left for future research.

[22] The 2003 reform introduced an actuarial flavor in the French pension scheme by giving a 3% increase in pension for any additional working year beyond the required number of contributive years.

Table 4: Calibrated values

Parameter		Reference
Discount factor β	0.9967	Annual interest rate of 4%
Consumption share in utility function ν	0.33	Prescott(1986), Cooley & Prescott(1995),
		Hansen & Imrohoroglu (1992)
		Rios Rull (1996), Huggett & Ventura (1999)
Relative risk aversion $\tilde{\sigma}$	1.33	Attanasio et al. (1999)
Workers aged 20-29		
Mean wage, French Francs	6817	French LFS
Wage standard deviation	0.1723	French LFS
Job separation rate λ_1	0.018	French LFS
Workers aged 30-49		
Mean wage, French Francs	7538	French LFS
Wage standard deviation	0.2095	French LFS
Job separation rate λ_2	0.0055	French LFS
Workers aged 50-54		
Mean wage, French Francs	7600	French LFS
Wage standard deviation	0.2046	French LFS
Job separation rate λ_3	0.0055	French LFS
Workers aged 55-59		
Mean wage, French Francs	8081	French LFS
Wage standard deviation	0.2596	French LFS
Job separation rate λ_4	0.011	French LFS
Workers aged 60-64		
Mean wage, French Francs	8081	French LFS
Wage standard deviation	0.2596	French LFS
Job separation rate λ_5	0.011	French LFS

Parameter		Target
unemployment benefit b_1 for workers aged 20-29	2387	Employment rate of workers aged 20-29: 0.83
unemployment benefit b_2 for workers aged 30-49	3098	Average replacement rate of unemployment benefits: 0.37
unemployment benefit b_3 for workers aged 50-54	3294	Unemployment benefit premium: 1.06
unemployment benefit b_4 for workers aged 55-59	3703	Unemployment benefit premium: 1.115
pension level p_5	8000	Average replacement rate: 0.85
search effectiveness γ	0.80	Average unemployment duration: 15

Table 5: Employment rates

Age groups	C_1	C_2	C_3	C_4	C_5
Age in years	20-29	30-49	50-54	55-59	60-64
1. Data	0.830	0.883	0.847	0.559	0.024
2. Benchmark model	0.827	0.867	0.874	0.549	0

Model assessment: As much external information as possible have been used in order to assess the ability of our model to replicate the employment rates by age. As can be seen in Table 5, we match quite well the decrease in the employment rate as the retirement age stands out. Especially, the dramatic decrease in the employment rate for workers aged 55 to 59 is quite well reproduced. This age group mainly differs by more generous unemployment benefits, a higher separation rate and a lower distance to the retirement age. It is enough to strongly decrease their employment rate in a way which is consistent with the data. It must be acknowledged that the levels are not perfectly reproduced, in particular the one specific to the 50-54 age group. Yet, we consider that this simple model works surprisingly well to capture the decline in the employment rates at the end of the working life cycle.

We also replicate the fact that French workers retire when they reach the full record of contributive years, as documented by Blanchet & Pelé (1997) [23]. Given the lack of heterogeneity in terms of careers, assumed for the sake of simplicity, it implies that all individuals must be retired at age 60 in our model. Given the calibrated preferences, the model is able to generate a 100% rate of retirement at 60. It turns out that no workers choose to delay retirement in the case of no actuarial adjustments (column C_5, Line 2 in Table 5).

Given the levels of non-employment incomes and pensions, the equilibrium tax rates are $\tau_b = 6.99\%$ and $\tau_p = 31.41\%$. Notice that these values are close to their empirical counterparts, respectively 6.4% and 26% in France despite the highly stylized model we are considering.

3.3 Investigating the feedback effect of retirement age on the job search

This section aims at investigating the interplay between the endogenous distance to retirement and individual job search decisions on the labor market.

3.3.1 Illustrating the mechanisms at work

In Table 5, the fall in the employment rate of workers aged 55-59 results from the combination of two different types of effect: the expected effect of the upward sloping profile of unemployment benefits and separation rates on the one hand and the distance effect on the other hand, that is specific to the life cycle framework. This section aims at illustrating

[23] 97.6% of men retire at the full pension age.

the respective role of each element.

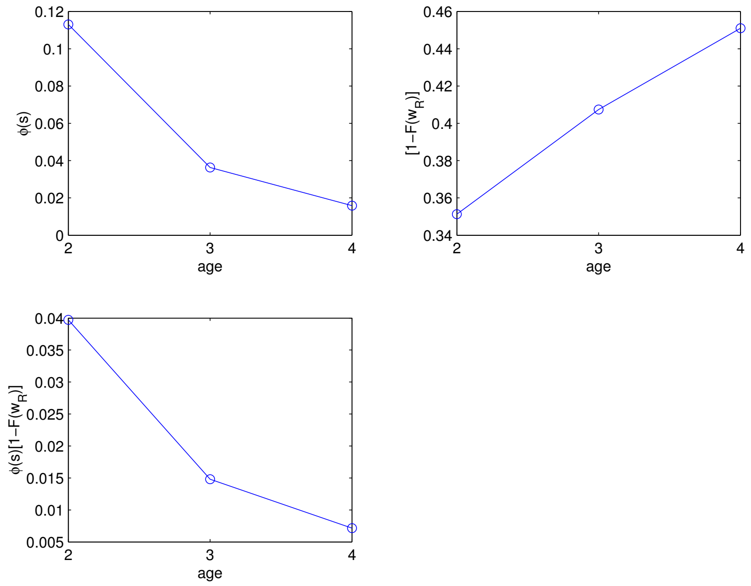
Younger workers are by definition not affected by the distance effect. Furthermore, in the benchmark calibration, workers aged 60 and beyond are retirees. So, in this section, we will focus on the behavior of age groups 2 to 4, people whose age is between 30 and 59.

A distance effect. How is the job search behavior altered when individuals get closer to their retirement age? In order to make the distance mechanism at work more transparent, we first examine the job search behaviors across ages when all non-employed incomes and separation rates are set at the same values, those specific to older workers. Figure 2 illustrates the two main forces at work in the model at the end of working life.

- First, older workers will accept lower wages because impatience increases with age: the shorter the distance to retirement, the smaller the benefit of waiting to see if a higher job offer becomes available, as the benefits of employment cannot be enjoyed for a long period. As a result, accepting a job becomes more attractive: a larger number of job offers becomes acceptable. This is directly measured by the increasing probability of accepting a job offer, $[1 - F(w_R)]$, where w_R denotes the reservation wage by age. Therefore, this first effect cannot account for the low employment rate of older workers in countries such as France.
- The second effect makes the model more consistent with French data. Even if older unemployed workers accept lower wage offers, their incentives to search for job offers decline. After age 55, their job search intensity falls and so does the probability of getting a job offer, measured by $\phi(s)$. Equations (11), (13) and (19) show that, as the individual ages, the gap between the values of an employed and a non-employed worker narrows whatever the reservation wage. The non-employed worker and the employed worker expect to become retirees and to receive the same pension: the value of employment converges to the one of non-employment. These effects explain the decrease in the employment surplus $\mathcal{S}$. As the non-employment income and the separation rate are constant ($b_i = b_4$, $\lambda_i = \lambda_4\ \forall i$), the job search intensity s_i decreases with age only because of the fall in $\mathcal{S}$ due to the distance to retirement effect (equation (19)).

Two economic forces move in opposite directions at the end of the working life. The decrease in the reservation wage leads to an increase in employment at the end of the

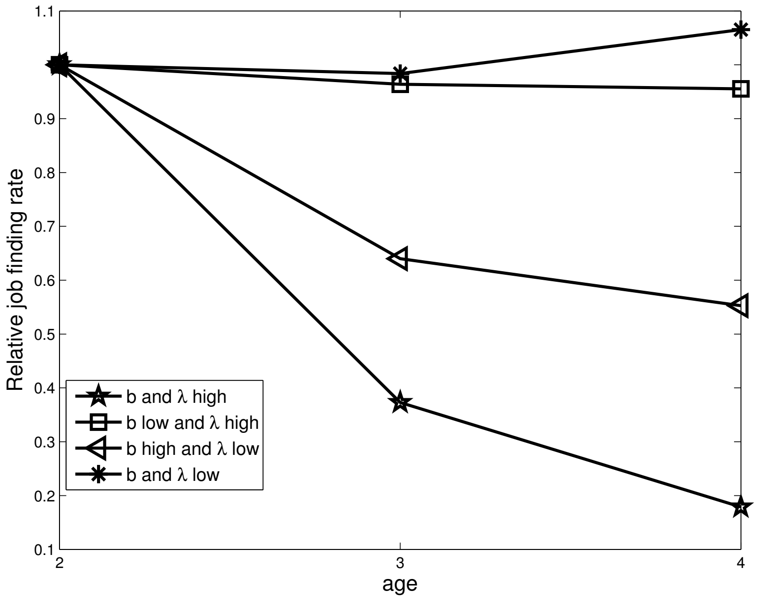
Figure 2: Search behavior over the life-cycle (b and λ flat over the life cycle)



life-cycle, while the decline in job search intensity, capturing the distance effect, implies that the transition rate from unemployment-to-employment, $\phi(s)[1 - F(w_R)]$, goes down at the end of the life-cycle. Our numerical example measures the combination of these two effects and shows that the distance effect gets the upper hand ($\phi(s)[1 - F(w_R)]$ declines) for the benchmark calibration.

However, it could be misleading to conclude that the distance to retirement alone explains this result. Equation (19) implies that the (high) level of the unemployment benefits and of the separation rate may influence the effect of the distance to retirement on the job search intensity. The impatience effect can also be influenced by the level of the unemployment benefit. Figure 3 shows the job finding rate of the different age groups relative to the middle age group (C_2) when b and λ are still constant over the life cycle but fixed at the level of middle-aged workers. The decrease in the transition rate from unemployment to employment over the life cycle is now much lower, particularly when the unemployment benefit is low; the impatience effect even dominates when both the unemployment benefit and the separation rate are fixed at a lower level. This suggests that the distance effect alters the employment rates of older workers *only in conjunction with* generous unemployment benefits and high separation rates. The levels of the unemployment benefit and of the separation rate determine the magnitude of the distance to retirement effect.

Figure 3: A conditional distance effect

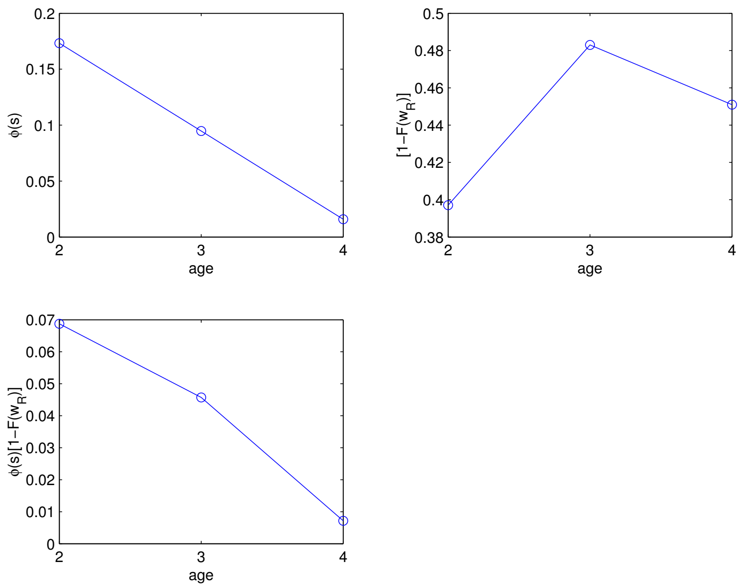


This result sheds light on the empirical results we obtained in Section 2. In the context of high unemployment benefits, the distance effect may be very significant. The number of years prior to retirement is crucial, since workers close to retirement age modify their job search behavior. However, this occurs only when unemployment benefits are high enough: the generosity of these programs amplifies the retirement age effect by giving unemployed people the means to wait for retirement without searching for a job. Furthermore, the distance effect modifies older workers' search especially when the separation rate is high. This generalizes our conclusion that the distance effect matters but in conjunction with other factors, especially higher unemployment benefits and separation rates. There is in that sense *no pure distance effect* in our model.

Adding upward sloping unemployment benefits. In addition to the distance effect, the age-increasing profile of the unemployment benefits contributes to the age-decreasing profile of the employment rate. First, the job search intensity is now much higher for younger workers (Figures 2 and 4). Secondly, the probability of accepting a wage offer is less age-increasing, and even lower at 55 than at 50. The upward sloping unemployment benefits partially offsets the impatience effect.

Adding upward sloping separation rates. Finally, the age-increasing separation rate profile during the working life is taken into account. All the mechanisms of the

Figure 4: Search behavior over the life-cycle when b increases with age



benchmark calibration are now at work: younger workers have lower separation rates than older workers. As a lower separation rate increases the expected job duration, the upward sloping profile of the separation rate contributes to amplify the decline in the job search intensity at the end of the working life (Figures 2 and 5). However, it implies that older workers are less choosy in their job acceptance, leading to a reinforcement of the impatience effect.

3.3.2 A quantitative evaluation

Line 2 in Table 5 (shown also in Table 6) shows that the combination of the distance effect and the rise in the non-employment income and in the separation rate at the end of the working life leads to a dramatic 30% fall in the employment rate. Figures 2 - 5 display the mechanisms behind this result. At this stage, one could argue that the decline in older workers' employment results more from the upward sloping unemployment benefits and separation rates than from the distance effect. In order to measure the role of the distance effect, Table 6 displays the employment rates predicted by the model for different values of unemployment benefits and separation rates. In all cases, these latter values are constant by age in order to identify the contribution of the distance effect.

Line 3 in Table 6 displays the results obtained for high unemployment benefits and separation rates (set at the level specific to the 55-59 year old individuals). First, at ages when the distance effect does not affect search behavior (before the age of 50), the

Figure 5: Search behavior over the life-cycle when λ increases with age.

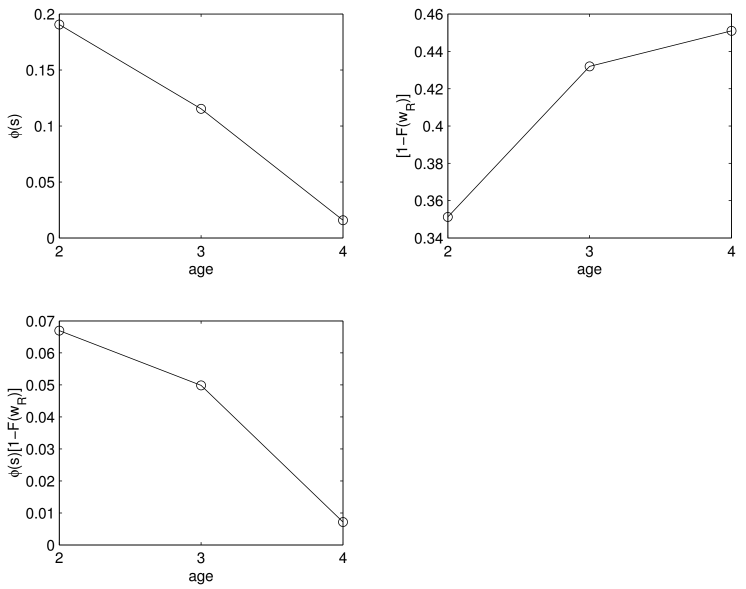


Table 6: Employment rates

Age groups	C_2	C_3	C_4
Age in years	30-49	50-54	55-59
1 . Data	0.883	0.847	0.559
2. Benchmark model	0.867	0.874	0.549
3. Model with b high and λ high	0.739	0.637	0.461
4. Model with b low and λ low	0.871	0.898	0.903
5. Model with b high and λ low	0.811	0.802	0.752
6. Model with b low and λ high	0.833	0.854	0.847

Note:

b high: all age groups receive older workers' unemployment benefits

b low: all age groups receive young workers' unemployment benefits

λ high: all age groups are characterized by older workers' separation rate

λ low: all age groups are characterized by young workers' separation rate employment rate is about 10% lower on Line 3 than on Line 2. This decrease can be interpreted as the pure effect of both the greater generosity of the unemployment benefits and the lower job duration. As the decline in the employment rate accelerates when retirement is imminent, the distance effect does quantitatively matter[24]. This suggests that the unemployment benefits and the separation rate alone account only for a third of the decline in the older workers' employment rate. If the workers aged 55-59 were at the same distance to retirement as the workers aged 30-49, their employment rate would be much higher. In that sense, the proximity to retirement explains the main component of the observed decline of their employment rate.

However, this does not imply that the distance to retirement alone (independently of the values of the unemployment benefits and of the separation rates) matters so much. As already emphasized in Figure 3, Line 4, Table 6 shows that the employment rates before retirement remain quite stable when considering low unemployment benefits and separation rates. Individuals at all ages are now encouraged to work, as the impatience effect dominates the decrease in the search intensity at the end of the working life. Lines 5 and 6 allow us to differentiate the impact of the unemployment benefits and the separation rates. The interaction of the distance effect with the generosity of unemployment benefits appears stronger.

The distance effect accounts for a decline of two-thirds in the employment rate at the end of working life only in conjunction with high unemployment benefits and depressed labor demand for older workers. Ljungqvist & Sargent (2008) obtain similar interactions in another context. Turbulent times, which create high skill depreciation during unemployment spells, discourage the job search if the unemployment benefits are indexed on last earnings. For the older workers, this effect is magnified because they have less time (a shorter horizon) for any accumulation of new skills if they find a job[25]. We show that

[24] This importance of the distance effect is robust to different values of key parameters. However, it can be shown that the lower the search efficiency γ, the lower the employment rate of older workers. Low values of γ could explain why older workers do not search intensively when the distance to retirement is short, thereby boosting the quantitative importance of the distance effect. In addition, the higher the risk aversion σ, the larger the distance effect. Indeed, for a non employed worker, the risky choice is the decision to keep looking for a job while the non search behavior yields a steady income. For workers who are close to retirement, the choice to remain on the labor market appears all the more risky as the gain from employment cannot be enjoyed for very long.

[25] We thank an anonymous referee for pointing out this analogy with Ljungqvist & Sargent's (2008) results.

the existence of generous assistance programs for older workers in Europe along with a depressed labor demand is enough to lead to strong interactions with the proximity to retirement which can explain the observed low employment rate.

3.4 The Double Dividend of Actuarially-Fair Pension Adjustments

Two options to deal with the lower employment rate at the end of the working life can be considered. On the one hand, decreasing the generosity of unemployment benefits would be efficient, in particular, and unexpectedly, by dampening the distance effect. On the other hand, delaying the retirement age could be another strategy if a high unemployment benefit for older workers is maintained: this argument reinforces the case for more actuarially-fair adjustments in Social Security provisions. We evaluate this policy in this Section.

Over the last decade, several pension reforms have been implemented in OECD countries to increase the labor-market participation of older people. Along the lines of the US Social Security system, the actuarially fair adjustment was introduced in the 1990s in Italy and Sweden which have adopted a so-called "notional defined contribution" model, thereby providing flexible retirement choices. Public pensions have been made more neutral *vis-à-vis* work-retirement decisions. Pension entitlements depend, among other things, on the number of years worked, the size of lifetime earnings and remaining life expectancy at the age of withdrawal.

In this section, we show that, beyond the incentive to delay retirement, the decrease in the tax on continued work has sufficiently large effects to encourage unemployed older workers to find a job. This is an additional point in favor of this policy, usually left aside by neglecting the impact of Social Security arrangements on job search behavior in an economy with full employment.

In the previous sections, pension schemes were characterized by an extreme tax on continued activity: the pension was constant whether individuals retired at 60 or 65 years old. In this section, the tax on continued work is lowered by increasing the pension for workers who choose to retire at age 65 rather than 60: an actuarially-fair policy amounts to a 46% increase in pension in the case of delayed retirement by 5 years. Let us recall that it remunerates five additional working years, and not only one. This value is consistent with Hairault et. al.'s (2008) computations on French data as well as the US 1983 old age pension reform. As we want to analyze pension reforms only, unemployment benefits are left unchanged.[26]

[26] This section aims at illustrating how the distance effect could magnify the impact of a common Social

Actuarially-fair pension schemes should greatly increase the value of being employed, first relative to the value of being retired, but also relative to the value of being unemployed. For unemployed workers aged 55 or more, the incentives to look for a job go up, as the horizon during which the unemployment status is dominated by employment is extended. Is this return on the job search large enough to reduce the effect of generous unemployment benefits and higher separation rates before the early retirement age? In the light of Figure 6, the answer to this question is a qualified *yes*.

- First, with incentive schemes, the implicit tax on continued activity is removed. Thus, more individuals remain at work until the maximum retirement age. 20.1% of workers choose to delay retirement until the age of 65 (Line 2, column C_5 in Table 7). All workers unemployed from 60 on choose to retire.
- The first effect is the standard expected gain from the introduction of actuarially-fair schemes. The job search model actually helps uncover an additional gain from this policy: incentive schemes not only encourage individuals to keep their jobs after the early retirement age, but also make job offers more attractive to unemployed people before this age because the distance to retirement increases. In age group C_4, a more intensive job search effort, relative to the benchmark case, reduces the fall in the transition rate to employment (Figure 6). The employment rate of age group C_4 goes up from 55% to 71% (Lines 1 and 2 in Table 7), despite the high non-employment benefits and separation rates.

Incentives to work longer generate a double dividend: the increase in pension because of continued activity not only encourages some employed workers to delay retirement but also gives incentives to non-employed workers below the age at which they are eligible to retire to search more intensively. Incentive schemes globally increase older workers' employment rate.

4 Conclusion

This paper aims at quantifying the effect of the retirement age decision on the job search prior to retirement. Based on French micro data, the time horizon before retirement seems to account for the low employment rate of older workers. We extend McCall's (1970)

Security reform implemented in some European countries. It is beyond the scope of the paper to assess the optimality of such a policy compared with alternative measures such as decreasing unemployment benefits.

Figure 6: Job search behavior over the life-cycle with incentive schemes

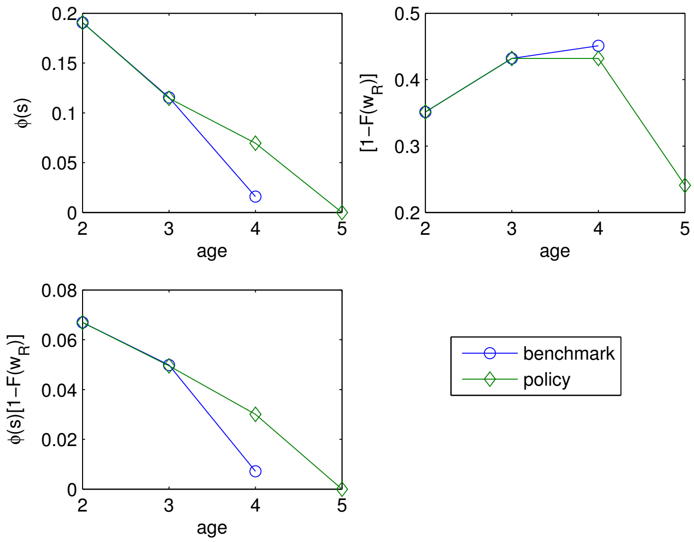


Table 7: Incentive schemes and employment rates

Age groups	C_1	C_2	C_3	C_4	C_5
Age in years	20-29	30-49	50-54	55-59	60-64
1. Benchmark	0.828	0.867	0.874	**0.549**	0
2. Retirement Policy	0.830	0.867	0.874	**0.714**	**0.201**

search model to allow for life cycle features and endogenous retirement. Calibration on the French economy confirms the major effects uncovered by the micro-econometric analysis. This gives theoretical grounds for the mechanisms at work on the labor market when the retirement age gets closer, in particular the strong interactions between the distance effect and generous unemployment benefits at the end of the working life. We also show that the distance effect modifies pre-retired workers' search when the separation rate is high. Time to retirement matters but in conjunction with other factors such as higher unemployment benefits and depressed labor demand. Finally, the model predicts that a decrease in the tax on continued activity not only makes more older workers delay retirement, but also encourages more unemployed people to find a job, yielding a double dividend from incentive schemes. It provides strong support in favor of policies that reward continued activity on an actuarially-fair basis.

Overall, we think that integrating the retirement deadline into labor market analysis is a promising approach which could be undertaken to revisit other important issues such as training, labor demand and wage bargaining. This is left for future research.

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APPENDIX

Table A.1: Age and expected retirement age

Age	11 years and more	Between 6 and 10 years	3 to 5 years	Less than 2 years	Total
50	1118	6934	0	0	8052
51	785	6970	0	0	7755
52	597	6920	0	0	7517
53	352	6993	0	0	7345
54	209	6860	0	0	7069
55	0	711	6038	0	6749
56	0	479	6188	0	6667
57	0	340	6283	0	6623
58	0	167	313	6091	6571
59	0	89	248	6369	6706
Total	3061	36463	19070	12460	71054

Table A.2: Descriptive Statistics - Men (1)

	Not employed	Employed	Total
Total	60893	319641	380534
	16.00	84.00	100.00
Number of years before retirement			
11 years and more	39257	273284	312541
	12.56	87.44	100.00
Between 6 ans 10 years	6665	29798	36463
	18.28	81.72	100.00
3 to 5 years	7068	12002	19070
	37.06	**62.94**	100.00
Less than 2 years	7903	4557	12460
	63.43	**36.57**	100.00
Marital Status			
Live with spouse	36199	238726	274925
	13.17	86.83	100.00
Live alone	24694	80915	105609
	23.38	76.62	100.00
Number of children			
No child	27138	98646	125784
	21.58	78.42	100.00
1 or 2 children	25145	172691	197836
	12.71	87.29	100.00
3 to 5 children	7846	46709	54555
	14.38	85.62	100.00
6 children and more	764	1595	2359
	32.39	67.61	100.00
Size of city			
Parisian Area	13650	60668	74318
	18.37	81.63	100.00
more than 200000 inhab Outside Parisian Area	13956	64212	78168
	17.85	82.15	100.00
20000 to 200000 inhab	10502	56432	66934
	15.69	84.31	100.00
less than 20000 inhab	14976	90600	105576
	14.19	85.81	100.00
Rural town	60893	319641	380534
	16.00	84.00	100.00

Table A.3: Descriptive Statistics - Men (2)

	Not employed	Employed	Total
Sector			
Industry	18661	109554	128215
	14.55	85.45	100.00
Agriculture	1981	7229	9210
	21.51	78.49	100.00
Construction	9842	36815	46657
	21.09	78.91	100.00
Services	30409	166043	196452
	15.48	84.52	100.00
Occupational Groups			
Blue Collars	36706	167477	204183
	17.98	82.02	100.00
Clerk	8985	33573	42558
	21.11	78.89	100.00
Middle skilled worker	10372	73529	83901
	12.36	87.64	100.00
Executive	4830	45062	49892
	9.68	90.32	100.00
Citizenship			
French	56017	303165	359182
	15.60	84.40	100.00
Non French	4876	16476	21352
	22.84	77.16	100.00
Education			
Low education	50143	229843	279986
	17.91	82.09	100.00
High education	10750	89798	100548
	10.69	89.31	100.00

Table A.4: Descriptive Statistics - Men (3)

	Not employed	Employed	Total		Not employed	Employed	Total
Age dummies				Time Dummy			
Less than 50 years old	38894	270586	309480	1990	3789	23288	27077
	12.57	87.43	100.00		13.99	86.01	100.00
50	113	6922	8052	1991	3744	23564	27308
	14.03	85.97	100.00		13.71	86.29	100.00
51	1221	6534	7755	1992	4159	23848	28007
	15.74	84.26	100.00		14.85	85.15	100.00
52	1334	6183	7517	1993	4817	24610	29427
	17.75	82.25	100.00		16.37	83.63	100.00
53	1431	5914	7345	1994	5428	24613	30041
	19.48	80.52	100.00		18.07	81.93	100.00
54	1522	5547	7069	1995	5098	25125	30223
	21.53	78.47	100.00		16.87	83.13	100.00
55	1709	5040	6749	1996	5188	25406	30594
	25.32	74.68	100.00		16.96	83.04	100.00
56	2392	4275	6667	1997	5241	24858	30099
	35.88	64.12	100.00		17.41	82.59	100.00
57	3035	3588	6623	1998	5076	25029	30105
	45.83	54.17	100.00		16.86	83.14	100.00
58	3706	2865	6571	1999	5275	25253	30528
	56.40	43.60	100.00		17.28	82.72	100.00
59	4519	2187	6706	2000	3837	21811	25648
	67.39	32.61	100.00		14.96	85.04	100.00
				2001	4512	26283	30795
					14.65	85.35	100.00
				2002	4729	25953	30682
					15.41	84.59	100.00

Table A.5: Strategy I : Logit on male employment probability - Estimates on other control variables (1)

	without distance		with distance	
	Coefficient	P value	Coefficient	P value
Age variables				
Age	0.0568	0.000	0.057	0.000
Age * Age	-0.0008	0.000	-0.001	0.000
Age = 50	-0.1012	0.0020	0.090	0.738
Age = 51	-0.2177	0.0000	0.047	0.849
Age = 52	-0.3250	0.0000	-0.494	0.028
Age = 53	-0.4245	0.0000	-0.358	0.091
Age = 54	-0.5554	0.0000	-0.611	0.001
Age = 55	-0.7883	0.0000	-0.972	0.000
Age = 56	-1.2869	0.0000	-1.632	0.000
Age = 57	-1.6938	0.0000	-2.097	0.000
Age = 58	-2.1476	0.0000	-2.557	0.000
Age = 59	-2.6207	0.0000	-2.853	0.000
Education (Reference : Low education)				
High education	0.2958	0.000	0.283	0.000
Marital status (Reference : live with a spouse)				
Lives alone	-0.8404	0.000	-0.841	0.000
Number of children (Reference : no children)				
1-2 children	0.1583	0.000	0.158	0.000
3-5 children	0.0249	0.163	0.023	0.199
+6 children	-0.4268	0.000	-0.428	0.000
Size of city (Reference : Parisian Area)				
+200000 inhab	-0.2791	0.000	-0.279	0.000
20000 to 200000 inhab	-0.1961	0.000	-0.196	0.000
- 20000 inhab	0.0105	0.628	0.010	0.659
Rural area	0.1365	0.000	0.137	0.000
Occupational group (Reference : Blue collar)				
Clerks	-0.1930	0.0000	-0.192	0.000
Middle White Collars	0.2650	0.0000	0.267	0.000
Executives	0.4340	0.0000	0.422	0.000

Table A.6: Strategy I : Logit on male employment probability - Estimates on other control variables (2)

	Without distance		With distance	
	Coefficient	P value	Coefficient	P value
Sector (Reference : Industry)				
Agriculture	-0.3413	0.0000	-0.342	0.000
Construction	-0.3595	0.0000	-0.360	0.000
Services	0.1971	0.0000	0.196	0.000
Citizenship (Reference : French)				
Non french	-0.4997	0.0000	-0.500	0.000
Time Dummy (Reference : 1990)				
1991	-0.0140	0.4850	-0.014	0.491
1992	-0.1109	0.0000	-0.111	0.000
1993	-0.2740	0.0000	-0.274	0.000
1994	-0.4101	0.0000	-0.410	0.000
1995	-0.3199	0.0000	-0.320	0.000
1996	-0.3274	0.0000	-0.328	0.000
1997	-0.3745	0.0000	-0.375	0.000
1998	-0.3214	0.0000	-0.323	0.000
1999	-0.3343	0.0000	-0.336	0.000
2000	-0.1738	0.0000	-0.175	0.000
2001	-0.0621	0.0080	-0.065	0.005
2002	-0.1416	0.0000	-0.145	0.000
Constant	1.5157	0.0000	1.514	0.000
Number of observations	380534		380534	

Table A.7: Strategy II: Experience and Distance effect. Estimates on other control variables (1)

	Estimation i) Constrained population Minimum age 60		Estimation ii) Constrained population Maximum age 65		Estimation iii) All individuals	
	Coeff.	P value	Coeff.	P value	Coeff.	P value
Age	0.0478	0.000	0.0861	0.314	0.0569	0.000
Age * Age	-0.0007	0.000	-0.0013	0.271	-0.0008	0.000
Education (Reference : Low education)						
High education	0.1710	0.000	-0.0722	0.756	0.2875	0.000
Marital status (Reference : live with a spouse)						
Lives alone	-0.8921	0.000	-0.5851	0.000	-0.8418	0.000
Number of children (Reference : no children)						
1-2 children	0.1909	0.000	-0.0300	0.738	0.1580	0.000
3-5 children	0.0483	0.014	-0.0843	0.542	0.0235	0.187
+6 children	-0.4415	0.000	-0.6867	0.311	-0.4269	0.000
Size of city (Reference : Parisian Area)						
+200000 inhab	-0.3465	0.000	-0.1606	0.130	-0.2794	0.000
20000 to 200000 inhab	-0.2602	0.000	-0.3508	0.003	-0.1961	0.000
- 20000 inhab	-0.0450	0.072	0.0495	0.757	0.0094	0.666
Rural area	0.1113	0.000	-0.1790	0.235	0.1356	0.000
Occupational group (Reference : Blue collar)						
Clerks	-0.2475	0.000	0.3574	0.039	-0.1919	0.000
Middle White Collars	0.2294	0.000	0.6550	0.000	0.2693	0.000
Executives	0.2834	0.000	1.3599	0.000	0.4271	0.000
Sector (Reference : Industry)						
Agriculture	-0.2936	0.000	-1.4415	0.004	-0.3433	0.000
Construction	-0.3276	0.000	-0.4745	0.033	-0.3604	0.000
Services	0.2306	0.000	-0.1764	0.076	0.1962	0.000
Citizenship (Reference : French)						
Non French	-0.4009	0.000	-0.5427	0.000	-0.4995	0.000

Table A.8: Strategy II: Experience and Distance effect. Estimates on other control variables (2)

	Estimation i) Constrained population Minimum age 60		Estimation ii) Constrained population Maximum age 65		Estimation iii) All individuals	
	Coeff.	P value	Coeff.	P value	Coeff.	P value
Time Dummy (Reference : 1990)						
1991	-0.0189	0.368	-0.0058	0.978	-0.0143	0.477
1992	-0.1026	0.000	-0.1086	0.606	-0.1109	0.000
1993	-0.2447	0.000	-0.3309	0.112	-0.2735	0.000
1994	-0.3699	0.000	-0.5293	0.009	-0.4100	0.000
1995	-0.2842	0.000	-0.6586	0.001	-0.3202	0.000
1996	-0.2971	0.000	-0.6831	0.001	-0.3274	0.000
1997	-0.3560	0.000	-0.6481	0.001	-0.3751	0.000
1998	-0.3028	0.000	-0.5844	0.004	-0.3224	0.000
1999	-0.3353	0.000	-0.5066	0.011	-0.3362	0.000
2000	-0.1881	0.000	-0.3174	0.122	-0.1754	0.000
2001	-0.0722	0.005	-0.2325	0.244	-0.0646	0.005
2002	-0.1325	0.000	-0.2660	0.184	-0.1450	0.000
Age dummies						
Age = 50	1.5644	0.009	-0.2791	0.937	1.6546	0.059
Age = 51	1.3515	0.028	-1.3199	0.702	1.6517	0.058
Age = 52	0.7889	0.205	12.0185	0.046	0.0569	0.945
Age = 53	-0.2183	0.722	6.8346	0.309	-0.6905	0.382
Age = 54	-0.8286	0.183	0.4738	0.943	-1.5628	0.040
Age = 55	-1.5167	0.015	6.1640	0.347	-1.8093	0.014
Age = 56	-1.0608	0.078	7.2829	0.244	-1.9628	0.003
Age = 57	-2.6823	0.000	4.6089	0.469	-4.0024	0.000
Age = 58	-2.2889	0.000	9.7218	0.181	-3.5070	0.000
Age = 59	-3.4921	0.000	9.7390	0.161	-4.3010	0.000
Constant	1.6183	0.000	0.8632	0.589	1.5188	0.000
Number of observations	287335		8081		380534	