

Direction des Études et Synthèses Économiques

G 2005 / 13

**The labour market after age 50:
some elements of a Franco-American comparison**

**Patrick AUBERT
Didier BLANCHET - David BLAU**

Document de travail



Institut National de la Statistique et des Études Économiques

INSTITUT NATIONAL DE LA STATISTIQUE ET DES ÉTUDES ÉCONOMIQUES

*Série des documents de travail
de la Direction des Etudes et Synthèses Économiques*

G 2005 / 13

The labour market after age 50: some elements of a Franco-American comparison

Patrick AUBERT*
Didier BLANCHET* - David BLAU **

AOÛT 2005

Earlier versions of this text have been presented to the NERO meeting, Paris, OECD, 30 June 2004, and to the D3E seminar, 16 February 2005. A French version has been published in *L'économie Française : Comptes et Dossiers*, 2005-2006 edition, INSEE. We thank L. Behaghel and J.F. Loué for their very useful comments, and C. Afsa for his help. Any remaining errors are ours.

* INSEE - Département des Etudes Economiques d'Ensemble - 15, bd Gabriel Péri - BP 100 - 92244 MALAKOFF Cedex

** University of North Carolina. D. Blau was visiting researcher at INSEE/CREST and D3E during the preparation of this paper.

The labour market after age 50: some elements of a Franco-American comparison

Abstract

This paper examines various supply and demand side aspects of the French labour market for older workers and puts them in perspective by comparing them to the US case. We first consider the supply side incentives (or disincentives) of basic pension schemes for the two countries : for France, we discuss how these incentives have been changed by the 1993 and 2003 pension reforms and we present some projections of the impact of these reforms on labour force participation rates, based on the DESTINIE dynamic microsimulation model. We then discuss, on the demand side, the hypothesis of a wage-productivity gap for older workers which could explain their lower employment rates. Evidence in favor of this hypothesis is not overwhelming. Nevertheless, workers who lose their jobs at older ages probably suffer a large loss of firm-specific and sector-specific human capital. In the US, this does not preclude re-employment, but at the cost of significant drops of wage levels. In France, the collective choice has been made since the 1970s to allow older workers who lose their jobs to completely withdraw from the labour market : these workers have access to preretirement schemes or specific dispositions of unemployment insurance (including an exemption from seeking employment). This system proved difficult to regulate. Due to these difficulties, France has not been able to do more than stabilize the employment rate in the 55-64 age bracket during the 1990s, after 20 years of continuous decline. The key unanswered question is whether it will be possible to increase the employment rate of this age group in the next two decades.

Keywords: Pensions, preretirement, senior workers.

Le marché du travail après 50 ans : éléments de comparaison franco-américaine

Résumé

Ce texte examine divers aspects du fonctionnement du marché du travail des seniors en France, sous les deux angles de l'offre et de la demande de travail, et les met en perspective en les comparant à la situation américaine. On examine d'accord en quoi les barèmes de retraite de base incitent ou désincitent à l'offre de travail dans les deux pays : pour la France, on examine comment ces incitations ont été ou vont être modifiées par les réformes de 1993 et de 2003 et nous présentons des évaluations des effets de ces réformes sur les taux d'activités, fondées sur le modèle de microsimulation dynamique DESTINIE. Du côté de la demande de travail, on examine ensuite l'hypothèse d'un écart salaire-productivité des seniors qui pourrait expliquer leur faible taux d'emploi. On ne trouve pas de preuves fortes d'un tel écart, mais ceci ne vaut que pour les seniors dont la productivité est mesurable, c'est-à-dire ceux qui sont en emploi. Pour les autres, la perte d'emploi se traduit inévitablement par des fortes pertes de capital humain spécifique à la firme ou au secteur. Aux Etats-Unis, ceci n'empêche pas le retour à l'emploi, mais il se fait au prix de pertes salariales importantes. En France, le choix collectif qui a été fait depuis les années 70 a été de plutôt permettre à ces travailleurs de se retirer totalement du marché du travail, soit grâce aux préretraites, soit à travers des dispositions particulières de l'assurance-chômage (y compris la dispense de recherche d'emploi). Ce système s'est avéré difficile à réguler. Ceci explique que la France n'ait pas pu faire plus que stabiliser le taux d'emploi dans la classe d'âge 55-64 pendant les années 90, après 20 ans de déclin continu. La question reste ouverte de savoir s'il sera possible d'augmenter le taux d'emploi de cette catégorie d'âge dans les décennies à venir.

Mots-clés : Retraite, préretraite, travailleurs âgés.

Classification JEL : H55 - J26 - J40

Introduction	5
I - The labour market for older workers: basic stylized facts.....	7
II - Supply side.....	11
<i>II.1 Pre-reform conditions</i>	11
<i>II.2 Reform : various policy options</i>	16
<i>II.3 Assessing the impact of the French 1993 and 2003 reforms</i>	19
III - Demand side	23
<i>III.1 Three candidates for explaining low demand for older workers</i>	23
<i>III.2 Assessing the wage-productivity gap for older workers: mixed evidence</i>	24
IV - Regulating the market for older workers: two very different options	27
<i>IV.1 A system without specific protection of older workers: what consequences for the old unemployed ?</i>	27
<i>IV.2 Passive indemnization of job loss: a system that has been difficult to regulate</i>	28
Conclusion	33
References.....	35

Introduction

It is common to point out how unsuccessful the French labour market has been in maintaining or creating jobs over the last decades. Of course, this general impression was temporarily offset by the sharp decrease in the unemployment rate between 1997 and 2001, from a little more than 12% to a little more than 8,5%, in a period of rapid growth in the labour force. This led to the feeling that “full employment” was becoming a realistic goal for the French economy. But this wave of optimism was dashed by the recent economic downturn. Employment growth has been close to zero since 2002, the unemployment rate went back up, and the question of whether France will be able to attain the employment targets fixed by the European Union in the near future has again become relevant.

There are certainly numerous causes for the low French employment rate but, among the many aspects of this question there are good reasons to have a deeper look at causes for low employment in one specific segment of the labour market, the one that concerns older workers. The low level of employment in the age group 55-64 accounts for a very significant part of the low overall employment rate. Understanding the labour market for older workers is, therefore, of particular relevance, not only for future pension expenditures but also for general economic performance.

The present paper discusses this question, with emphasis on two specific aspects of the problem. First, we will place equal emphasis on the supply and demand sides of this market. Recent international comparisons have strongly emphasized the role of supply-side factors (Blöndal and Scarpetta, 1999; Gruber and Wise, 2004; Duval, 2004). These comparative studies have presented evidence suggesting that low employment rates are a response to low incentives to stay at work past certain ages, due either to normal retirement or to pre- and early retirement schemes. There is little doubt that this factor plays a role in France: nobody will deny that the pension system has been precisely designed to allow for large exits from the labour force around the age of 60. But there is also little doubt that we require better knowledge about demand side aspects of the problem. If the goal is to restore higher employment rates in the 55-64 bracket, we need policies that walk on two legs: restoring incentives to work for older workers, but also encouraging employers to keep or to hire workers of this age group. Recent surveys on the same topic actually try to combine the two dimensions (Lerais and Marioni, 2004; Marioni, 2005; OECD, 2005)

The second main contribution of this paper will be to put the French situation in international perspective, with a particular emphasis on the US case. This choice does not necessarily imply that the US case is considered as a benchmark for assessing the performance of the French labour market. This choice is rather motivated by the magnitude of the contrast between the French and the US situation, which makes the comparison particularly instructive, and also by the availability of some directly comparable studies for the two countries, on which this paper will strongly rely¹.

The paper will be organized as follows. After a brief presentation of some stylized facts concerning employment of older workers in France, section 2 will concentrate on supply side problems. Concerning France, some evaluations will be provided on expected impacts on labor supply of older individuals of the two major pension reforms enacted in 1993 and 2003.

The third section discusses one of the most often cited obstacles to employment of older workers in France, i.e. their high cost relative to their productivity. The evidence

¹ In fact, the French part of this paper relies on a series of studies performed at INSEE on this topic over the last few years, both on supply and demand side aspects. Some of these studies have been conducted in the context of international comparison projects (Blanchet and Pelé, 1999; Mahieu and Blanchet, 2004), others have been more or less inspired by previous studies realized on US data (Crépon, Deniau and Perez-Duarte, 2003; Aubert and Crépon, 2004).

on this point remains mixed: older workers who are still in employment do not seem to see their productivity falling below their wage levels. But this does not rule out the hypothesis that large numbers of older individuals are out of the labor market precisely because their productivity has been adversely affected by, for example, obsolescence of technologies they are able to use, or the emergence of new competitors on international markets. This can explain simultaneously why they may have been laid off by their former employers, and why it is difficult for them to re-enter the labour market.

This raises the question of the coverage offered by social protection against such negative shocks to the productivity of older workers. US data show that older workers who lose their jobs generally face relatively large wage cuts when they find a new job. It is precisely to offer coverage against such wage losses that preretirement schemes or special dispositions of unemployment insurance for older workers have been developed in France. In contrast, the US system assumes that older workers are flexible enough to be able to cope with the wage cuts associated with involuntary job changes.

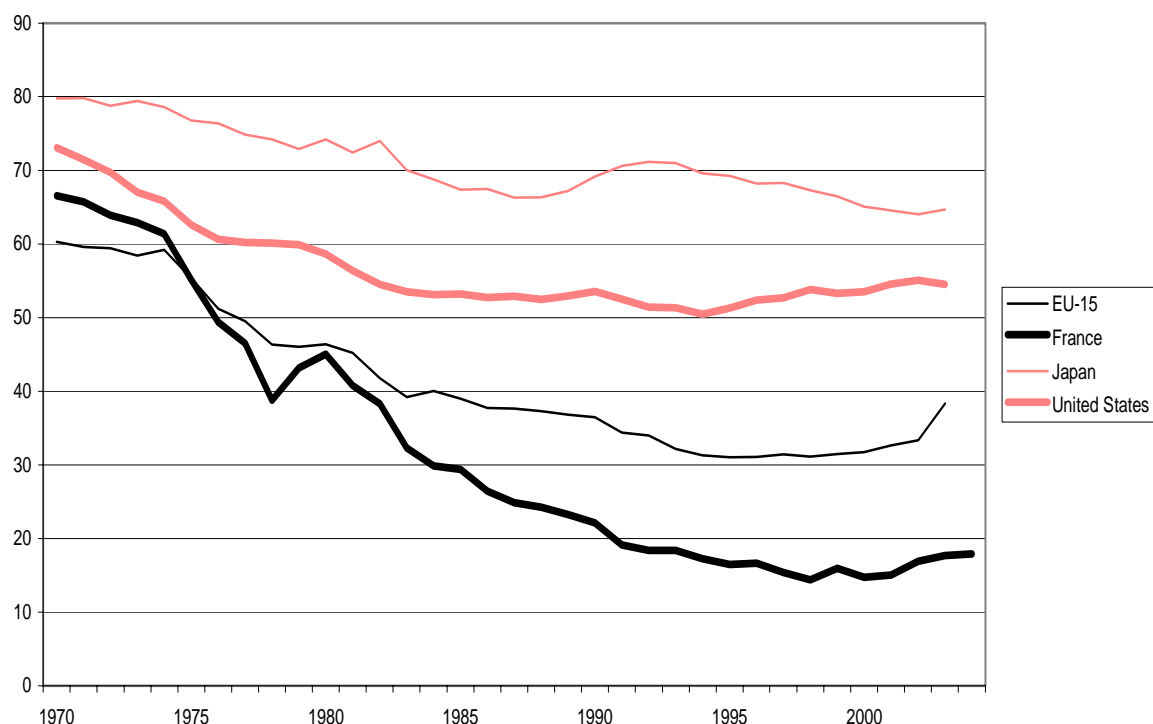
It is beyond the scope of the paper to discuss the relative merits of these two very different systems: they reflect different social choices or values. However, when protection is offered against negative productivity shocks at the end of one's career, as in France, it is important to understand how to avoid excessive use of this facility, in particular by employers themselves. In France, this has been attempted either by administrative control, or by financial penalties targeted toward lay-offs of older workers. The fourth section of this paper uses recent research to assess the efficiency of this second group of instruments. Unfortunately, this efficiency remains limited: this suggests that these tools alone are not sufficient for regulating labour market transitions in this age group. Other actions are probably required: antidiscrimination policies such as those developed in the US are perhaps not directly transposable to France, but positive actions to combat employers' stereotypes against older workers would probably be of some use. A final section briefly concludes.

I - The labour market for older workers: basic stylised facts

To start, we can briefly describe the main facts about employment of older workers in France. Figures 1 and 2 give employment rates for men since 1970. They confirm that France lies well behind a majority of developed countries, not only Japan and the US where employment rates of older workers remain quite high (and even exceptionally high in the case of Japan), but also compared to the average of EU-15 countries. This was not the case at the beginning of the 1970s, when French levels were comparable to the average. The relative decline of French employment rates started around 1974, first for the 60-64 age group², and then for the 55-59 age group during the first half of the eighties. Since the middle of the eighties, the employment rate more or less stabilized in the 55-59 group, at about 65%, while the employment rate in the 60-64 age group continued declining and is now around 15%.

We do not show similar figures for women, which are less easy to interpret, due to the general increase of female employment rates across successive generations. But we give, both for men and women, labour force transition rates between ages 50 and 70 which explain the profiles of employment rates at these ages (figure 3). Transitions from employment to non employment display spikes at the ages of 60 and 65, which, as we shall see in a moment, have a particular significance in the basic French pension system. But probabilities of leaving employment are already large before age 60, at more than 10% per year between 55 and 59. A more detailed analysis by Behaghel (2003) shows that this probability increased between the end of the 70s and the 90s : the group of workers ages 50 or more is an age group in which tenure has lost part of its protective role against the risk of job loss.

Figure 1: Employment rates, men, 60-64 (Source OECD)



² The brief upswing in 1977-79 is due to a composition effect. The 1975-1979 period corresponds to the period where small cohorts born during WWI transited through this age group. This first accelerated the decline of the average activity rate in this group (due to the lower weight of the youngest people in this age group, whose activity rates are higher), compensated by an opposite movement in the following years (Givord, 2002).

Figure 2: Employment rates, men, 55-59 (Source OECD)

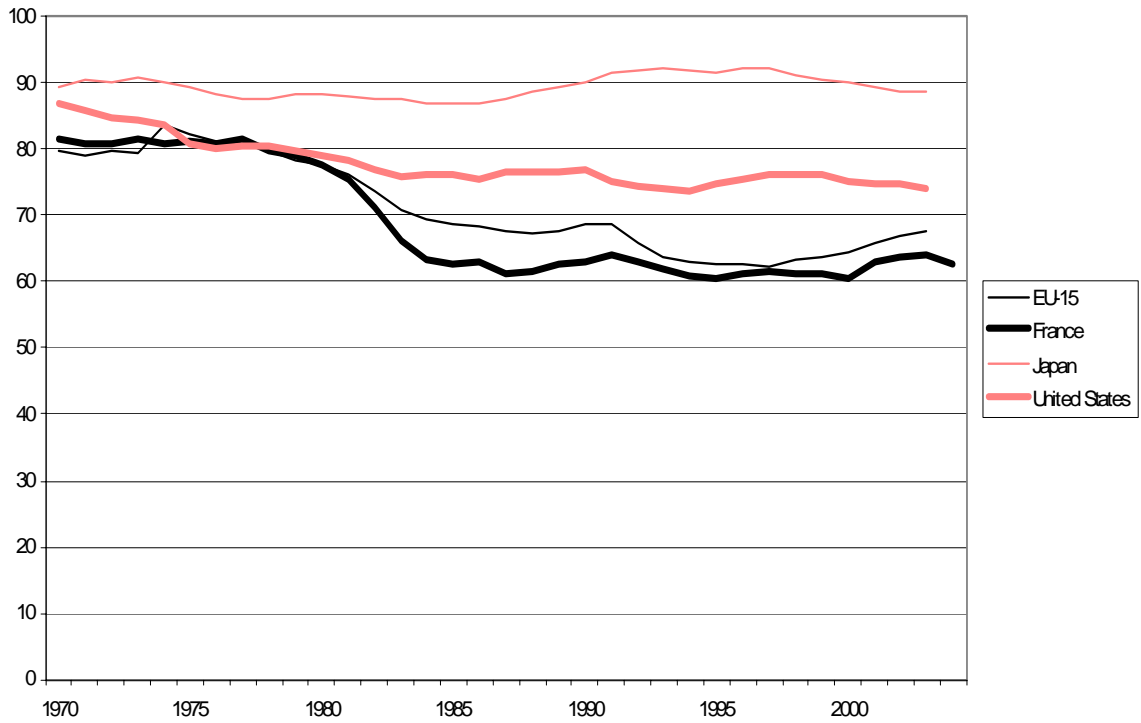
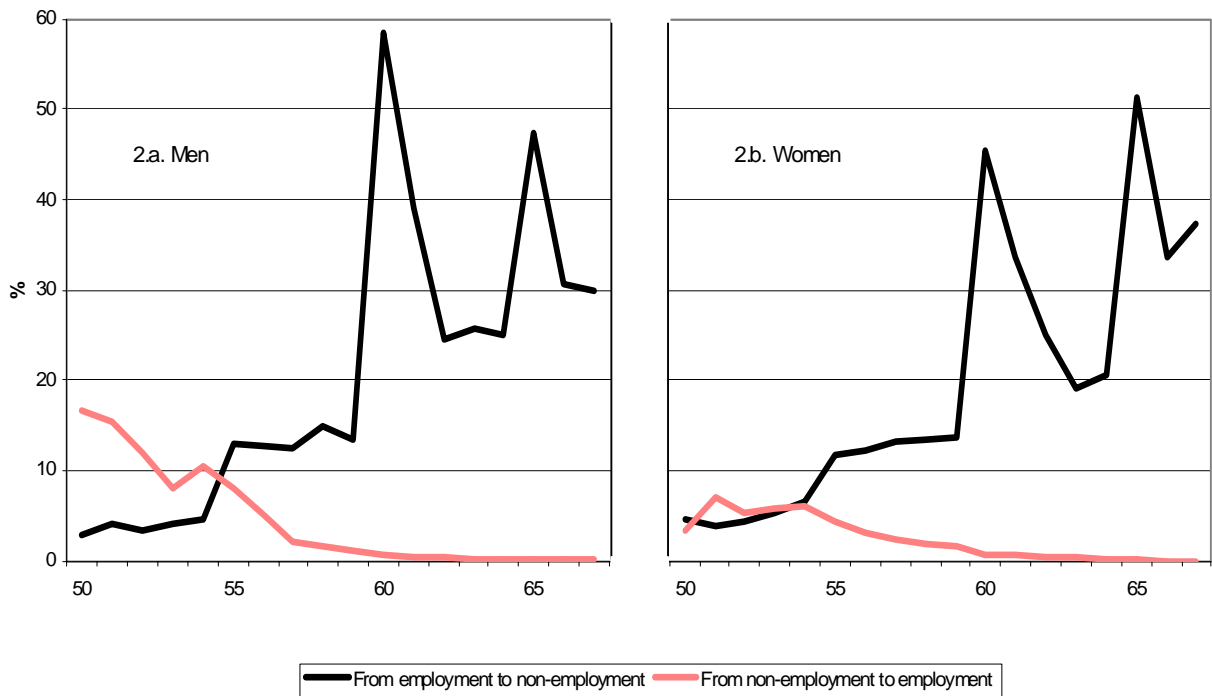
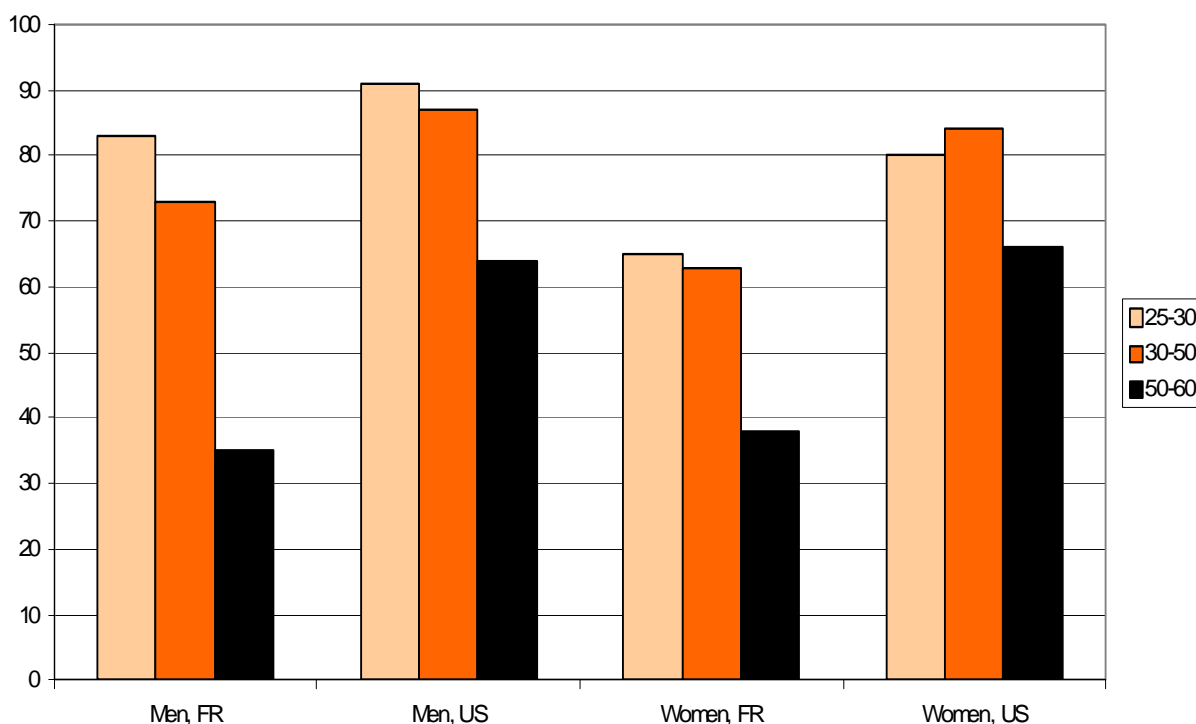


Figure 3: Transition probabilities between employment and non-employment, France



Source: LFS, INSEE. Probabilities of leaving employment are estimated for full-time workers only. Probabilities of returning to employment include returns to full-time and part-time employment.

Figure 4: Annual probabilities of returning to employment for unemployed workers in France and in the US, according to gender and age



Sources: Cohen and Dupas (2000). For the US, PSID data from the 1988-1992 period, for France, LFS data between, 1991 and 1996.

Conversely, while the probability of returning to employment from non-employment is still slightly positive at 50, it becomes practically equal to zero past ages 56 or 57.

This very low rate of return to employment sharply contrasts with the US situation where rates of return to employment, even if they also decline after 50, remain much larger than in France. An illustration is given by figure 4, built from results given by Cohen and Dupas (2000). This figure gives rates of return of unemployed worker one year after job loss, evaluated respectively from the Panel Study on Income Dynamics (PSID) for the US, and from Labour Force Surveys for France. Data are relatively old, 1988-1992 for the US and 1991-96 for France, but this does not matter that much for a comparison which is essentially structural. A difference between rates of return to employment is already observed at median ages, which reflects the greater fluidity of the US labour market. But this gap increases after 50: the reemployment probability is about 65% for a senior worker in the US, nearly twice the value that is observed for his or her French counterpart³.

³ This gap is still higher if we enlarge the age bracket to 50-64, as done in Cohen, Lefranc and Saint-Paul (2000): according to them, the ratio between the two probabilities on this age groups is from 1 to 10 between France and the US. These transition rates are however monthly rates, which present much more variability than annual ones (annual probabilities neutralize infra-annual movements that compensate for each other).

II - Supply side

Whatever the role of demand side factors in the explanation of low French employment rates between ages 55 and 64, it is clear that supply side considerations play an important role, specifically between ages 60 and 64. Low LFP rates for France are the natural response to the fact that the French system does not encourage and even discourages work in this age bracket. These disincentives were intentional: the evolution of pension rules that occurred since Social Security creation in 1946, and in particular the implementation of retirement at age 60 in 1983 was explicitly aimed at organizing massive exits from the labour force at this age which, at that time, was considered as the normal age at retirement collectively favored by public opinion.

What are more precisely these incentive properties of the French pension system, and how do they compare to those in the US system? To avoid complexity, let us restrict ourselves for both countries to the first pillar schemes that have the largest coverage. In France, the most important scheme is the “general regime” which provides the first pillar pension for all wage earners from the private sector (about 60% of the whole labor force). We shall compare this to the US Old Age and Survivors Insurance (OASI). Concerning France, we shall also describe some elements of pensions rules for civil servants, covering about 20% of the labor force.

Table 1 synthesizes rules of these different systems, including those that have applied until recently, and target rules that will result, ultimately, from reforms implemented over the last decades in the two countries. For France, these reforms took place in 1993 and 2003. In the US, a reform took place in 1983, but in both cases the reforms are expected to have their full effect around 2020. Let us start with the analysis of pre-reform situations, i.e. rules that prevailed in the two countries at the beginning of the 90s.

II.1 Pre-reform conditions

A first step is to describe “normal” retirement conditions. In France, we define “normal” retirement by reference to the concept of “full rate” pension. In the general regime this full rate pension is equal to 50% of a reference wage which, until the 1993 reform, used to be the average of past wages over the 10 best years of one’s career, truncated at the social security ceiling (the social security ceiling is roughly equivalent to the average wage)⁴.

In the US, an individual retiring at the normal age gets a pension level (PIA for Primary Insurance Amount) which is also a fraction of average past wages, with two major differences with the French case. The first one is that the average of past wages (the AIME, Average Indexed Monthly Earnings) is computed over the quasi-totality of people’s careers (35 years); the second difference is that the ratio between this AIME and the PIA depends on the position in the hierarchy of wages, with a highly progressive formula. This introduces a component of vertical redistribution in the system, which does not exist in the more strictly Bismarckian French system.

⁴ This first pillar pension is supplemented by one or two pensions delivered by complementary pension schemes (the most important ones are the ARRCO and the AGIRC). These complementary schemes are mandatory: the general regime and these complementary schemes together provide replacement rates of about 80% of the last net wage.

Table 1: Pre and post-reform major rules for the main French and US pension schemes

	France, regime general (salaried workers in the private sector)			France, public sector		USA, OASDI	
	Before the 1993 reform	Changes introduced by the 1993 reform	Changes introduced by the 2003 reform	Before the 2003 reform	Changes introduced by the 2003 reform	Initial rules	Rules that will prevail after full implementation of the 1983 reform
First age at which retirement is possible	60	No change		55 or 60 years, depending on categories	No change	62	62
Age or duration conditions for "normal" retirement	60 or more with at least N=37.5 years of contribution, or 65 without any condition on N	Duration condition raised from 37.5 years to 40 years (in 2003)	Duration condition raised to 41 (between 2008 and 2012), and to be increased to 41.75 years in 2020*.	37.5 years	Duration condition raised to 41 (in 2012), and to be increased to 41.75 years in 2020*.	65	67
Pension level at the NRA	If N= 37.5, 50% of the average of wages, truncated to the SS ceiling, over the 10 best years of ones career. If N<37.5, this amount is prorated.	The period over which past wages are averaged is increased from 10 to 25 years . (process to take place between 1993 and 2008).	No change	75% of the last wage	No change	A fraction of the average wage over the 35 best years of ones career. The fraction is 90% in the lowest bracket, 32% in the next bracket, and 15% in the highest bracket.	No change
Reduction for retirement before the NRA	Prorating effect plus a reduction of 10% for each missing year	No change	Additional reduction reduced to 5% per missing year	Only the prioritisation effect	Proratisation effect plus a reduction of 5% for each missing year	5/9 th percent for each month before the NRA	5/9 th percent per month between 64 and 67. 5/12 th percent between 62 and 64.
Increase for retirement after the NRA	None	No change	3% for each year of postponement	None	3% for each year of postponement	6% for each year of postponement	8% for each year of postponement

* Depending on future changes of life expectancy at 60.

Figure 4.a: Replacement rate depending on age at retirement. Individual started working at age 17. (See text for details)

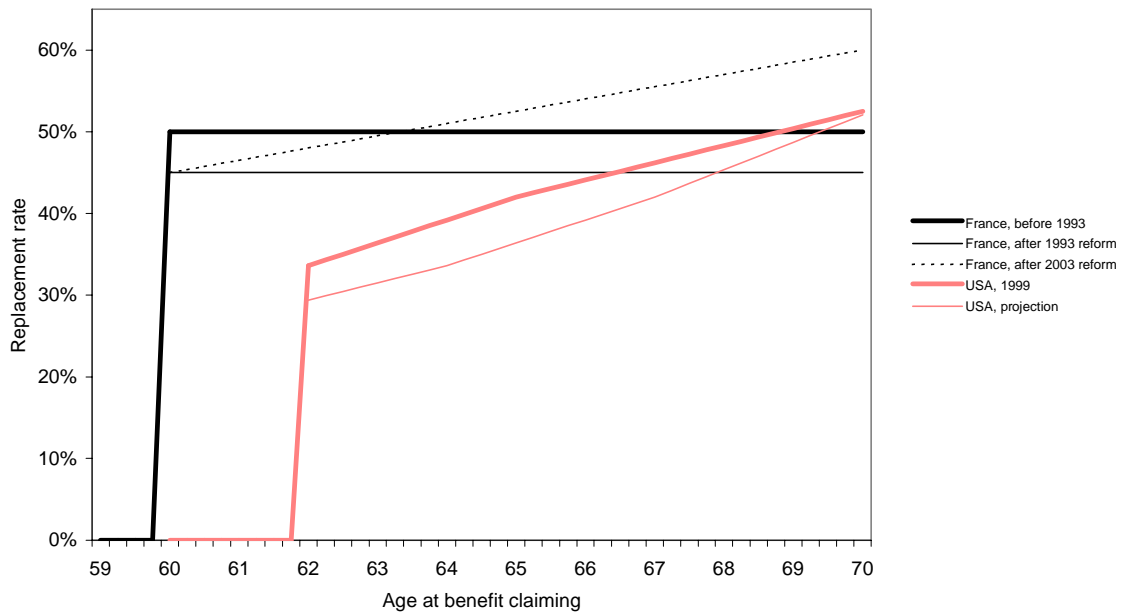


Figure 4.b: Replacement rate depending on age at retirement. Individual started working at age 20. (See text for details)

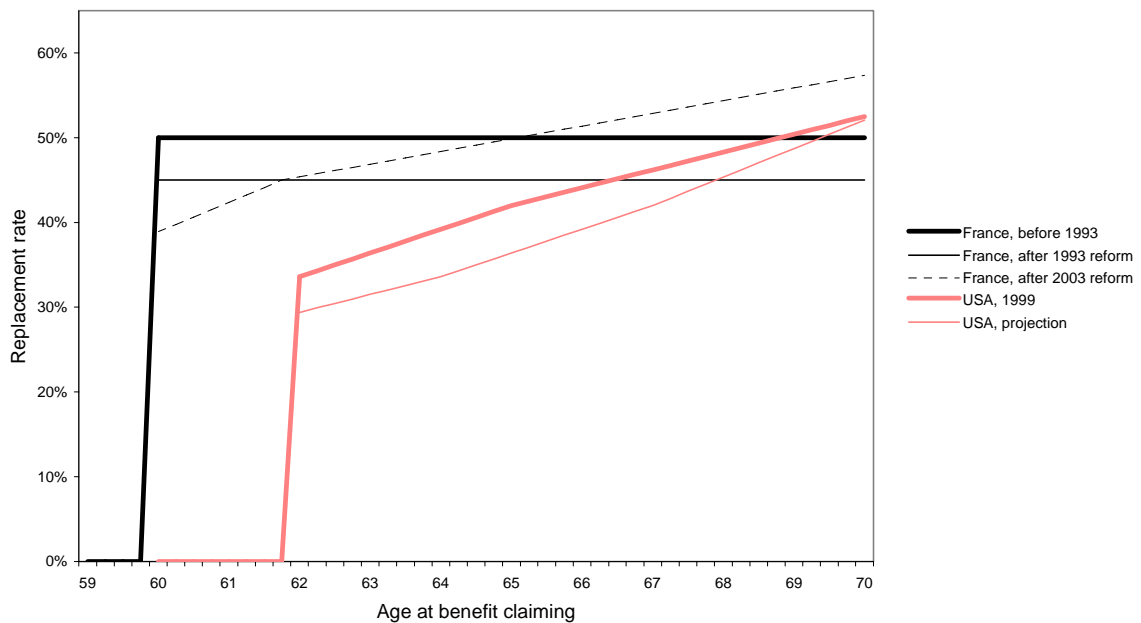


Figure 4.c: Replacement rate depending on age at retirement. Individual started working at age 23. (See text for details)

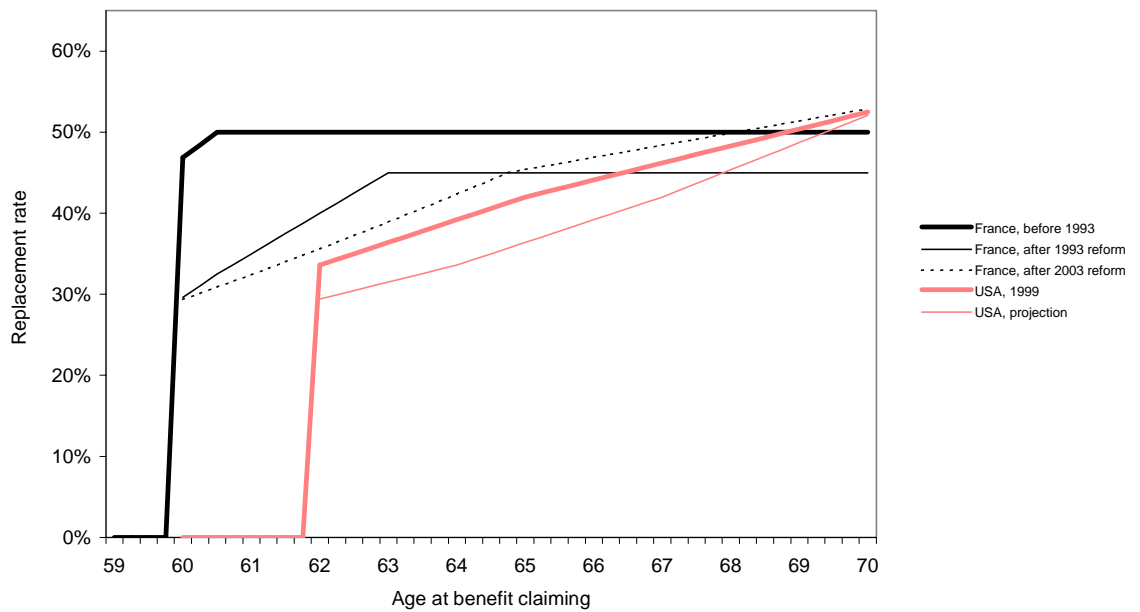
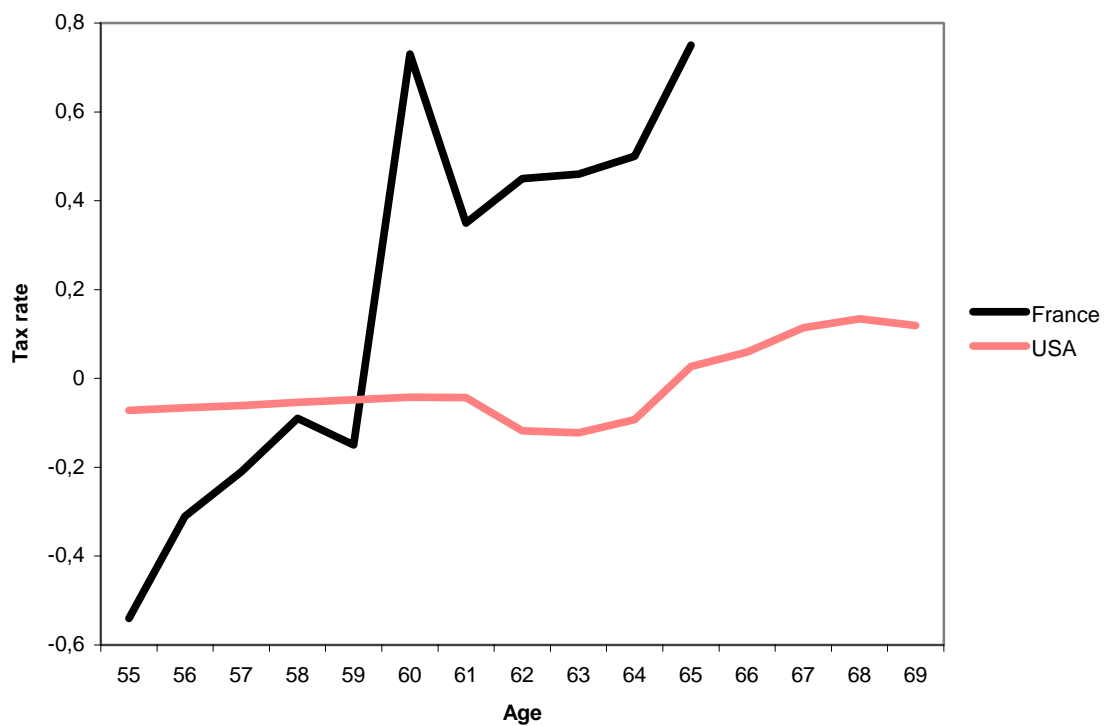


Figure 5: Implicit tax on continuing employment as a function of age



Source: Blanchet and Pelé (1999) and Diamond and Gruber (1999)

On the whole, however, both systems offered a pension of 40% to 50% of average past wages to the *median* worker retiring at the *normal* age under standard conditions.

The main differences concerned (a) the value of this normal age, and (b) how the pension changes when the actual retirement age differs from this normal age.

In the US, the normal retirement age used to be 65 with a reduction of the pension by $5/9^{\text{th}}$ of a percent for each month of pension receipt before 65 (with a minimum age of 62), and a bonus of 6% for each year of postponement past 65, up to age 70.

In France, since 1984, the normal age in the private sector can be considered as being 60, but the reality is a bit less simple because the condition to reach the full rate involves not only age, but also the number of years of contribution, according to a complex non-linear formula. Let a be age at retirement, n the number of years of contributions at this age, and w the reference wage. Under pre-1993 rules, the replacement rate of 50% was applicable only for people retiring with at least $n_{\text{max}}=37.5$ years of contributions (and was not increased if n is higher than this number). In other cases, the pension was, if the individual retired at 65:

$$P = 0,5 \cdot (\min(n/n_{\text{max}}, 1)) \cdot w$$

or, if he or she retired between 60 and 65:

$$P = (0,5 - 0,05 \cdot \min(65 - a, n_{\text{max}} - n)) \cdot (\min(n/n_{\text{max}}, 1)) \cdot w$$

In this latter case, the pension was affected by a double reduction: one due to the proportionality of the pension to the number of years of contribution, and the other due to the fact that the proportionality factor was itself reduced. This additional reduction was quite substantial: it amounted to 5 percentage points (i.e. a 10% decrease) for each missing year to reach either age 65 or a number of years of contribution equal to n_{max} (the condition that is more favorable to the individual is the one applied).

Finally, the rules for civil servants in France were more generous: the “normal” replacement rate was 70%. Part of this difference with the private sector corresponds to the fact that the pension system for civil servants is essentially a single pillar system, but civil servants also benefit from the fact that this replacement rate applies to their very last wage, and not to an average of past wages. Concerning age at retirement, the normal age is also 60 for a majority of these civil servants, but retirement can occur as early as 55 for some categories of workers exposed to more difficult working conditions.

We shall come back to the case of civil servants later, when commenting on the recent 2003 reform, and for simplicity, we shall now restrict ourselves to the comparison between the US OASI and the French General Regime. Figures 4.a to 4.c give the profiles for replacement ratios depending on age at retirement for three cases corresponding to a worker who started working at ages 17, 20 or 23, respectively, and supposed to have worked continuously until retirement. If we concentrate at this stage on the first and fourth series displayed on this graph, corresponding to our “initial” or “pre-reform” schedules for France and the US, we see the marked contrasts between the two schedules. The French replacement rate was generally at its maximum by age 60, the only exception being the case of the individual having started at age 23 who had to retire one half year after his sixtieth birthday in order to get the maximum replacement rate. The US schedule only starts at age 62, and generally provides a much lower replacement level.

II.2 Reform: various policy options

How do such patterns affect retirement behavior? At least three main aspects must be distinguished (Duval, 2004):

- The impact of the normal age at retirement: we generally observe a concentration of departures at this age, due possibly to the adoption of this age as a social norm for retirement.
- The impact of overall generosity of benefits: at a given age, *ceteris paribus*, we expect that the probability of retiring will be higher the higher the level of benefits available at this age.
- A slope effect, i.e. the impact of the increment to the expected present discounted value of net benefits over the whole retirement period resulting from postponement of retirement. A useful baseline for this slope effect is the case of actuarial neutrality where this net increment is zero: this occurs if the increase of the replacement rate for one year of additional work exactly offsets the additional year of pension contributions and the shorter expected duration of pension receipt. A positive increment can therefore be interpreted as a subsidy to postponement and a negative increment can be interpreted as a form of implicit labor taxation.

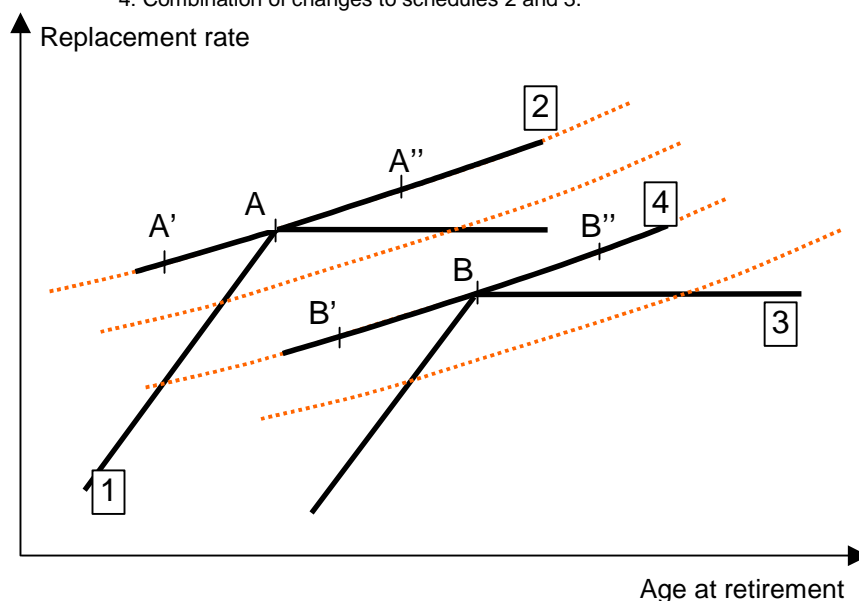
In practice, these effects are not independent from each other: in France, the NRA was the same age at which the benefit level reached its maximum, and was also the age at which the slope effect changed abruptly from labor subsidy to labor taxation. Figure 5, drawn from Blanchet and Pelé (1999) and Diamond and Gruber (1999) provides a clear illustration of this taxation effect, compared to the situation that prevails in the US, computed for a median worker. Work in France was heavily “subsidized” until the age at which the full rate was attained, and heavily taxed after this age. The US profile of net implicit taxation is much flatter and closer to zero, corresponding to quasi-actuarial neutrality on both sides of the normal retirement age.

The three factors described above suggest that different options were available for trying to raise retirement age in a country like France. Figure 6 presents these three possibilities in a diagram giving again replacement ratios as a function of retirement age, and where the set of dotted lines describes the family of actuarially neutral schedules (there is actually an infinity of such schemes, each of them corresponding to a different equilibrium level of contribution rates to the pension system). Starting from schedule 1 which is a stylized representation of the initial French scheme, a first option was to move to schedule 2, i.e. a simple shift to actuarial neutrality around the normal age at retirement (point A). A second option was to move to schedule 3 corresponding to a global down- and rightwards move of the initial schedule without any change of its general shape. The last option presented on the figure is the combination of these two policies, leading to schedule 4.

One can argue that the only point that matters for pension reform is to come as close as possible to actuarial neutrality, i.e. to choose any of the schedules represented by the dotted lines, no matter which one is finally chosen. The argument is the following. Assume that the schedule has been chosen too low: individuals who want to retire early with high replacement rates will compensate for this through increased savings before retirement (and more dissaving after) in order to retire at their preferred retirement age. Assume instead that the proposed schedule is too high: individuals who prefer a late retirement will nevertheless go on retiring late, and will adjust their consumption profile the other way round, by reducing their savings while active (or even running a debt that they would repay once retired). In such a setting, moving to schedule 2 could by itself be sufficient to provide appropriate incentives for retirement, without any need to globally move rightwards on the diagram.

Figure 6: three scenarios for changing the schedule of pension benefits.

- 1: Initial schedule
- 2: New actuarial schedule with the same reference conditions as schedule 1
- 3: Simple translation of the non-actuarial schedule 1.
- 4: Combination of changes to schedules 2 and 3.



But there are at least two reasons for considering such a policy as insufficient. The first is that we are clearly not in a world of perfect capital markets, and empirical analysis confirms that retirement behavior is affected simultaneously by the implicit taxation of labor and by the level of benefits (see Mahieu and Blanchet, 2004 and more generally the collection of other national studies in Gruber and Wise, 2004).

The second reason applies even if we believe in the assumption of perfect capital markets. If the final goal is to limit the growth or level of pension expenditures, moving to schedule 2 is of no help: even if this move is successful in bringing age at retirement to point A'' (which is not guaranteed at all, since behavior can move as well to point A'), this is compensated by a higher average level of pensions. By definition of actuarial neutrality, the two effects exactly compensate for each other in the long run⁵.

It comes as no surprise, therefore, that we have had reforms that also incorporate a global move of the schedule in the south east direction. This came in two steps, 1993 and 2003.

The 1993 reform has been exclusively of the 1→3 type. It instituted a progressive increase of the number of years of contribution required to reach full retirement, from 37.5 years for cohorts born in 1943 or before to 40 years for cohorts born in 1943 1953 and after, i.e. an increase by one quarter between each successive cohort, during ten years. Simultaneously, this reform changed the rules for computing the reference wage in a way which is expected to reduce the pension at the full rate by about 10% in the long run (Bardaji et al., 2003): the main tool for doing so has been to increase the period over which past wages are averaged from 10 to 25 years, combined with a revaluation of these past wages on the basis of past prices, instead of past average wages as before. On the whole, this corresponds to the kind of move from schedule 1 to schedule 3, without, at this stage, any attempt to bring the schedule closer to actuarial neutrality.

⁵ Two reports from the late 1990s are illustrative of the opposition between these two options. The Charpin report (Charpin, 1999) explored the idea of a substantial shift of the normal retirement age (a duration condition raised to 42.5 years) associated with increased flexibility of the schedule around this new retirement age, while the Taddei report (Taddei, 2000) only argued for increased flexibility of access to retirement around the current NRA.

The second step, in 2003, has been of the 1→4 type. One important feature of this reform has been to extend the application of the 1993 reform to the public sector (where the condition was still 37.5 years), with a convergence planned for 2008, then to program a parallel move of the duration necessary to get the full rate in both sectors from 40 years in 2008 to 41 years in 2023. This will be followed by further evolutions indexed on the evolution of life expectancy: the idea is to have each year of increase in life expectancy divided between additional years at work and additional years of retirement in a proportion of 2/3 and 1/3. Given current projections of life expectancy, this is expected to move the duration condition to 41.75 years in 2020. Simultaneously, a move toward actuarial neutrality will occur under these new reference conditions for the full retirement, first by reducing the penalty for retirement before the full rate, and then by introducing an incentive to postpone retirement beyond this age, by offering a 3% bonus for each additional year of work. Similar mechanisms are introduced for pensions in the public sector.

We can go back to figures 4.a to 4.c to see more precisely the impact of these two reforms for our three reference situations. Since the reform does not directly affect age conditions, but acts on the duration condition, its impact is strongly differentiated by age at entry in the labor force. This property is desirable *per se* on equity grounds if it favors low income workers who entered employment at very young ages and who generally have lower life expectancies than other categories of workers. The 2003 reform added one element in this direction, since it introduced possibilities of retirement before age 60 with 40 years of contributions for people currently in their fifties who started working as early as ages 14, 15 or 16 years.

The comparison of figures 4.a and 4.c confirms this differentiated impact. For the individuals having started working at ages 17 or 20 (assuming continuous activity after this age), the 1993 reform alone only implied a global decline of the pension level, without any change in its profile which remained flat before and after the reform. For individuals having started at age 23, the reform introduced an additional penalty for retirement at 60. The 2003 reform has more far reaching implications, even if it does not have any additional effect on the “normal” replacement rate. For the individual who started working early, it does not affect pension entitlement at age 60, but allows increasing the pension level in case of postponement (note that, since the bonus remains sub-actuarial, postponement for such an individual would lead to a reduction of the long run burden of pensions). We could say that, for this specific case, the policy is more of the 1→2 type than of the 1→4 type.

For the individual who started working at age 20, the age at which the full rate is attained is moved rightwards from 60 to 61.75 years. Around this new pivotal age, he faces a lower penalty than before in case of earlier retirement, and has an incentive to continue working beyond this age. We are now typically in a 1→4 change. It is for the individual who started working at age 23 that the reforms have had or will have the strongest effects. For this individual, the 1993 reform had already introduced strong penalties in case of a departure before age 63. The new 2003 reform will not change much the penalty in case of a departure at the earliest age of 60, due to offsetting effects of the increase in the duration required for the full rate and the reduction of the penalty for each year of retirement before this full rate, but it reduces the pension level for all cases of departure between 60 and 65.

In fact, for this particular case, the 2003 reform brings the schedule quite close to the initial US profile. However, in the same time, this US profile will have itself shifted rightwards, as a consequence of the long-term changes initiated by the 1983 reform. In this US case, the slope of the profile is not expected to change considerably: it was already close to actuarial neutrality, and the adjustments reinforce the bonus in case of late departure (from 6 to 8% per additional year), and the introduction of a piecewise linear formula in case of departure before the NRA (5/9th of a percent per month reduction for the first 36 months before the normal age but only 5/12th for the next 24 months before the normal age). The most important change concerns the NRA itself, which will be increased to 67 by 2022.

Thus, conditions under which pensions are computed and their link to age will remain significantly different in the future between the two countries. However, it remains true that the 1993 and 2003 reforms in France already represent a significant change, especially if we consider that this change will interact with the fact that age at entry into the labor force has increased for more recent birth cohorts. The fact that the pension depends on the number of years of contribution at least as much as on age implies that age at entry into the labor force is of crucial importance: its shift upwards means that we will not only have the consequences of the rightward shift of benefit patterns described in figures 4.a to 4.c, but also the fact that we will have a decreasing number of people for whom case 4.a is relevant, and increasing numbers of people facing constraints of the 4.b or 4.c types.

II.3 Assessing the impact of the French 1993 and 2003 reforms.

How can we evaluate the impact of the French pension reforms on labour supply? We need two things: a behavioral model describing how a given individual reacts to the change in incentives that we have just described, and a model that projects, at various horizons, the distribution of people according to the age at entry to the labor force and other characteristics that affect the incentives they face. Given the rules for computing pensions, this requires a full projection of individual careers.

These two requirements are fulfilled by the Destinie dynamic microsimulation model, which has been developed at INSEE over the last ten years. This microsimulation model projects, at the horizon of 2040, full work and earnings histories for a sample of about 50,000 people⁶ drawn from a household asset survey which has the advantage of providing retrospective information on past careers. The current version of this model is based on the 1998 edition of this survey. Careers are projected in the model according to a set of transition probabilities and to individual wage equations estimated from labor force survey data. Early versions of this model used a simple representation of retirement behavior, namely the hypothesis of exogenous departure at the full rate. This assumption can be considered as relatively realistic for the past, but should become less relevant given the changes induced by ongoing reforms. In fact, sticking to this assumption would have meant denying any kind of impact of changes in penalization or bonus rules for retirement before or after the NRA, a position which is hard to defend *ex ante*⁷. For this reason, the model has been enriched over the last years by a module that allows for choice of retirement behavior.

One possibility for this module could have been the implementation of semi-reduced form models such as those developed in the series of national studies coordinated by Gruber and Wise (Gruber and Wise, 2004). For this project, logit models of the retirement decision were developed and tested, with explanatory variables such as the benefit level, the implicit tax rate on continuing labor, or other indicators of the global shape of pension entitlements according to age at retirement. Such models have been used in these studies to model the impact of some "typical" reforms, such as a rightward shift of the whole schedule of pension entitlements by exactly three years (typically a 1→3 reform) or a "common reform" consisting in a quasi-actuarially fair scheme offering a replacement rate of 60% at age 65, with an early retirement age of 60 and penalization or bonus of 6% for each additional year below or above the age of 65 (Mahieu and Blanchet, 2004).

These studies show that the most efficient of these stylized reforms seemed to be the 3 year increase reform, but the predicted impact varies considerably according to the

⁶ The model also projects full demographic histories, used for computing additional pension benefits linked to the fact of having raised children, and also used for simulating survivors' pensions.

⁷ Even for the 1993 reform, it seems that postponing of the retirement age did not exactly follow the increase in the age at access to the full rate pension (Bozio, 2004).

exact econometric specification of the retirement model; the predicted change in the average retirement rates may be as high as 3.14 years but as low as 0.19 years. Anyway, such models are not well suited for simulating the consequences of complex changes such as those implied by the 1993 and 2003 reforms. In particular, the quality of the adjustment they give on existing data remains strongly dependent on specific age dummies, and we have no information on the way such dummies must be changed to take into account changes in pension rules implied by the reforms. For this reason, the Destinie model instead uses a structural model, which is an adaptation of the Stock and Wise option value model (Stock and Wise, 1990; Mahieu and Sédillot, 2000).

Returning to figure 6, the model aims at computing the proportions of people who will react to the shift from schedule 1 to 4 by moving from point A to points such as B, B' and B". The model differentiates people according to age at entry to the labor market and sector of employment (private and public), since the impact of the reform is not going to be the same in the two sectors: even if the reform organizes a convergence between these two sectors, this convergence is only partial, and points of departure are, anyway, extremely different.

Tables 2 and 3 sum up briefly what are currently the main results of explorations made with the Destinie model. Table 2 is restricted to the private sector, since it presents results for the 1993 reform. In fact, two causes of changes in age at retirement can be distinguished: even with the pre-1993 rule the increase in the age at entry to the labour force would have caused an increase of the average age at benefit claiming by 0.3 years, from 61.2 to 61.5. To this we must add the impact of the reform itself, including its interaction with this increasing age at entry to the labour market: this adds 0.6 years more, i.e. a nearly one year increase between cohort 1935-1940 and cohort 1965-74.

Table 3 shows the additional effect of the 2003 reform. To give an idea of the differential impact according to age at entry in the labour market, this second table splits the population of each cohort into four groups, defined by quartiles of the number of years of education (this variable also constitutes the proxy used by the model to describe relative social status for individuals). In the private sector, the additional impact of this new reform is weak compared to changes already generated by the 1993 reform. The impact is even negative for the more educated group. The 1965-1974 birth cohort retires 0.4 years earlier than under the 1993 reform only: according to the model, this group takes advantage of the reduction of penalties for early retirement and retires at 62.9 instead of 63.4. All three other groups increase their retirement age, either because of the further increase of the duration required to get the full rate, or because they take advantage of the new bonuses for retirement after the normal age.

As expected, changes are much larger in the public sector. The reform results in changes of the age at retirement ranging between +1.5 and +2.4 years. The average level of training is higher in this sector, with the result that the new duration condition is on the average more constraining. Also, there is a strengthening rather than a reduction of penalties for retirement before this duration condition is attained. This is particularly constraining for people who previously could have retired as early as 55 without excessive penalties. This group will now face much stronger penalties if they leave at this age without having reached the 41 or 41.75 years of contribution condition.

Table 2: Impact of the 1993 reform on average age at retirement

Cohort	Before the reform			After the reform			Average change due to reform		
	Total	Men	Women	Total	Men	Women	Total	Men	Women
1935-40	61,2	60,4	61,9	61,5	60,8	62,1	0,3	0,4	0,2
1940-44	61,3	60,4	62,2	61,6	60,6	62,5	0,2	0,2	0,3
1945-54	61,2	60,5	61,8	61,5	60,9	62,2	0,4	0,4	0,4
1955-64	61,1	60,7	61,4	61,5	61,1	61,9	0,5	0,4	0,5
1965-74	61,5	61,2	61,7	62,1	61,9	62,2	0,6	0,7	0,5

Source: DESTINIE model

Table 3: Impact of the 2003 reform on average age at retirement, by education level

Cohort	Private sector					Public sector				
	Total	Educ level 1	Educ level 2	Educ level 3	Educ level 4	Total	Educ level 1	Educ level 2	Educ level 3	Educ level 4
Before the 2003 reform										
1945-54	61.5	61.3	61.1	61.7	62.9	58.6	57.4	58.1	58.8	60.7
1955-64	61.5	61.3	61.0	61.5	62.7	57.9	57.2	57.6	58.3	59.3
1965-74	62.1	61.5	61.7	62.2	63.4	58.6	57.3	58.5	59.2	60.0
After the 2003 reform										
1945-54	61.6	61.0	61.3	61.6	62.8	60.2	58.7	59.9	60.8	62.1
1955-64	61.9	61.4	61.7	62.2	62.8	60.1	59.6	60.0	60.3	60.9
1965-74	62.3	61.7	62.3	62.5	62.9	60.8	59.8	60.8	61.4	61.5
Average change due to reform										
1945-54	0.0	-0.4	0.1	0.4	0.2	1.6	1.3	1.8	1.9	1.4
1955-64	0.4	0.2	0.6	0.8	0.1	2.2	2.4	2.4	2.1	1.7
1965-74	0.2	0.3	0.6	0.4	-0.4	2.2	2.4	2.3	2.2	1.5

Source: DESTINIE model, Buffeteau and Godefroy (2004)

As expected, changes are much larger in the public sector. The reform results in changes of the age at retirement ranging between +1.5 and +2.4 years. The average level of training is higher in this sector, with the result that the new duration condition is on the average more constraining. Also, there is a strengthening rather than a reduction of penalties for retirement before this duration condition is attained. This is particularly constraining for people who previously could have retired as early as 55 without excessive penalties. This group will now face much stronger penalties if they leave at this age without having reached the 41 or 41.75 years of contribution condition.

On the whole, the global impact expected from this reform, on the supply side, is an increase of the average age at benefit claiming of about 1.8 years, which would correspond to an increase of the total labour force of about 640000 people at the 2020 horizon. Globally, including the 1993 and the 2003 reform and the trend that would have occurred even without reform, LFP rates in 2020 are expected to be about 28% in the 60-64 age group compared to 16% in 2004. Of course, these results are no more than simulations that are strongly dependent on the quality of the underlying model. The robustness of the model is hampered by the fact that, up to now, the French system left little room for the revelation of individual preferences concerning income/leisure trade-offs: it is only by observing future consequences of the increased flexibility of retirement possibilities around the normal age that we can hope to have

better estimates of the structural parameters that form the basis for these simulations. Even if these estimates were robust, one additional limit of such projections is the assumption of stability of these structural parameters.

A final important consideration in evaluating the simulation results is that they ignore the demand side of the labor market. What really matters for the equilibrium of the pension system is to know how these supply-side effects will translate into employment. As far as the public sector is concerned, the main effect of the projected delayed retirement age will be to slow down entry into public employment, since it is unlikely that the postponing of retirement in the public sector will be accompanied by the creation of new public jobs. Positive effects on employment are, therefore, strictly dependent on the capacity of the private sector to simultaneously retain the oldest of its workers while absorbing the cohorts of new entrants.

This labor demand problem has two aspects. One concerns the future global balance between labour supply and labour demand over the next decades and is clearly beyond the scope of the current paper. The other aspect specifically concerns the labor market for older workers: it is to understand whether and how these supply side changes will be accompanied by changes in employers' willingness to employ older workers. Actually, there are at least two indications that a demand side problem exists for older individuals:

- The development of preretirement schemes has been an answer (even it was not necessarily the right one) to the propensity of firms to get rid of their older workers.
- Firms also have shown a tendency to hire relatively few older workers, even at ages where no preretirement schemes exist.

One can also mention at this level that the predictions by supply-side models of the Stock and Wise type for France cannot be considered as a proof that pure supply-side factors dominate the explanation of employment rates by older workers in France. The spike of departures at the full rate is not only due to the fact that this age is the one that maximizes the discounted stream of benefits for the pensioner, but also to the fact that, until the 2003 reform⁸, this was the age at which the employer was allowed to freely terminate the labour contract without any penalty or other formality. The magnitude of the spike is thus compatible with demand-side as well as supply-side explanations of low employment rates by older workers in France. It is therefore important to look more closely at reasons that may explain attitudes of employers *vis-à-vis* their ageing workers.

⁸ This 2003 reform globally increases this age to 65, whatever the pension entitlements at this age. However, employers obtained the preservation of the former rule for some sectors.

III - Demand side

III.1 Three candidates for explaining low demand for older workers

What do we now know concerning the demand side in France? What are the elements of comparison with the US situation?

Three main explanations can be proposed for a low level of labour demand for older workers. One is non-economic: it consists of discrimination against older workers, due to stereotypes without any economic justification. The second, on the contrary, assumes that there is a real economic problem due to a gap between these workers' productivity and their wage, either the wage they get as long as they remain in the same firm, or the wage they demand once they find themselves in unemployment (the reservation wage). A third explanation does not need to assume that there is a specific productivity problem for older workers. The idea is that firms are confronted with a *global* problem of excess labour, and they prefer to solve this problem by getting rid of older workers because this is socially better accepted than other forms of downsizing. Of course, this is the case precisely because these workers are covered by relatively generous pension or preretirement schemes.

The discrimination thesis deserves examination, but it is difficult to document with statistical evidence. Anti-discrimination policy is a central aspect of US demand side policy in favour of older workers, since the introduction of the Age Discrimination in Employment Act (ADEA) during the 1960s. There is no direct evidence about the extent of discrimination against older workers in the US before the ADEA, but there is some evidence that the ADEA and similar state laws had an impact on the labour market for older workers. For instance, Adams (2004) uses data from the Current Population Survey (CPS) on white men in the 1960s, the period when the federal law (ADEA) and many state laws took effect. He reports that employment among workers in the age range covered by the laws (typically 50-65) increased following passage of the laws in states that passed a law, relative to employment in states that did not or had not yet passed a law. Neumark and Stock (1999) use data on white men from the decennial censuses of 1940 through 1980. Like Adams, they find positive effects of anti-discrimination laws on employment of workers in the covered age ranges. In sum, the evidence suggests that US anti-discrimination laws succeeded in raising employment of covered workers, even if it may have been sometimes at the cost of reduced employment of uncovered workers.

Such tests are not possible in France. But a recent opinion survey conducted by the Ministry of Labour among managers or heads of human resource departments in a sample of 3000 firms shows the existence of strong stereotypes concerning older workers (Minni and Topiol, 2004). The survey results also show that these stereotypes affect hiring decisions, but not separation decisions (Anglaret, 2002). Discrimination in hiring decisions is also apparent from the frequent references by employers to age in discussions of hiring (Marchal and Rieucau, 2005).

The question remains, however, whether such practices have no economic ground at all, or whether they have an economic basis: is the reluctance of employers to hire old workers completely arbitrary, or does it result from observations that these employers are actually making, on the average, concerning the productivity or the adaptability of these workers? In particular, what about the hypothesis that productivity declines relative to the wage at the end of the career?

III.2 Assessing the wage-productivity gap for older workers: mixed evidence

Evidence in favour of a strong role for the wage-productivity gap in France comes from cross-country comparisons. The profile of the average wage by age is much steeper in France than in other OECD countries, except Japan. In particular, the relative wage premium associated with being aged 50 to 59 in France seems to be twice as high as in the US (Table 4). Provided that this figure reflects a truly faster wage growth in France, this leads to the conclusion that there is a productivity/wage ratio problem for older workers, unless we think that productivity grows much more rapidly with age in France than in the US.

Nonetheless, such data must be used with caution. First, conclusions vary a lot according to sources and methodology. For instance, using 1995 data, OECD (2000) finds virtually the same age profile of average wages in France and in the US. Second, table 4 provides raw figures. Therefore, it does not account for the possibility of different composition or selection effects in different countries. In particular, the eviction of low wage older workers from the labour market in France might partly explain why the relative wage is higher for those older workers who remain on the labour market.

As a consequence, some attempts have been recently made to look at the productivity/wage ratio more closely. This has been done in relatively similar terms for the US and France, using micro-data. All studies rely on a production function approach to estimate separately productivity and wage. Workers' productivity by age is estimated as the contribution of the proportion of the age group in the firm's workforce to the average productivity of firms.

Table 4: Relative average wage by age in OECD countries (2000)

Men								
Age	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Japan	100,0	123,6	144,3	156,9	165,9	172,1	157,6	107,1
France	100,0	115,4	125,9	148,7	160,7	173,8	199,2	229,5
Germany	100,0	123,6	128,8	136,4	142,6	140,2	133,9	141,1
Italy	100,0	117,8	128,4	143,6	140,8	146,1	148,8	133,6
UK	100,0	121,3	133,4	131,3	128,9	134,3	117,5	107,4
US	100,0	113,0	130,5	135,0	138,3	143,1	139,9	127,7
Women								
Age	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
Japan	100,0	112,4	116,4	114,8	111,1	108,7	103,1	85,7
France	100,0	113,6	127,6	121,0	135,0	157,4	153,4	152,0
Germany	100,0	121,6	111,1	122,7	121,8	129,2	124,0	113,4
Italy	100,0	105,5	111,0	115,0	129,9	129,2	121,0	122,9
UK	100,0	113,1	109,7	111,1	108,0	100,2	101,1	
US	100,0	109,5	114,8	119,5	121,1	123,1	112,0	106,4

(These are relative average wages by age group. No controls for composition, selection or cohort effects are included.)

Source: *OECD Wage Data base of Full Time Workers*, quoted in Gauthié (2004)

Full time workers, weekly (UK), monthly (Germany, France, Japan) or yearly (US, Italy) average gross wage; wage are after tax in Italy and excludes extras in Japan.

Sources for countries are: Japan: *Basic Survey on wage structure* (2000); France: *Labour Force Survey* (2000); Germany: *German socio-economic panel* (1998); Italy: *Survey of Italian household's income and wealth from Banca Italia* (1998); United Kingdom: *Labour Force Survey* (2000); United States: *Current Population Survey* (2000).

For the US, Hellerstein, Neumark and Troske (1999) find no evidence of a gap between wage and productivity at older ages. They find that productivity and wage increase with age at a similar rate. However, their estimates are quite imprecise. In particular, productivity differences across age groups are not statistically significant. Using a larger dataset, Hellerstein and Neumark (2004) find somehow different results. They find that productivity falls faster than the wage after 55. On the whole, older workers (aged more than 55) are estimated to be roughly 20% overpaid compared to prime aged workers (35 to 54 year old), whereas younger workers are about 10 % underpaid.

Similar estimations have been performed in France by Crépon, Deniau and Perez-Duarte (2003), using an even larger dataset. They find young workers (aged 25 to 34) to be the most productive group in the workforce. Although they use a different definition for age groups, their results are similar to those in Hellerstein and Neumark (2004) i.e. older workers (over 55) are about 10 % overpaid compared to prime aged workers (35 to 49), whereas younger workers (below 35) are 10 to 15 % underpaid.

But these first results suffer from two symmetrical biases. First of all, they only apply to workers who are still in employment. By construction, they tell us nothing about the productivity of workers that have been excluded from the labour market. *A priori*, this bias would rather play toward an overestimation of average productivity at higher ages. On the opposite side, this approach can underestimate the intrinsic productivity of older workers due to a problem of inverse causality: if a firm is less productive than the average, it is likely that it will lose part of its market, hence grow less or even decline, leading to lower hiring rates and an increasing age of its workers. In that case, labour force ageing will be a consequence rather than an explanatory factor of a lower productivity.

Aubert and Crépon (2004) provide estimations that control for the second of these two biases. Estimations are run on a dataset of French firms similar to the one in Crépon, Deniau, Perez-Duarte (2003), and using thinner age groups (i.e. 9 age groups of size 5 years). They find that productivity increases with age until 40 and remains quite flat afterwards. They also find that the productivity/wage ratio remains constant across age until 55. It decreases by 5 to 10 % across sectors after 55, but this decrease is not statistically significant. The correction of the second of the two biases that we have mentioned therefore goes in the right direction and leads to a message that is much less negative concerning the relative productivity of senior workers. But this first bias remains, particularly for ages where exclusion from the labour market is frequent, i.e. after 55.

A second group of studies tries to avoid this other bias. They do not try to measure productivity but concentrate instead on labour demand by firms, and examine whether the composition of labour demand by age varies according to factors such as technological or organizational changes. The idea is to give up the goal of trying to produce a full comparison of productivity levels by age, but instead to see whether these technological or organizational changes affect the relative productivities of the different age groups, leading to changes in the structure of demand. These studies bring us back to a less optimistic view: it actually seems that technological or organisational changes play against the employability of older workers.

Such an approach has been developed by Aubert, Caroli and Roger (2004) for industry and extended to the service sector by Ananian and Aubert (2004). They implement this approach in two ways, a static and a dynamic one. The static approach consists in comparing the relative shares of the different age groups in the total wage bills of innovating and non-innovating firms. Technological innovation is measured by indicators such as use of the internet or of microcomputers. Organisational innovation is measured by indicators such as the practice of just-in-time or quality circles, the development of polyvalence or autonomy by workers. A positive association between innovation and the share of the youngest age groups in the total wage bill is considered as evidence of a bias of innovation against older workers. Here again, we

face circularity problems. Is it technological change that leads to changes in the age structure? Is it a younger age structure that makes change easier? Or is it only a result of the fact that firms that are more innovative grow faster, have higher hiring rates, leading them to a younger age structure? The dynamic approach helps solving this identification problem, examining how technological or organizational changes affect the age structure of hiring and separations *after* they have been introduced. If there is a relation, it can be more unambiguously interpreted as running from innovation to recruitment practices. Actually, this dynamic approach confirms the age bias measured by the static approach.

On the whole, the conclusions of all these studies are therefore mixed. There is at least one result that seems robust. The Aubert-Crépon study rejects the idea that productivity starts declining strongly as soon as age 50, since the selection bias that we have in their approach cannot play a strong role at this age. Their study also excludes the idea that a wage-productivity discrepancy would also exist for older workers that are still in employment: this result was not warranted *ex ante*. It means that there are no apparent cross subsidies between age groups of workers within firms. But this does not tell us anything about the relative productivity of workers aged 55 or more who are outside employment. For these workers, the second group of studies suggest that technological and organizational change actually restricts the apparent employability of such workers. It is therefore not excluded at all that this unfavourable effect plays a role in the exclusion of at least one part of these workers. In fact, the results of the two groups of studies are consistent with the assumption of a labour market whose selectivity would increase with age. This selectivity would lead to a filtering of those ageing workers whose skills are better protected against technological or organisational changes or to the effects of national or international competition.

Now, tenants of the discrimination hypothesis can oppose that biases in labour demand measured by the second group of studies do not necessarily reveal real biases of innovation against older workers, but only employers' beliefs concerning these biases. If employers who innovate have a bias in favour of younger workers, we cannot say whether this is due to the fact that these workers actually have a lower capacity to adapt to these changes, or whether this only reflects stereotypes of employers concerning this adaptability. Such results are therefore not sufficient to invalidate the discrimination hypothesis. In fact, it is plausible that reality mixes the two elements.

IV - Regulating the market for older workers: two very different options

IV.1 A system without specific protection of older workers: what consequences for the old unemployed?

Even in the absence of technological or organizational change and even without discrimination, other factors can explain low rates of re-employment for workers losing their jobs at relatively old ages. The increase of productivity with age for workers in employment that appears in the Aubert-Crépon analysis has, in fact, three components:

- The first one is the accumulation of general human capital that can be used in all firms or at least in a relatively large number of firms.
- The second one is the accumulation of firm-specific human capital that can be used only in the firm where the worker currently works.
- The third one results from the fact that the quality of the matching between the worker and his job generally increases with his age. The first job for an employee is not necessarily the one in which his skills or abilities are optimally valued, and professional mobility is generally one means to improve this matching and to increase one's productivity and wage.

It is only the first of these three factors that has value on the labour market after a job loss. Firm or sector-specific human capital or the fact of having progressively improved the match between one's abilities and one's occupation during the previous phases of one's career are lost. This could explain the low rate of voluntary mobility by older workers and the fact that an older worker who has lost his job will generally not be able to find a new one without accepting a large wage reduction.

There are, therefore, a large number of factors that can lead to significant reductions in economic status for workers losing their jobs at relatively old ages. Measuring the magnitude of this reduction has been the object of many studies in the US. We shall rely here on one of the most recent ones, the study by Farber (2003). The study uses data from the Displaced Worker Supplement (DWS) to the monthly Current Population Survey (CPS). This dataset provides information that can be used to estimate the earnings loss of workers who lose a job. The DWS has been added to the regular CPS instrument in either January or February of even-numbered years since 1984. Individuals interviewed in these months are asked if they were displaced from a job at any time in the preceding five years (1984-1992) or three years (1994-2002). Displacement is defined as involuntary separation due to a plant closing, a layoff, or an employer going out of business. Farber (2003) provides a detailed discussion of conceptual and measurement issues concerning the DWS. He also provides an analysis of the data from the 1984-2002 surveys. We can use his estimates to illustrate the magnitude of earnings losses of displaced older workers.

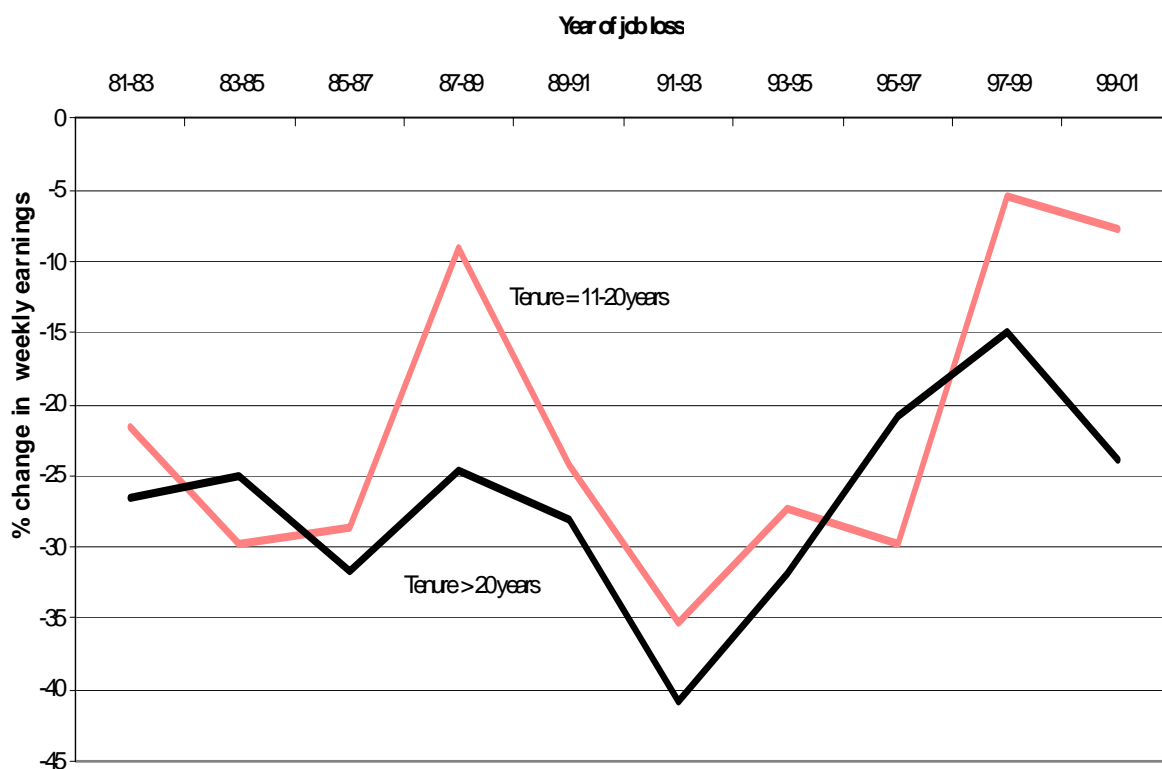
Farber estimates a regression in which the dependent variable is the logarithm of real weekly earnings at the survey date minus the logarithm of real weekly earnings at the date of job loss. The sample consists of individuals who were displaced from a full time job during the three years preceding the survey and who were reemployed at a full time job at the survey date. The regression is estimated separately for each survey, and the entire sample of eligible workers is pooled for each year. The sample contains individuals aged 20-64. The explanatory variables include dummy variables for race, sex, age categories, education categories, job tenure (on the lost job) categories, and years-since-job-loss categories. We use the regression estimates reported in Table 3 of Farber (2003) to measure the average earnings loss of white men aged 55-64 (at the survey date) with exactly 12 years of schooling (a high school diploma) who were displaced in the calendar year immediately prior to the survey date

(for example, calendar year 2001 for individuals interviewed in January 2002). We report separate estimates for workers with 11-20 years and with more than 20 years of job tenure on the old job at the time of displacement. These categories of job tenure seem most relevant, because the majority of older workers have long job tenure.

The estimates are summarized in Figure 7. We observe job losses that vary according to the economic cycle, ranging from more than 40% during the 1991-93 recession to less than 10% during the two expansion periods, for workers with tenure between 11 and 20 years. Losses estimated for the two tenure groups are often close to each other, but with differences that are generally larger during expansion periods. The unweighted average wage loss over the entire period is 29% for workers with tenure between 11 and 20 years, and 37% for workers whose tenure is greater than 20 years.

Individual consequences of a job loss, which are important at all ages, are therefore particularly unfavourable for older workers, since they are much more likely to belong to the group of workers with long tenure. We note that these estimates are probably underestimates of the magnitude of the loss in wages that are offered to these workers, since observations are only available for those who actually return to employment.

Figure 7: Earnings Loss of Displaced Workers in the U.S. (Source: Farber, 2003)



IV.2 Passive indemnization of job loss: a system that has been difficult to regulate

For France, it is difficult to build equivalent estimates for workers over 55, since returning to employment in this age group after losing one's job is an almost non-existent phenomenon, as was shown in figures 3.a and b. We can however make a comparison with the US for younger age groups, and make the assumption that the comparison over these age groups can be extrapolated to older ones. One can for

instance rely on Lefranc (2003), who made the same kind of computation as Farber with PSID data on the US side and LFS data on the French side. For the 25-55 age group, wage losses induced by an unemployment spell are relatively similar effects in the two countries. One can also mention results for France by Lainé (2003) who finds relatively divergent results: these results suggest a relatively limited wage loss between two successive jobs, even at older ages, even when the two jobs are separated by an unemployment spell. There is therefore an apparent uncertainty about the magnitude of the problem. But we face once again a selectivity bias: at higher ages, reemployment becomes increasingly selective, so that we certainly strongly underestimate the average level of wages offered to older employees that have lost their previous jobs.

It is precisely to avoid these losses that France has opted, over the last decades, and in contrast to the US, for a policy of relatively generous coverage of older unemployed workers. This policy certainly lowered the social costs of large restructurings that occurred in some industrial sectors (e.g. the steel industry). But there is now a widespread feeling that it has, in turn, exacerbated the natural downward tendency of employment in the 55-64 age bracket, with the creation of a form of "preretirement culture" (Guillemard, 2003) without any of the positive impact that was sometimes expected *ex ante* on employment rates of other demographic groups.

A brief look at the history of the French preretirement system is useful at this stage. It is illustrated in table 5 and figure 8. In a first step, preretirement schemes were targeted toward the 60-64 age group and very specific sectors. The first preretirement schemes were introduced in the early 1970s. During this first stage, preretirement was considered as exceptionnal, and even not really welcomed by employees themselves for whom this form of exclusion from the labour market was considered as a denigration of their social value. However, in the face of declining demand and rising unemployment, this method has been increasingly considered by firms as one convenient way to deal with excess capacity, while the idea of an early exit from the labour force became progressively more popular among employees themselves.

The growth of preretirement in the 60-64 age bracket can be observed in figure 8: the total stock of people in these schemes grew to more than 400,000 people by 2003. This contributed substantially to the strong decline of employment rates between ages 60 and 64 that was shown in figure 1. This explains why the availability of retirement at age 60, in 1984, does not show up in figure 1 in the form of a sudden drop of employment rates in the 60-64 age bracket: in large part, this reform essentially consisted in a transformation of preretired people into "normal" retirees.

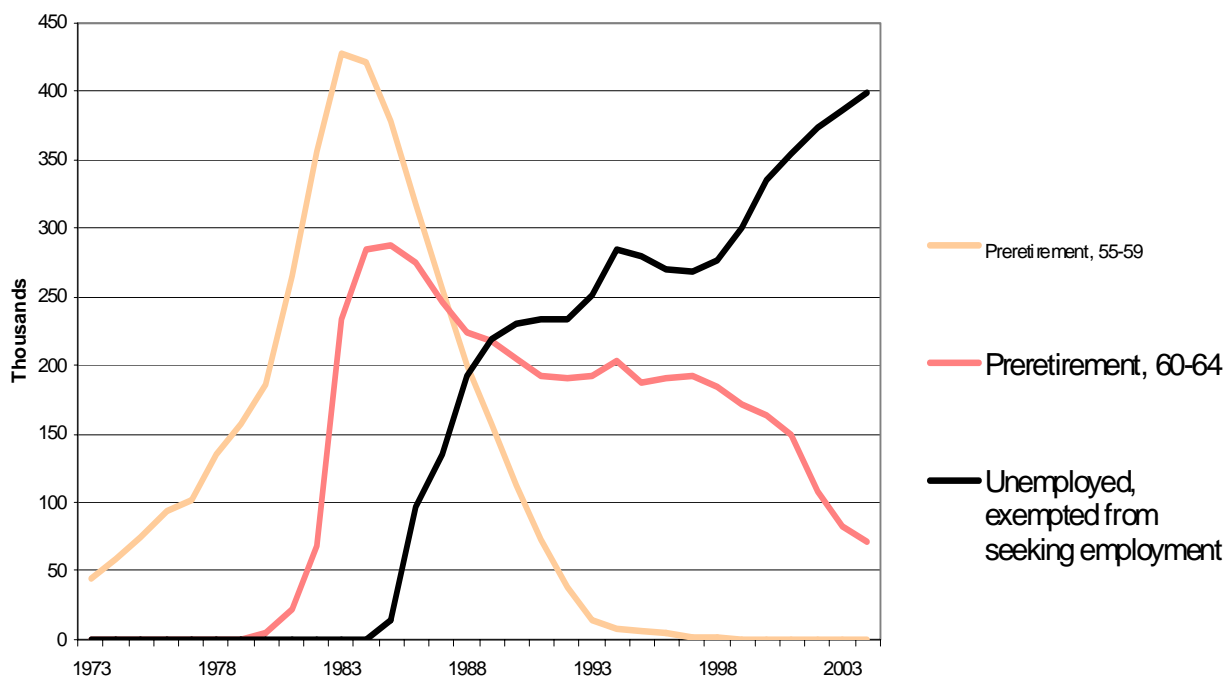
After the introduction of retirement at age 60, the belief was that there was no more need for preretirement schemes. Figure 8 shows that, instead, the preretirement problem tended to reconstitute itself below the new NRA, resulting in a decline in employment rates in the 55-59 age group. It did so through two routes. One has been the development or the introduction of new preretirement schemes in the 55-59 age group (the main scheme being at that time the ASFNE, a specific allowance financed by the State, through the National Fund for Employment). The other one has been the development of specific dispositions for older unemployed people in the national system of unemployment insurance: not only do workers, past certain ages, benefit from larger allowances which are maintained until their access to normal retirement, but, since 1985, these workers are not required to seek employment (DRE, for *Dispense de Recherche d'Emploi*). The development of these two routes explains a large part of the decline of employment rates in the 55-59 age bracket that occurred during the second half of the 80s and which was illustrated in figure 2. This time, it was agreed that such a decline could not be allowed to continue, and policies were introduced to regulate the use of preretirement. What were these policies, and what are we able to say, *ex post*, about their effectiveness?

Table 5: Main characteristics of preretirement schemes developed since 1972.

	1972	1977	1982	1983	1985	1992	1996	1997	1999	2000	2004	Age groups covered
Preretirement schemes (private sector)												
Garantie de ressources-licenciement												60-64
Garantie de Ressources demission												60-64
Allocation Specifique du Fonds National pour l'Emploi (ASFNE)												>56 (or 50)
Contrat de solidarité démission												>55
Contrat de solidarité retraite progressive												>55
Preretraites Progressives (PRP)												>55
Allocation de remplacement pour l'emploi (ARPE)												>58
Cessation anticipée de certains travailleurs salariés (CATS)												>55
Cessation anticipée d'activité des travailleurs de l'amiante (CAATA)												
Preretirement schemes (public sector)												
Congé de fin d'activité (CFA)												
Specific dispositions of unemployment insurance towards older workers												
Dispense de recherche d'emploi (DRE)												>57,5

(Grey areas correspond to periods when schemes have been effective)

Source: updating of Burricand and Roth, 2000

Figure 8: Population in preretirement schemes (Source: DARES)

Access to most preretirement schemes is allowed only for people laid-off in the context of collective « social plans », which are negotiated between firms and the Ministry of Labour. Regulation can therefore be quantitative: flows of entry into preretirement can be regulated according to some predefined quotas. Since 1994, there has been a continuous decline of the most important of these schemes, the ASFNE, for whom the number of beneficiaries has declined from nearly 180,000 people to only 38,000 people at the end of 2002. Even if this decline has been partly compensated by the development of the various alternative schemes mentioned in table 5, the overall trend has been a decline in the total number of preretired people in the 55-59 age group.

But the efficiency of this regulation has been limited by the existence of the other route for early exits, i.e. unemployment insurance. Until 1986, access to unemployment insurance was itself subject to a form of direct control, since any lay-off for economic reasons required an administrative authorization. But this administrative authorization was suppressed in 1986. In this new context, restrictions of access to preretirement have had a tendency to be compensated by a redirection of flows of older workers toward unemployment insurance: the transfer from the “preretirement” to the DRE category over the last decade is also very neatly illustrated by figure 8. Since the end of the 1980s, the movements of the two series are strongly symmetrical.

In order to discourage use of the DRE category, it was decided to penalize employers in case of lay-offs of older workers, with the introduction of the Delalande tax in 1987. The idea was dictated by efficiency as well as by equity considerations. Workers laid-off at older ages are more costly for unemployment insurance. An employer who lays-off such a worker imposes a cost that is supported by the community of all employers and employees, since it is financed by employers' and employees' contributions on wages. Introducing a form of co-payment by the employer who is responsible for the lay-off mitigates this externality. This system bears some resemblance to the US system of experience rating, which is another form of co-payment imposed on employers who have an excessive tendency to lay-off. The US experience rating system applies to all categories of laid-off workers, while the Delalande system is specifically devoted to the group of older laid-off workers.

Are we able to assess the efficiency of this system? As with any form of firing costs, there are both direct and indirect effects. The direct effect is that the Delalande contribution should, in principle, dissuade employers from dismissing workers in the relevant age groups. The indirect effect is that it should also dissuade employers from hiring such workers or workers approaching these age groups, since an eventual separation from such workers will be costly.

Variation over time in the coverage of the Delalande contribution offer the opportunity to partly identify and quantify these two effects. Table 6 summarizes the changes in the Delalande system over time. Two studies (Bommier et al., 2003 and Behaghel et al., 2004) have exploited these changes and have examined their impact on labour markets transitions of various age groups using LFS data.

Table 6: Amount of the Delalande Tax (in proportion to gross monthly earnings)

		Age at lay-off										Exemptions
	Firm' size	50	51	52	53	54	55	56	57	58	59	
From July 1987 to June 1992	All sizes							3	3	3	3	
From July 1992 to Dec. 1992	>20	1	1	2	2	4	5	6	6	6	6	No tax for employees that have been hired after age 50.
	<20	0.5	0.5	1	1	2	2.5	3	3	3	3	
From Jan. 1993 to Dec. 1998	All sizes	1	1	2	2	4	5	6	6	6	6	
Since Jan. 1999	>50	2	3	5	6	8	10	12	12	10	8	
	<50	1	1	2	2	4	5	6	6	6	6	

Source: Behaghel, Crépon and Sédillot (2004)

Given the global observation from figure 8 that DREs have continuously increased over the last 15 years, it comes as no surprise that these two studies find impacts of the Delalande tax that are at best marginal. Behaghel et al. (2004) test the direct and indirect effect. They split the direct effect itself in two subcomponents: a level effect and a slope effect. The level effect is due to the fact that a higher level of the tax dissuades an employer from laying-off a worker. The slope effect results from the fact that the tax rate increases with age-at-layoff within some age ranges (see Table 6), and this can have the opposite effect of accelerating lay-offs: the employer may prefer laying-off his worker immediately at a low cost, rather than bearing the risk of being obliged to do so later at a higher cost. These level and slope effects are introduced in logit or probit models of lay-offs, estimated on individual LFS data. The estimated effects do not appear to be very robust: they are not completely inconsistent with prior expectations, but depend on specification and vary across socio-economic groups.

On the other hand, Behaghel et al. argue that the Delalande Tax may have had the negative indirect effect of reducing hiring of older workers. This hypothesis is tested using the exemption introduced in 1992 as a natural experiment. Using double difference methodology, they show that the exemption of the Delalande Tax for workers hired after age 50 has had opposite effects on hiring rates of workers over and below 50. Hirings for the latter category have been reduced. However, they acknowledge that this change could be explained as well by the development, over the same period, of some subsidized contracts for workers over 50 (CRE for *Contrats de Retour à l'Emploi*).

Bommier et al. (2003) reach relatively similar conclusions concerning the weakness of direct effects of the Delalande tax on lay-off rates. Their test consists of observing the consequences of the 1992 extension of the tax to the 50-55 group. This extension seems to have lowered, as expected, transitions rates from employment to unemployment in this age group, but this result is not robust to controls for whether the individual was hired before age 50 or not. On the other hand, using the same data and the same methodology they confirm the idea that the introduction of the DRE in 1985 had the effect of increasing the transition rate from employment to unemployment (this is consistent with the fact that DREs have been a substitute for other forms of preretirement). However, they do not observe any significant impact of DRE on the rate of return to employment: freeing older unemployed people from job seeking obligations has been almost neutral on their rate of return to employment, since these job seeking efforts were already, *de facto*, inefficient.

Conclusion

As announced in the introduction, this paper did not offer a full comparison of labour markets for French and US senior workers. Many aspects of this comparison would deserve further exploration: bridge jobs, the role of part-time employment, but also the role of early retirement plans provided by firms. A full comparative analysis between the two countries would also require a comparison of skill levels by cohorts, of modalities of certification for skills that are acquired on the job, of life long learning.

But these additional elements would certainly not contradict the major observation that, at the onset of the 1990s, the French and US labour markets for older workers were characterized by two major differences:

- Concerning retirement *stricto sensu*, a US pension system which was both less generous than the French system (providing lower benefits at a given age), and closer to actuarial neutrality with respect to the incentive to retire at any specific age.
- Concerning the management of non-employment before normal retirement, the French system had opted for relatively generous systems of subsidies to older non-employed workers who are not yet eligible for retirement, while the US system leaves the burden of adjustment to employment shocks to workers themselves, the only regulation being the one provided by anti-discrimination legislation.

The 2003 pension reform in France represents a significant attempt to correct the strongest of the distortions that existed in the French pension system and which had been left uncorrected by the previous 1993 reform. At this stage, according to available projection tools (the Destinie model), this is expected to lead to 650,000 more labour force participants at horizon 2020. This step is not insignificant. But it will contribute to solving pension problems only if these additional older labour force participants can actually find jobs. Attention has therefore shifted to the demand side of the labour market.

On this demand side, one common opinion is that low demand for older workers is explained by a large gap between their wages and their productivity. Evidence is far less overwhelming than could have been expected, but studies of the wage-productivity differential suffer from the fact that wages and productivities are only observed for people who are still in employment. Further work needs to be done concerning people who are out of employment. At this stage, we cannot rule out the hypothesis that some senior workers are out of the labour market because of negative productivity shocks either at the individual level or at the level of the firms they were working in. This is at least what is suggested by the negative association that is observed between technological and organizational changes and the age structure of labour demand. This is also what is shown by conditions of reemployment of laid-off senior workers who are able to return to employment, especially in the US.

Of course, such results do not completely solve the problem of sorting out what is due to true productivity problems and what results from employers' a priori beliefs concerning that productivity. Have all these people been laid-off because of an unfavourable evolution of their productivity/wage ratio? Are they victims of the stereotypes concerning their productivity or their capacity of adaptation to change? Or is there a deliberate choice to rely on this age group for adjusting to global problems of excess labour capacity, simply because the existence of a better safety net for these workers make this choice socially more acceptable? The historical development of French preretirement lends support to the latter thesis, but this does not rule out the two other ones. These three factors are not mutually exclusive. They even have a tendency to reinforce each other: the development of preretirement schemes may have helped maintain relatively high wage levels for people who remain in

employment, and it may also have reinforced stereotypes concerning the productivity or adaptability of older workers, calling in turn for further extensions of preretirement.

The French system has just been able, since the early 1990s, to contain the trend toward earlier exits from the labour force. It is still too soon to know whether it will be able to shift from simple stabilization of employment rates in these age groups at a low level to the substantially higher employment rates necessary for long run fiscal balance of the pension system.

References

- Adams, S. J. (2004) « Age Discrimination legislation and the employment of older workers » *Labour Economics*, vol. 11, pp. 219-241.
- Ananian S. and Aubert P. (2004) « Travailleurs âgés, nouvelles technologies et changements organisationnels : un réexamen à partir de l'enquête REPONSE », Document de travail INSEE/DESE n° G2004/11
- Anglaret, D. and Bernard, S. (2003) « Chômage et retour à l'emploi après 50 ans : une moindre exposition au chômage, des difficultés pour retrouver un emploi », *Premières Synthèses*, DARES, n° 45-1.
- Aubert P. and Crépon B. (2003), « La productivité des salariés âgés: une tentative d'estimation », *Economie et Statistique*, n°368, pp.95-119
- Aubert P, Caroli E. and Roger M. (2004) « New Technologies, Workplace Organisation and the Age Structure of the Workforce : Firm-Level Evidence », Document de travail INSEE/DE-SE n°G2004/07.
- Bardaji J., Sédillot B. and Walraët E. (2003), « Un outil de prospective des retraites : le modèle de microsimulation Destinie », *Economie et Prévision*, n° 160-161, pp. 193-214.
- Béghaghel, L. (2003) « Insécurité de l'emploi : le rôle protecteur de l'ancienneté a-t-il baissé en France ? », *Economie et Statistique*, n° 366, pp. 3-23.
- Behaghel, L. Crépon, B. and Sédillot, B. (2005) « Contribution Delalande et transitions sur le marché du travail », *Economie et Statistique*, n° 372, pp. 61-88.
- Blanchet, D. and Pelé, L.P. (1999) « Social security and retirement in France », in *Social security and retirement around the world*, J. Gruber and D.A. Wise, Eds, NBER/University of Chicago Press.
- Blöndal, S. and Scarpetta S. (1998) « The retirement decision in OECD countries », *OECD Economics Department Working Papers*, n° 202.
- Bommier, A., Magnac, T. and Roger, M. (2003) « Le marché du travail à l'approche de la retraite entre 1982 et 1999, évolutions et évaluations », *Revue Française d'Economie*, 2003, n° 18, pp. 23-82.
- Bozio, A. (2004) « Does increasing contribution length lead to higher retirement age : evidence from the 1993 pension reform », Delta-CESifo conference on Strategies for Reforming Pension Schemes, Munich, 5-6 novembre
- Brunet, F. and Richet-Mastain, L. (2002) « L'âge des salariés joue surtout à l'embauche », *Premières Synthèses*, n° 15.3, DARES.
- Buffeteau, S. and Godefroy, P. (2005) « Conditions de départ en retraite selon l'âge de fin d'études : analyse prospective pour les générations 1945 à 1974 », *Document de travail INSEE/DESE n°G2005/1*.
- Burricand, C. and Roth N. (2000) « Les parcours de fin de carrière des générations 1912-1941: l'impact du cadre institutionnel », *Economie et Statistique*, n° 335, pp. 63-79.
- Charpin, J.M. (1999) *L'avenir de nos retraites, rapport au premier ministre*, La Documentation Française, Paris.

- Cohen, D., Lefranc, A. and Saint-Paul, G. (1997) « French unemployment: a transatlantic perspective », *Economic Policy*, n° 25, pp. 267-291.
- Cohen, D. and Dupas, P. (2000) « Trajectoires comparées des chômeurs en France et aux Etats-Unis », *Economie et Statistique*, n° 332-333, pp. 17-26.
- Crépon B., Deniau N. and Perez-Duarte S. (2003), « Productivité et salaire des travailleurs âgés », *Revue française d'économie*, vol. 18, n° 1, pp. 157-185.
- Diamond, P.A. and Gruber, J. (1999) « Social security and retirement in the United States », in *Social security and retirement around the world*, J. Gruber and D.A. Wise, Eds, NBER/University of Chicago Press.
- Duval, R. (2003) « The retirement effects of old-age pension and early retirement schemes in OECD countries », OECD Working paper n° 320.
- Farber, H. (2003). « Job Loss in the United States, 1981-2001 » *National Bureau of Economic Research Working Paper*, n° 9707.
- Gautié J. (2004), « Les marchés internes du travail, l'emploi et les salaires », *Revue Française d'Economie*, vol. 18, n°4, pp. 33-63.
- Givord, P. (2003), « Prévoir l'évolution des taux d'activité aux âges élevés : un exercice difficile », *Economie et Statistique*, 255-356, pp. 105-121.
- Guillemard, A.M. (2003), *L'âge de l'emploi. Les sociétés face au vieillissement*, Armand Colin.
- Hellerstein J. and Neumark D. (2004), « Production Function and Wage Equation Estimation with Heterogeneous Labor: Evidence from a New Matched Employer-Employee Data Set », *NBER Working Paper*, n° 10325.
- Hellerstein J., Neumark D. and Troske K. (1999), « Wages, Productivity, and Worker Characteristics: Evidence from Plant-Level Production Functions and Wage Equations », *Journal of Labor Economics*, n° 17, pp. 409–446.
- Lainé, F. (2003) « La mobilité professionnelle et salariale des salariés âgés analysée à travers les DADS », *Document de Travail de la DARES*, n° 66.
- Lefranc, A. (2001) « On the sensitivity of returns to seniority to the measurement of earnings », Draft, THEMA, Université de Cergy-Pontoise.
- Lefranc, A. (2003) « Labor market dynamics and wage losses of displaced workers in France and the United States », *William Davidson Institute Working Paper*, n° 614, September.
- Lerais F. and Marioni P. (2004) « Dossier âge et emploi : synthèse des principales données sur l'emploi des seniors », *Documents d'Etudes de la DARES*, n° 82.
- Mahieu, R. and Blanchet, D. (2004) « Estimating models of retirement behaviour on French data », in *Social security programs and retirement around the world: microestimations*, J. Gruber and D.A. Wise, Eds, NBER/University of Chicago Press.
- Mahieu, R. and Sédillot, B. (2000) « Microsimulation of the retirement decision: a supply-side approach », *Document de Travail INSEE/DESE*, n° G2000/07.
- Marchal, E. and Rieucau, G. (2005) « Candidat de plus de 40 ans, non diplômé ou débutant s'abstenir », *Connaissance de l'emploi*, n° 11, Centre d'Etudes de l'Emploi.

- Marioni, P. (2005) « Accroître l'emploi des seniors : entre volontés et difficultés », *Premières Informations et Premières Synthèses*, n° 04.1, DARES .
- Minni, C. and Topiol, A. (2004) « Les entreprises face au vieillissement de leurs effectifs », *Economie et Statistique*, n° 368, pp. 43-63.
- Monso, O. and Tomasini, M. (2003) « Le vieillissement dans les entreprises : faire face aux innovations technologiques », *Premières Informations et Premières Synthèses*, n° 09.2, DARES
- Neumark, D., and Stock, W.A. (1999) « Age discrimination laws and labor market efficiency » *Journal of Political Economy*, 107: 1081-1125.
- OCDE (2000), « Le vieillissement de la population active dans les pays de l'OCDE », *in Perspectives de l'emploi* (Chapitre 4), Paris, Juillet
- Stock, J. and Wise, D. (1990) « Pensions, the option value of work, and retirement », *Econometrica*, vol. 58, n° 5, 1151-80.
- Taddei, D. (2000) *Retraites Choisies et progressives*, Rapport du Conseil d'Analyse Economique, n° 21, La Documentation Française.