Intragenerational Distributional Analysis

in the French Private Sector Pension Scheme

A Microsimulation Approach

1. Introduction

Social Security taxes and benefits, as intertemporal allocation devices, are often compared to tutelary life-cycle savings. Governments can thus use them to foster redistribution. As already evidenced, from the intergenerational point of view, a pay-as-you-go system conveys solidarity between different cohorts. The system may also induce redistribution within one generation, which is the issue at stake in this paper.

The intragenerational distributional impact of the pension scheme could result from the individual heterogeneity in the population, combined with the features of Social Security rules. In particular, there are several redistributive devices in the French private sector pension scheme. One of these devices is the existence of a so-called 'minimal contributive' pension. Besides, there are several non-contributive devices that allow unemployed or early retired people, or women with children to get additional pension rights.

Our goal is to evaluate the level of redistribution under the current rules. The redistributive transfers are measured using the internal rate of return, defined as the rate of return which balances out the flow of contributions and the flow of benefits. In an analytical perspective, we aim at isolating the different devices of the Social Security design that are likely to induce redistribution. Following Gustman and Steinmeier's (2001) approach, we consider both the individual and the household level. Indeed, under the assumption of income pooling, the financial transfers occurring within the household through Social Security (most commonly from husband to wife) are fictitious. Therefore, under the assumption of income pooling, intra-household transfers should be excluded. We thus quantify the distributional impact of the pension scheme using the internal rate of return, at both individual and household levels.

The French pension system is composed of a wide range of pension schemes that provide quite different old-age benefits. About 65 % of workers (most wage earners in private firms) fall under the *Régime Général*, whereas civil servants, farmers or self-employed people have specific schemes (Blanchet, Pelé, 1997). In this study, we only consider workers who have spent their whole career under the *Régime Général* for pensions i.e. private sector workers. The coexistence of many specific pension schemes may be a factor of redistribution between beneficiaries of different schemes, but this aspect of intragenerational redistribution is not studied here.

The only way to have data on the lifetime careers of couples in France is to complete existing data on couples using a simulation approach. We rely on the 1998 Financial Assets survey and on the French microsimulation model Destinie, developed at INSEE. Our results are based on a cohort of households with spouses born between 1948 and 1960.

We find that the pension scheme is progressive as far as individuals are concerned. High-income workers are less advantaged. To be more precise, women, and especially low-income women, benefit more from redistribution than men. At the household level, the system remains redistributive although it displays less intragenerational transfers, as expected. Finally, in order to identify the impact of some of the potentially redistributive pension rules on the overall progressivity of the system, we perform simulations leaving those rules aside.

The analysis in terms of vertical redistribution (between households with different levels of income) is the main issue of the paper. However, the paper does not limit to this dimension. It also offers an interpretation in terms of horizontal redistribution, mostly according to the number of children.

In a first section, we present a short survey of the literature on the topic of intragenerational redistribution. A second section details the rules of the Social Security pension scheme in the French private sector. The data are described in a third section. A fourth section displays the working and income patterns in our sample. The redistributive impact of current rules is detailed in a fifth section and a sixth section illustrates redistribution under alternative rules.

2. A brief overview of the literature

A pension scheme is commonly said to be redistributive if the return on contributions is higher for low income persons than for higher income ones. In very contributive pension schemes, i.e. when the relationship between contributions and benefits is tight, the return on contributions hardly depends on the level of income. Intragenerational transfers are therefore almost absent. For instance, in the polar case of actuarially fair pension schemes, Coppini (1976) and Lagarde and Worms (1978) consider that there is no redistribution. Conversely, as lump-sum pension schemes provide the same level of pension whatever the amount of contributions paid, they thus foster high levels of redistribution. As a synthesis, in the case of a two part benefit with a lump-sum part and a contributive part, as in Deaton, Gourinchas and Paxson (2000), the higher the lump-sum part, the more redistributive the system.

Contributive pension schemes and redistribution are not mutually exclusive. This is the case when the link between contributions and benefits is partial. In the French private sector, several devices may induce

redistribution. As detailed below, for private sector workers, the part of the wages standing below or above the so-called 'Social Security ceiling' fall under different pension schemes and a second distinction separates executives from non-executives (see the next section for more details on the rules). The features of each of the involved pension schemes are different: the level of the contributions is not the same, the calculation of the pension does not follow the same rules. As a result, they can generate different returns. Bajram (2000) evidences that the existence of the 'Social Security ceiling' has had anti-redistributive implications in the past, providing higher returns for executives. In an illustrative case study, Assous, Bonnet, Colin (2001) show that the rate of return is comparable among executives and non-executives as long as differences in life expectancy are not taken into account. Another redistributive factor is the fact that, in the *Régime Général* pension scheme, the pension level is based on the average of the best 25 annual wages. So the contributions of the whole career are not taken into account, which loosens the link between contributions and pensions.

Non-contributive devices also foster redistribution. The French system guarantees a minimum level of pension, subject to contribution length conditions but independent from the amount of contribution. Moreover, in the French *Régime général*, some non-worked spells can be included in the contribution duration used for the calculation of the benefits. Such devices provide an insurance against the ups and downs of a career, as they reduce their impact on old-age income (Caussat, 1996).

Finally, some non-contributive devices are explicitly aimed at those who raised several children (especially women). Studying the rules of these 'family advantages', Bonnet and Chambaz (2000) show that these devices generate individual discrepancies according to several dimensions: the number of children, the gender, the status, the level of income and the path of labor force participation.

The redistribution analysis performed here is restricted to occupational pension schemes and neglects private pension plans as well as individual savings, as they are not much developed in France. Taking these additional post-retirement income sources into account should temper the redistributive effect of Social Security pensions, mainly because they usually benefit more to the high-income group (Delhausse, Perelman and Pestieau, 1992).

The levels of contributions and benefits are not the only individual characteristics to be taken into consideration in order to discuss the differences in the rates of return of the pension scheme. Several papers emphasize the important part played by life expectancies regarding this issue. For instance Kessler and Masson (1985) show that, in the French system, the pension scheme is likely to generate transfers from the low-earners to the high-earners, as lifetime expectancies are positively correlated with labor income. Creedy, Disney and

Whitehouse (1993) and Atkinson, Creedy and Knox (1996) show that, in the British and Australian cases respectively, the redistributive impact of lump-sum benefits can be cut down when the differences in life expectancies across the population are considered. Legros (1994) sums up this idea, confronting Continental-type and Atlantic-type pension schemes. She concludes that, with differential mortality, the latter may be closer to actuarial fairness, the former being more anti-redistributive.

In order to evaluate the redistributive impact of Social Security pension schemes, both the individual level and the household level should be taken into account, as underlined in several recent papers. In a study on German data, Galler (1996) concludes that although individual data suggests that the pension scheme is redistributive, this effect is ambiguous when households are taken into account. Indeed, women labor force participation decreases with their husbands' income.

Coronado, Fullerton and Glass (2000) and Gustman and Steinmeier (2001) find similar results in the American case. The two papers show that the apparent progressivity of the system is an artifact. It disappears when the households are ordered according to the 'relevant' lifetime income indicator. Like the previously quoted papers, Coronado, Fullerton and Glass (2000) put forward the anti-redistributive impact of differences in life expectancies. Above all, both papers emphasize that the global redistributive pattern of the pension scheme is substantially weakened when couples are taken into account.

As this topic has not been explored in the case of France, we study the redistributive outcomes of the French private sector pension scheme, focusing on the household level. More precisely, our goal is to measure the level of redistribution induced by the current rules accounting for the structure of the population, in particular in terms of number of children and life expectancy. Redistributive transfers can occur between couples of different levels of income, or can be induced by differences in the number of children or the status[1]. The specific effects of several features of the private sector pension scheme will also be quantified.

[1] Executive / non-executive.

3. The French pension system for private sector workers

For private sector workers, the pension system is a two-pillar scheme: the first one provides basic pensions (the so-called *Régime Général*); the second one includes complementary old-age benefits (ARRCO and AGIRC). The two pillars provide a survivor benefits device. The rules that determine the level of pensions are briefly presented below. For a more detailed description, see Blanchet, Pelé (1997).

Basic pensions

The computation of the basic pension is rather complex. It depends on three terms: the reference wage, the pension rate and a so-called 'proratization' variable. The last two factors depend on the number of quarters of contribution.

- Since the major 1993 reform, for people born after 1948, the reference wage (*salaire annuel moyen* or *SAM* i.e. average annual wage) is computed as the average gross wages of the 25 best years of the career. The earnings are truncated to the 'Social Security ceiling' that prevailed that given year and then reevaluated[2].
- The pension rate has a maximum value of 50 % (*'full rate'*) that is automatically reached when the retirement age is 65. Nonetheless, one can retire from 60. In this case, the pension rate equals 50 % only if the total number of contribution quarters is greater than 160 (for people born after 1942). Otherwise it decreases by 1.25 % for each missing quarter to reach either the age of 65 or 160 contribution quarters.
- The contribution period is actually made up of effective working periods and of periods when the worker has not paid contributions: unemployment periods (when the worker receives unemployment benefits) and early retirement periods are added to the number of working years. The name of 'contribution period' may therefore look a bit inappropriate but we keep it, as it is most commonly used in this context.
- Regarding the so-called 'children advantages', women benefit from a two year contribution length bonus for each child. Other duration bonuses can be granted, subject to means-tested conditions, to parents who choose to retire from the labor market to bring their children up (*Assurance Vieillesse des Parents au Foyer* i.e. old age insurance for house-parents). Eventually, parents who brought up three children or more receive a 10 % extra for their pensions.

[2] In 2002, the monthly SS ceiling amounts to 2352 €. The 25 best wages entering the computation of the reference wage are reevaluated using a wages index (before the end of the 1980s) and a consumption price index (since then).

- If the contribution period is superior to 150 quarters, the pension cannot be smaller than a specific « contributive minimal amount » (*minimum contributif*)[3]. For contribution periods inferior to 150 quarters, a proratized « contributive minimal amount » is granted for those who retire after 65.
- The proratization term states that the amount of pensions is cut by about 0.7 % for each missing quarter to reach the reference period of 150 quarters.

Complementary pensions

Beside the basic pension benefit, two mandatory complementary systems exist for wage earners in private firms: the ARRCO regime that applies to everybody and the AGIRC regime exclusively for executives. Non-executive workers pay contributions to the ARRCO on the basis of their whole wages. Executives pay contributions to the ARRCO on the part of the wages below the 'Social Security ceiling', and to the AGIRC[4] on the part of the wages above the ceiling.

Each working year, people receive a number of units ('*points'*) proportional to their contributions. The amount of their complementary benefit is computed as the product of the total number of units they have accumulated since the beginning of their career by the current selling-value of the unit ('*valeur du point'*). This value roughly follows the consumption price index. These schemes are highly contributive. They are not fully contributive because of the existence of downward adjustments for people below the full rate in the *Régime Général.* The level of these complementary pensions is also strongly dependent on the date of purchase of the points as the buying-value of the units are not indexed on the wages.

Like basic pensions, complementary pensions provide an extra (5 % for ARRCO and 10 % to 30 % for AGIRC) for people who brought up three children or more.

Survivor benefits

Like direct pensions, survivor benefits (*pensions de réversion*) are made up of two elements: basic pensions and complementary pensions.

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[3] In 2002, the minimal level amounts to 525.63 € per month.

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

Basic survivor benefits are paid to the survivor spouse[5] of a deceased worker if the survivor fulfills three main conditions: being older than 55, having been married for at least two years and receiving a total personal income lower than a fixed amount (2080 times the minimal hourly wages (SMIC)). The basic survivor benefit amounts to 54 % of the basic pension of the deceased spouse, including the children extras, has an upper bound (27 % of the 'Social Security ceiling') and a lower bound (the amount of the *allocation aux vieux travailleurs salariés* proratized on the basis of a contribution period of 60 quarters). The basic survivor pension can be added to other personal basic pensions of the survivor spouse, subject to cumulative restrictions.

There is no means-tested condition to receive a complementary survivor pension. But an age condition remains (in general 55 for ARRCO pensions and 60 for AGIRC pensions). The complementary survivor benefit amounts to 60 % of the deceased spouse complementary benefit, including the extras for children.

4. The data

To study redistribution at the household level, we need data on the careers of each member of the household (earnings, contributions, retirement age) as well as on demographic events (age of death). In France, such data exist at the individual level[6] but not for households. Failing this, we rely on the 1998 French Asset Survey and extend it to further years using microsimulation. The survey provides the wages in 1998 and retrospective data on the working status of the members of the household. We complete the data by simulating the economic and demographic events that affect this population thanks to the dynamic microsimulation model Destinie of INSEE (See appendix 1 for more details). This model has already been used in a study of intergenerational redistribution by Bonnet and Mahieu (2000). At the individual level, we simulate the past wages and forecast the future participation on the labor market and wages. We also simulate the ages of retirement as a trade-off between income and leisure in line of the Stock and Wise model (1990). This approach allows for a good representation of the heterogeneity of the population.

As mentioned in section one, differences in mortality according to the level of income can generate anti-redistributive effects. It is therefore crucial to take these differences into account. In Destinie, all the socio-professional variables are summarized in one proxy: the age at leaving school. Both the wages determination

[5] If the deceased worker has been married more than once, all his (unmarried) former spouses are eligible to a part of his reversion pension.

[6] For instance gathering the EIR sample (*Echantillon Inter-Régimes de Retraités* of the *Direction de la Recherche, des Etudes, de l'Evaluation et des Statistiques*), the DADS panel of earnings (*Déclarations Annuelles de Données Sociales* of INSEE) and eventually the UNEDIC files about unemployment.

process and the mortality hazard reflect differences in ages at leaving school, which guarantees that the differences of mortality by level of income are included in the model.

In a study of redistribution at the household level, it is necessary to consider the main features of the careers of the two members of the couples that could have a redistributive impact. First of all, the matching process can have several consequences on the joint career profiles of the spouses: the spouses generally have small age differences (in France, the average age difference is 2 years). They will thus meet similar economic conditions during their career, similar contribution rules and pensions calculation rules. The widowhood duration and therefore the length of collection of the survivor benefits also depend on the age difference between the spouses. Moreover, if the spouses have comparable qualification levels (assortative mating), their levels of wages will be positively correlated, which will reduce the intra household redistributive transfers.

The labor supply literature shows that participation decisions result from household choices, as evidenced in Blundell and MaCurdy's survey (1999). This element is partly integrated in our sample as we know the past participation decisions for each year before 1998. But the simulations of the ends of the careers do not consider the household dimension of couples labor supply[7].

Our sample excludes single persons and concentrates on couples. But we do not restrict to married couples[8]. A recurrent problem with respect to couple analysis is the instability of couples. Studying redistribution at the household level implies to follow the wages and retirement pensions received by each couple throughout their lifetime. As unions may disrupt and new partnerships may start at any age, we have to choose at which moment we select the two members of the couples that we are going to follow, for instance the couples observed at a given date or age.

As couples disruptions are quite frequent in France and as the subject of the selection of the two spouses has not been much detailed in the previous studies, we provide some methodological outline on this issue. A first solution would be to follow couples observed in the Asset Survey in 1998. This choice would provide a good representation of the heterogeneity of the sample and allow for joint labor supply choices before 1998. But for instable couples, the household income will loose part of its economical meaning, in particular because the

[7] Recent papers on American data (Blau 1998, Gustman, Steinmeier 2000) have also evidenced the joint dimension of retirement decisions. A recent French study on this topic (Sédillot, Walraet 2002) has shown that this result is less clear-cut with French pension rules and that women are more likely to take their spouse's retirement decision into account than men. We do not integrate this joint retirement pattern into our retirement choice modeling.

[8] In order to be eligible to the survivor benefit, we suppose that the spouses get married when they get older.

survivor pension attribution process may distort the income of the selected household. For instance, if a person is first married to a high income spouse who dies and then remarries a low income spouse who dies too, the final survivor benefit will be low whereas the first spouse would have provided a high survivor benefit. A second example is that of a survivor spouse starting a new partnership. He/she will then loose his/her entitlements to a survivor benefit but the second spouse will not be taken into account in our representation, as we only keep one spouse. A solution is to focus on couples observed at a later date or age, closer to the age of the attribution of the first survivor benefit. More precisely, for each individual, we select the spouse who is at the origin of the first survivor benefit received by the individual, or who dies simultaneously. This definition is not unequivocal: an individual may belong to two selected couples[9]. In such a case, we select the first couple formed. This choice limits the survivor pension attribution problem and does not significantly alter the representativity of the sample, since less than 10 % of the selected couples were formed after 1998.

The choice of the cohorts must fulfill two contradictory needs. On the first hand, to look from an intragenerational point of view means a small number of cohorts. In particular, individuals from the studied cohorts must be faced to identical retirement rules. For the 1993 reform to reach its full effect, we have to concentrate on individuals born in 1948 or after. On the other hand, since we focus on couples, we need to study couples where both spouses belong to the selected cohorts. Obviously, if we select too few cohorts, we will restrict to couples where the two spouses are almost the same age, which may add a bias. Moreover, such a constraint would reduce dramatically the size of our sample. Faced to this trade-off, we select couples where the two spouses were born between 1948 and 1960. We do not select our sample according to the employment status of the spouses: we do not restrict our study to couples with both spouses participating in the labor market. For individuals who have had a work experience, we impose that they belong to the private sector. Our sample gathers 1192 couples, i.e. 2384 individuals.

[9] For instance, if a widower receiving a survivor benefit from his first wife gets married and then dies, his second wife will also receive a survivor benefits. The two resulting couples (man + first wife and man + second wife) will then be recorded.

5. The work history and lifetime earnings in the sample

In this section, we detail the earning profiles of the individuals and couples of our sample. We describe the distribution of working years and lifetime wages through different indicators.

Building lifetime earnings indicators

In order to describe the lifetime work pattern in our sample and to order the individuals and couples according to their lifetime earnings, we need to create synthetic indicators which will summarize information on the earnings throughout the working period.

The simplest idea would be to choose the institutional earnings measure used in the calculation of the Social Security pension, the average annual wage called *salaire annuel moyen* (SAM). But the calculation rule of the SAM is not neutral as far as redistribution is concerned. First, the wages are updated with a yearly index, which used to be a wage inflation index up to the end of the 1980s and is now closer to the consumer prices index. This break in the revaluation method is purely institutional and does not represent any economic change for the workers. Second, for the individuals of the sample, the SAM is based on the best 25 annual gross wages, and if a person has worked less than 25 years, the average will be computed on all the working years. So the SAM will not directly differentiate between long careers and short ones. Moreover, the part of the wages taken into account to determine the SAM is capped to the 'Social Security ceiling'. So the SAM would not display any difference among all workers earning more than the ceiling. The choice of this indicator is not appropriate to analyse the return to contributions paid on the part of the wage above this ceiling.

To solve the two matters of indexation and of the capping of the wages, a natural idea is to index the wages on the evolution of a single index and to remove the upper limit for the wages. The index that we choose is the average net wages in the national economy. Other choices, such as a price index or a gross wages index should not induce major differences in an intragenerational context. Besides, we now concentrate on net wages (the SAM uses gross wages), as they are more appropriate than gross wages to measure the available income. One topic remains: the choice of the length of the working period considered in the computation of the indicator. Three extreme alternatives can be pointed out. We can consider the last known wages before retirement, the average of the yearly wages over all working years, or eventually the total earned wages through the working period. The last known wage is clearly not representative of the whole career of the individual, as it reflects the wages at one date. We will not consider it later. The two remaining indicators write:

Average wages per working year = $\frac{\sum_i nw_i \frac{ANW_{1997}}{ANW_i}}{\sum_i I(nw_i > 0)}$ Total lifetime wages = $\sum_i nw_i \frac{ANW_{1997}}{ANW_i}$,

where nw_i is the net wages earned on year *i* and ANW_i is the average net wages of the national economy on year *i*.

The average of net wages on all working years is the average yearly income earned by a person on years when he/she had the opportunity to work. It is a good indicator of the average wages that a person can reach provided that this person participates in the labor market and finds a job. But it neglects the trend of the career profile. The lifetime total wages indicator includes the notion of non-working years (i.e. years when the wages equal zero) and is more likely to account for the ups and downs of a career. We will refer to these two indicators as the average wages per working years and the lifetime total wages.

These two indicators reflect a lifetime earnings level, which is not identical to a lifetime standard of living. Indeed, two households with the same instantaneous income level may have different standards of living if the families are not the same size. We define a lifetime equivalent wages indicator based on the instantaneous net wages per consumption unit, following the INSEE definition of consumption units[10]. We then define the total lifetime equivalent wages as the sum of the indexed instantaneous wages per consumption unit, i.e. $\sum_i \frac{nw_i}{cu_i} \frac{ANW_{1997}}{ANW_i}$, with cu_i the number of consumption units on year *i*.

Distributive patterns of income and working years

Income. The first pattern is that, unsurprisingly, women earn in average far less than men. For instance, the average wages per working year are in average 20,800 €(1997) for men and 11,700 €(1997) for women.

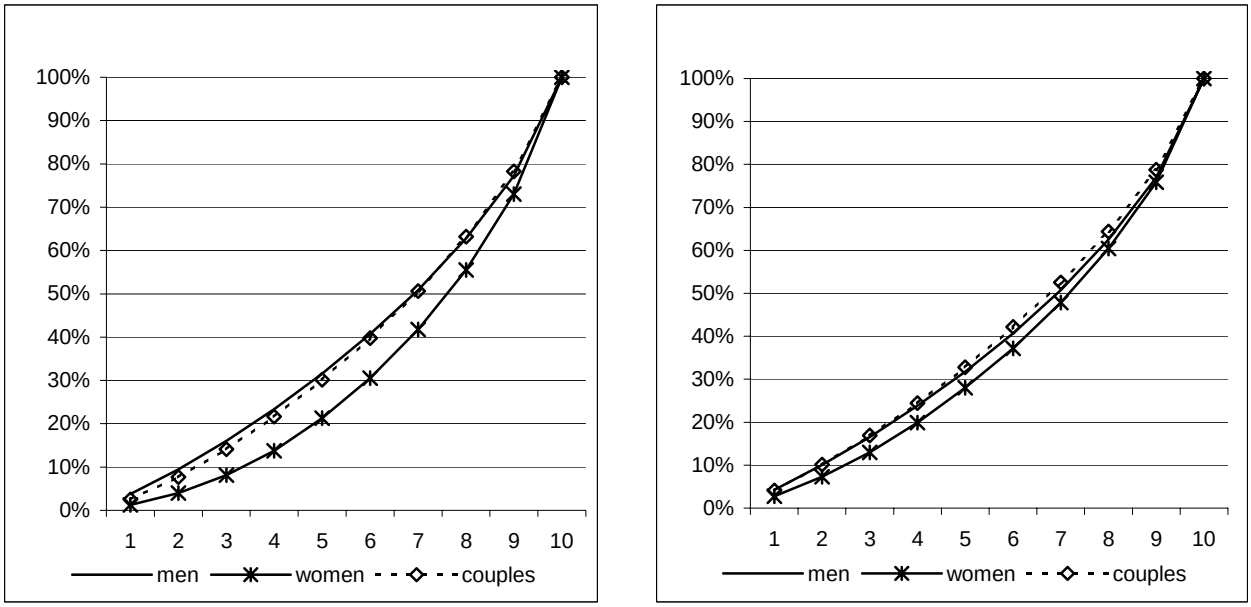
Focusing on the distribution of the lifetime earnings indicators in the sample, we compare the shape of their Lorenz curves. The distribution of men lifetime total wages Lorenz-dominates the distribution of women total wages i.e. the distribution of total wages among women displays more 'inequalities' than among men (figure 1a). The distribution of couples lifetime total wages Lorenz-dominates the women distribution but is very close to the distribution of men in terms of inequality. The matching process reduces the 'inequalities' in total

[10] At each period, the number of consumption units of a household is worth 1 unit for the first adult plus 0.5 for the spouse and per child over 14 plus 0.3 per child under 14.

wages as the level of inequality among couples is equivalent to the smaller of the intra-gender level of 'inequality' (men's one) (see Appendix 2).

Figure 1: Lorenz curves for men, women and couples of our sample

1a. Lifetime total wages **1b. Average wages per working year**



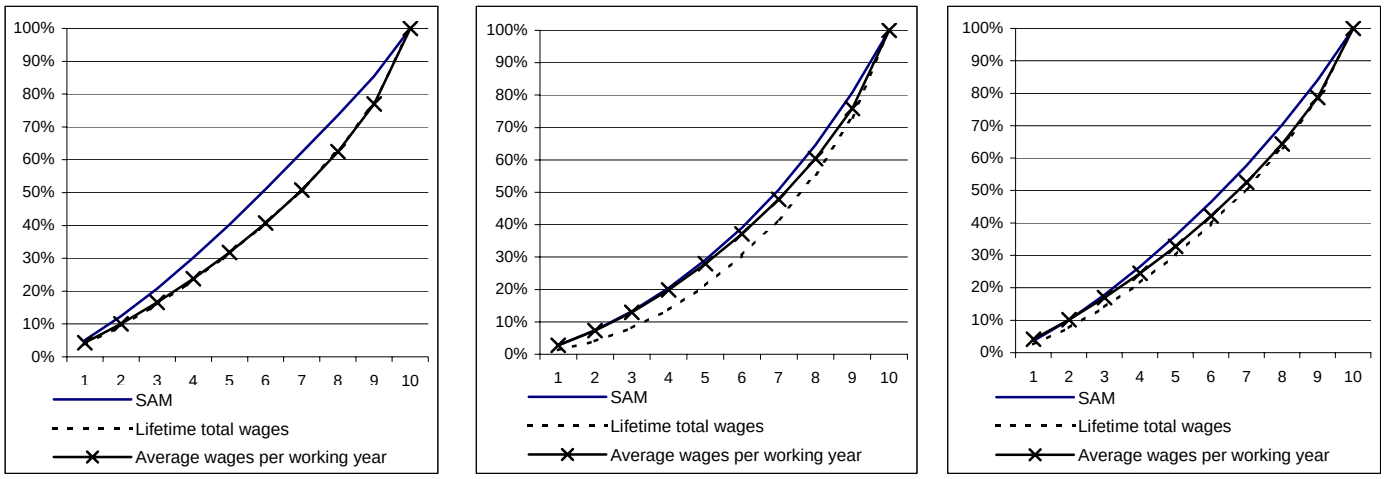
The difference between the Lorenz curves of men and women is reduced when examining the distribution of the average wages per working year (figure 1b). Indeed, among women (and to a lesser extent among couples), the distribution of the total lifetime wages is more unequal than the distribution of the average wages per working year whereas they display the same level of 'inequality' among men (figure 2). This results from the fact that women are more likely to experience non working spells than men. Furthermore, it means that, for women, the number of working years is correlated to the level of wages: women with low average wages could have worked a smaller number of years.

For men, women and couples, the distribution of the SAM always Lorenz-dominates the distributions of the lifetime total wages and the average wages per working year. The main difference between the SAM and the average wages lies in the capping of the wages. In this respect, the divergence between the two curves is stronger for men than for women, which illustrates the fact that men whose wages are above the ceiling are proportionally more numerous than women.

The last distributive pattern regarding income is that the size of the household appears to be unrelated to the level of wages in our sample. The distribution of the total lifetime equivalent wages (not presented) is indeed very close to the one of the total lifetime wages.

Figure 2: Lorenz curves for three indicators of lifetime earnings

2a. Men **2b. Women** **2c. Couples**



Working years and contribution period. The average number of effective working year is much smaller than the average contribution period (table 1). For men, the military service, unemployment and early retirement periods mainly account for the difference. For women, the 11 years gap results from the contribution duration bonuses for children (two years per child), the contribution benefit for women who retire from the labor market to bring their children up (AVPF) and eventually unemployment and early retirement periods.

Table 1: Average contribution and working years

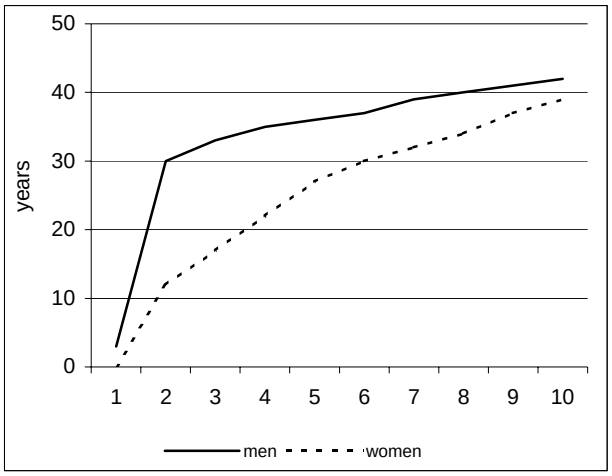
	Contribution years	Working years	*Children bonuses*	*AVPF*	*Early retirement periods*	*Validated unemployment periods*
Men	41.1	36.5	*0*	*0*	*2.1*	*1.4*
Women	38.7	27.7	*4.1*	*3.1*	*1.7*	*1.8*

Finally, figure 3 presents the deciles of working years and contribution years by gender. As well known for those generations, we observe on figure 3a that most of the men have had long careers (about 70 % of the men worked during more than 35 years) and that most of the women have worked very little (more than 70 % of the women worked less than 35 years). Consequently, the women's working years distribution is quite widespread. As already pointed out in the study of the average durations, the distinction between men and women almost disappears when examining the contribution length. After the third decile, the values of the

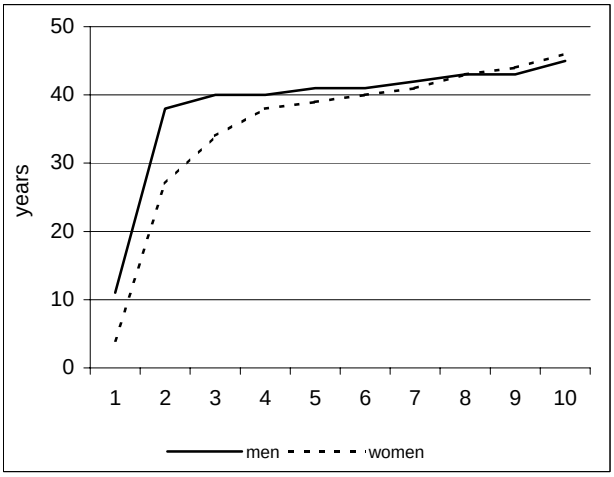
deciles of men and women are very close: 80 % of the women benefit from more than 35 contribution years (figure 3b).

Figure 3: Deciles of the working or contribution length

3a. Number of working years



3b. Number of contribution years



Number of working years by level of income. The previous paragraph evidences the high frequency of women with short careers. To go further, we analyse the correlation between the level of income and the length of the working period. We detail in table 2 the averages of contribution and working durations per decile of income.

The averages of contribution duration and working duration are quite stable for men in different deciles of average income. They display a slight decline as the average income increases, which must correspond to longer schooling periods. For women, we notice the same flat trend for average contribution lengths but the average working length increases with the level of income : women who have low average wages are more likely to be unemployed or stay at home to take care of their children than women with higher average wages. When looking at the average contribution period by level of income, this phenomenon is offset by the non-contributive duration bonuses (table 2a).

As the lifetime total wages indicator integrates the number of working years, the average working period should mechanically increase with the level of total wages. This increasing trend is observed for both men and women (table 2b). For men, the non-contributive bonuses (mainly unemployment and early retirement periods) are sufficient to offset the shorter working periods. As a result the average contribution periods do not vary with the level of total income. For women, we observe that the average contribution periods are increasing

with the level of total wages, as the non-contributive length bonuses only partially compensate for all the years of inactivity or unemployment.

The total lifetime equivalent wages indicator adds the dimension of the size of the family. Comparing the working years and contribution years with a total lifetime wages ordering or with an equivalent lifetime wages ordering evidences almost no difference (table 2c).

As already seen with the distributions of contribution and working length, in the French context, it is striking that non-contributive duration bonuses almost totally offset the career risks. As a result, contribution durations show a moderate sensitiveness to the ups and downs of a career. In this respect, we can already assert that the French private sector pension scheme fulfils an insurance goal.

Table 2: Averages of validated and working periods (in years)

a- By decile of average wages per working year

	1	2	3	4	5	6	7	8	9	10	all
Men											
Validated period	41.1	41.6	42.0	41.6	42.1	41.2	41.0	40.8	40.3	39.3	41.1
Working period	35.3	36.5	37.7	37.0	37.9	36.5	36.4	36.6	36.1	34.9	36.5
Women											
Validated period	37.6	36.8	38.6	38.0	38.3	39.9	39.4	39.9	41.0	38.1	38.7
Working period	24.1	21.4	23.6	26.0	27.7	29.5	30.7	31.8	32.3	30.3	27.7

b- By decile of lifetime total wages

	1	2	3	4	5	6	7	8	9	10	all
Men											
Validated period	38.6	41.6	41.3	41.9	41.9	41.8	41.8	40.9	40.9	40.4	41.1
Working period	30.6	36.0	36.0	37.5	37.6	37.7	38.3	37.0	37.3	37.0	36.5
Women											
Validated period	32.3	36.4	36.1	38.7	38.7	39.6	41.1	40.9	42.3	41.4	38.7
Working period	12.2	18.6	23.0	26.2	28.1	31.0	33.8	33.5	35.3	35.8	27.7

c- By decile of total lifetime equivalent wages

	1	2	3	4	5	6	7	8	9	10	all
Men											
Validated period	39.0	40.9	42.0	41.5	41.7	42.0	41.2	40.7	41.4	40.6	41.1
Working period	31.3	35.4	37.0	36.3	37.4	38.2	37.3	36.7	37.9	37.5	36.5
Women											
Validated period	34.3	35.2	36.7	38.3	38.4	40.2	39.8	41.4	41.8	41.2	38.7
Working period	12.7	19.0	23.2	25.6	27.9	31.8	32.2	34.2	35.1	35.7	27.7

As a consequence of this analysis, when we group individuals by earning decile, the rankings according to the three indicators are strongly correlated. Indeed, 87 % of men, 77 % of women and 76 % of couples belong to the same decile of total wages and of average wages or to the adjoining ones. For men, the close link between the two rankings is explained by the homogeneity of the number of working years among all of them. For women, the working period length increases with the average wages per working year. Since the total lifetime wages indicator is the product of the average wages by the number of working years, the deciles of total wages and of average wages of women roughly gather the same persons.

Ranking men, women or couples according to the total lifetime wages or according to the total equivalent wages also proves very similar: 84 % of men, 96 % of women and 95 % of couples belong to the same or adjoining decile. As a result, ranking the individuals or couples according to one lifetime earnings indicator will be enough in a first approach of redistribution.

6. Redistribution under the current rules

The internal rate of return as a measure of redistribution

To measure redistribution, we use the internal rate of return of the pensions (shortened below in 'internal rate of return') . It is usually defined as the discount rate that makes the discounted sum of taxes equal to the discounted sum of benefits. Its interpretation is direct: it corresponds to the financial rate of return that would have guaranteed the same benefits if the individual had saved the contributions in a personal account. Besides, the internal rate of return meets the key requirement to take into account the whole series of taxes and benefits. Eventually, it does not require the somewhat arbitrary choice of a discount rate, which is the usual problem when comparing the discounted values of pensions and contributions. For instance, when Coronado, Fullerton and Glass (2000) set their discount rate at 4 % instead of 2 %, they come to reverse conclusions about

the progressivity of the American Social Security system. By definition, the internal rate of return does not fall under such a criticism. However, as often underlined (Vernière, 1998), it raises another problem in terms of its sensitiveness to small differences in individual situations. But this is the unavoidable consequence of the fact that it reflects accurately individual heterogeneity.

The replacement rate (see the box in the next subsection) is not very appropriate to measure the redistribution induced by the pension scheme. However, the replacement rate can help to understand the redistributive effects linked to the ceiling.

One of the main dynamic assumptions of the Destinie model is that, each simulated year, the contribution rates adjust the financial balance of the pay-as-you-go pension schemes. As a result, in the French demographic context, the contribution rates increase significantly in the close future, in simulations. The level of the rate of return is slightly influenced by this assumption, but the intragenerational distributive pattern is not affected.

Vertical redistribution

The first result is that from an individual point of view, the French private sector pension scheme fosters redistribution (table 3). When comparing men and women, the difference in financial returns is obvious. Women take more advantage from redistribution than men: whatever the level of wages, women always benefit from higher internal rates of return than men. Globally, the median rate of return is 2.9 % for men against 4.0 % for women. This pattern may result from the combination of several effects: women have longer lifetime expectancies than men; besides, they are more likely to benefit from non-contributive length bonuses.

For men, the trend of the internal rates of return relatively to their deciles of wages is flat: there is no vertical redistribution among men. On the opposite, the internal rates of return of women are noticeably decreasing with the level of average wages. They drop from 6.9 % for the lowest decile of average wages to 3.6 % in the highest decile. The vertical redistribution among women may be explained by the decreasing pattern of the non-contributive length bonuses with the level of wages (table 2). So, from the individual point of view, the bulk of redistribution is taking place from men to women, and from richer women to poorer women. Among all, low-income women are the highest beneficiaries of redistribution.

Table 3: Median internal rate of return by decile of average wages per working year

	1	2	3	4	5	6	7	8	9	10	all
All individuals	6.1 %	4.2 %	3.7 %	3.4 %	3.2 %	3.2 %	3.1 %	3.1 %	3.0 %	2.9 %	3.4 %
Men	3.1 %	2.9 %	2.9 %	3.0 %	2.9 %	2.9 %	3.1 %	2.8 %	2.9 %	2.8 %	2.9 %
Women	6.9 %	5.2 %	4.8 %	4.0 %	3.8 %	3.7 %	3.6 %	3.6 %	3.7 %	3.6 %	4.0 %

At the household level, the global redistributive pattern remains (table 4). The intragenerational transfers are clearly visible: the median rates of return decrease with the decile of average wages by 0.6 points in the first half of the distribution and are stabilized for higher levels of wages.

Table 4 also presents the median internal rate of return for men and women according to the level of average wages of the couple. For a given decile, the discrepancy between the internal rate of return of men and women reveals the transfers which operate within the households. The median internal rates of return of women still decrease with the income decile of the couple and are always much higher than the median internal rates of return of men: there are transfers within the household whatever the level of income of the couple. However, these intra-household transfers are more significant for low-income couples.

Table 4: Median internal rate of return by decile of average income of the couple

	1	2	3	4	5	6	7	8	9	10	all
Men	3.1 %	2.9 %	3.0 %	2.9 %	2.9 %	2.9 %	3.0 %	2.8 %	3.0 %	2.9 %	2.9 %
Women	5.6 %	4.1 %	4.1 %	3.7 %	4.0 %	3.8 %	3.8 %	3.9 %	3.8 %	3.8 %	4.0 %
Difference	*2.5*	*1.3*	*1.1*	*0.8*	*1.1*	*0.9*	*0.8*	*1.1*	*0.8*	*0.9*	*1.1*
Couples	3.8 %	3.5 %	3.3 %	3.2 %	3.1 %	3.2 %	3.1 %	3.1 %	3.1 %	3.1 %	3.2 %
Couples - Without the Survivor benefit	3.6 %	3.3 %	3.2 %	3.1 %	3.0 %	3.1 %	3.0 %	3.0 %	3.1 %	2.9 %	3.1 %

The outcomes of the survivor benefit device on couples vertical redistribution should be twofold. The main beneficiaries of the survivor benefit should be couples where the widowhood duration is long, mainly because the age difference is high, and also where the difference in level of pension is high, due to the rules. The redistributive effect of the survivor benefits should not be connected with the level of income of the couple. This intuition is consistent with our observations: when we do not include the survivor benefit, the reduction of rate of return of couples is homogeneous across the deciles of average wages. For each decile, the rate of return is 0.1 to

0.2 point lower when the survivor benefit is not included. Further investigations show that the reduction of the rate of return is correlated to the difference in the level of pension of the spouses and also, to a lesser extent, to the duration of collection of the survivor benefit. These results are less visible because of the sensitivity of the drop of the internal rate of return to external parameters, such as the age of widowhood.

The replacement rate and the effects of the ceiling

The replacement rate is commonly defined as the ratio of the pension during the first year of retirement to the wages during the last working year. This is a very common indicator, since it is easy to compute, and its interpretation in terms of standard of living is straightforward. A usual reproach is that the replacement rate is an instantaneous measure of welfare. Therefore, it is not appropriate in order to measure redistribution: it does not take into account the profile of wages during the career nor the length of collection of the pension. Following Colin, Legros, Mahieu (1999), we enlarge the notion of the replacement rate, including a reference to the whole series of life-cycle wages. We consider a long-run replacement rate, which is the ratio of the first net pension to the average net wages during working years. Actually, the average net wages during working years that we use here is exactly the average net wages indicator presented above.

Comparing the level of wages to the pension measures the part of income insured through the pension scheme. In the French private sector, the share of income insured through the pension scheme is smaller for high-income persons (table *i*). In the French context, the replacement rate allows to measure the level of insurance of each of the pension schemes. For instance, we split the global pension of couples in two parts: the pensions paid by pension schemes collecting taxes under the 'Social Security ceiling' (CNAV and ARRCO) and the pensions corresponding to the part of the wages above the ceiling (AGIRC with our assumption). The share of income insured through the first two pension schemes neatly decreases with the level of average wages for the four highest deciles of average wages. The replacement rate 'above the ceiling' partly compensates for this loss.

Table *i*: Median long run replacement rate by decile of average wages

	1	2	3	4	5	6	7	8	9	10	all
All individuals	101 %	71 %	67 %	72 %	73 %	74 %	73 %	72 %	67 %	60 %	71 %
Men	76 %	73 %	74 %	74 %	74 %	73 %	70 %	67 %	64 %	58 %	71 %
Women	130 %	80 %	71 %	66 %	65 %	67 %	67 %	73 %	73 %	61 %	71 %
Couples - whole pension	77 %	71 %	69 %	68 %	68 %	66 %	66 %	63 %	59 %	52 %	67 %
Couples - under the ceiling	77 %	71 %	69 %	67 %	66 %	63 %	61 %	53 %	46 %	30 %	62 %
Couples - above the ceiling	0 %	0 %	0 %	0 %	1 %	2 %	4 %	8 %	13 %	21 %	2 %

The decomposition of the replacement rate in a replacement rate below the ceiling and a replacement rate above the ceiling is a first step for a comparison of the returns to the contributions below and above the ceiling. Indeed, it allows to concentrate only on the couples whose pension above the ceiling is significant i.e. the four or five highest deciles of average of net wages. For couples' pensions corresponding to the part of the wages below the 'Social Security ceiling', the internal rates of return by decile of average wages are very close to the rates of return of the whole pension, with a slight difference for the highest decile (table *ii*). The rate of return to the contributions above the ceiling is harder to apprehend as the survivor benefit plays an important part in the return to these contributions: for half of the couples of the four highest deciles of income, the woman never earns wages above the ceiling. The decreasing trend of the rate of return of contributions above the ceiling with the decile of income is hard to interpret, it is partially explained by the instability of the rate of return for scarce contribution spells. Indeed, the cost of an AGIRC point varies a lot with the date of purchase, which results in a high instability of the rates of return in the cases when the couples bought AGIRC points only a few times. Globally, the median rate of return of the contributions above the ceiling is higher than the return on contributions below the ceiling for the studied cohort.

Table *ii*: Median rate of return of couples under and above the ceiling by decile of average wages

	1	2	3	4	5	6	7	8	9	10	all
Whole pension	3.8 %	3.5 %	3.3 %	3.2 %	3.1 %	3.2 %	3.1 %	3.1 %	3.15 %	3.1 %	3.2 %
Under the ceiling	3.8 %	3.4 %	3.3 %	3.2 %	3.1 %	3.2 %	3.1 %	3.0 %	3.08 %	2.9 %	3.2 %
Above the ceiling							4.2 %	3.8 %	3.5 %	3.4 %	4.0 %
Above the ceiling without survivor benefit							3.8 %	3.6 %	3.4 %	3.2 %	3.7 %

Horizontal redistribution

We have evidenced redistribution of the pension scheme from high earning couples towards low earning couples. To measure the redistribution which may occur within couples who have similar lifetime wages, we focus on the dispersion of the internal rates of return among couples who have comparable average net wages. Although each quartile of the internal rate of return decreases when average wages grow, the distribution of the internal rate of return of households of the same wages quartile is not very narrow (table 5). Some redistribution remains within couples belonging to the same quartile of average wages.

Table 5: Distribution of the rates of return of couples according to the level of average net wages

	Average net wages in the first quartile	Average net wages in the second quartile	Average net wages in the third quartile	Average net wages in the last quartile	All
First quartile of internal rate of return	3.0 %	2.7 %	2.7 %	2.6 %	2.7 %
Second quartile of internal rate of return	3.5 %	3.2 %	3.2 %	3.1 %	3.2 %
Third quartile of internal rate of return	4.0 %	3.5 %	3.6 %	3.5 %	3.6 %

The remaining redistribution is partially due to the differences in the number of children between households with comparable lifetime wages. This dimension can be explored by ranking the individuals or couples according to their total lifetime equivalent wages or, more directly, by ranking them according to the number of children. As the level of wages is not correlated to the number of children in our sample, the income factor will not interfere when we rank the individuals (or couples) according to their number of children.

When ranking the individuals or couples according to their total lifetime equivalent wages, the lowest deciles gather people with lower income and more children than the average. Therefore, they are more likely to benefit from 'children advantages': the 10 % extra (for men and women) and contribution length bonuses (for women). With this indicator redistribution towards low deciles is enhanced (table 6).

Table 6: Median internal rate of return by decile of total lifetime equivalent wages

	1	2	3	4	5	6	7	8	9	10	all
All individuals	6.9 %	4.7 %	3.6 %	3.4 %	3.1 %	3.2 %	3.2 %	3.1 %	2.9 %	2.9 %	3.4 %
Men	3.1 %	3.0 %	2.8 %	3.1 %	2.9 %	3.0 %	2.8 %	2.9 %	2.8 %	2.7 %	2.9 %
Women	8.0 %	5.9 %	5.0 %	4.3 %	4.0 %	3.5 %	3.6 %	3.6 %	3.6 %	3.5 %	4.0 %
Couples	4.3 %	3.8 %	3.5 %	3.1 %	3.2 %	3.2 %	3.2 %	3.1 %	3.1 %	3.0 %	3.2 %

Table 7 illustrates more explicitly the effect of the non-contributive advantages related to bringing up children. For women, the median rates of return by number of children result from interactions between the different institutional 'children advantages'. Women who have brought up more children have higher rates of returns, with a major gap between two and three children.

Regarding couples, families with more than three children benefit more from redistribution than the others. Beyond this limit, the median rates of return increase with the number of children. The redistributive effect of the non-contributive 'children advantages' is still visible on the couples level.

Table 7: Median internal rate of return according to the number of children

	0	1	2	3	4+	all
Men	2.8 %	3.0 %	2.9 %	2.8 %	3.0 %	2.9 %
Women	3.4 %	3.6 %	3.8 %	4.9 %	6.5 %	4.0 %
Couples	2.9 %	3.2 %	3.1 %	3.5 %	3.8 %	3.2 %

7. Further analysis: redistribution under alternative scenarii

The previous section evidences the intragenerational redistribution induced by the private sector pension scheme. In an analytical perspective, we now identify the distributive impact of some features of the Social Security design and also of the mortality structure among the cohort. There are several potentially redistributive devices in the French private sector pension scheme. The main ones are the entitlement to additional pension rights for women who raised children and to pension extras for parents of three children or more, the existence of a 'minimal contributive' pension level and of contribution length bonuses. This section presents the distributive pattern of the pension scheme if we fictitiously removed the mortality heterogeneity or one of the above-mentioned Social Security rules.

Homogeneous mortality

As exposed previously, our simulation method accounts for differences of mortality hazard according to the level of income. The positive correlation between income and life expectancy may induce anti-redistributive effects. The present section aims at measuring to which extent heterogeneous mortality offsets redistribution. In this respect, we simulate the death ages of the individuals of our sample under the assumption of homogeneous mortality rates. To be more precise, we make the assumption that the mortality rates are the same for all men and women, whatever their qualification level. They slightly vary with time so as to match the French demographic projections.

The two dimensions of the assumption of homogeneous mortality rates have to be isolated. First, men will globally die later than with heterogeneous rates and women will die earlier. Second, with homogeneous rates, life expectancy is not correlated with the level of income any more: low income workers live longer than with heterogeneous rates (relatively to the average of their gender). Conversely, high income workers live

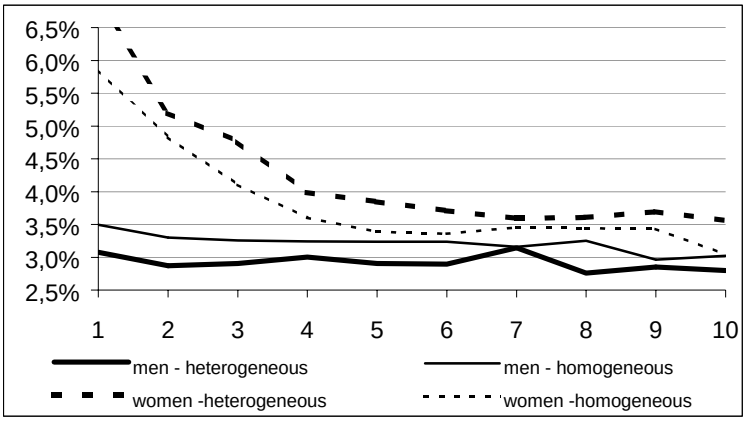
proportionally shorter with homogeneous mortality rates. As shown in appendix 1 (figure A), the differences in mortality hazards are more visible among men than among women. The second effect should thus be more obvious among men.

The first point appears through a decrease of the gap between men and women: the internal rates of return of men globally increase by 0.3 point whereas those of women decrease for all deciles (table 8). In other words, the intra-household transfers lessen. The second dimension has an impact mostly for men: the internal rates of return evidence a decreasing profile with the level of average wages, instead of being flat like previously (figure 4). Under the assumption of homogeneous mortality, there is some vertical redistribution among men. Heterogeneous mortality thus generates anti-redistributive effects among men. For women, the redistributive pattern is a little smoothed. The redistributive pattern of couples is not affected by this scenario.

Table 8: Median internal rate of return by decile of average wages

	1	2	3	4	5	6	7	8	9	10	all
All individuals	5.3 %	3.8 %	3.5 %	3.3 %	3.3 %	3.3 %	3.3 %	3.3 %	3.2 %	2.9 %	3.4 %
Men	3.5 %	3.3 %	3.3 %	3.2 %	3.2 %	3.2 %	3.2 %	3.3 %	3.0 %	3.0 %	3.2 %
Women	5.9 %	4.8 %	4.1 %	3.6 %	3.4 %	3.4 %	3.5 %	3.4 %	3.4 %	3.0 %	3.6 %
Couples	3.9 %	3.4 %	3.3 %	3.5 %	3.3 %	3.2 %	3.2 %	3.2 %	3.0 %	3.0 %	3.3 %

Figure 4: Comparison of the profiles of median internal rate of return by decile of average wages homogeneous mortality vs. heterogeneous mortality



Removing the 'children advantages'

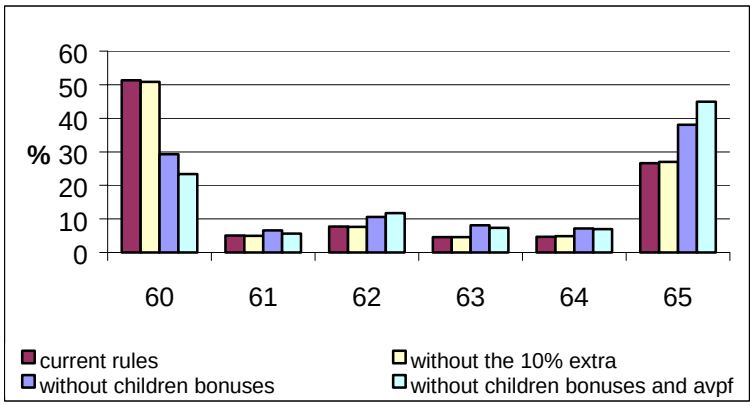
In order to identify the institutional elements which are likely to foster redistribution, we compute the levels of pensions under the assumption that we remove the two kinds of 'children advantages'. The children length bonuses are non-contributive length bonuses which are specifically addressed to women with children. They may therefore generate redistributive transfers towards households with children. The 10 % pension extra also explicitly benefits households with children (three or more). As the extra is proportional to the pension, the redistributive outcomes may not only be horizontal (towards families with three children or more). They may tend to favor higher wages households and therefore generate anti-redistributive transfers. However, in the sample, only a third of the households brought up three children or more and this proportion is hardly affected by the level of wages. The 'vertical' redistributive impact should thus be limited.

We fictitiously remove the length bonuses in two steps: first the bonus of two years per child for women and then the AVPF length bonuses for non working parents, which mostly concern women. As a direct consequence, the contribution period of women with children will dramatically decrease, and so will their pension levels. This is what we call the first round effect. In a more global approach of this modification of the rules[11], we consider that the date of retirement is endogenous. One can expect that the affected women will choose to postpone their retirement date in order to get closer to the 'full rate' even if they cannot compensate for the loss in the proratisation term. This delay in retirement ages is illustrated in figure 5. This 'second round' effect will interact with the 'first round' effect.

In like manner, we proceed to a simulation without the 10 % extra. For this scenario, the 'second round' effect is negligible (figure 5).

[11] A fully global approach would also consider the decision of participation on the labor market throughout the life-cycle as endogenous.

Figure 5: Distribution of the retirement ages of women under the current rules and without the 'children advantages'

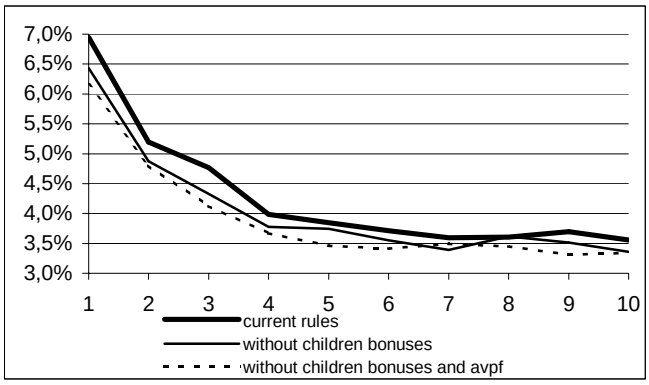


Redistributive effect of the children length bonuses

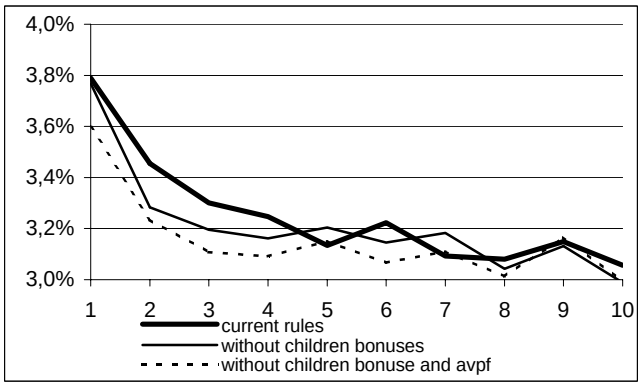
The first modification of the rules does not affect men at all. For women and for couples, the effects of the children bonuses and of the AVPF length bonus for different deciles of average wages are of comparable magnitude (figure 6). Concerning women, the levels of internal rates of return decrease quite homogeneously for all deciles. The reduction of the rate of return is slightly stronger for the women of the lowest deciles of average wages. Globally, for women, the redistributive pattern is the same as the one observed with the current rules. For couples, the levels of internal rates of return decrease for the first half of the distribution. As a result, the redistribution observed under this fictitious change of the rules is a little reduced compared to the one observed under the current rules. The weak correlation between the level of wages and the number of children accounts for this conservation of the redistributive pattern.

Figure 6: Median internal rate of return by decile of average wages

6a. Women



6b. Couples[12]

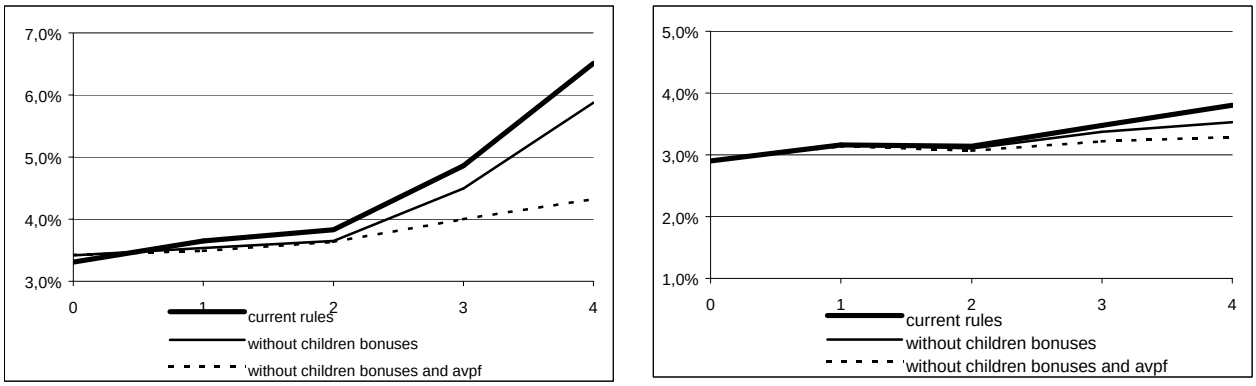


The effects of the children length bonuses on the internal rates of return of women's pensions by number of children are far less important than the effects of the AVPF length bonus. When we remove the children length bonuses, the rates of return of women's pensions are a little less sensitive to the number of children than under the current rules (figure 7). When removing the AVPF length bonus, the gap between two and three children is clearly lessened. This effect comes from the rules of attribution of the AVPF: mothers of three children or more benefit from the AVPF through the means-tested *Complément familial* which provides unrestricted length bonus entitlements for low income households. For couples, the effects of both length bonuses are comparable. When removing them, the redistributive transfers towards families with more children are lessened. Globally, only the third child effect, partially due to the pension extra, remains. Further growth of the rate of return with the number of children has disappeared.

[12] Because of the assumption that the pension scheme is financially balanced, removing the length bonuses results in a drop in the amount of pensions which lessens the contribution rates. That is why the internal rate of return of couples can be slightly higher under this scenario than under the current rules.

Figure 7: Median internal rate of return by number of children

7a. Women **7b. Couples**



Redistributive effect of the 10 % pension extra

The redistributive impact of the 10 % pension extra is more visible for men than for women (figure 8 and 9). For women, removing the extra results in a slight reduction of the internal rate of return of pensions of mothers of three children or more. For men, the internal rate of return homogeneously decreases for all the deciles of income. The drop for father of three children or more is very neat. As a result, couples' internal rates of return homogeneously decrease for all deciles of income. The 10 % extra thus does not foster anti-redistributive transfers among couples. However, it induces transfers from women to men, which are anti-redistributive from the individual point of view but neutral form the household point of view. The 10 % extra is moreover highly liable for the increase of the internal rate of return of pensions of couples between two and three children.

Figure 8: Median internal rate of return by decile of average wages

8a. Men **8b. Women** **8c. Couples**

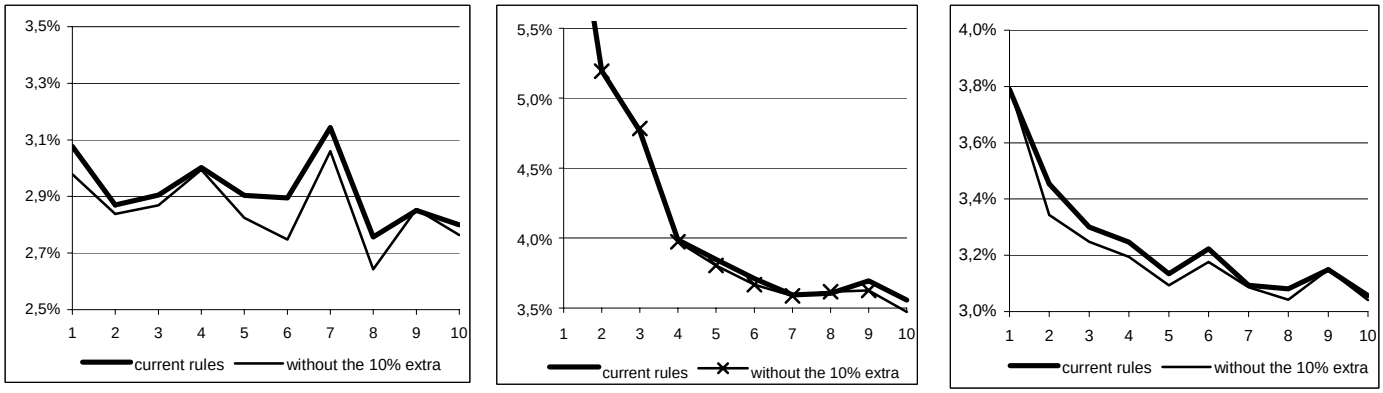
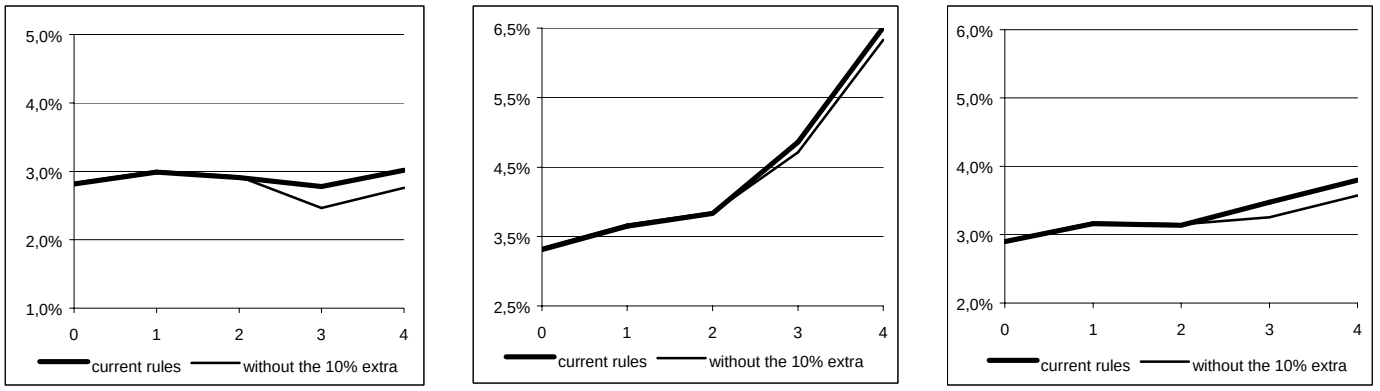


Figure 9: Median internal rate of return by number of children

9a. Men **9b. Women** **9c. Couples**

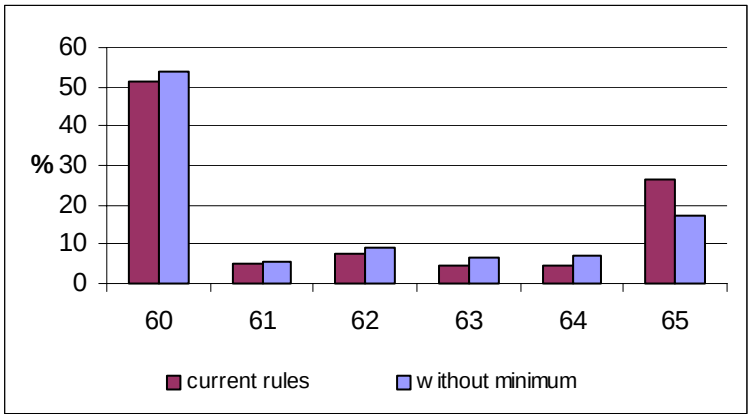


Removing the 'minimal contributive' pension level

In order to isolate other institutional features which may generate redistribution, we compute the levels of pensions under the assumption that we remove the 'minimal contributive' pension level. With the current rules, this device guarantees a level of income (525.63 Euros per month in 2002) to workers who have contributed more than 150 quarters. Those who have contributed less than 150 quarters are guaranteed a proratized level of income if they retire after the age of 65. 28 % of the women of our sample benefit from this rule, whereas it concerns only 3 % of the men.

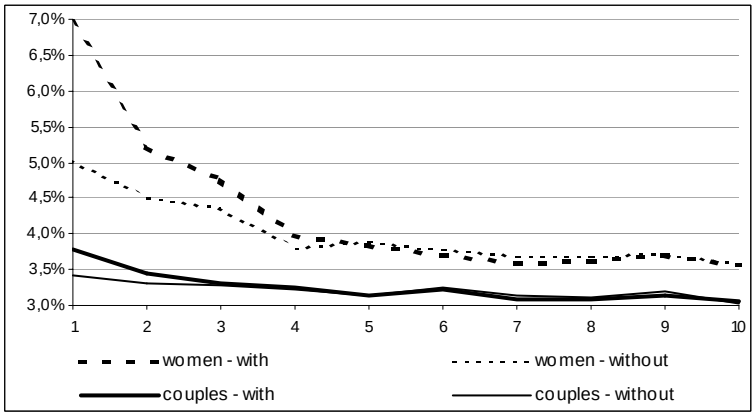
When we fictitiously remove the 'minimal contributive' pension level, men are thus hardly affected and the levels of pension of about a third of the women decrease. On top of this first round effect, the affected women may choose to postpone their retirement age in order to compensate for the loss of level of pension. But for women who contributed less than 150 quarters, the benefit of the 'minimal contributive' pension device occurred only when they reached the age of 65. As a consequence, removing this device may also suppress an incentive to wait until 65 for retirement and result in earlier retirement. Eventually, the two effects are combined and the general pattern is that women retire at the same age on average but less women retire at 65 (figure 10).

Figure 10: Distribution of the retirement ages of women under the current rules and without the 'minimal contributive' pension level



Consistently with the proportion of women receiving the 'minimal contributive' pension level, the median internal rates of return of the first three lifetime wages deciles of women are sharply reduced (figure 11). Therefore, low income women benefit less from redistribution than with the 'minimal contributive' pension level. The first two income deciles of couples take also clearly less advantage of the redistribution than previously. Judging from our indicator, there remains almost no redistribution among couples of the first half of the income distribution.

Figure 11: Comparison of the profiles of median internal rate of return by decile of average wages with and without the 'minimal contributive' pension level



8. Conclusion

The paper first evidences the importance of redistributive transfers which operate among individuals. At the individual level, women benefit more from redistribution than men, low-income women being the highest

beneficiaries of redistribution. When removing the intra-household transfers, at the couple level, redistribution is still evident. It favours more the lower levels of income.

The usual vertical redistribution (according to the level of income) goes along with horizontal redistributive transfers towards the households who brought up more children. The length bonuses for children directly account for these transfers. The 10 % extra for children cumulates the two dimensions of redistribution. Most of all, it favours households with three children or more but does not induce anti-redistributive transfers among couples. It only proves 'vertically' anti-redistributive in the sense that it benefits more to men than to women. The effects of the 'minimal contributive' pension level device on redistribution appear mainly for low-income women. Low income couples benefit from less redistribution when the 'minimal contributive' pension level device is removed. The existence of heterogeneous mortality hazard among individuals results in small anti-redistributive transfers mostly among men. However, globally there are no redistributive transfers among men of different levels of lifetime wages.

This paper relies on the internal rate of return as a measure of the redistribution due to the pension scheme. A possible extension could be to test the robustness of this indicator using some other distributional indicators, like the ones evidenced in Gustman and Steinmeier (2001) and Coronado, Fullerton and Glass (2000). Such indicators allow intuitive interpretations in terms of redistribution, but they often require the debated use of a discount rate.

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Appendix 1: The dynamic microsimulation model Destinie: a brief overview

This appendix gives a brief overview of the structure and of the main assumptions of the microsimulation model Destinie. For a more detailed description, see Bardaji, Sédillot, Walraet (2002).

The main purpose of the model is to simulate the evolution of old-age pensions in the long run accounting for the heterogeneity of careers and the change in the demographic structure. The model is based on individual data derived from the 1998 Financial Assets Survey. The initial sample is composed of 23,000 households i.e. about 50,000 individuals. Each person is characterized by demographic and economic information such as age, income (wages, pensions...), relatives, labor participation. The age at leaving school is a key variable of the model. It sums up all the heterogeneity in term of social status, socio-professional group and qualification. A person's age at leaving school is related not only to the average one of his cohort but also to his father's and mother's. This latter assumption accounts for some kind of 'social replication'.

In order to follow this population year by year from 1998 to 2040, different kinds of events are simulated:

- A labor market submodule simulates the situation on the labor market after 1997. The information on labor market participation before 1997 is available in the survey. To model transitions on the labor market, six states are distinguished: school, employment, unemployment, inactivity (mainly housewives), early retirement and retirement. The labor market module is organized in two steps. The first one simulates the participation whereas the second determines if a participating individual is employed or unemployed. Transition probabilities are estimated from recent Insee Employment Surveys. The transitions are considered as a first-order Markovian process and depend on sex, age, age at leaving school, and, for women, the number and the age of children. For each person who is no longer at school and not retired yet, the model randomly determines, given his transition probabilities, whether his labor force situation changes. The parameters of the transition equations are adjusted to account for changes in the macroeconomic environment: the increasing labor force participation of women, the decreasing occurrence of early retirements. In particular, the unemployment rate is supposed to reach 6 % in 2015.
- The income submodule simulates wages and pensions. The annual wage is the sum of a deterministic component and a stochastic one. The first one is econometrically adjusted, for each sex, to the age at leaving school and the total tenure on the labor market. The stochastic component includes an individual fixed effect and

an autocorrelated residual. To allow for productivity gains related to technical progress, we add an exogenous 1.6 % increase each year. In the model, all unemployed (respectively early retired) persons receive unemployment (respectively early retirement) benefits. The retirement decision is simulated as a trade-off between income and leisure in line with the Stock and Wise model (1990). Once a person retires, his pension benefit is indexed on price inflation. The model also simulates survivor pension benefits and the old age minimum benefit (*minimum vieillesse*).

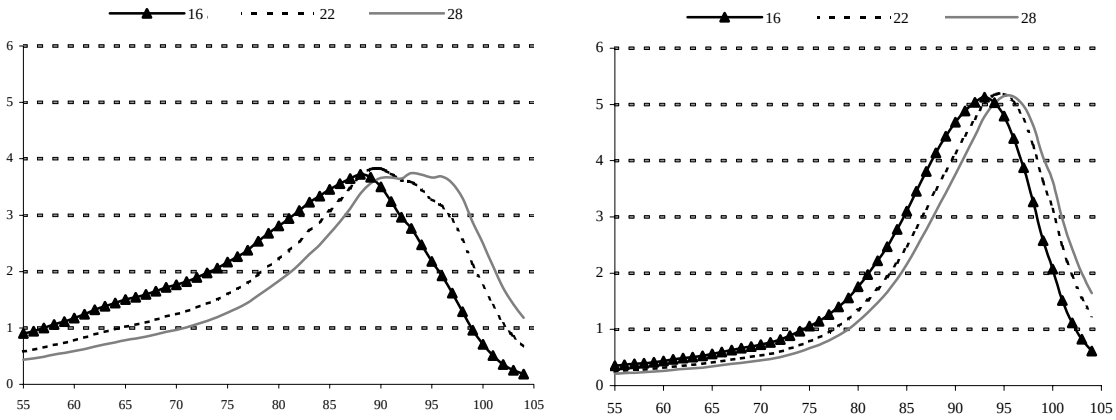
- A demographic module simulates events such as death, birth, immigration, departure from parents' home, unions (thanks to a matching process), separations (Robert-Bobée, 2001). In order to compute all the demographic events that affect the cohorts that we follow, we run this module until 2070. The model allows for differences in mortality hazards according to the age at leaving school (figure A).

Figure A:

Distribution of the death ages conditionally on being alive at 55

according to the age at leaving school (16 - 22 - 28 years old)

10a. Men born in 1945 **10b. Women born in 1945**



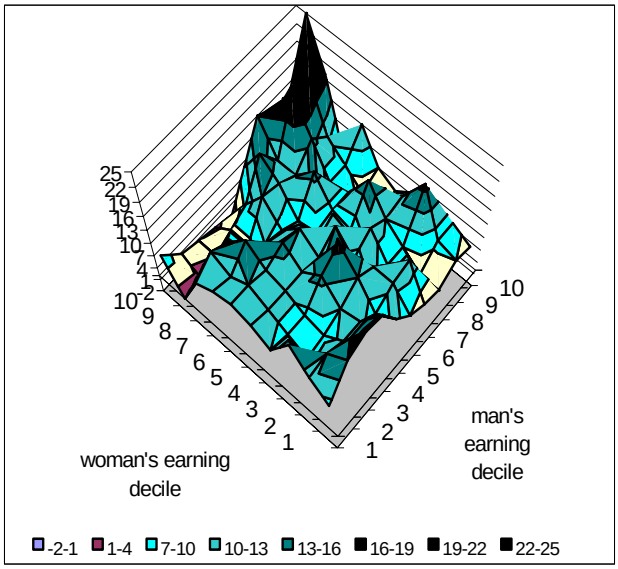
Appendix 2: Individual and couple earnings

This appendix provides some information on the earning levels of the spouses and the matching process. Figure B1 presents the cross distribution of the deciles groups of average wages of the spouses. The main feature is that high wages men get matched with high wages women, and that low wages women get matched with medium wages men. On the whole, for non-extreme earning levels, the matching process tends to smooth the individual wages distribution.

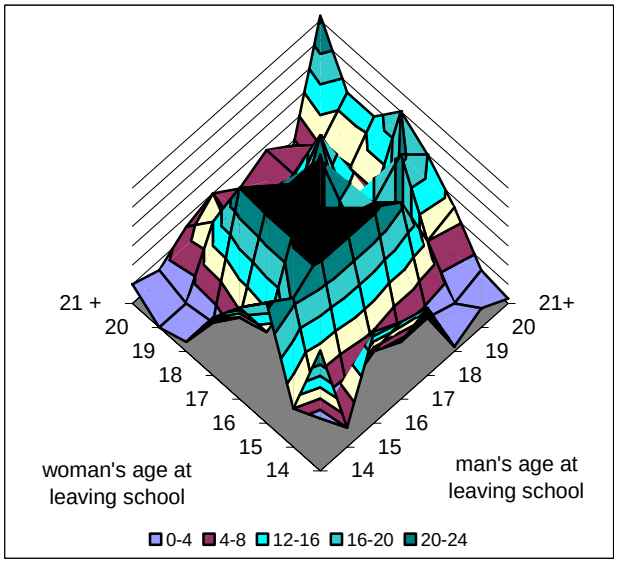
Consistently to what is commonly observed, with Destinie modelling, the level of the wages depends on the work experience. As a result, the average wages of two persons who have the same qualification will be smaller for the person who has worked less years. The matching process of the spouse should thus be more apparent when comparing the qualification levels of the spouses. The cross distribution of the ages at leaving school of men and women (figure B2) shows again that highly qualified women get matched with highly qualified men. Here again, medium qualified women get matched with higher qualified men. As the women of our sample are globally more qualified than the men, about one third of them are more qualified than their partner. But the differences in qualification are moderate.

Figure B: Men and women cross distributions

B1: Deciles groups of average wages



B2: Age at leaving school



Source: Destinie simulation on a sample of married individuals born between 1948 and 1960 and working in the private sector.