Redistribution through alternative pension reforms : A life-cycle analysis on French occupational groups*

Pierre-Yves Hénin† and Thomas Weitzenblum‡

n°2003-07

*This research was supported by the "Commissariat Général du Plan", as part of the targetted research program of Cepremap. Results and opinions expressed in this paper are own to the authors.

†CEPREMAP and EUREQua, Université de Paris I

‡CEPREMAP and EURIsco, Université de Paris IX

Redistribution through alternative pension reforms : A life-cycle analysis on French occupational groups

Abstract : Reforms of pension systems are currently engaged or considered -in many of the European countries, like in France. Alternative reforms not only involve different macroeconomic effects but also large distributive consequences both between ages, income or socio-economic groups.This paper uses a life-cycle equilibrium model, with heterogeneous agents and individual risk, to assess the effects of various pension reform scenarios on different occupational groups in France. The effects of reforms are shown on wealth and consumption profile as well as on measures of inequality.

Effets redistributifs de réformes alternatives des retraites : Une analyse de cycle de vie par PCS en France

Résumé: Différentes réformes des systèmes de retraite sont actuellement engagées ou envisagées dans divers pays européens dont la France. Les schémas alternatifs de réforme ont non seulement des implications macroéconomiques différentes mais aussi des conséqueces redistributives importantes entre classes d'âge et de revenu. Cette étude utilise un modèle d'équilibre de cycle de vie, avec des agents hétérogènes confrontés à des risques individuels, pour évaluer les effets de divers scénarios de réforme des retraites sur différentes catégories socio-professionnelles en France. Les effets des réformes considérées sont caractérisés tant en termes de profils d'accumulation et de consommation que d'indicateurs d'inégalité.

Mots Clés : âge de la retraite, catégorie socio-professionnelle, Profils d'accumulation et de consommation, réforme des retraites, redistribution

Keywords : Occupational groups, Pensions, Redistribution, Retirement age

JEL Classification : D31, H55,J26

1 Introduction

Reform of pensions systems lies at the top of the agenda of policy adjustments to be decided in many European countries, especially those which - like France - have postponed major revisions of their on-going system. The unsustainability of generous pay-as-you-go systems - unless huge increases in contribution rate are implemented - is well documented. The menu of the policy reforms is also known [see, e.g., Disney (2000), Schwartz, Demirguc-Kunt (1999) and for France, Charpin (1999)]. Overlapping generation life-cycle models have been widely used to provide quantitative evidence on the impact of alternative pension reforms. However, the bulk of this work has been devoted to assessing the intergenerational redistributive implications of reforms. Intragenerational redistribution and risk sharing also underlie major issues commending the social desirability and the political feasability of alternative reforms.

This paper aims to provide a quantitative assessment of the redistributive impact of alternative pension reforms within a life-cycle stochastic general equilibrium model calibrated on French occupational groups. Our characterization of the redistributive impact alternative pensions systems will focus on the respective consumption profiles for different occupational groups, accounting for differences in life-cycle earnings and life expectancy between these groups.

The original impulse in designing dynamic general equilibrium models relevant for tax and social security analysis was given by Auerbach and Kotlikoff (1987). Major developments include the consideration of uncertain lifetimes and borrowing restrictions (Hubbard and Judd (1987)) and the role of idiosyncratic risk in explaining precautionary savings (Aiyagari (1994)). Imrohoroglu, Imrohoroglu and Joines (1995) pionneered the use of stochastic, heterogeneous-agent general equilibrium models in the analysis of pensions systems. As a main result, this class of stochastic model relativizes those of deterministic models *à la Auerbach and Kotlikoff* that a pay-as-you-go system strongly reduces saving and thus the equilibrium capital stock[1].

It is also well known that the standard life-cycle model does not spontaneously fit various facts on wealth or consumption profiles and distribution. This model underpredicts the concentration of wealth, given the level of earnings inequality and especially underpredicts the level of asset holdings by retirees. It is important for a model aiming to deliver a sensible evaluation of pension reforms to be consistent with the major stylized facts in matter

[1]See De Nardi et alii (2001) for a survey paper on savings and pensions in general equilibrium models.

of inequalities and profiles of wealth and consumption.

A significant feature in accouting for wealth concentration is the existence of bequests (De Nardi, 1999, Fuster, 1999). Furthermore, as shown by Barro (1974), bequests, when operative, allow for reverse transfers compensating the charge of financing pensions by contributions of the young[2]. Usually, the heterogeneity between households is represented as a heterogeneity in income, or, more basically, an inequality in earnings ability (Huggett and Ventura, 1999, Altig et alii, 2001 and, on the French case, Hairault and Langot, 2002). Cebeddu (2000) considers more fundamental dimensions of heterogeneity, such as sex, race and education level, thus allowing to account for life expectancy. Our paper retains a description of heterogeneity through seven occupational socio-economic groups, in French, "Professions et catégories socio-professionnelles". Although highly correlated with earnings ability, the occupational groups represent a highly persistent social classification of people sharing consumption habits, and, to some extent, sensitivity to political values and arguments. At the limit, we discard intergroup social mobility during an individual life-cycle and consider that social mobility only occurs between generations. The level of income risk is also conditional on occupation rather than, as usual, constant or a mere function of income levels.

Workers-consumers from these occupational groups behave rationally in a dynamic stochastic general equilibrium economy. We first solve the model in a benchmark calibration, stylizing the French demographic conditions in the 1990's in order to check its ability to reproduce with a reasonable approximation the prevailing features of wealth inequality and consumption profiles. We thus consider new demographic conditions, supporting the dependency ratio expected to prevail in France in 2040. Equilibrium is computed for alternative policy scenarios characteristic of the menu of pensions reforms most frequently considered.

The paper is organized as follows. Section 2 sets out the assumptions of the model and our main choices of specification. It defines the general equilibrium to be considered in subsequent sections. Section 3 deals with calibration and the solution techniques. It provides results for the benchmark equilibrium, representative of the situation of the French economy in the 90's. Section 4 is the core of the paper. It introduces new demographic regime and the main policy scenarios. Comparative results directly provide us with an assessment of the distributive impact of alternative pensions systems. Section 5 extends the results by considering alternative macroeconomic scenarios,

[2]Caballe and Fuster (2000) examine the effects of social security payments on the distribution of bequests.

especially dealing with the behavior of the interest rate. Limiting cases of a closed vs. a fully open economy allows to illustrate the importance of the adjustment in the interest and wage rates. Section 6 concludes on the main lessons - and also on some limits - of the exercise.

2 The model

In this section, we describe a model accounting for the various dimensions relevant for the assessment of pensions reforms:demographic process, social mobility and individual risks, preferences over life-cycle consumption and bequest, consistency and market clearing conditions of equilibrium.

2.1 Demographics and social mobility

We consider an overlapping generations economy. Each period, a large number $\overline{N}$ of agents enters the economy and therefore the labour force at age 20. In particular, this implies that there is no population growth. Agents face a mortality risk m_i^j conditional on their age i and their occupational group j, with $m_i^j = 0$ up to the age 50 and $m_i^j = 1$ at a maximum age of death. Every agent belongs to the same group j for his whole life-cycle, but his heir belongs to a group j' with a probability $sm_j^{j'}$, the set of probabilities $\left\{sm_j^{j'}\right\}$ defining the social mobility process within the economy.

Assuming stationarity of this demographic process, the number N_i^j of agents of age i and group j present in the economy derives from the distribution of entrants φ_0^j and the cumulated survival probabilities.

$$N_i^j = \varphi_0^j \overline{N} \prod_{k=0}^{i} \left(1 - m_k^j\right),$$

and the distribution of agents by age group for $j < j_{\max}$ are generically given by:

$$\Psi_i^j = \frac{\Psi_0^j \prod_{k=0}^{i} \left(1 - m_k^j\right)}{\sum_{j' \leqslant j_{\max}} \left(\Psi_0^{j'} \prod_{k=0}^{i} \left(1 - m_k^{j'}\right)\right)}$$

$\overline{N}$ is fixed in order to get a total population normalized to 1 at the demographic steady state.

$$N_{tot} = \overline{N} \sum_{i \leqslant i_{\max}} \sum_{j \leqslant j_{\max}} \left(\Psi_0^j \prod_{k=0}^{i} \left(1 - m_k^j\right)\right) = 1$$

The retirement age is taken exogenous and equal to $i_R + 1$.

2.2 Income process and bequests

Life-cycle earnings, denoted $w_{i,l}^j$, combine 3 components. First, the average wage regularly increases according to a trend factor $(1+g)^t$. Second, every agent benefits from an age-earning profile $w_{i,l}^j$ common to all members of his occupational group. Third, individual income risk is modelled as an unemployment risk. Transitions between employment ($l = e$) and unemployment ($l = u$) follow a Markovian process $\left\{\pi_{l,l'}^{j,i}\right\}_{l,l'=e,u}$ with probabilities conditional on age and group. The incidence of unemployment on income depends on the replacement ratio from unemployment compensation r_1, common to all groups. Pensions are set as a replacement ratio r_2^j applied to the last wage perceived[3]. In practice, pensions are calculated on an average of the best $10-25$ year

In order to focus on the financing of pensions, which in the French system is performed through a roughly proportional contribution on wage income, we assume a unique contribution at a common rate τ, thus discarding other taxes and social contributions.

Apart from wage, unemployment compensation and pensions, bequests are the last source of resources for an agent. Every agent gives birth to one descendant at the age of thirty, who becomes his heir except in the case, not excluded because of the cross survival probabilities, where his descendant dies first[4]. Bequests are anticipated by those agents with a living ascendant, and the ascendant's preferences account for the extra consumption afforded to their heirs.

2.3 An agent's preferences and decision problem

An agent of age i and group j decides upon his consumption level, and therefore savings, in order to maximize the expected discounted value of a time separable utility function.

$$\max E_t\left(U\right) = \max_{C_n^t, i\leqslant n\leqslant i_{\max}} \left\{u\left(c_i^t\right) - u_l \right.$$
$$\left. + \sum_{n=i+1}^{i_{\max}} \left[\beta^{n-i} \prod_{k=i+1}^{n-1} \left(1-m_k^j\right)\right] . \left(\left(1-m_n^j\right) . u\left(c_n^{t+n-i}\right) + m_n^j . v(a_n^{t+n-i} - t(a_n^{t+n-i}))\right)\right\} \tag{1}$$

where β is the discount rate, c_n^t the agent's consumption at age n and time t, a_n^t his wealth at age n and date t. The functions $u()$ and $v()$ denote respectively the period utility of consumption and the indirect utility from

[3] A more general specification of the pension incomes is introduced when considering specific scenarios of pensions reforms.

[4] In that case, bequests are redistributed over the whole population.

bequests, u_l is the disutility at work and the function $t(a)$ represent bequests taxation.

The disutility at work writes :

$$u_l = -\zeta \kappa_w \left(hc_{i,h}^{j,t} \right)^{1-\rho}$$

where hc is a measure of the human capital of the agent, ζ measures the intensity of this disutility (common to all agents), and κ_w is a binary parameter equal to 1 (resp. 0) when the agent is part of the labour force (resp. is retired). The presence of the human capital aims at measuring the disutility in efficiency terms : it simply needs reflect the relative levels of income (and therefore consumption) between the different agents. Consequently, if the consumption of all agents are roughly equal to hc, the disutility will be $hc.\zeta \left(hc\right)^{-\rho} \simeq c.\zeta.u'(c)$ so that the cost in utility amounts roughly to a fraction ζ of the agent's consumption.

Current utility from consumption is taken as a standard constant relative risk aversion function with an elasticity ρ. We follow De Nardi (2000) and Heer (1999) in assuming that an agent, facing a non-zero probability of death, takes care of the indirect utility of the wealth transmitted to his heir. The indirect utility of a bequest b, net of taxes $t(b)$, is written as

$$v(b) = \phi_1 . \left(\overline{c}^t + \frac{b - t(b)}{\phi_2} \right)^{1-\rho}$$

where $\overline{c}^t$ is the (unconditionned) expectation of consumption of the heir. The ϕ_1 parameter provides a flexible way to parameterize the degree of altruism of agents *w.r.t.* their descendant. This specification, qualified of *warm glow* by De Nardi (2000), implies that bequests behave like a luxury good, consistently with the large concentration of bequest in actual economies. Besides, agents form expectations regarding future inheritance, as long as their ascendants are still alive. We assume that the only information agents have regarding their ascendants consists of their age and their occupational group. Rational agents would then consider the probability distribution of their ascendant's wealth when forming their expectations. To simplify the computation, we assume that agents expect the average wealth of their ascendant of age i and group j.

The agent's optimization problem may be given a recursive representation according to the following Bellman equation, with $V\left(a^t, j, i, l, j'\right)$ the value function of an agent of age i, occupational group j, employment status l, and whose ascendant is of the occupational group j'[5].

[5] Variables k, j, i, l are state variable pertaining directly to the agent. j' is also a state

$$
\begin{cases}
\forall i < i_{\max}, \\
V(a,j,i,l,j') = \max\limits_{C_i \geqslant 0} \{u(c_i) \\
+\beta\left(1+g\right)^{1-\rho}\left(1-m_{i+1}^{j}\right)\left[\left(1-m_{i+1+i_{\bullet}}^{j'}\right)\sum_{l'=e,u}\left(\pi_{l,l'}^{j,i+1}V(a',j,i+1,l',j)\right)\right. \\
\left.+m_{i+1+i_{\bullet}}^{j'}\sum_{l'=e,u}\left(\pi_{l,l'}^{j,i+1}.V\left(a'+\widehat{h}\left(j',i+1+i_p\right),j,i+1,l',0\right)\right)\right] \\
+\beta.\left(1+g\right)^{1-\rho}.m_{i+1}^{j}.v(a'-t(a'))\} \\
\text{s. c.} \left| \begin{array}{l}
\forall i < i_R \begin{cases} (1+g).a' = (1+r)a + w_i^{j0}.(1-\tau) + f - c_i \text{ for } l = e \\ (1+g).a' = (1+r)a + b_i^{j0}.(1-\tau) + f - c_i \text{ for } l = u \\ a' \geqslant 0 \end{cases} \\
\forall i \geqslant i_R \begin{cases} (1+g).a' = (1+r)a + b_j.(1-\tau) + f - c_i \ , \ \forall l = e,u \\ a' \geqslant 0 \end{cases}
\end{array} \right.
\end{cases}
$$

The formulation assumes a constant interest rate r, and a strict liquidity constraint, excluding borrowing at any age ($a' \geqslant 0$). Due to the trend growth in earnings, every variable has been normalized in order to ensure stationarity, e.g. $a = \frac{a^t}{\{1+g\}^t}$, $V(z) = (1+g)^{t(1-g)}\widetilde{V}(z,t)$. In particular, the growth-adjusted discount rate is $\beta\left(1+g\right)^{1-\rho}$.

Standard dynamic programming solution provides value for consumption as a decision rule and the law of motion of the distribution of wealth

$$a' = a'(a,j,i,l,j')$$

2.4 Equilibrium of the economy

Under the assumptions of the model, labour supply and thus employment in efficiency terms are exogenous and constant at the demographic steady state. The pension agency is assumed to balance contributions and pensions at any period, with a zero net wealth. National wealth is equal to the sum of assets over agents. Two polar cases are those of a closed economy and of full capital mobility. In a closed economy, national wealth equals productive capital entering the aggregate production function

$$Y_t = AK_t^{\alpha}L_t^{1-\alpha}$$

with L_t the sum of employed agents over different ages i and groups j, weighted by their efficiency level (or, identically, their earning ability).

In the case of full capital mobility, the interest rate r is exogenous and constant and the domestic productive capital is disconnected from the national

variable because expectations are formed conditionnal on their ascendant's occupational group. The age of the ascendant is not an independent variable, since it can be deduced from the agent's age.

wealth. As a further consequence, as the capital/labour ratio is constant, the average wage rate is also independent of savings.

Although the perfect mobility case greatly simplifies the equilibrium solution, it imposes the implausible implication of the interest rate being invariant *w.r.t.* huge responses of savings to pensions reforms. On the opposite, it is also irrelevant to model a medium sized European economy like France as a closed one. We thus retain as our basic framework an imperfect mobility case, leaving to further examination in section 5 the implications of alternative polar cases in interest rates determination.

Capital market equilibrium in this imperfect mobility case satisfies the condition :

$$r_t = r_0 - \alpha(A_t - K_t)$$

which implies an interest differential $(r_t - r_0)$ decreasing with the excess supply of domestic capital $(A_t - K_t)$.

Further equilibrium conditions are:

- the average wage rate clears the labour market;
- pensions and unemployment compensations are paid by contributions levied on wages;
- receipts from taxes on bequests and assets left by deceased with no surviving heir are fully redistributed
- asset accumulation solves the problem (1)
- bequests expectations are correct
- $\Lambda()$, the probability distribution of wealth conditional to age, occupational group and employment status is the only stationary distribution consistent with the decision rules.

3 A benchmark equilibrium of the French economy in the 90's

In order to validate our model as a relevant tool for assessing pensions reforms under future demographic conditions, we first consider a benchmark equilibrium, representative of the demographic and policy conditions prevailing in France during the 90's.

3.1 Existing demographic and policy regimes

We consider 6 occupational groups from the INSEE nomenclature of PCS

1. Entrepreneurs (chefs d'entreprise)
2. Top executives and professionals (cadres supérieurs et professions libérales)
3. Other executives (cadres moyens)
4. Intermediate occupation (professions intermédiaires)
5. Clerks and skilled workers (employés et ouvriers qualifiés)
6. Unskilled workers (ouvriers non qualifiés)

Although included in the total working population, the figures for the craftsmen and trademen are not reported as this group is particularly heterogeneous in terms of income and employment status. Farmers are not included in the model. Specific demographic tables are taken from INSEE (1993) and specific earning profiles are borrowed from Direr and Weitzenblum (2002).

We consider the steady state associated to this benchmark demographic regime. What we look at first is the dependency ratio implied from this demographics and the retirement age being scheduled at 60. We obtain a dependency ratio of pensioners over the active labor force of 0.41, consistent with that mentionned in the Charpin report (1999)[6].

The unemployment replacement ratio r_2 is fixed at 70% (see Martin, 1996) and the pension replacement rate varies with the occupational group (INSEE Données Sociales, 1993) as reproduced in the following table.

TAB. 1 - Pension replacement rate by occupational group

	Replacement rate r_2^j (%)
Entrepreneurs	50
Top executives, professionals	56
Other executives	56
Intermediate profession	70
Clerks and qualified workers	78
Low-qualified workers	80

[6] We do not consider the broader dependency ratio of pensioners plus dependant children over active labor force.

The budget of the pension system and that of unemployment insurance are consolidated. Balancing this global budget implies a contribution rate $\tau = 32\%$.

Other behavioral "deep" parameters are assumed identical across occupational groups : the relative risk aversion parameter ρ is set at 1.5, the discount rate β and the parameter v are set in order to reproduce a wealth/income ratio of $A/Y = 2.7$ and the observed bequest/wealth ratio B/A of 1.5%. This implies $\beta = 0.998$ (quarterly) and $\phi_1 = 0.39$.

Finally, we have calibrated the disutility at work ζ as follows. Because of the additive form of this disutility, the value of ζ has no reprecussion on the accumulation decisions. Therefore, the features of the calibrated model developped above will hold whatever the value of ζ. The method used here consists in computing the equilibrium for different retirement age around the initial one and with the initial demographic patterns (90's). We have computed the *ex ante* expected utility of a new entrant for these different retirement ages, and found the range of value of ζ for which the initial retirement age (60) maximizes the *ex ante* utility. We then have chosen for ζ the median value over this range. The rationale here is that, with no precise idea on the value of ζ, we have assumed that, given the initial life expectancy, the current policy is optimal.

3.2 The benchmark economy

Equilibrium solutions for the calibrated model are obtained using a grid discretization technique. Value functions and policy rules are computed through backward induction, starting from the maximal age down to age 20. Distributions are approximated by sampling over 200000 individuals. The solution process involves the following steps:

1. guess values for the interest rate r and the wage rate per efficient unit w;

2. guess values for the tax rate τ and inheritance expectations $h()$;

3. given these variables, compute the value functions and the policy rules by backward induction;

4. simulate the path of a dynasty of 200000 generations, and record at each age their state;

5. given the obtained distributions, check if the *ex ante* inheritance expectations and the simulated one are close enough. If not, update

inheritance expectations and go back to step 2. Proceed in the same manner for the tax rate;

6. once convergence for τ and $h()$ is achieved, compute the interest rate from the reduced form with the wealth obtained from the simulation. If it is close enough to the *ex ante* interest rate, stop. If not, update the interest rate and the wage rate (through the factor price frontier) and go back to step 1.

The equilibrium solution is characterized first by the following set of aggregate indicators, reported on the first column, headed "Bench 90" of the table 2.

Insert here Table 2

Given the equilibrium population structure, the different replacement rates *a priori* postulated for the occupational groups result in an average replacement ratio of 66.2 %. The contribution rate required on net wage income in order to balance the pension expenses is found equal to 32 %. The aggregate assets to income ratio is 2.69, as the consequence of the calibration of the time preference parameter. The equilibrium interest rate, given the intermediate degree of capital mobility assumed as the benchmark case is 5.1 %. Although the average income of retirees amounts only to 93 % of the one of people in the labor force, their average assets amount to 162 % and even their consumption is larger (121 %). Due to the exhaustion of assets by eldest and/or poorest retirees, the percentage of liquidity constrained consumers is a bit greater among them than among active people.

The benchmark model does a good job w.r.t. the standard life-cycle model in accounting for the huge inequality in wealth distribution, much larger than the inequality in either income or consumption, as documented by the inter-decile ratios. We report separately the D9/D5 and D5/D1 ratios in order to assess the respective contributions of the upper part and of the lower part of the distribution.

Besides the pure age effect, the only one operative in an homogenous consumer life-cycle model, four other mechanisms contribute to explaining wealth inequality in our model :

i) Unequal life-expectancy and therefore retirement duration

ii) lower replacement rates for the upper income earners

iii) larger bequests to the wealthier, due to limited social mobility

iv) larger incentive to leave bequests by the wealthier[7], as social mobility implies a relative regression for their heirs.

A comprehensive, while parcimonious, characterization of the heterogeneity in the benchmark economy, is provided by the profile of life-cycle consumption and wealth accumulation for each occupational group reported on figures 1 and 2[8].

Insert here Figures 1 and 2

While the general profile is the standard life-cycle one, with a progressive accumulation up to the retirement age, and progressive decumulation after, the figure 1 shows contrasted features by occupational groups. The assets accumulated by the workers, especially the unqualified ones, peak before the retirement age and are exhausted through their eighties. Only the executives and entrepreneurs systematically keep assets for their heirs up to their maximal life-time.

The consumption profiles reported on figures 2 show that consumption peaks earlier the poorer is the consumer[9].

4 Alternative pensions reforms to cope with the new demographic regime

The on-going demographic changes, with the baby-boomers next to retire, strongly challenges the sustainability of the generous pay-as-you-go system existing in France and, more generally, in Continental Europe. We have to introduce a workable definition of the new demographic regime and the core menu of possible pensions reforms.

[7] the performance of the model in reproducing wealth inequality in France is more closely examinated in Weitzenblum (2001) and Direr and Weitzenblum (2002).

[8] See Deaton and Paxson (1994) and Attanasio et alii (1999) for a study of inequality in intertemporal consumption profiles.

[9] It is important to notice that these consumption profiles are given for a cross section by age at a given date. Individual consumption profile through time include a further wage (or productivity) trend.

4.1 The new demographic regime

Although the effects of the demographic changes will extend well beyond the 21st century, we choose to represent as the typical object for pensions reform evaluation a stylized steady state representative of the conditions expected to prevail circa the year 2040. Assuming constant entry flows, we adjust the survival probabilities in order to account for the likely increase in life expectancy, assuming the same absolute gain for all occupational groups. The most important parameter is the dependency ratio which, under constant regulation regarding the retirement age, jumps to 69% from the initial level of 41% in the benchmark 90's economy.

Due to the change in the dependency ratio, adjustments are required to maintain the sustainability of a PAYG system. We do not consider in this study radical reforms like a full privatization of the social security system, sometimes proposed in the U.S.. We rather focus on a range of feasible reforms, consistent with a strong political support for the maintenance of a PAYG system. Given this *a priori* perspective, three main options lie on the agenda:

- Keep the replacement rates, therefore the pension income, unchanged, and increase the contribution rate in order to balance the social security budget, scenario denoted thereafter CRR (for Constante Replacement Rate)
- Keep the contribution rate unchanged w.r.t. the benchmark equilibrium, but reduce the replacement ratios (thereafter, CCR, for Constant Contribution Rate)
- Delay the age of retirement (DR) while doing the residual adjustment through the contribution rate (hereafter DR-CRR) or through the replacement rate (DR-CCR)

As an alternative way of reducing pension expenditures, pension income may be indexed on prices rather than on wages. The replacement rate of a retiree thus decreases regularly w.r.t. the current average wage. We will only consider the case where the residual adjustment is performed through the contribution rate, leaving unchanged the replacement rate at the period of retirement (hereafter CIRR, for constant initial replacement ratio).

In every case, we regard as mandatory the date of retirement. This simplification departs from the actual system governed by two instruments: a

legal age for perceiving pensions[10] and a mandatory duration of contributions required to benefit the full replacement rate. The French system is very dissuasive of anticipated retirement[11] but also not incitative of postponed retirement. So we can consider that modelling the retirement age as mandatory is a reasonable approximation.

This reform agenda is also a stylization of the French debate on another point. The current situation -in September 2002- is no longer described by our benchmark system, as important reforms of the pensions for the private sector have been decided since 1993. Typical of the French situation is an unsustainable gap between the perspectives offered to private and to public sector workers. However we assume, of course for tractability but mainly for the sake of equity considerations and political feasability, that a durable reform should involve a roughly symmetric treatment for employees of both private and public sectors.

4.2 Comparing equilibria under alternative pension reforms : first issues

The characterization of five scenarios of pension reform in the "new" demographic conditions is reported on table 2. Let us first focus on the comparison between the constant replacement (CRR) and the constant contribution (CCR) cases. *Ex post* balance of the pension system implies that a 30 % increase in the contribution rate is required in order to maintain the replacement rate or a 38 % decrease in the replacement rate has to be imposed in order to keep unchanged the contribution rate.

As expected, we get a huge increase in savings when pensions are cut with an increase of two thirds in the asset to income ratio, but we obtain also a less expected savings effort in the constant pensions increased contribution (CRR) case, the A/Y ratio increasing by 18 %.

Under imperfect mobility, saving accumulation under CCR depresses the interest rate by 93 basis points, but only by 25 basis points under the CRR scenario.

Cutting pensions in order to maintain the contribution rates reduce retirees consumption which however remains greater (107 %) than the consumption of people within the labor force.

[10] Individual decision of early retirement is costly in terms of pension replacement rate. However, early retirement is frequent due to specific pre-retirement programs, especially for the unemployed.

[11] of course, this legal age of 60 admits many exceptions, especially for the public sector or large utility or public transportation companies.

Cuts in pensions under CCR increase income inequality but reduce wealth inequality. An unexpected result is that the second effect dominates, and that lower replacement rates ultimately reduce consumption inequality. This result is consistent with the comparison performed by De Nardi (2000) between the US and the Swedish cases, which shows that high transfers dissuade low income worker from savings, thus contributing to reproduce wealth and to some extent consumption inequality.

The constant initial replacement case (CIRR) provides intermediate macroeconomic results, but stands closer to the constant contribution case for its distributive effects.

As expected, delaying retirement by five years alleviates the required adjustment in pensions or contributions. Maintaining the replacement ratio only requires 12.5 % more contribution (instead of 30 %). Maintaining the contribution rate requires a 19 % (instead of 38 %) cut in the pension rates. Asset accumulation is still higher than in the benchmark case as a higher labor force stimulate capital accumulation although the motive of saving for retirement is not so strong as in the previous cases.

An amazing result is that delayed retirement increases wealth and consumption inequality. This results from the two following effects of a longer worker life : i) cumulated wage income represents a larger part of the total wage-plus-pension life cycle income and ii) the relative weight of the bequest motive for saving is increased w.r.t. the retirement motive, which explains the extra differential in wealth accumulation.

4.3 Alternative pension reforms : the consequences for occupational groups

In order to assess the contrasted effects of alternative pension reforms for the different occupational groups, we compute the average wealth accumulation and consumption profiles for every group under the alternative scenarios. In order to save place, these profiles are reported on figure X and X only for the "top executives" and "qualified workers" groups[12].

Insert here Figures 3.a and 3.b

Figures 3.a and b show the extra effort in savings required in case of pension cuts. Under the constant contribution scenario (CCR), assets of top executives peak 50 % higher than under the CRR scenario, but the extra

[12] Comprehensive results are available upon request.

accumulation is much larger for workers, whose maximal assets is 80 % higher than under CRR. The contrast is even greater if we consider the asset holding at the age of 80, which is 55 % greater (under CCR rather than under CRR) for workers but only 8 % greater for top executives. The constant initial replacement (but decreasing) care CIRR, involve a smaller, but more lasting, saving effort. Asset holdings at 60 are 24 % greater for top executive (46 % for workers). At the age of 80, top executive still holds 8 % more assets, but workers have to hold 100 % more wealth in order to compensate for their decreasing pensions.

Insert here Figures 4.a and 4.b

As shown by figures 4.a and b, these large saving efforts do not suffice to maintain consumption. Clearly, cutting pensions in order to contain contribution rate switches the consumption profiles; Top executives enjoy roughly 19 % more consumption at an age of 30, while losing 12% at 90. Workers only gain 17 % at 30, and lose 11 % at 90. Low qualified retirees are the most severely hurt, with consumption at 90 19 % lower under CCR than under CRR.

We also notice that the constant initial replacement rate (CIRR) does not preserve the consumption of the eldest workers better than the initially lower replacement rates prevailing under CCR.

Of course, the delayed retirement allows for consumption profiles dominating the other scenarios, with a greater gain for executives. We also notice than the accumulation profiles are less affected by the pension system under delayed retirement. With less accumulation by workers, wealth inequality is greater under delayed retirement.

4.4 Who gains and who loses ? An overall assessment

As the model involves an explicit and calibrated specification of preferences it allows to compute a welfare measure of the impact of alternative pension reforms for median workers of the different occupational groups by age. Since working is costly (in utility terms), it is not straightforward that a postponment of the retirement age will induce any welfare gains.

Rather than providing arbitrary measures of changes in utility, we compute a transfer measure of the gains or the losses from alternative pension reforms. Taking the CRR (constant replacement) as the reference case, we compute for the winners the *equivalent transfer*, i.e. the money transfer, in

quarters of net wages, which would have provided them with the same welfare as that of the benchmark. For the losers, we measure the loss by the *compensatory transfer* which would be required in order to maintain their utility. We have considered a once-and-for-all transfer. Therefore, it does not have the dimension of a flow (income), but rather of a stock (a discounted sum of future incomes). Compensatory transfers are reported with a negative sign.[13]

Since we have a great number of different agents, these transfers are calculated for the median agent (with respect to her expected intertemporal utility) for all occupational groups and for various different ages.

Insert here Tables 3, 4, 5

As expected, the gains and losses from pension cuts (versus increases in contribution) are monotonic with age, the balance turning negative for 50 year-old agents. The age effect is highly significant, for all occupational groups. Gains are largest for new entrants. Indeed, they somewhat discount their future utility at retirement. But, more important, they will benefit from a reduction of the contribution rate for a longer time span. Besides, the welfare gains from an increase in their after-tax income are higher when young, because then virtually all of them are liquidity-constrained. As their age increases, the gains bear on a shorter period, and all turn negative at the age of 50. After the age of 60, the cost (the compensatory transfer, in absolute value) is hump-shaped. This is due to two opposed mechanisms. On the one hand, the young retired need not reduce too much their consumption, since they can use their assets to make-up for the decrease in pensions. This tends to make the cost increasing with age. One the other hand, as agents get older, their life expectancy is strongly reduced. Therefore, the cost bears on a shorter remaining life span. Recall that the transfer is homogeneous to a stock, or to the sum of flows for the remaining life span. The former effect dominates for young retired, while the latter explains why costs decrease for older ages. At the age of 60, the transfer needed to make new retired indifferent between a cut in pensions and more generous pensions is roughly worth a year of pension. This can be compared with the transfer which, added to the CCR scheme, would yield the same discounted intertemporal pension flow as that of the CRR case for a newly retired at age 60 and

[13] We cannot use a single type of transfer -compensatory or equivalent- for all computations, because these transfers often turn out to be negative. In cases where the median agent has no asset, it is impossible to compute her welfare for negative asset holdings.

who would deterministically die when reaching the life expectancy. When considering a deterministic life equal to the remaining life expectancy at age 60, we can quickly compute the discounted sum of future reductions in pensions in the CCR scenario with respect to CRR. It is worth around 8.3 quarterly before-tax wages for low qualified workers, whose life expectancy at 60 is around 25 years. The gap between the *ex post* compensatory transfer (3.2) and the *ex ante* transfer is of course due to the adjustment in savings : in the CCR case, agents have accumulated more assets, which roughly amounts to 60% of the global saving effort required to make new retirees indifferent. As a second important result, the differences in gains (or losses) among occupational groups are not particularly significant.

The gains and losses from delayed retirement are neither monotonic neither so evenly distributed. Both the young and the eldest gain, at the expense of the medium age classes (40 to 60). Retired gain because they have had to undergo a longer working period in the past, but can take advantage of it in the present and the future. Pensions are somewhat higher than in the benchmark, because they are indexed on the after-tax wage, which is higher when delaying retirement (the contribution rate being lower). Young agents gain mainly because this policy increases their after-tax wage. Gains, however, are quite small for young workers, especially the low-qualified ones. As they get older, all agents have already taken advantage of part of the benefits of the reform (by increased consumption levels at young ages), but now have to face a disutility at work which will last longer. From the age of 40, the cost significantly increases, reaching its climax at 60. At this age, the cost is quite high : for low-qualified workers, it amounts to 8 years of wage.It is significantly smaller for other occupational groups, especially the executives (less than 3 years of wage). The reason is that, at the age of 60, life expectancy is quite different among occupational groups. Indeed, the gain of delaying retirement for 60 year-old agents lies in the increase in their pensions, the cost consisting of a longer disutility at work. For the agents with the smallest life expectancy (LQ workers), the gain will bear on a shorter period. The cost, however, is virtually the same for all occupational groups, since the probability for a 60 year-old agent to die in the next 5 years is rather small for all agents. From the age of 70, gains are smaller for LQ workers, for the very same reason : the gain bears on a shorter remaining life span. In the end, the trade-off between working longer ($DR - CRR$) or consuming less at retirement (CCR) is clearly less beneficial for agents with a lower life-expectancy.

Gains for the young are amplified when delayed retirement is combined with constant contribution rates, but losses for the middle aged workers are then very large. It even turns out that 90 year-old low qualified workers are

better-off in the benchmark than in the $DR-CCR$ scenario This means that even after having undergone a longer working period, the remaining gains are smaller than the cost due to less generous pensions.

As the delaying of retirement is a likely component of pension reform, as recommended in France by the Charpin report (1999), these results are highly relevant to consider. When implementing this reform, authorities have to be aware of its welfare redistributive consequences and to look for adequate compensations for people the more directly affected : the sixty year old workers, especially the low qualified ones.

5 Alternative macroeconomic scenarios

So far, the consequences of alternative pension reforms have been examined under a particular macroeconomic scenario, with an interest rate mildly sensitive to domestic excess savings. In this section, we will consider the robustness of these results with respect to alternative behavior of the interest rate. This point is important as the assessment of pension system depends much on intertemporal arbitrages and therefore on interest rates. We thus examine the two polar cases, respectively of a small open economy with an exogeneously given interest rate, independent w.r.t. domestic savings, and the case of a closed economy, where the interest rate flexibly adjusts the supply of savings to the demand for productive capital. In order to save time and place, only the basic scenarios CRR and CCR, will be explicitly considered in this exercise.

Technically, the small economy case consists in fixing the interest rate $r = r_0$ in the model. This fixed level in chosen equal to the benchmark case, i.e. 5,1 %. In the open economy case, the equilibrium interest rate is computed through the market clearing condition

$$K(r) = A(r)$$

with $K(r)$ the demand for productive capital and $A(r)$ the sum of accumulated assets.

Insert here Table 6

Due to the calibration of the model, the equilibrium interest rate in a benchmark 1990 closed economy is still 5,1 %. The new demographic regime induces extra savings in any pension system, therefore lowering the equilibrium interest rate. As expected, the constant contribution case, involving

lesser pensions and more individual extra savings, severely depresses the interest rate from 5,1 to 3,33 %, while the constant replacement scenario (CRR) weakly affects the rate (from 5.1 to 4.64). As savings is rather interest sensitive in this economy, the asset to income ratio in the CCR case is nearly halved in the closed economy w.r.t. the small open one. Retired are strongly affected, their consumption amounting only 91 % of the one of an active worker, instead of 130 % in the small open economy. Wealth inequality is larger, but consumption inequality is quite unaffected, the increase in inequalities with age being compensated by less inequality (due to less capital income) within a cohort. The message for this exercise is important. The ability to compensate lower pensions through a larger personal savings is very dependant upon the level of interest rate. Although we may consider that the small open economy case is more relevant for a medium-sized country like France, the different mature OECD countries are likely to adopt similar reforms, inducing an international bulk of savings and therefore depressing the world interest rates. The efficiency of policies willing to substitute a capitalization component to PAYG pension systems will suffer from this interest rate adjustments, as noticed by van Groezen et alii (2002).

6 Conclusion

Using an heterogeneous agent, life-cycle model calibrated on the French economy, we show that alternative pension reforms induce first-order redistributive effects. Redistribution of income, wealth and consumption does not only occur between age groups but also between occupational groups.

Among the non-trivial results of the study, the following are worth noticing

- a less generous pension system, to be compensated by individual savings, reduces wealth inequality, and even to some extent consumption inequality, as the distance between the median agent and the rich ones shrinks more than the distance from the poors to the median is increased

- delaying the age of retirement allows for consumption profiles dominating the ones which prevail under other scenarios. Welfare accounting however, shows that this reform, favourable on average, may strongly hurt people in their 50's and 60's, especially within the less advantaged occupational groups

- the success of pension reducing reforms rests on a favourable interest rate. If the interest rate is reduced - either due to extra domestic capital accumulation in a closed economy, either due to similar savings - inducing reforms being performed at the world level, the situation of retirees deteriorates.

  Of course, these results are developed using a stylized model of a steady state economy. Among the developments of the analysis to be performed, the computation of transitional dynamics has to be considered in priority.

References

Aiyagari S.R., "Uninsured idiosyncratic risk and aggregate saving", *Quarterly Journal of Economics,* 1994, 109, 659-684.

Altig D., A.J. Auerbach, L.J. Kotlikoff, K. Smetters and J. Walliser, "Simulating fundamental tax reform in the United States", *American Economic Review,* 2001, 91-3, 574-595.

Attanasio O., J. Banks, C. Meghir and G. Weber, "Humps and bumps in lifetime consumption", *Journal of Business and Economic Statistics,* 1999, 17, 22-35.

Auerbach A.J. and L.J. Kotlikoff, *Dynamic Fiscal Policies,* Cambridge University Press, 1987.

Barro R.J., "Are government bonds net wealth ?, *Journal of Political Economy,* 1974, 223-247.

Caballe J. and L. Fuster, "Pay-as-you-go social security and the distribution of bequests", mimeo, February 2000.

Charpin J.M., *L'avenir de nos retraites,* La Documentation Française, 1999.

Cubeddu L., "Intragenerational redistribution in unfunded pension systems", *IMF Staff Papers,* 2000, 47.1.

Deaton A. and Paxson, "Intertemporal choice and inequality, *Journal of Political Economy,* Juin 1994, 102.3, 437-467.

De Nardi M., S. Imrohologlu and T. Sargent, "Projected US demographics and social security, *Review of Economic Dynamics,* 1999, 2, 575-615.

De Nardi M., S. Imrohologlu and T. Sargent, "Saving and pension reform in general equilibrium models, *Oxford Review of Economic Policy,* 2001, 17, 20-39.

De Nardi M., "Wealth inequality and intergerational links, FRB of Chicago, mimeo, February 2000.

Direr A. and Th. Weitzenblum, " Modéliser la distribution des richesses en France", 2002, mimeo.

Disney R., "Crises in public pension programmes in OECD : What are the reform options ?", *Economic Journal,* Février 2000, F1-F23.

Fuster L., "Is altruism important for understanding the long-run effects of social security ?", *Review of Economic Dynamics,* 1999, 2, 616-637.

Hairault J.O. and F. Langot, "On the distributional effects of demographic changes under different pension schemes", paper presented at the SED conference, New York, June 2002.

Hubbard R.G. and K.L. Judd, "Social security and individual welfare : Precautionary savings, liquidity constraints and payroll tax", *American Economic Review,* 1987, 77, 630-646.

Huggett M. et G.Ventura, "On the distributional effects of social security reform", *Review of Economic Dynamics,* 1999, 2(3), 498-531.

Imrohologlu A., S. Imrohologlu and D.H. Joines, "A life cycle analysis of social security", *Economic Theory, 1995.*

Heer B., "Wealth Distribution and Optimal Inheritance Taxation in Life-Cycle Economies with intergenerational Transfers", 1998, mimeo.

Hurd M., "The economics of individual ageing", dans *Handbook of Population and Family Economics,* M. Rosenzweig and O. Stark, 1997, North Holland (ed.).

INSEE La société française, 1993, *Données sociales.*

van Groezen B., L. Meijdam and H. Verbon, "General equilibrium effects of privatisation : the missing piece in social security reform, CentER D.P., n° 2002-24, April 2002.

Martin J., "Indicateurs de taux de remplacement aux fins de comparaisons internationales", *Revue Economique de l'OCDE,* 26, 115-132.

Schwartz A. and A. Demirguc-Kunt, "Taking stock of pension reforms around the world", World Bank, May 1999.

Weitzenblum T. *Interactions entre hérérogenéité et fluctuations individuelles non assurables. Applications aux inégalités de richesse et au risque de chômage,* doctoral dissertation, Université Paris I.

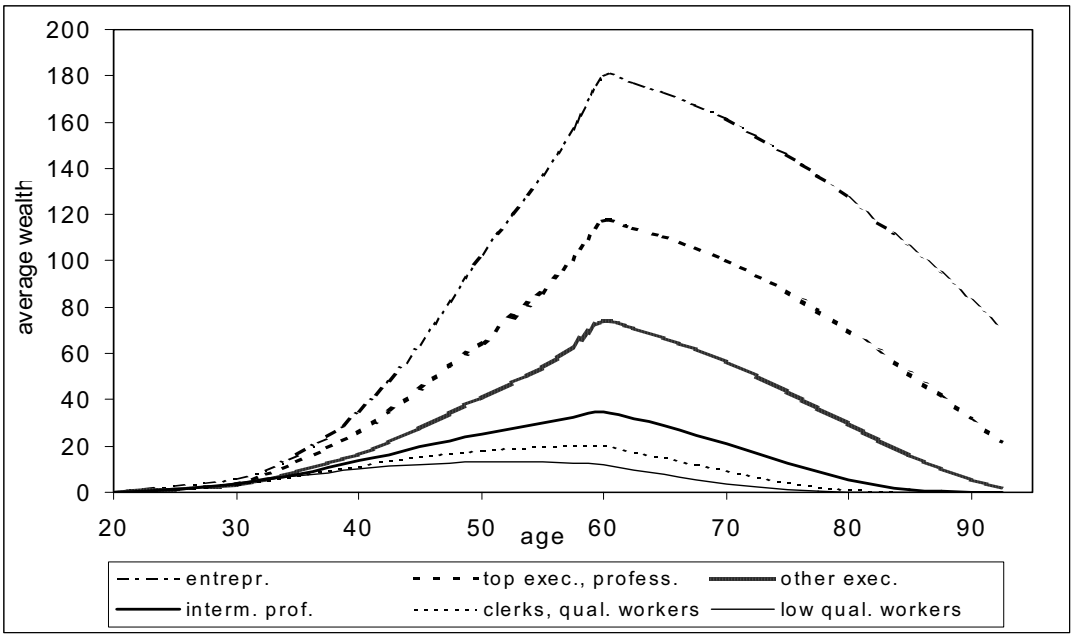


Figure 1 : Wealth accumulation profiles in the 90s

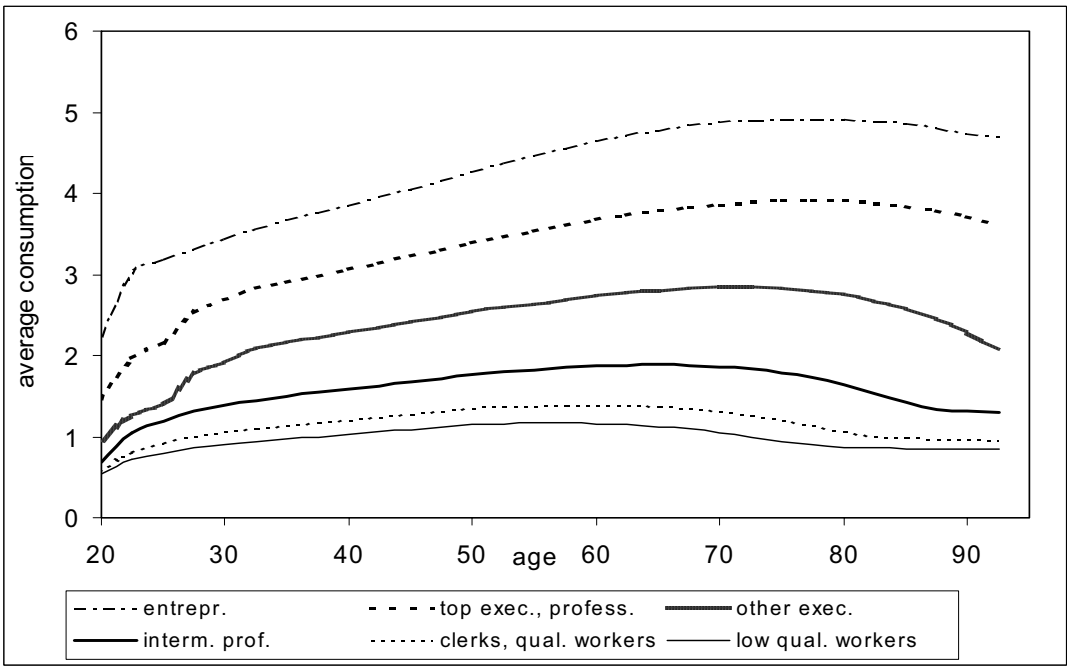
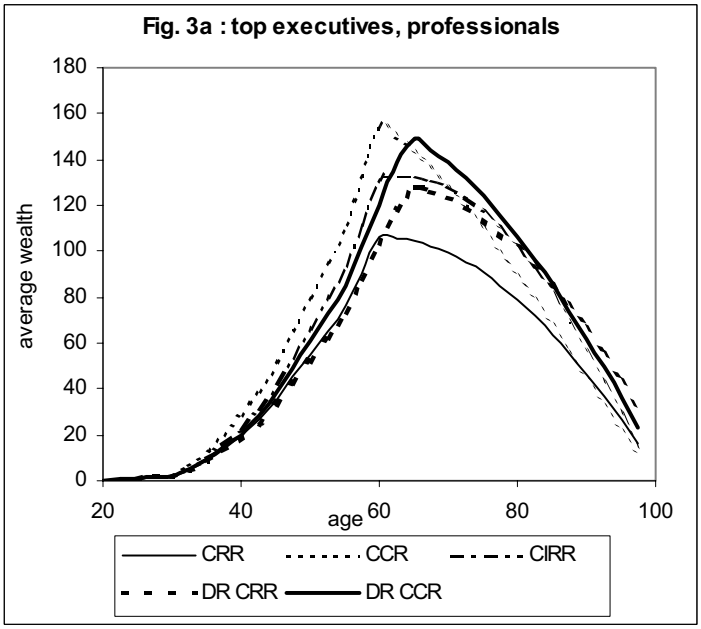
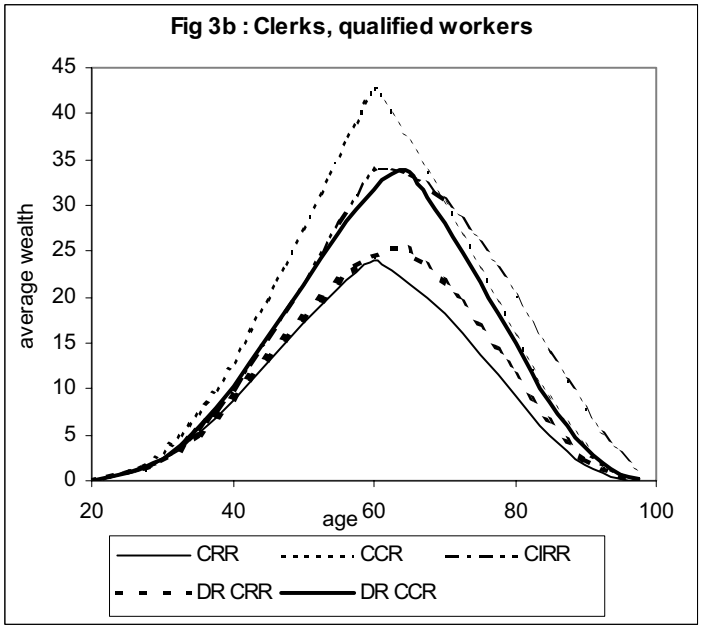
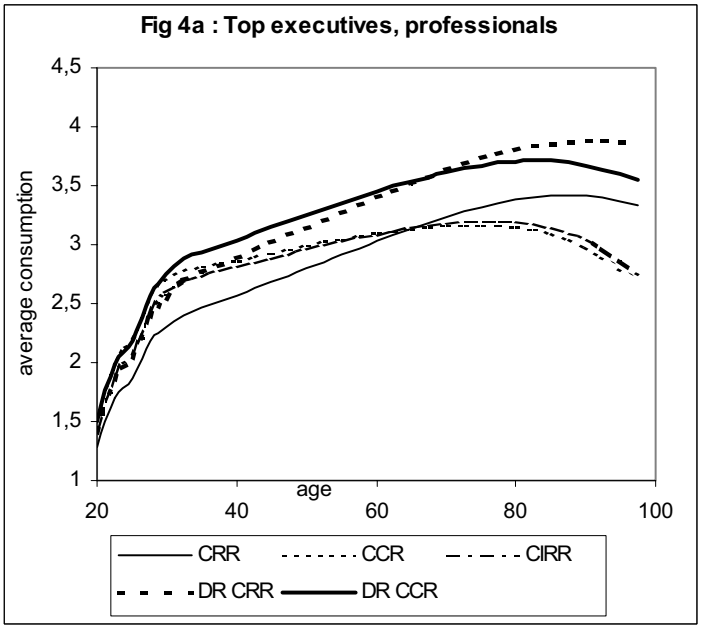


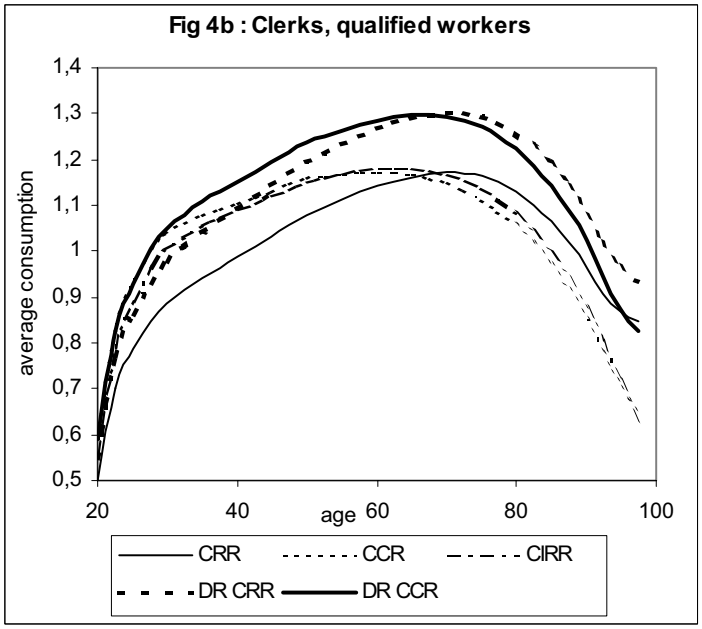
Figure 2 : Consumption profiles in the 90s





Figures 3a and 3b : Wealth accumulation for different pension system reforms





Figures 4a and 4b : Consumption profiles for different pension system reforms

Table 2 : Aggregate and distributional impact of various pension system reforms

		$Bench90$	CRR	CCR	$DR-CRR$	$DR-CCR$	$CIRR$
contrib. rate τ (%)		32.0	41.4	32.0	36.0	32.0	35.7
average replac. rate $\overline{\theta}$ (%)		66.2	66.5	41.2	66.4	53.8	50.3
A/Y		2.69	3.19	4.49	3.17	3.69	4.23
r (%)		5.1	4.85	4.17	4.84	4.54	4.31
Inc^R/Inc^{LF}		0.93	0.95	0.67	0.94	0.81	0.81
A^R/A^{LF}		1.62	1.95	1.82	1.91	1.87	2.37
C^R/C^{LF}		1.21	1.26	1.07	1.25	1.16	1.11
% liquidity constr. R		10.3	5.3	2.6	5.1	3.6	0.5
% liquidity constr. LF		8.5	8.7	8.3	7.9	7.9	9.1
	$D9/D1$	245	240	167	269	312	160
Wealth	$D9/D5$	5.33	4.36	3.67	4.72	4.33	3.90
	$D5/D1$	46	55	45.50	57	72	41
	$D9/D1$	2.93	2.89	3.31	2.97	3.11	3.21
Income	$D9/D5$	1.93	1.90	1.85	1.96	1.92	1.88
	$D5/D1$	1.52	1.52	1.79	1.52	1.63	1.71
	$D9/D1$	2.71	2.65	2.40	2.73	2.59	2.45
Cons.	$D9/D5$	1.85	1.88	1.69	1.90	1.80	1.71
	$D5/D1$	1.46	1.41	1.43	1.44	1.44	1.43

Table 3 : Winners and losers, CCR vs. CRR

Age\Group	Entr.	Top exec.	Other exec.	Interm. prof.	Q. work.	LQ. work
20	8.4	8.8	9.3	9.6	9.3	8.8
30	4.9	6.2	5.3	4.6	4.8	4.8
40	1.6	1.6	1.7	1.7	1.8	2.0
50	−0.6	−0.7	−0.7	−0.7	−0.4	−0.2
60	−5.2	−3.8	−3.8	−3.7	−3.8	−3.2
70	−6.7	−5.2	−4.7	−4.1	−4.1	−4.0
80	−8.3	−5.4	−4.6	−4.1	−4.4	−4.5
90	−8.0	−4.1	−3.1	−2.7	−3.3	−4.0

Table 4 : Winners and losers, $DR - CRR$ vs. CRR

Age\Group	Entr.	Top exec.	Other exec.	Interm. prof.	Q. work.	LQ. work
20	2.9	2.4	2.4	1.0	0.3	0.2
30	1.3	2.0	0.9	−1.3	−2.4	−2.5
40	−1.3	−2.1	−2.2	−4.4	−5.8	−6.0
50	−4.4	−5.5	−5.7	−8.9	−10.8	−11.3
60	−8.7	−9.8	−10.2	−16.1	−22.2	−23.9
70	12.5	10.6	9.6	7.4	6.3	5.5
80	11.1	9.1	7.2	5.3	4.0	3.6
90	9.9	7.1	4.5	3.0	2.0	1.5

Table 5 : Winners and losers, $DR - CCR$ vs. CRR

Age\Group	Entr.	Top exec.	Other exec.	Interm. prof.	Q. work.	LQ. work
20	6.5	6.5	6.8	5.2	3.9	3.7
30	3.2	4.4	3.6	1.2	0.2	0.3
40	−0.2	−1.0	−1.0	−3.4	−4.7	−4.9
50	−4.7	−5.8	−5.8	−9.2	−11.1	−11.5
60	−10.1	−11.1	−11.3	−17.5	−23.3	−25.1
70	9.3	8.4	7.9	6.0	4.4	3.8
80	6.8	6.3	5.5	3.8	2.2	1.5
90	5.2	4.4	3.1	1.7	0.4	−0.8

Table 6 : Impact of pension system reforms for different capital mobility

	Closed economy		Small open economy	
	CRR	CCR	CRR	CCR
contrib. rate τ (%)	41.4	32	41.4	32
average replac. rate $\overline{\theta}$ (%)	66.5	41.2	66.5	41.2
A/Y	2.79	3.14	3.70	5.99
r (%)	4.64	3.33	5.1	5.1
Inc^R/Inc^{LF}	0.92	0.59	0.99	0.83
A^R/A^{LF}	1.86	1.62	2.07	2.13
C^R/C^{LF}	1.21	0.91	1.33	1.32
% liquidity constr. R	7.5	8.6	3.3	0.3
% liquidity constr. LF	9.3	10.7	8.0	6.5
	$D9/D1$	204	215	143.5	128.75
Wealth	$D9/D5$	4.43	4.22	4.22	3.55
	$D5/D1$	46	51	34	36.25
	$D9/D1$	2.79	3.38	2.96	3.40
Income	$D9/D5$	1.86	1.81	1.94	1.97
	$D5/D1$	1.50	1.86	1.53	1.73
	$D9/D1$	2.58	2.59	2.75	2.72
Cons.	$D9/D5$	1.84	1.83	1.90	1.84
	$D5/D1$	1.40	1.41	1.45	1.48