CEPII

CENTRE D'ÉTUDES PROSPECTIVES ET D'INFORMATIONS INTERNATIONALES

No 2003 – 14
September

Notional Defined Contribution : A comparison of the French and German Point Systems

Florence Legros

Notional Defined Contribution : A Comparison of the French and German Point System

Florence Legros

No 2003 – 14
September

TABLE OF CONTENTS

NOTIONAL DEFINED CONTRIBUTION : A COMPARISON OF THE FRENCH AND THE GERMAN POINT SYSTEMS

SUMMARY

NDC (Notional Defined Contribution) schemes are often presented as ideal pensions schemes in order both to reduce intra and intergenerational inequalities and to balance PAYG pensions schemes. In particular, they are supposed to be cure for various shocks including demographic shocks.

In order to provide better incentives for a later retirement, some experts do promote marginal actuarial fairness. First, this would imply some specificificities that are not in the majority of the pensions schemes; second, these specificities can be very costly and not wishable for the schemes balance; third, marginal actuarial fairness appears as very difficult to implement. In order to combine individual freedom, incentives and financial equilibrium for all the ages and the individuals, actuarial fairness in level seems to be a favourite concept. This concept naturally leads to NDC schemes: it provides to all the individuals, all the wages categories, the same yield. For each individual, the discounted sum of contributions must be equal to the discounted sum of benefits.

We show that from these characteristics come the NDC schemes defaults, particularly in terms of intragenerational fairness; in addition because of the uncertainty about economic trends and cycles and about demographics, the ability of these schemes to stabilize automatically is very questionable; it is why we do suggest that "pure" NDC scheme are very questionnable. The swedish NDC scheme, often considered as an "ideal" NDC, is taken as an example. It has no automatic stabilizing device; the German pensions scheme by points - despite its "return spring" - is condamned to deficit, the French pension scheme balance totally depends on the quality of the experts' forecasts.

ABSTRACT

This paper provides a comparison between the French and German pension schemes by points to NDC pensions schemes (Notionnal Defined Contributions).

The formal equivalence is rather simple to prove ; on the other hand, like the Swedish pension scheme often supposed to be examplary, French and German pensions schemes are not immune to unexpected macroeconomic and demographic shocks. In other respects, generally speaking, searching intragenerational fairness by the way of this type of pensions schemes is questionable due to the large disparity between incomes and life expectancies.

J.E.L. classification: H55, J22, J26
Keywords: schemes by points, pays-as-you-go, actuarial fairness, notionnal accounts

SYSTÈMES DE RETRAITE EN COMPTES NOTIONNELS : UNE COMPARAISON DES RÉGIMES PAR POINTS FRANÇAIS ET ALLEMAND.

RÉSUMÉ

Les systèmes de retraites dits en comptes notionnels à cotisations définies (notés NDC) sont souvent présentés comme étant les systèmes idéaux pour à la fois réduire les inégalités intra et intergénérationnelles et pour équilibrer les régimes en répartition. En particulier, ils sont réputés montrer une résistance particulièrement forte aux chocs, notamment démographiques.

Afin d'inciter à une retraite plus tardive, les experts penchent généralement pour la neutralité actuarielle à la marge. D'une part, cela requiérerait un certain nombre de particularités que n'ont pas les régimes de retraite ; d'autre part, ces spécificités peuvent s'avérer extrêmement coûteuses et peuvent même être finalement néfastes à l'équilibre financier des régimes de retraite. En outre, la neutralité actuarielle à la marge est extrêmement difficile à appliquer, notamment si l'on prend en compte les disparités de revenus et d'espérances de vie.

Afin de combiner la liberté individuelle, les incitations, l'équilibre financier pour toutes les cohortes et tous les individus, la neutralité actuarielle en niveau semble préférable. Ce concept mène naturellement aux régimes de retraite en comptes notionnels : ceux là donnent à tous les individus, quel que soit leur salaire, le même rendement. Pour chaque individu, la somme actualisée des cotisations est, dans ces régimes, égale à la somme actualisée espérée de toutes les prestations.

Nous montrons que de ces caratéristiques proviennent précisément les défauts des régimes ne comptes notionnels à cotisations définies, notamment en terme d'équité intragénérationnelle. En outre, à cause de l'incertitude macroéconomique et démographique, l'aptitude de tels systèmes à s'équilibrer automatiquement est douteuse ; c'est la raison pour laquelle nous remettons en question l'existence de régimes en comptes notionnels "purs". Le régime suédois, par exemple, qui est souvent cité comme étant un modèle du genre ne possède pas l'aptitude à se stabilisater automatiquement qui a fait sa réputation, le régime par points allemand – malgré l'intégration d'une force de rappel automatique – est condamné au déficit, l'équilibre des régimes Français par points est totalement dépendant de la qualité des prévisions effectuées par les comités de pilotages.

RÉSUMÉ COURT

Nous comparons ici les régimes par points français et allemand aux régimes de comptes notionnels à cotisations définies. L'équivalence formelle est relativement simple à démontrer ; en revanche, pas plus que le régime suédois, souvent cité comme un modèle du genre, les régimes français et allemands posent problème lorsqu'il s'agit de résistance à des chocs économiques ou démographiques non anticipés. Par ailleurs, de manière générale, la recherche d'équité intragénérationnelle via ce type de système se heurte aux disparités de revenus et d'espérances de vie.

J.E.L.: H55, J22, J26
Mots-clés: régimes par points, répartition, neutralité actuarielle, comptes notionnels

NOTIONAL DEFINED CONTRIBUTION : A COMPARISON OF THE FRENCH AND THE GERMAN POINT SYSTEMS

Florence Legros [*]

1. INTRODUCTION

When comparing pension schemes, four questions arise:

- adequacy of objectives,
- economic efficiency,
- degree of redistribution provided by pensions schemes,
- the way how the pension scheme resists to various economic and demographic shocks.

Here we do not deal with the two first questions but address essentially the last one. However, because of the characteristics the notional defined contribution (further noted as NDC) pension schemes have, we shall be called to talk also about the third point. The central role of the internal return rate remains thus undisputed.

Another point not taken into account (or touched very marginally) in this paper are the exogenous risks linked with the pension schemes: macroeconomic risks for the fully funded schemes (further FFS) and political risks for the pay-as-you-go pension schemes (further PAYG).

The paper will be organised as follows:

1- we shall describe very quickly the French and the German pensions schemes;

2- we shall present key points of NDC and actuarial fairness: how pure NDC guarantees the actuarial fairness at the margin and in average and how this is reflected in the role of the life expectancy in the parameters of NDC pension schemes;

3- we shall present the conceptual equivalence between the systems and highlight what differs in the design and in the evolution policies. This will enable us to point out

[*] Cepii and University of Paris 9. I thank to Robert Holzmann for helpful discussions and valuable comments. An acknowledgment is also due to Jean-Louis Guérin for the fruitful discussions we had during our former co-authorship dealing with actuarial fairness (Guérin, Legros, 2003). Of course, the remaining errors are fully mine.

how the systems differ when there is an external shock (demographic, economic, etc.);

4- we finally conclude about the possibility (and the opportunity) to move from a scheme by points towards a NDC (pure and/or with a minimum pension scheme). In this part we shall discuss the redistributive impacts between generations or inside the generations of such transition and schemes.

2. A QUICK DESCRIPTION OF FRENCH AND GERMAN PENSION SCHEMES

French and German pension schemes have a component by points i.e. a part of these schemes provides a pension which depends of the individuals' whole carreer. This chapter aims to describe and enlighten these schemes.

France

We shall describe here the main French pension scheme: the compulsory pension scheme that provides pensions to the private enterprises' employees (including white collars). This population represents something like 61% of the active population. Aside from that one, there are plenty of other schemes: some work like the basic French pension scheme (i.e. "régime général", see below) and some like the private sector pension scheme (i.e. they include both a scheme which is close to the "régime général" and a scheme by points).

For the private sector, the French pensions rely on two pillars:

The basic general scheme ("régime général", CNAV) which offers benefits corresponding to the share of the wages below the "social security ceiling" (TRA, equal to 2432 euros per month, as of 1/1/2003) and the complementary schemes: AGIRC for executives and only for the fraction of their wages over TRA, and ARRCO for the others workers' total wage and executives' wages below TRA.

Table 1: Schemes/contributions in the French main pension scheme

Considered wage share:	***TRA (0/SS ceiling)***	***TRB (up to 4XTRA)***	***TRC (up to 8 X TRA)***
Population			
Non executives	CNAV *Wage earners: 6.55* *Firms: 8.2 %* + Firms: 1.6 of the total wage ARRCO *Cont. Rate: 6%* *Call rate: 125* *(firm: 4.5/wage earner: 3)*	ARRCO *Cont. Rate: 10%* *Call rate: 125*	
Executives	CNAV *Id upper* ARRCO *Cont. Rate:6* *Call rate: 125*	AGIRC *Cont. Rate:10* *Call rate: 125*	AGIRC *Cont. Rate:10* *Call rate: 125*

At the beginning of 2003, the CNAV pension (P_{cnav}) was computed as follows:

$$P_{cnav} = w * a * Min[1, (T / 37.5)]$$

with w being the yearly gross reference wage average of the 25 best wages for the generation born after 1948[1] and a being the rate of pension :

$$a = 0.50 * [1 - 0.10 * Min[40 - T; 65 - A)]$$

where T is the number of contributing years and A the retirement age.

The actual reform (approved 24th of July 2003 by the parliament) holds for this scheme and will affect the formula as follows: the full rate contributing period (today 40 years) will increase according to the gain in life expectancy (1 quarter a year between 2008 and 2012, half a quarter a year between 2012 and 2020); the discount rate which is today 0.10 will decrease in order to reach 0.05 in 2013 step by step; the T/37.5 coefficient will decrease by 2 quarters a year in order to reach T/40 in 2008 and to take into account the increase in the full rate contributing period. If we denote by T' this full rate, the contributing period in the above formula becomes:

$$P_{cnav} = w * a * Min[1, (T / T')]$$

$$a = 0.50 * [1 - 0.05 * Min[T' - T; 65 - A)] ,$$

[1] The 1993 reform changed this point : previously the reference wage was computed on the 10 best wages. The number of wages increased by one a year since 1993. The reform will fully hold for the 1948 cohort.

Note the existence of a minimum pension provided by CNAV; it actually reaches 6935.07 euros per year for a single person and 12440.87 euros of a cohabiting or married couple.

The complementary pension schemes are fully contributory schemes and the first pensions after retirement (P_{comp}) are computed according to a system of points which are the pension basic units and which are "sold" when people retire at the age of A (after a career of length T) at the price which prevails during the year C+A (C being the cohort generation, i.e. the birth year) VP_{C+A}.[2]

$$P_{comp,C+A} = \left[\sum_{T} po\text{int}\, s \right] * VP_{C+A}$$

During any year t, during the working period, the flow of accrued points can be computed as follows:

$$po\text{int}\, s_t = po\text{int}\, s_{ARRCO,t} + po\text{int}\, s_{AGIRC,t}$$

$$po\text{int}\, s = [t_{ARRCO,\text{TR}\,A} * w \leq \text{TR}\, A + t_{ARRCO,\text{TR}\,B} * \text{TR}\, A < w \leq \text{TR}\, B] / PP_{ARRCO}$$

for non executives; while for executives:

$$po\text{int}\, s = [t_{ARRCO,\text{TR}\,A} * w \leq \text{TR}\, A] / PP_{ARRCO} + [t_{AGIRC} * \text{TR}\, A < w \leq \text{TR}\, C] / PP_{AGIRC}$$

where $\tau_{ARRCO,TRA}$, $\tau_{ARRCO,TRB}$ and τ_{AGIRC} are the so called "facial contribution rates" of the regimes (respectively 6, 10 and 16% in mid-2003); TRB and TRC are respectively equal to 4 and 8 times TRA (9 728 and 19 456 euros per month respectively). PP_{ARRCO} and PP_{AGIRC} being the "purchasing" price of a point.

Note that during the retirement period pensions are revalued at the inflation rate.

One of the ways to handle the resources of the schemes is a coefficient that, applied to the facial contribution rate, increases these contribution rates.

For example the flow of income of ARRCO is given by:

$$Resource_{ARRCO} = [t_{ARRCO,\text{TR}\,A} * coeff\,] * w \leq \text{TR}\, A + [t_{AGIRC} * coeff\,] * \text{TR}\, A < w \leq \text{TR}\, C$$

With coeff today equal to 125%, that leads the effective contribution rates of 9.5, 12.5 and 20%. Note that this coefficient (the "call rate") is an important means to manage the scheme, like the price and the value of the point.

Briefly speaking (and with costless simplifications, for instance forgetting the "comp" index and considering a weighed average for the contribution rate as for the price and value of the point), the French complementary pensions by points are computed according to the following formula for the individual i who retires in A after a contribution period lasting from t_0 to A-1:

[2] Today, the value of the point is 1.0698 euro for a ARRCO point and 0.3796 for a AGIRC point. The purchasing prices are respectively : 12.0852 euros (ARRCO) and 4.21548 (AGIRC).

/i/ $$P_{C+A}^{i} = \sum_{t=t_0+1}^{A} \frac{t_{t-1} * w_{t-1}^{i}}{PP_{t-1}} * VP_{C+A}$$

at the pensionable age A (during the year A+C) while the resources of the scheme in t are:

$$R_t = \sum_i t_t * w_t^i * coeff_t$$

Note that while pensions are indexed on prices after A, PP and VP are changed regularly by the boards of the schemes according to the forecasts done about the pension schemes. Note as well that AGIRC and ARRCO are private associations linking together sectoral pension schemes. This is because each economic sector has its own pension scheme. French complementary pension schemes are purely Bismarckian schemes compared to the basic scheme that only partially relies on the career and that includes a Beveridgian part. They are managed by trade unionists with the help of retirement specialists, including actuaries, financial investors, etc. They have been created in 1945, being designed by insurers. They became compulsory in 1972 and the accounts are by individuals.

The management of the executives' pension scheme AGIRC can be shown as an example of the "piloting" of such schemes. Since the first oil shock, the stop in the pensions' increase has been scheduled. The analysis of AGIRC data shows the prevailing, discreet and progressive mechanism based on the price of the point (PP). As soon as PP increases quicker than the contributors' average wage, the number of won points decreases: in 1970, a 13.9% of the taxable wage share contribution provided 1000 points while the same contribution rate would have provided only 850 points at the end of the 90s (Hamayon, 1995).

Germany

The German pension scheme (described for example in Queisser, 1996, Vernière, 2001) seems simpler since it relies on only one scheme by points that covers not only the employees of the private enterprises but also certain self employed and some other specific parts of the population: at the end, 85% of the active population.

In fact, as it includes the early retirement pension scheme, the qualifying conditions are quite complex. It is not the case in France where – de jure – the early retirement does not exist. "Old workers", who are exempted to search for a job, do draw pensions generally funded either by unemployment or by disability insurances.

Another point that differs from the French pension schemes is that the contributory ceiling is rather low. As was said previously, in France people must contribute until 8 times the social security ceiling (19,456 euros), i.e. 8.5 times the average wage; in Germany the contributory ceiling is 1.8 times the average wage. This has strong implications that will be discussed in the next section of this paper.

There is no minimum contributory wage, but very low pensions are scaled up if people have contributed for at least 35 years: in this case, the personal points can be multiplied by 1.5, up to a maximum of 75% of the value of contribution for average earnings of all insured persons. Since the 2001 reform (Veil, 2003) there is a minimum pension that provides a help for very low-income pensioners. On the other hand there are non-contributory additional rights for part-time working women and for children's care.

As for the French pension schemes by points, each working period provides pension rights according to the wage earned by the contributor; but this wage has a rather low ceiling of 1.8 times the average wage. The gross pension is given by the following formula (with the same notations as those for France and $\overline{w}_t$ being the gross average wage in t):

/ii/ $$P^i_{C+A} = \sum_{t=t_0}^{A} \frac{w^i_{t-1}}{\overline{w}_{t-1}} * a^{\,i} * VP_{C+A}$$

with α,being the entry factor corresponding grosso modo to the French rate of pension, α and w^i_t is the part of the wage under the ceiling.

$a = 1 - [0.003(780 - A(12)]$ which means that there is a discount equal to 0.003 per month in case the pension is drawn before 65; (A(12) means age A in months).

Most of the adjustments rely on the value of the point VP. The 2001 reform deeply changed the parameters in the indexation formula:

/iii/ $$VP_t = VP_{t-1} \frac{\overline{w}_{t-1}}{\overline{w}_{t-2}} * \frac{x - t_{t-1} - m_{t-1}}{x - t_{t-2} - m_{t-2}}$$

where x is the indexation coefficient :

x=1 between 2001 and 2010 (that means a full indexation on net wages)

x= 0.9 after 2010 (partial indexing).

μ is the contribution rate to the voluntary additional private pension scheme sponsored by the fiscal chapter of the reform. What we call here net wage is in fact the wage net of all contributions dedicated to pension schemes.

The value of μ increases between 2001 to 2008, from 0.5 to 4% and remains stable *after* 2008. It corresponds to the value that binds the fiscal constraint. This can be interpreted as the "coefficient" of the French scheme since it affects the pensions in order to have resources which are higher than pensions; here the pensions are increasing less quickly than the resources.

Another point is that, as in the French scheme, the life expectancy does not appear explicitly in the pensions' formula but can be implicitly introduced by the scheme equilibrium. If we make the assumption that the fiscal resources of the pension scheme (ecotax, 32%) remains constant and/or that, in the long run, this tax is a share of the wage bill which is a constant share of the national income; we can derive the resources as:

$$R_t = \sum_i t_t * w_t^i$$

The implicit way, how the life expectancy is introduced into the pension formula, has a non- negligible role in the decrease of the forecasted value of the points in the future years. According to: 1) the change in the value of μ, 2) the forecasted increase in the contribution rate τ, the decrease in the point value VP will be more than 10% during the transition period.

3. NDC AND ACTUARIAL FAIRNESS

In both the countries, individuals use to quit their job 5 years before the legal pensionable age. In order to provide incentives to delay this retirement , actuarial fairness at the margin is a concept which must be explored. In the following chapter we show that even if we ignore the value of leisure, actuarial fairness at the margin is very difficult to implement and can lead myopic individuals to poverty. It is why actuarial fairness at the margin is a favourite concept which provides to everyone a pensions strictly equivalent to his/her contributions: it spontanously leads to NDC. Unfortunately, we show in the second part of this chapter that this collective concept can be unfair over all for low life expectancy individuals.

Actuarial fairness at the margin: an individual concept

Actuarial fairness at the margin works along those lines: early retirement is swapped against a decrement in the pensions benefits during the whole retirement period. If the agent does not retire one year earlier, at date t-1 and age A, but waits till date t and age A+1, he will pay his contributions and will benefit from a full pension. On the other hand, if he retires early, his benefits will be reduced by a fraction d during all his retirement (later called rebate), he will save contributions and benefit from a longer period of leisure.

That actuarially fair decrement in pension is measured in such a way that the choice of the agent does not threaten the budgetary equilibrium of the system. If the decrement rate is set at a higher value, early retirement will improve the financial situation of the system; if it is less, the opposite applies. Whatever the case, the decrement will have an impact on agents' behaviour: in the first case, if the rebate is high, it is costly for an agent to leave early and few workers are likely to make that choice; in the second, if low, early retirement benefits the pensioners and the attractiveness of that formula will help degrading the budgetary balance of the system.

It should be noted that the decrement/rise rate depends on individual career's profile: if two agents are considered, having earned the same rights to pension benefits, but with different last year of activity wages, the value of the rebate must be higher for the one having the largest wage. Intuitively, that agent must be rewarded by a higher premium if he delays his retirement decision.

With the same logic, we can guess (for a formal demonstration see Annex) that if pensions are indexed on gross wages, the upgrade/rebate has to be higher than if they are indexed on prices.

From a very simple model (see Annex), where r is the individual discount rate, r, the interest rate, and ℓ^{A}_{t-1}, the income equivalent of the leisure associated with leaving activity one year early, (Guérin and Legros, 2003), the following summarised results can be derived:

- if $r = r$ and $w^{A}_{t-1} = \ell^{A}_{t-1}$, then the worker makes no difference between an early job cessation or a delayed retirement ;

- if $r = r$ but $w^{A}_{t-1} < \ell^{A}_{t-1}$, then the worker draws a high satisfaction from leisure, and he will opt for an early retirement, with the actuarially fair decrement in benefits.

- if $w^{A}_{t-1} < \ell^{A}_{t-1}$, and $r < r$, then because his discount rate is high, the individual prefers to retire early as he does not give much weight to the loss in income induced by an early retirement.

- if $w^{A}_{t-1} > \ell^{A}_{t-1}$ and $r < r$, then the individual opts for a postponed retirement but if $w^{A}_{t-1} > \ell^{A}_{t-1}$ and $r > r$, then the preference for the present of the individual isso high that the financial gain induced by actuarial fairness at the margin does not mean much to him, and the agent retires early.

So the efficiency of the system's parameterisation strongly depends on individual preferences, most importantly on the taste for leisure and on the preference for the present. On a general note, it can be assumed that there is a high probability that high taste for leisure and preference for the present are true for ageing workers. Many reasons can be given for that point: residual life expectancy is lower; the number of healthy years left is reduced; the higher uncertainty prevailing on life expectancy does increase preference for the present.

The value of the actuarially fair rebate changes with the indexing rule (and this holds as well for an indexing of the net wages). It rises with the interest rate and the contribution rate, and decreases in line with life expectancy, inflation rate, technical progress and

replacement rate. It is worth noting that with realistic data and even without giving any value to the leisure, the rebate will have high values: 6,6% with indexed pensions on prices and 7,1% in case of indexed pensions on gross wages. As can be seen, for a standard "Bismarckian" PAYG pensions system, actuarial fairness at the margin implies a high value of the rebate, far from the values given by a linear calculus (a replacement rate of 60% after 40 years of work gives an annual rate of acquisition of 1.5%); so, it is necessary to have a bend in the curve of benefits acquisition. In other words, the concept of actuarial fairness at the margin can only apply to a part of the age distribution. In concrete terms, because of the indexing rule on the net wages (even in case of partial adjustment), Germany should have a more steeply sloping curve than France. This implies as well that because the productivity gains change every year, the rights acquisition curve has to change as well.

Let's consider now the case of a system displaying both Beveridgian and Bismarckian elements: every pensioner earns a pension compouned of two parts: one being proportional to his carreer (as previously) and one being a lump sum fixed independently of his career profile, not subject to the rebate. Such a system cannot be simultaneously actuarially fair to every member as the benefits rebate rate is now a function of the wage and so depends on the wage profile of the individual. Due to the existence of such minima in both the German and the French systems, actuarial fairness for the whole system is only a "wishable trend" and cannot be reached.

The existence of a contributory ceiling is another point that moves the schemes away from the marginal actuarial fairness; it is particularly the case of Germany; assuming that a worker has a non-negligible probability to attain this wage at the end of his working life. That means that when this is the case, the bonus is null.

Another thing is to discuss the cost of the marginal actuarial fairness: if the leisure is valued highly, the value of the rebate (or the bonus) should be higher than the values given previously. That means that there are two levels of the rebate/bonus, which provide the actuarial fairness: a financial level – with a null value of leisure - which insures the equilibrium of the scheme and – bigger- an individual level which insures the personal optimality. If we now consider that the population is roughly divided between high and low incomes ; that, 1/ it exists a decreasing relationship between life expectancy and value of leisure[3]; 2/ we have non-bismarckian elements in the pension scheme which imply a decreasing relationship between the individual wage and rebate. In these cases, the optimal rebate for low incomes will be higher than the optimal rebate for high incomes; so, if the government's wish is to retain high and low incomes on the labour market (what pools the longevity risks, as can be seen in table 2) the rebate should be quite high but very costly.

Marginal actuarial fairness is costly and rather difficult to implement as soon as the life expectancy has to be taken into account as correlated with the value of leisure.

[3] Ther obviously exists a link between rho and the life expectancy ; it is included in the relationship between rho and the value of leisure.

Table 2: Life expectancy at the age of 60 and socio-professional categories (the case of France)

Category	Males	Females
Executives, self employed	22.5	26.0
Intermediate profession (technicians, etc.)	19.5	25.0
Artisan, shopkeepers, firms managers	19.5	25.0
Employees	19.0	24.0
Workers	17.0	23.0

In order to combine individual freedom, incentives and financial equilibrium for all the ages, actuarial fairness in level seems to be a favourite concept. In this case, the acquisition of rights is a continuous unbroken straight line which is the condition for uniqueness of the PAYG yield. This relationship is supposed to lead to pure actuarial fairness. It has certain advantages but its labour incentive character is less distinct than in the case of marginal actuarial fairness.

NDC: actuarial fairness in level

In an actuarially fair system in level, the discounted sum of contributions must be equal for every individual to the discounted sum of benefits; in addition, the discount rate is the same for every member of a cohort. As can be seen, the presence of Beveridgian elements in a pension system prevents the existence of such characteristics. In the same way, the existence of specific contributory advantages or of a ceiling on benefits are outside that logic. Those systems are left aside in the following analysis. As soon as the pension system does allow for a full freedom in retirement age, the respect of actuarial fairness in level necessarily implies the respect of actuarial fairness at the margin. At the steady state, with invariant demographic and economic structures, if everybody earns back what he contributed, the financial balance of the system is ensured. But the respect of actuarial fairness in level does not imply budgetary balance in case of a demographic or economic shock.

Two kinds of pension systems can aim to that notion of actuarial fairness: first the fully funded schemes and second the notional accounts or the system by points. The later differ from pure fully funded schemes by their financing (the vast majority of such systems are PAYG systems), but also by the virtual nature of the acquired benefits. Every contributor has a personal account that records all of his/her pension contributions over his/her active lifetime. The hoarding of those contributions does constitute a virtual capital upgraded according to a specific rule of indexing. On retirement date, that virtual capital stock is converted in annuities according to a transformation coefficient depending on the liquidation age and retirement life expectancy. In sharp contrast with the notion of actuarial fairness at the margin, fairness in level takes into account the whole career profile of the agent, without focusing on the last years of activity.

Of course that concept must be considered at the collective level, given the uncertainty prevailing on individual life expectancy.

The most important defining parameter of such a system must be the rate of discount (or rate of return) used to compare past paid contributions and future earned benefits.

With the same notation as above, and taking into account the average life expectancy of the cohort in question, the internal rate of return of the system r can so be defined as $1+r_t = \frac{P^i{}_{t+1} * s_{t+1}}{t_t w_t}$ where s_{t+1} is the cohort life expectancy. In other words, s_{t+1} is the portion of period t+1 that is to be lived by the cohort or the average individual of the cohort: $s_t = \frac{\sum_i s_t^i}{N_t}$. Note that the value of that rate, as well as the contribution rate, are assumed to be the same for all the agents at the given date.

Of course, for an individual one is able to compute his own personal internal return rate: $1+r^i{}_t = \frac{P^i{}_{t+1} * s^i{}_{t+1}}{t_t w^i{}_t}$

As soon as the system is of a PAYG nature, the earnings at date t of the system can be written as /iv/ $R_t = \sum_i t_t w_t^i$ and the benefits paid amount to:

/v/ $E_t = \sum_j P_t^j * s_t^j$ [4] with i denoting the contributing active people and j the pensioners. The budgetary balance of such a system depends on the indexing rule, which sets the internal rate of return and the evolution of pension benefits: that rule is generally given by the evolution of an economic parameter.

Let us examine the conditions in which an ex-ante equilibrium can be reached by the system:

Denoting g_t the indexing rate of the pensions between t and t+1:

$P_{t+1}^j = P_t^j (1+g_t)$;

$E_{t+1} = \frac{s_{t+1}}{s_t}(1+g_t)\sum_i p_t^j s_t^j = \frac{s_{t+1}}{s_t}(1+g_t)E_t$;

[4] We follow Valdés-Prieto, 2000, but we add the consideration of life expectancy.

$$R_{t+1} = \frac{t_{t+1}}{t_t} \sum_i t_t \frac{w_{t+1}^i}{w_t^i} w_t^i = \frac{t_{t+1}}{t_t} \frac{\sum_i w_{t+1}^i}{\sum_i w_t^i} R_t$$

as in a PAYG pension scheme, $E_t = R_t$,

/vi/ $E_{t+1} = R_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1}}{s_t}(1+g_t)\frac{t_t}{t_{t+1}} \frac{\sum_i w_t^i}{\sum_i w_{t+1}^i} R_{t+1}$.

As soon as the pension scheme contribution rate does not vary (which is generally the purpose of the switching from a "usual" PAYG towards a NDC PAYG), the indexing rule will try to provide an automatic stabilising device to the pension scheme. At the first glance, there is no NDC or point pension scheme providing this kind of automatic stabiliser, with the single exception of Sweden. Italy uses the total wage bill as an indexing device, France relies on inflation and Germany on net wages.

Anyway, there is a huge difference between, on the one hand, a simple comparison of the ability of different factors to achieve the stability of the scheme and, on the other hand, the expectation about the ability of the system to stabilise ex ante. In other words, even if the stabiliser is adequate, it can be inefficient or even unable to play its role.

4. NDC AND RESISTANCE TO VARIOUS SHOCKS

As a consequence of the above developments, actuarial fairness at level, highly comparable to pure NDC can be a source of unfairness and has no automatic stabilizing device. In other words, if the stabilizing of this type of scheme is –in fact – discretionary (as an example, a decrease in pensions avoiding imbalances) the actuarial fairness is broken. This implies a perfect forecasting.

As shown, previously there is a need for a « zero pillar » (Holzmann, 2003) in order to provide some redistribution towards the poorests.

A pure NDC – actuarially fair at level – is then far from being ideal. In this chapter, consider the French and German case to which we add the Swedish one, often presented as an ideal NDC.

Let us now consider a simplified version of the Swedish system, often considered as a prototype of NDC **–** a PAYG scheme with virtual funding.

The basis of such a scheme is a "virtual" capital, given as a result of the accumulation of pension rights through the people's contributions. This capital is re-evaluated each period, let us say at the rate r, while A is the age when retiring and C is the birth date, which identifies the cohort C:

$$K_t^C = K_{t-1}^C(1+r_{t-1}) \text{ or } K_t^C = \sum_T t w_{t-1}(1+r)^t$$

since the capital K_t^C comes from the past flows of contributions during the contributing period T. At age A, an individual can draw a pension which is supposed to be re-evaluated during the pension period (finishing in D). This actualised pension, P_A^C, is the capital divided by s_A^C,the life expectancy of the cohort C when aged A, which appears in this type of scheme as a central management parameter. So we have:

$$(1+g)^{D-A} * P_A^C = \frac{K_A^C}{s_A^C} \text{ and } P_{t+1}^C = (1+g)P_t^C \text{ after retirement.}$$

In the **Swedish pension scheme** r = 1.6% and this is a parameter of a "yield in advance" given to the contributors representing an economic growth benchmark. During the pension period, the index g is close to the nominal growth rate of the per capita GDP from what this yield in advance is derived. Without any loss, we shall assume later that r=0 and g equals the nominal growth rate of the per capita GDP. With the same simple mathematical manipulation as above, it is rather easy to be led to:

$$E_{t+1} = R_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1}}{s_t}(1+g_t)\frac{t_t}{t_{t+1}}\frac{\sum_i w_t^{i_C}}{\sum_i w_{t+1}^{i_{C+1}}} R_{t+1}$$

where we see that it is not only the period that is in the equilibrium but the cohort as well. Thus the equilibrium is both in time and in space. The C+1 factor means that the cohorts have aged by one unit of time, let' say one year. Here we can see that the two periods' model provides both a helpful information and also an optical illusion. In fact, a perfect NDC scheme would require a yearly adjustment to the evolution in the life expectancy, including an adjustment for all pensions, which have already been drawn and not only for pensions of new pensioners.

In addition, the fact that the index g is the nominal growth rate of the per capita GDP implies that there is an "automatic adjustment" only when the share of the wages in the GDP is constant and if the active population remains constant, which is precisely the problem in case of fall in the fertility rate. In the former case a high GDP growth with a slack wage growth would be a source of financial unbalances since the PAYG resources are wages and social income.

$$E_t = \sum_j \sum_{t=t_0+1}^{A} \frac{t_{t-1} * w_{t-1}^j}{PP_{t-1}} * VP_{C+A} * s_j^t \text{ and then:}$$

$$R_{t+1} = E_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1}^{j+1}}{s_t^j} * \frac{VP_{C+A+1}}{VP_{C+A}} \sum_{t=t_0}^{A} \frac{t_t / PP_t}{t_{t-1} / PP_{t-1}} * \frac{\sum_i \sum_t w_t^i}{\sum_i \sum_t w_{t-1}^{i-1}} * \frac{t_t \sum_i w_t^i}{t_{t+1} \sum_i w_{t+1}^{i+1}} * R_{t+1}$$

$\frac{VP_{C+A+1}}{VP_{C+A}} \sum_{t=t_0}^{A} \frac{t_t / PP_t}{t_{t-1} / PP_{t-1}}$ represents the adjustment parameters of the scheme.

It calls for some remarks:

- First, there are three parameters, which are the contribution rate, the price and the value of the point. The transformation of one wage unit into n units of pensions depends of the relative evolution of the three parameters.

- Mentioned parameters can be changed every year but the burden will not be on the same persons. Changing the contribution rate and /or the price of the point will affect both the contributors and the pensioners (like a change in the contribution rate in a "normal" PAYG pension scheme) but the "old" contributors will be affected during a shorter period. Changing the value of the point will affect both the young retirees and the contributors whose pension will be changed by this decrease/increase (this can be compared in a change in the replacement rate).

- These changes are deterministic, there is no explicit rule but they rely on the long-run forecasts done by actuaries.

- The fact that the changes in these parameters can be annual and that they are more or less deterministic – this means that it is rather easy to adjust them, especially if some forecasting errors were made. The bigger the errors, the greater the changes and the more difficult they are to implement .In the past, the adjustments have been done in the correct time intervals. As a result, the French complementary pension schemes AGIRC and ARRCO became richer by 40 millions of euros in provisions;

- The above result shows again the need for yearly adjustments: the first term represents the life expectancy change between two cohorts and may be rather weak. The $\frac{\sum_i \sum_t w_t^i}{\sum_i \sum_t w_{t-1}^{i-1}}$ and the $\frac{t_t \sum_i w_t^i}{t_{t+1} \sum_i w_{t+1}^{i+1}}$ terms respectively represent the change in the contribution base between the two cohorts and the opposite of the change in the pension rights between the two cohorts.

In the ***German pension scheme***, two equations:

$$P^i_{C+A} = \sum_{t=t_0}^{A} \frac{w^i_{t-1}}{\overline{w}_{t-1}} * a^{\,i} * VP_{C+A}$$

$VP_t = VP_{t-1} \frac{\overline{w}_{t-1}}{\overline{w}_{r-2}} * \frac{x - t_{\,t-1}}{x - t_{\,t-2}}$ remain without any change in the reasoning, provided we take into account the fact that the contributions to the additional pension fund are exogenous and/or that the sensitivity of a FFS scheme to the demographic shocks is the same as the sensitivity of a PAYG to the same shock.

That implies the following:

$$P^i_{\,t+1} = P^i_t * \left[\underbrace{\frac{\overline{w}_{t-1}}{\overline{w}_{r-2}} * \frac{x - t_{\,t}}{x - t_{\,t-1}}}_{(1+g_t)} \right]$$

In other words, we have the same NDC scheme as that one described earlier in this paper (part 2). It leads to a corroboration: /vi/: $E_{t+1} = R_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1}}{s_t}(1+g_t)\frac{t_t}{t_{\,t+1}} \frac{\sum_i w^i_t}{\sum_i w^i_{t+1}} R_{t+1}$.The analysis seems rather simple to conclude and, on the surface, it leads to a notional interest rate, which is the growth rate of the net average wage. In fact, g_t depends on t_t which depends on the PAYG equilibrium in *t*, which comes from g_{t-1}, giving $\overline{P}_t$. Intuitively, there is a huge difference between the French and the German pension schemes: while any change in *VP* in the French pension scheme is a burden for contributors (as future pensioners and not for the yet pensioned to whom pension has not been changed), a change in *VP* in the German pension scheme is a shared burden between pensioners and contributors since any change in t_t will imply a change in g_t. In other words if the increase in the point value *VP* between *t* and *t+1* is too great, the PAYG is unbalanced and re-balanced by an increase in t_{t+1} (a burden for the contributors), which decreases g_{t+1} (a burden for both contributors and retirees, in other words for present and future retirees). The pending problem now is to explain:

A) How does this "return spring" [5] work?

[5] The discussed mechanism of "return spring" is thus a sort of a balancing mechanism reacting by a feedback to potential disequilibria.

B) How the balance in PAYG is achieved? I.e. what are the links to financial stability of the NDC scheme?

A) How does this "return spring" work?

Roughly speaking the mechanism is the following one:

$$\left.\begin{matrix} t_t \\ t_{t-1} \end{matrix}\right\} \rightarrow 1+g_t \rightarrow VP_{t+1} \rightarrow E_{t+1} \rightarrow t_{t+1} \rightarrow g_{t+1}$$

Manipulating the previous equations, and taking into account the PAYG equilibrium

$t_t * \overline{w}_t * N_t = \overline{P}_t * s_t * N_{t-1}$ where $\overline{P}_t$ is the average pension in t. It then implies:

$1+g_t = \dfrac{\overline{w}_t * x - \overline{P}_t * s_t /(1+n_{t-1})}{\overline{w}_{t-1} * x - \overline{P}_{t-1} * s_{t-1} /(1+n_{t-2})}$ which shows that – putting apart x – the notional interest rate is the increase in the average wage, which is diminished by the share of the average pension. This share is the ratio of the probability to survive when retired to the increase in the labour force n. In other words, the "reimbursed" share of the average pension increases when the life expectancy increases and it decreases when the labour force increases[6].

There again, the main problem is hidden in the use of the two periods' model. s_t is the life expectancy of the retired persons; it is in fact a weighted average of all the life expectancies of all the cohorts of retirees. In other words, this inertia sentences the scheme to deficit and thus to a contribution rate increase.

This allows answering partially the second question:

B) How does it balance the PAYG, i.e. how does it bear on the financial stability of the NDC pension scheme?

As we just said, the notional interest rate does partly depend on the past life expectancies while ensuring that the financial equilibrium of the NDC would suppose to introduce the future life expectancies as well as the expected increase in the total amount of contributions. That would imply to take into account a change in the wage bill, which obviously does not appear in the indexing rate formula. With respect to this remark,

[6] The Rurup report (summarized in Boersch-Supan, 2003) suggests 1/ an increase in the pensionable age ; 2/ the introduction of a so called « sustainability factor » (pensionners/contributors) that is supposed to be not based on the life expectancy. The above formulas show that 1/ this factor is already taken into account ; 2/it is based on the life expectancy.

assumptions about the automatic stability are in conflict with a change – that means a change neither in the labour force nor in the wages. Their realism is therefore questionable.

5. CONCLUSIONS : NOBODY'S PERFECT

As soon as the same acquisition and accumulation rules apply to all individuals in a given age group, one can see clearly the potential contradiction between the actuarial fairness aims (insurance logic) and the redistributive goals since, in fact, the life expectancy strongly depends on socio-professional groups. Actually, life expectancy is positively correlated with income. For example, French life expectancy when 60 is today 19 years for males and 23.5 for females in average, 17 for a male farm worker, 27 for executive females. A general rule applying to all will penalise the poorest by not taking into account their reduced lifespan.

At the same time, underestimating the time spent in retirement by the richest individuals is likely to undermine the financial balance of the system: the "average" life expectancy is measured without being weighted by the costs of benefits to be paid by the system, i.e. by the costs higher for high wage earners. A part of those unbalances is made up for by the non-differentiation between men and women (professional pensions discrimination is considered in Europe as jobs and wages discrimination). This improves the budgetary stability of the system, given the gaps in income and life expectancy and every other things taken as equal. However, that observation does not answer the disparity in the life expectancy question: as the intra-generational variance is higher than the inter-generational variance, the NDC obviously favours financial equilibrium to social equilibrium, as life expectancy is highly correlated with income.

On the other hand, for a social reason, all these schemes have introduced either minimum pensions (like in Sweden and Germany) or are "only" complementary schemes, For example, in France, there is a basic scheme offering the possibility of a minimum pension. In Sweden there is a double protection against poverty at the old age for unemployed or socially subsidised people: in addition of a minimum pension provided by the scheme, the social income (unemployment, disability subsidies, etc) provide contributions to the pension schemes and then provide supplementary rights.

Even though the existence of parametric pension systems offering high degrees of freedom to their customers is highly creditable, nevertheless, it would be dangerous if such schemes were set without a minimum legal retirement age since the system is no cure for the myopia of the agents. In the concept, like in our model, agents are considered to be perfectly rational and informed. Nevertheless, the empirics of behaviour of economic agents suggests that their decision-making is subject to uncertainty, risk, intransitivity of preferences and a violation of basic axioms of rationality (Bell, 1985, Starmer, 2000). With absolute freedom, the agents would not be very protected against the bias in their decision making arising from uncertainties or unrestrained optimism concerning life expectancy – situation all the more dangerous if pensions are no longer indexed on wages and/or if the pensions are low according to an early chosen retirement age.

NDC application to a real economy under uncertainty is problematic. We know what a heavy problem the uncertainty is when talking about pensions, Various reports are full of illustrations of such an uncertainty: forecasted contribution rates can vary by 15% depending on the assumptions about the future as remote as 2040 (Konrad and Wagner, 2000, for the German example).

Uncertainty can turn to future wages, forecasted active population [7], birth rates [8] and life expectancies. Most of the time, pension schemes "give" too much according to NDC philosophy and this is right even in the purest NDC schemes.

When comparing French and German models, it seems that the French scheme – having no automatism in its indexing device – can be regulated each year according to the forecasts. It may be finally the best way to be reactive but that means: 1) the existence of reliable and frequent forecasts; 2) a total independence of the boards in front of retirees and even wage earners lobbies.

While the second point militates for clear written rules, instead of the existing state of affairs, the first point is very questionable (Lassila, Valkonen, 2002).

Germany adopted a special way to correct the excessive generosity of the scheme after some time: what we called a "return spring" is a mechanism in which the pension yield is lowered by the present contribution rate, which is a way to shift the burden on both the active and the retired population. Unfortunately, the active population pay three times: once by the contribution rate, the second time by its future replacement rate and the third time because the life expectancy index based in the past is a source of costly inertia.

An alternative precautionary strategy would be to use the less favourable assumptions in order to adapt the parameters of the schemes. Of course, with such a strategy it is probable that the scheme will get into surplus within some years. In this case, these surpluses would be helpful by becoming a buffer fund which is demonstrated as a useful tool for intergenerational equity.

There again, social consequences could be questionable. Such a mechanism would decrease the average pension - i.e. the pension of every individual. If we admit that the changes in life expectancy usually profit more to the highest socio-professional categories, this mechanism would cost more to the poor than to the rich. A solution could be by adopting a Beveridgian scheme up to the average wage and, for the rest of the contributary wage, a pure NDC.

[7] As an example about such an uncertainty, French council for retirement schemes forecasts for 2040 are based on an assumption in which the active population was to increase by 10 millions, while CEPII's forecasts rely on an increase by 1 million only.

[8] That will affect again the entire active populations. Note that in this area divergences in statistical estimations world-wide are enormous.

A pure NDC would be a actuarially fair at level scheme. An ideal NDC would provide: redistribution, incentives to work later, information, automatic stabilizing. The non discrimination between categories with different life expectancies makes the scheme non redistributive.

Because there is a need for zero pillar schemes for redistribution, for contributory ceilings and decrement/increment devices for incentives, the schemes are put away from pure NDC.

An ideal NDC cannot be a pure NDC.

Then why promoting NDC? If pensions schemes are made in order to promote individuals' responsibility, the favourite schemes are FFS ; if in addition, the question is to promote "social responsibility" a favourite choice is NDC schemes. In this case, stabilizing devices are key points.

BIBLIOGRAPHY

Artus, Patrick (2000), « Quelques résultats de base, préalables à la réflexion sur les retraites », *Flash CDC-Marchés*, n° 2000-17, janvier.

Bell, David (1985), « Disappointment in decision making under uncertainty », *Operations Research*, 33, p. 1-27

Boersch-Supan, Axel (2003), «The Rurup commission's pension reform recommendations», *MEA newsletter*, n°6, june.

C.O.R. (Conseil d'orientation des retraites) (2001), *Retraites : renouveler le contrat social entre les générations*, Premier rapport du conseil d'orientation des retraites, La Documentation Française.

Guérin, Jean-Louis, Legros, Florence, (2003), « Neutralité actuarielle : un concept élégant mais délicat à mettre en œuvre », Revue d'économie financière, N°68, pp. 79-90.

Hamayon, Stéphane (1995), «Perspectives du système de retraite en France», in Cochemé and Legros ed. *Les retraites, genèse, acteurs, enjeux*, Armand Colin.

Holzmann, Robert (2003), «Toward a Reformed and Coordinate Pension System in Europe: Rationale and Potential Structure», Paper prepared for the *NDC conference* in Stockholm, Worldbank, september.

Konrad, Kai, Wagner, Gert (2000), « Reform of the public pension system in Germany », DIW discussion paper n°200, february.

Lassila, Jukka, Valkonen, Tarmo, (2003), «Retirement age policies and demographic uncertainty in Lithania: a dynamic CGE analysis», Contribution to the Workshop on welfare and the labour market, Marseilles, October 25-26.

Queisser, Monika (1996), « Pensions in Germany », *Policy research working paper N° 1664*, World Bank

Starmer, Chris (2000), «Developments in non-expected utility theory: the hunt for a descriptive theory of choice under risk », *Journal of Economic Literature*, 38, p. 332-382

Valdés-Prieto, Salvador, (2000), « The financial stability of notional account pensions », *Scandinavian Journal of Economics*, n° 102, (3), p. 395-417.

Veil, Mechthild (2003), « La réforme des retraites, premiers pas, débats, interrogations », *Chronique internationale de l'IRES*, n° 82, mai.

Vernière, Laurent (2001), « Allemagne, la réforme 2002 du système de retraite », *Question retraites, document de travail CDC* N° 2001-41.

ANNEX: Actuarial Fairness at the Margin

In the following simple model, the contribution rate is t . If an agent does not retire by one year earlier, at date t-1 and age A, but waits till date t and age A+1, he will pay his contributions: τw_{t-1}^{A} and will benefit from a full pension, with liquidation rate p. On the other hand, if he retires early, his benefits will be reduced by a fraction d during all his retirement.

That may be summed-up by the following equation:

$$/1/ \quad -tw_{t-1}^{A} + \sum_{j=1}^{N} \frac{1}{(1+r)^{j}} . p_{t+j-1}^{A+j} = \sum_{j=0}^{N} \frac{1}{(1+r)^{j}} . (1-d)\, p_{t+j-1}^{A+j}$$

Where d denotes the actuarially fair decrement in benefits and N is the last age of pension earnings.

So as to keep things simple, we omit in the previous equation the uncertainty prevailing over life expectancy. Taking it into account would lead to multiplying both sides of the equation by survival probabilities. That operation would not modify the accounting reasoning. However, life expectancy uncertainty interacts with behaviour of risk-adverse agents: whatever the decrement/rise rate in pensions benefits associated with early/late retirement, an increase of this uncertainty brings forward the retirement decision.

The left hand side of /1/ is the sum of discounted pensions benefits at rate r received from date t by an agent if he retires at age A+1. The right hand side is the sum of discounted pension benefits received from date t-1 by the agent if he retires at age A, reduced by a fraction d.

The choices made by the workers so depend on their individual preferences. It we note $R^{(1)}$ and $R^{(2)}$ for income equivalents of the welfare of agents in situation 1 (delayed retirement), or 2 (late retirement):

$$/2/ \quad R^{(1)} = w_{t-1}^{A} . (1-t) + \sum_{j=1}^{N} \frac{1}{(1+r)^{j}} . p_{t+j-1}^{A+j}$$

With r the discount rate of the individual considered; and:

$$/3/ \quad R^{(2)} = (p - d.p)_{t-1}^{A} + \sum_{j=1}^{N} \frac{1}{(1+r)^{j}} . (p - d.p)_{t+j-1}^{A+j} + \ell_{t-1}^{A}$$

With ℓ_{t-1}^{A} the income equivalent of the leisure associated with leaving activity one year earlier.

Let's note p, the inflation rate and q, the productivity gains of the economy, gains supposed to pass on to real wages. Nominal wages then increase at the rate $p+q$. As done in Artus (2000), pensions benefits are assumed to be upgraded (indexed) at the rate $\pi + x\theta$, rate which covers all potential indexing rules. If $x=0$, pensions are indexed on inflation, if $x=1$, they are indexed on gross wages. It must be reminded that this upgrading rate is generally also the rate applied to activity wages for calculating pension benefits.

The replacement rate of gross wage, noted b, has the following value:

$$p_t^{A+1} = \beta . w_{t-1}^A . (1 + \pi + x.\theta)$$

Equations /2/ and /3/ so become:

/2/
$$R^{(1)} = w_{t-1}^A . (1-t) + p_{t+j-1}^{A+1} \sum_{j=0}^{N-1} \frac{(1+p+x.q)^j}{(1+r)^j}$$
$$= w_{t-1}^A . (1-t) + b . w_{t-1}^A \sum_{j=1}^{N} \left(\frac{1+p+xq}{1+r} \right)^j$$

/3/ $$R^{(2)} = b.(1-d) w_{t-1}^A . \frac{1+p+x.q}{1+p+q} . \sum_{j=0}^{N} \left(\frac{1+p+x.q}{1+r} \right)^j + \ell_{t-1}^A$$

Additionally, the actuarial fairness condition /1/ can be rewritten:

/1'/ $$-t w_{t-1}^A + b . w_{t-1}^A \sum_{j=1}^{N} \left(\frac{1+p+x.q}{1+r} \right)^j = b.(1-d) . w_{t-1}^A \frac{1+p+xq}{1+p+q} \sum_{j=0}^{N} \left(\frac{1+p+xq}{1+r} \right)^j$$

and gives, with /2/ and /3/, under the following assumptions:

- if $r = r$ and $w_{t-1}^A = \ell_{t-1}^A$, then $R^{(1)} = R^{(2)}$ and the worker makes no difference between the two situations, such as early job cessation or delayed retirement, what gives, under the assumption of an actuarially fair scale at the margin, the same satisfaction.

- if $r = r$ but $w_{t-1}^A < \ell_{t-1}^A$, then $R^{(1)} < R^{(2)}$. In that case, the worker draws a high satisfaction from leisure, and will opt for an early retirement, with the actuarially fair decrement in benefits.

- if $w_{t-1}^A < \ell_{t-1}^A$, what are the determinants of the retirement decision? Equations /2/ and /3/ give /4/:

/4/
$$R^{(1)} - R^{(2)} = -t.w_{t-1}^A + b.w_{t-1}^A.\sum_{j=1}^{N}\left(\frac{1+p+xq}{1+r}\right)^j - b.(1-d)w_{t-1}^A\frac{1+p+xq}{1+p+q}\sum_{j=0}^{N}\left(\frac{1+p+xq}{1+r}\right)^j$$
$$= -t.w_{t-1}^A + b.w_{t-1}^A.\sum_{j=1}^{N}\left(\frac{1+p+xq}{1+r}\right)^j - \left[-t.w_{t-1}^A + b.w_{t-1}^A.\sum_{j=1}^{N}\left(\frac{1+p+xq}{1+r}\right)^j\right]$$

As soon as $t < b$, the contribution rate is lesser than the replacement rate, which is always the case, and $r < r$, then $R^{(1)} > R^{(2)}$. In other words, when the time discount rate of an individual is high, he prefers to retire early as he does not give much weight to the loss in income induced by an early retirement.

- if $w_{t-1}^A \neq \ell_{t-1}^A$, actuarial fairness at the margin gives:

$$R^{(1)} - R^{(2)} = \left(w_{t-1}^A - \ell_{t-1}^A\right) + w_{t-1}^A b\left(1-(1-d)\frac{1+p+xq}{1+pq}\right)\sum_{j=1}^{N}(1+p+xq)^{j-1}\left[\frac{1}{(1+r)^j} - \frac{1}{(1+r)^j}\right]$$

If $w_{t-1}^A > \ell_{t-1}^A$ and $r < r$, then $R^{(1)} > R^{(2)}$. But if $w_{t-1}^A > \ell_{t-1}^A$ and $r > r$, then we do have $R^{(1)} < R^{(2)}$ as the second part of the right hand side is always negative and lower in absolute value than w_{t-1}^A. In other words, the preference for the present of an individual is such that the financial gain induced by actuarial fairness at the margin does not mean much to him, and the agent retires early.

LIST OF WORKING PAPERS RELEASED BY CEPII[9]

No	*Title*	*Authors*
2003-13	How Different is Eastern Europe? Structure and Determinants of Location Choices by French Firms in Eastern and Western Europe	A. C. Disdier & T. Mayer
2003-12	Market Access Liberalisation in the Doha Round: Scenarios and Assessment	L. Fontagné, J.L. Guérin & S. Jean
2003-11	On the Adequacy of Monetary Arrangements in Sub-Saharian Africa	A. Bénassy-Quéré & Maylis Coupet
2003-10	The Impact of EU Enlargement on Member States : a CGE Approach	H. Bchir, L. Fontagné & P. Zanghieri
2003-09	India and the World Economy : Traditional Specialisations and Technology Niches	S. Chauvin & F. Lemoine
2003-08	Imination Amongst Exchange-Rate Forecasters : Evidence from Survey Data	M. Beine, A. Bénassy-Quéré & H. Colas
2003-07	Le Currency Board à travers l'expérience de l'Argentine	S. Chauvin & P. Villa
2003-06	Trade and Convergence : Revisiting Ben-David	G. Gaulier
2003-05	Estimating the Fundamental Equilibrium Exchange-Rate of Central and Eastern European Countries the EMU Enlargement Perspective	B Egert & A. Lahrèche-Revil
2003-04	Skills, Technology and Growth is ICT the Key to Success	J. Melka, L. Nayman, S. Signano & N. Mulder
2003-03	L'investissement en TIC aux Etats-Unis et dans quelques pays européens	G. Cette & P.A. Noual
2003-02	Can Business and Social Networks Explain the Border Effect Puzzle?	P.P. Combes, M. Lafourcade &

9 Working papers are circulated free of charge as far as stocks are available; thank you to send your request to CEPII, Sylvie Hurion, 9, rue Georges-Pitard, 75015 Paris, or by fax : (33) 01 53 68 55 04 or by e-mail Hurion@cepii.fr. Also available on: \\www.cepii.fr. Working papers with * are out of print. They can nevertheless be consulted and downloaded from this website.

9 Les documents de travail sont diffusés gratuitement sur demande dans la mesure des stocks disponibles. Merci d'adresser votre demande au CEPII, Sylvie Hurion, 9, rue Georges-Pitard, 75015 Paris, ou par fax : (33) 01 53 68 55 04 ou par e-mail Hurion@cepii.fr. Egalement disponibles sur : \\www.cepii.fr. Les documents de travail comportant * sont épuisés. Ils sont toutefois consultable sur le web CEPII.

2003-01	Hyperinflation and the Reconstruction of a National Money: Argentina and Brazil, 1990-2002	T. Mayer J. Sgard
2002-18	Programme de travail du CEPII pour 2003	
2002-17	MIRAGE, a Computable General Equilibrium Model for Trade Policy Analysis	M.H. Bchir, Y. Decreux, J.L. Guérin & S. Jean
2002-16	Evolutions démographiques et marché du travail : des liens complexes et parfois contradictoires	L. Cadiou, J. Genet & J.L. Guérin
2002-15	Exchange Rate Regimes and Sustainable Parities for CEECs in the Run-up to EMU Membership	V. Coudert & C. Couharde
2002-14	When are Structural Deficits Good Policies?	J. Chateau
2002-13	Projections démographiques de quelques pays de l'Union Européenne (Allemagne, France, Italie, Royaume-Uni, Pays-Bas, Suède)	R. Sleiman
2002-12	Regional Trade Integration in Southern Africa	S. Chauvin & G. Gaulier
2002-11	Demographic Evolutions and Unemployment: an Analysis of French Labour Market with Workers Generations	J. Château, J.L. Guérin & F. Legros
2002-10	Liquidité et passage de la valeur	P. Villa
2002-09	Le concept de coût d'usage Putty-Clay des biens durables	M.G. Foggea & P. Villa
2002-08	Mondialisation et régionalisation : le cas des industries du textile et de l'habillement	M. Fouquin, P. Morand R. Avisse G. Minvielle & P. Dumont
2002-07	The Survival of Intermediate Exchange Rate Regimes	A. Bénassy-Quéré & B. Coeuré
2002-06	Pensions and Savings in a Monetary Union : An Analysis of Capital Flow	A. Jousten & F. Legros
2002-05	Brazil and Mexico's Manufacturing Performance in International Perspective, 1970-1999	N. Mulder, S. Montout & L. Peres Lopes
2002-04	The Impact of Central Bank Intervention on Exchange-Rate Forecast Heterogeneity	M. Beine, A. Benassy-Quéré, E. Dauchy & R. MacDonald
2002-04	The Impact of Central Bank Intervention on Forecast Heterogeneity	M. Beine, A. Benassy-Quéré, E. Dauchi & R. MacDonald

2002-03	Impacts économiques et sociaux de l'élargissement pour l'Union européenne et la France	M.H. Bchir & M. Maurel
2002-02	China in the International Segmentation of Production Processes	F. Lemoine & D. Ünal-Kesenci
2002-01	Illusory Border Effects: Distance Mismeasurement Inflates Estimates of Home Bias in Trade	K Head & T. Mayer
2001-22	Programme de travail du CEPII pour 2002	
2001-21	Croissance économique mondiale : un scénario de référence à l'horizon 2030	N. Kousnetzoff
2001-20	The Fiscal Stabilization Policy under EMU – An Empirical Assessment	A. Kadareja
2001-19	Direct Foreign Investments and Productivity Growth in Hungarian Firms, 1992-1999	J. Sgard
2001-18	Market Access Maps: A Bilateral and Disaggregated Measure of Market Access	A. Bouët, L. Fontagné, M. Mimouni & X. Pichot
2001-17	Macroeconomic Consequences of Pension Reforms in Europe: An Investigation with the INGENUE World Model	Equipe Ingénue
2001-16*	La productivité des industries méditerranéennes	A. Chevallier & D. Ünal-Kesenci
2001-15	Marmotte: A Multinational Model	L. Cadiou, S. Dees, S. Guichard, A. Kadareja, J.P. Laffargue & B. Rzepkowski
2001-14	The French-German Productivity Comparison Revisited: Ten Years After the German Unification	L. Nayman & D. Ünal-Kesenci
2001-13*	The Nature of Specialization Matters for Growth: An Empirical Investigation	I. Bensidoun, G. Gaulier & D. Ünal-Kesenci
2001-12	Forum Economique Franco-Allemand - Deutsch-Französisches Wirtschaftspolitisches Forum, Political Economy of the Nice Treaty: Rebalancing the EU Council and the Future of European Agricultural Policies, 9th meeting, Paris, June 26th 2001	
2001-11	Sector Sensitivity to Exchange Rate Fluctuations	M. Fouquin, K. Sekkat, J. Malek Mansour, N. Mulder &

		L. Nayman
2001-10*	A First Assessment of Environment-Related Trade Barriers	L. Fontagné, F. von Kirchbach & M. Mimouni
2001-09	International Trade and Rend Sharing in Developed and Developing Countries	L. Fontagné & D. Mirza
2001-08	Economie de la transition : le dossier	G. Wild
2001-07	Exit Options for Argentina with a Special Focus on Their Impact on External Trade	S. Chauvin
2001-06	Effet frontière, intégration économique et 'Forteresse Europe'	T. Mayer
2001-05	Forum Économique Franco-Allemand – Deutsch-Französisches Wirtschaftspolitisches Forum, The Impact of Eastern Enlargement on EU-Labour Markets and Pensions Reforms between Economic and Political Problems, 8th meeting, Paris, January 16 2001	
2001-04	Discrimination commerciale : une mesure à partir des flux bilatéraux	G. Gaulier
2001-03*	Heterogeneous Expectations, Currency Options and the Euro/Dollar Exchange Rate	B. Rzepkowski
2001-02	Defining Consumption Behavior in a Multi-Country Model	O. Allais, L. Cadiou & S. Dées
2001-01	Pouvoir prédictif de la volatilité implicite dans le prix des options de change	B. Rzepkowski
2000-22	Forum Economique Franco-Allemand - Deutsch-Französisches Wirtschaftspolitisches Forum, Trade Rules and Global Governance: A long Term Agenda and The Future of Banking in Europe, 7th meeting, Paris, July 3-4 2000	
2000-21	The Wage Curve: the Lessons of an Estimation Over a Panel of Countries	S. Guichard & J.P. Laffargue
2000-20	A Computational General Equilibrium Model with Vintage Capital	L. Cadiou, S. Dées & J.P. Laffargue
2000-19	Consumption Habit and Equity Premium in the G7 Countries	O. Allais, L. Cadiou & S. Dées
2000-18	Capital Stock and Productivity in French Transport:	B. Chane Kune &

	An International Comparison	N. Mulder
2000-17	Programme de travail 2001	
2000-16	La gestion des crises de liquidité internationale : logique de faillite, prêteur en dernier ressort et conditionnalité	J. Sgard
2000-15	La mesure des protections commerciales nationales	A. Bouët
2000-14	The Convergence of Automobile Prices in the European Union: An Empirical Analysis for the Period 1993-1999	G. Gaulier & S. Haller
2000-13*	International Trade and Firms' Heterogeneity Under Monopolistic Competition	S. Jean
2000-12	Syndrome, miracle, modèle polder et autres spécificités néerlandaises : quels enseignements pour l'emploi en France ?	S. Jean
2000-11	FDI and the Opening Up of China's Economy	F. Lemoine
2000-10	Big and Small Currencies: The Regional Connection	A. Bénassy-Quéré & B. Coeuré
2000-09*	Structural Changes in Asia And Growth Prospects After the Crisis	J.C. Berthélemy & S. Chauvin
2000-08	The International Monetary Fund and the International Financial Architecture	M. Aglietta
2000-07	The Effect of International Trade on Labour-Demand Elasticities: Intersectoral Matters	S. Jean
2000-06	Foreign Direct Investment and the Prospects for Tax Co-Ordination in Europe	A. Bénéssy-Quéré, L. Fontagné & A. Lahrèche-Révil
2000-05	Forum Economique Franco-Allemand - Deutsch-Französisches Wirtschaftspolitisches Forum, Economic Growth in Europe Entering a New Area?/The First Year of EMU, 6th meeting, Bonn, January 17-18, 2000	
2000-04*	The Expectations of Hong Kong Dollar Devaluation and their Determinants	B. Rzepkowski
2000-03	What Drove Relative Wages in France? Structural Decomposition Analysis in a General Equilibrium Framework, 1970-1992	S. Jean & O. Bontout
2000-02	Le passage des retraites de la répartition à la capitalisation obligatoire : des simulations à l'aide	O. Rouguet & P. Villa

	d'une maquette	
2000-01*	Rapport d'activité 1999	
1999-16	Exchange Rate Strategies in the Competition for Attracting FDI	A. Bénassy-Quéré, L. Fontagné & A. Lahrèche-Révil
1999-15	Groupe d'échanges et de réflexion sur la Caspienne. Recueil des comptes-rendus de réunion (déc. 97- oct. 98)"	D. Pianelli & G. Sokoloff
1999-14	The Impact of Foreign Exchange Interventions: New Evidence from FIGARCH Estimations	M. Beine, A. Bénassy-Quéré & C. Lecourt
1999-13	Forum Economique Franco-Allemand - Deutsch-Französisches Wirtschaftspolitisches Forum, Reduction of Working Time/Eastward Enlargment of the European Union, 5th meeting, Paris, July 6-7 1999	
1999-12*	A Lender of Last Resort for Europe	M. Aglietta
1999-11*	La diversité des marchés du travail en Europe : Quelles conséquences pour l'Union Monétaire ; Deuxième partie : Les implications macro-économiques de la diversité des marchés du travail	L. Cadiou, S. Guichard & M. Maurel
1999-10*	La diversité des marchés du travail en Europe : Quelles conséquences pour l'Union Monétaire ; Première partie : La diversité des marchés du travail dans les pays de l'Union Européenne	L. Cadiou & S. Guichard
1999-09	The Role of External Variables in the Chinese Economy; Simulations from a macroeconometric model of China	S. Dees
1999-08	Haute technologie et échelles de qualité : de fortes asymétries en Europe	L. Fontagné, M. Freudenberg & D. Ünal-Kesenci
1999-07	The Role of Capital Accumultion, Adjustment and Structural Change for Economic Take-Off: Empirical Evidence from African Growth Episodes	J.C. Berthélemy & L. Söderling
1999-06	Enterprise Adjustment and the Role of Bank Credit in Russia: Evidence from a 420 Firm's Qualitative Survey	S. Brana, M. Maurel & J. Sgard
1999-05	Central and Eastern European Countries in the International Division of Labour in Europe	M. Freudenberg & F. Lemoine

1999-04	Forum Economique Franco-Allemand – Economic Policy Coordination – 4 th meeting, Bonn, January 11-12 1999	
1999-03	Models of Exchange Rate Expectations: Heterogeneous Evidence From Panel Data	A. Bénassy-Quéré, S. Larribeau & R. MacDonald
1999-02	Forum Economique Franco-Allemand – Labour Market & Tax Policy in the EMU	
1999-01	Programme de travail 1999	

CEPII
DOCUMENTS DE TRAVAIL / WORKING PAPERS

Si vous souhaitez recevoir des Documents de travail,
merci de remplir le coupon-réponse ci-joint et de le retourner à :

Should you wish to receive copies of the CEPII's Working papers,
just fill the reply card and return it to:

Sylvie HURION – Publications
CEPII – 9, rue Georges-Pitard – 75740 Paris – Fax : (33) 1.53.68.55.04

M./Mme / Mr./Mrs .....

Nom-Prénom / Name-First name .....

Titre / Title .....

Service / Department.....

Organisme / Organisation .....

Adresse / Address.....

Ville & CP / City & post code .....
Pays / Country..... Tél. .....

Désire recevoir les **Document de travail** du CEPII n° :

*Wish to receive the **CEPII's Working Papers No**:* .....

.....

.....

.....

.....

.....

.....

.....

.....

☐ Souhaite être placé sur la liste de diffusion permanente (**pour les bibliothèques**)
*Wish to be placed on the standing mailing list **(for Libraries)**.*