

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

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Abstract

The paper discusses similarities and differences between NDC and the French and German point systems. The study focuses on how these systems differ when there is an external shock (demographic, economic, or other) and discusses the possible consequences of moving from the point system to NDC. The French point system—because it does not have automatism in its indexing device—can be regulated each year according to forecasts. The paper concludes that this may be the best way to react to changes in the economic and demographic environment. However, to do so this requires, first, reliable and frequent forecasts, and, second, total independence of the governing board of the scheme from the retiree and worker lobbies. While the second requirement can be handled with rules, as opposed to the current state of affairs, it is questionable as to whether the first requirement can be fulfilled. Germany has adopted a method to correct the excessive generosity of the scheme with what the author calls a “return spring”—a mechanism in which the pension yield is lowered in relation to a desired contribution rate. This mechanism is reinforced by the “Rürup sustainability factor,” which explicitly introduces the dependency ratio and accounts for life expectancy changes. With this strategy, it is probable that the German scheme will move into surplus within some years, allowing for a reserve that might be needed for intergenerational transfers. The paper concludes by asking the question, why introduce NDC? The author’s answer is that financial defined contribution (FDC) schemes promote individual responsibility, while NDC maintains the principle of social cohesion in public pension schemes.

Classification JEL: H55, J22, J26

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Introduction

In recent years, many countries have taken steps to increase the age at which individuals receive benefits from their retirement programs. This is supposed to shift the incentives in the right direction: that is, to keep workers in the workforce longer than they have been in the recent decades. Notional defined contribution (NDC) pension plans have been considered one of the best means to increase the effective retirement age because they take into account the individuals' whole career, from the first day to the last. From this point of view, they are closer to actuarial fairness than traditional pay-as-you-go (PAYG) defined benefits (DB) pension plans.

This is probably one reason why NDC have received increasing attention during the last years, even if the ability to increase the labor force participation rates for the older workers has probably been oversold.

Other reasons why NDC has received attention recently are qualities such as transparency, flexibility, adequacy of provided pensions, and robustness: that is, the ability to resist various economic and demographic shocks.

This study focuses on the feature of robustness and assesses it by analyzing the Swedish system (as a benchmark) and comparing it to the German and French schemes that often have been claimed to be NDC variants (Valdès-Prieto 2000; Watson Wyatt 2004).

To this end, the chapter is organized as follows. The next section briefly describes the French and the German pensions schemes. It then considers key points of NDC and actuarial fairness: how pure NDC guarantees actuarial fairness both at the margin and on average, and how this is reflected in the role of the life expectancy in the parameters of NDC pension schemes. In the third section, the study focuses on the conceptual equivalence between the French, German, and Swedish systems and highlights the differences in their design and in their evolution policies. This leads to a discussion of how the reactions of these systems differ when there is an external shock (demographic, economic, or other). The chapter concludes with a discussion about the possibility (and opportunity) to move from a point scheme toward a NDC scheme (whether pure, with a minimum pension scheme, or some combination). The conclusion considers the redistributive impacts of such a transition between generations and inside a generation.

A Quick Description of French and German Pension Schemes

French and German pension schemes have a component that uses points: that is, part of these schemes provides a pension that depends on the individuals' whole career.

France

This section focuses on the main French pension scheme: the compulsory pension scheme that provides pensions to employees in private enterprises, including white collar workers: about 61 percent of the working population. There are plenty of other schemes. Some run like the basic French pension scheme, the so-called "régime general", discussed below. Some run like the private sector pension scheme. The previous ones include both a scheme that is close to the "régime général" and a scheme with points.

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

The basic general scheme ("régime general", or CNAV) offers benefits corresponding to the share of the wages below the social security ceiling (TRA, equal to 2516 euros per month, for the year 2005). The complementary schemes include AGIRC for executives, for the fraction of their wages over TRA; and ARRCO, for the others workers, based on their total wage, and for executives, for wages below TRA. These plans are summarized in table 10.1.

Table 10. 1 Schemes and Contributions in the Main French Pension Scheme

Considered wage share:	Below TRA	up to three times TRA	up to eight times TRA
Population			
Non-executives	CNAV <i>Workers: 6.55%*</i> <i>Firms: 8.2 %*</i> <i>Total: 14.75%*</i>	CNAV: + <i>Firms: 1.6%</i> ARRCO <i>Workers: 6.4%</i> <i>Firms: 9.6%</i> <i>Calling rate: 125 %**</i> <i>Effective rate: 20%*</i>	
Executives	CNAV <i>Id non executives</i> ARRCO <i>Id. Non executives</i>	AGIRC <i>Workers:6%</i> <i>Firms: 10%</i> <i>Calling rate: 125%**</i> <i>Effective rate: 20%*</i>	AGIRC <i>Workers:6%</i> <i>Firms: 10%</i> <i>Calling rate: 125%**</i> <i>Effective rate: 20%</i>

Source: Author's compilations.

Notes:

*Contribution rates: they are applicable to the gross wage in the defined interval (EX: below the TRA)

** The calling rate is a multiplicative factor which is applied to the contractual contribution rate in order to increase the schemes' resources (EX: Below the TRA, workers are supposed to contribute up to 2.4% of their gross wage – contractual rate – but pay in reality 125% of 2.4% i.e. 3% while they accumulate their rights proportionally to the contractual rate,).

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

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

where w is the yearly gross reference wage average of the 25 best wages for the generation born after 1948.¹ The “rate of pension”, α , is:

$$\alpha = 0.50 * [1 - 0.10 * \text{Min}[40 - T; 65 - A)],$$

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

The last reform (approved on August 21, 2003) will progressively affect the formula as follows. The full rate contributing period (40 years, currently) will increase according to the gain in life expectancy (one quarter a year between 2009 and 2012, in order to increase 42 years in 2012). The discount rate, which is currently 0.10, will decrease step by step to reach 0.05 in 2013. The $T/37.5$ term's denominator (currently 37.5, corresponding to the full rate contributing period before the previous reform in 1993) will increase by two quarters a year to reach $T/40$ in 2008 ; at this period it will be equal to the full rate contributing period (40 years). After 2008, it will increase by one quarter a year and reach 42 years in 2012. If the corresponding full rate is denoted by T' , the contributing period in the above formula becomes:

$$P_{cnav} = w * \alpha * \text{Min}[1, (T / T')], \text{ and}$$

$$\alpha = 0.50 * [1 - 0.05 * \text{Min}[T' - T; 65 - A)].$$

Note the existence of a minimum pension provided by CNAV. It reaches 6,935 euros per year for a single person and 12,440 euros for a cohabiting or married couple.

The complementary pension schemes are fully contributory schemes. The first pensions after retirement, P_{comp} , are computed according to a system of points, which are the pension basic units. These are “sold” when people retire at the age of A (after a career of length T) at the price that prevails during the year $C+A$ (C being the cohort generation: that is, the birth year). Thus the value of the point, VP , a virtual price at which individuals transform their virtual capital - corresponding to the sum of the points that are accumulated during the working period - into a yearly pension, is expressed as, VP_{C+A} .²

$$P_{comp,C+A} = \left[\sum_T points \right] * VP_{C+A}$$

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

$$point\ s_t = point\ s_{ARRCO,t}$$

$$point\ s = [\tau_{ARRCO,TRA} * w \leq TRA + \tau_{ARRCO,TRB} * TRA < w \leq TRB] / PP_{ARRCO}$$

For executives:

$$point\ s = [\tau_{ARRCO,TRA} * w \leq TRA] / PP_{ARRCO} + [\tau_{AGIRC} * TRA < w \leq TRC] / PP_{AGIRC},$$

where $\tau_{ARRCO,TRA}$, $\tau_{ARRCO,TRB}$, and τ_{AGIRC} are the so-called “contractual contribution rates” or “facial contribution rates” of the regimes (respectively, 6 and 16 percent in 2005); TRB and TRC are equal to three and eight times TRA (7 548 and 19,456 euros per month, respectively, in 2005). PP_{ARRCO} and PP_{AGIRC} are the “purchasing” price of a point.

Note that during the retirement period, while basic pensions (CNAV) are revalued at the inflation rate, complementary pensions are revalued at the point’s value, VP_t .

One of the ways to handle the resources of the schemes is a coefficient, the “calling rate” which, applied to the facial contribution rate, increases the schemes’ resources. For example, the flow of income of ARRCO is given by:

$$Resource_{ARRCO} = [\tau_{ARRCO,TRA} * coeff] * w \leq TRA + [\tau_{ARRCO} * coeff] * TRA < w \leq TRB.$$

With the current *coeff* equal to 125 percent, that leads to the effective contribution rates of 7.5, and 20 percent. This coefficient (the “calling rate”) is an important means to manage the scheme, like the price and the value of the point. This rate was lower than one during the first decades of existence of the system and now increases more or less regularly.

Simplifying matters,³ the French complementary pensions by points are computed according to the following formula for an individual i who retires at age A after a contribution period lasting from t_0 to $A-1$:

$$P_{C+A}^i = \sum_{t=t_0+1}^A \frac{\tau_{t-1} * w_{t-1}^i}{PP_{t-1}} * VP_{C+A} \quad (10.1)$$

This is the pension that the pensioner gets when aged of $A+C$ while the resources of the scheme in t are:

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

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 about the pension schemes. Also note that AGIRC and ARRCO are private associations linking together sectoral pension schemes. This is because when the schemes were created each economic sector had its own pension scheme. French complementary pension schemes are fully contributive and proportional schemes (according to their Bismarckian origin), compared to the basic scheme that only partially relies on the career and that includes a flat part. They are managed by trade unionists with the help of retirement specialists, including actuaries and financial investors. They were created in 1945, and were designed by insurers. They became compulsory in 1972. The accounts are held by individuals.

The management of the executives' pension scheme, AGIRC, serves as an example of the "piloting" of such schemes. Since the first oil shock in 1974, a decrease in the pensions' yield has been scheduled. The analysis of AGIRC data shows the prevailing, discrete, and progressive mechanism based on the price of the point (*PP*). This is because as soon as *PP* increases more quickly than the contributors' average wage, the number of points earned decreases. In 1970, a share contribution of 13.9 percent of the taxable wage provided 1,000 points, while the same contribution rate would have provided only 850 points at the end of the 1990s (Hamayon 1995). The trade-off between the price increase, the value decrease, and the calling rate management is a result of the burden-sharing between retirees and contributors. Until 1976, the AGIRC point value was the result of an automatic adjustment by comparing for the next 10 years the expected contributions' flows to the expected pensions' flows (and taking into account the buffer fund⁴ balance). In 1976, the point value was forecast to drop sharply and the pensions' schemes' board chose to favor the retirees and to employ the calling rate.

Germany

The German pension scheme (described, for example, in Queisser 1996; Vernière 2001) seems simpler since it relies on only a single point scheme that covers not only the employees of the private enterprises but also certain self-employed and some other specific parts of the population: some 85 percent of the active population.

In fact, as it includes an early retirement pension scheme, the qualifying conditions are quite complex. Note that this is not the case in France, where, by law, early retirement does not exist. Old workers," i.e. workers just below the retirement age, are exempted to search for a job that they would not find anyway and do draw pensions that are generally funded either by unemployment schemes or by disability insurance. This "tool" has been hugely used by firms in order to decrease their wage bill when useful.

Compared to the French pension schemes, the contributory ceiling in the German system is rather low. As noted, in France, workers must contribute until their wage reaches eight times the social security ceiling (20 128 euros): that is, 8.5 times the average wage. In Germany, the contributory ceiling is 1.8 times the average wage. This has implications that will be discussed in the next section of this chapter.

There is no minimum contributory wage in Germany, 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 percent of the value of contribution for average earnings of all insured persons. Since the 2001 reform (Veil 2003) there has been a minimum pension, which helps very low-income pensioners. On the other hand, there are non-contributory additional rights for part-time working women and for children's care.

Like the French pension point schemes, each working period provides pension rights according to the wage earned by the contributor. The gross pension is given by the following formula:

$$P_{C+A}^i = \sum_{t=t_0}^A \frac{w_{t-1}^i}{\bar{w}_{t-1}} * \alpha^i * VP_{C+A}, \quad (10.2)$$

The notations are the same as for France in equation 10.4: \bar{w}_t is the gross average wage in t ,

α is the entry factor corresponding *grosso modo* to the French rate of pension, and w_t^i is the part of the wage under the ceiling.

$\alpha = 1 - [0.003(780 - A(12))]$, where $A(12)$ means age A in months.

This means that there is a discount equal to 0.003 per month in case the pension is drawn before 65.

Most of the adjustments rely on the value of the point VP .

The 2001 reform deeply changed the parameters in the indexation formula:

$$VP_t = VP_{t-1} * \frac{\bar{w}_{t-1}}{\bar{w}_{t-2}} * \frac{x - \tau_{t-1} - \mu_{t-1}}{x - \tau_{t-2} - \mu_{t-2}} \quad (10.3)$$

The indexation coefficient, x , was supposed to change. Between 2001 and 2010,

$x=1$, meaning a full indexation on net wages. After 2010,

$x= 0.9$, meaning partial indexing.

The variable μ is the contribution rate to the voluntary additional private pension scheme sponsored by the fiscal chapter of the reform. What is called here net wage is in fact the wage net of all contributions dedicated to pension schemes (but containing the personal income tax).

In the forecasting exercises, the value of μ was supposed to increase between 2001 to 2008, from 0.5 to 4 percent, and remain stable after 2008. It corresponds to the value that binds the fiscal constraint.

This reform has quickly been judged as inefficient.⁵ The so-called Rürup report led in October 2003 to another indexing formula, which will hold until 2010:

$$VP_t = VP_{t-1} * \frac{\bar{w}_{t-1}}{\bar{w}_{t-2}} * \frac{x - \tau_{t-1} - \mu_{t-1}}{x - \tau_{t-2} - \mu_{t-2}} * SF_t \quad (10.4)$$

SF is the sustainability factor, defined as:

$$SF_t = \left(1 - \frac{s_{t-2} * N_{t-3} / N_{t-2}}{s_{t-3} * N_{t-4} / N_{t-3}} \right) * 0.25 + 1$$

where:

$s_{t-2} * N_{t-3} / N_{t-2}$ is the socio-demographic dependency ratio: that is, the ratio of the retirees (in $t-2$, those who were active in $t-3$ and living in $t-2$) to those active in $t-2$.

That means that—in the long run, with a constant demographic structure—the pensions will increase like the gross wages. In the transition period (the demographic shock), the pensions will increase like net wages minus the 25 percent of the demographic drift (that is, 25 percent of the demographic drift will be “paid” by retirees).

As in the French scheme, life expectancy does not appear explicitly in the pensions’ formula. It is implicitly introduced by two means: by the scheme equilibrium that links the contribution rate to the dependency ratio; and by means of the dependency ratio, which strongly depends on the retirees life expectancy.

If it is assumed that the fiscal resources of the pension scheme (ecotax, the german energy tax program dedicated to limit the industrial consumption of polluting energy, 32 percent of the scheme resources) remain 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, resources can be derived as:

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

1- NDC and Actuarial Fairness

In both countries, many individuals used to quit their job five years before the legal pensionable age. To provide incentives to delay this retirement, actuarial fairness at the margin is a concept that must be explored. The following section shows that even if one ignores 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 on average is a preferable concept. It provides every generation a pension strictly equivalent to its contributions; it spontaneously leads to NDC. Unfortunately, the second part of this section shows that this collective concept can be unfair overall for individuals with low life expectancies. .

Actuarial fairness at the margin: an individual concept

Actuarial fairness at the margin works along those lines: early retirement is swapped against a proportional reduction of the pensions benefits during the whole retirement period. If the agent decides to postpone his retirement (after a legal minimum retirement age, for example) and do not retire at date $t-1$ and age A , but waits until date t and age $A+1$, he or she will pay his or her contributions and will benefit from a higher pension. On the other hand, if he or she retires early, his or her benefits will be reduced by a fraction d during his or her entire retirement (this reduction is called “decruel”). By retiring early, the agent will save contributions and benefit from a longer period of leisure.

That actuarially fair decruel 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 decruel 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 decruel will have an impact on agents’ behaviour. In the first case, if the decruel is high, it is costly for an agent to leave early and few workers are likely to make that choice. In the second, if the decruel is low, early retirement benefits the pensioners and the attractiveness of that formula will help degrade the budgetary balance of the system.

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

With the same logic, it can be inferred that if pensions are indexed on gross wages, the accrual/decruel has to be higher than if they are indexed on prices. (For a formal demonstration, see the annex.)

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

- If $\rho = r$ and $w_{t-1}^A = \ell_{t-1}^A$, then the worker is indifferent between ceasing work early or delaying retirement.
- If $\rho = r$ but $w_{t-1}^A < \ell_{t-1}^A$, then the worker draws a high satisfaction from leisure, and he or she will opt for an early retirement, with the actuarially fair decrual in benefits.
- If $w_{t-1}^A < \ell_{t-1}^A$, and $\rho < r$, then because his or her discount rate is high, the individual prefers to retire early, as he or she does not give much weight to the loss in income induced by an early retirement.
- If $w_{t-1}^A > \ell_{t-1}^A$ and $\rho < r$, then the individual opts for a postponed retirement, but if $w_{t-1}^A > \ell_{t-1}^A$ and $\rho > r$, then the individual's preference for the present is so high that the financial gain induced by actuarial fairness at the margin does not mean much to him or her, and the agent retires early.

So the efficiency of the system's parameterization 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 aging 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 about life expectancy increases preference for the present.

The value of the actuarially fair decrual rate changes with the indexing rule. (This holds as well for an indexing on the net wages.) It rises with the interest rate and the contribution rate, and decreases in line with life expectancy, the inflation rate, technical progress, and the replacement rate. It is worth noting that with realistic data and even without giving any value to the leisure, the decrual will have high values: 6.6 percent with indexed pensions on prices and 7.1 percent in the case of indexed pensions on gross wages. As can be seen, for a standard "Bismarckian" PAYG pension system, actuarial fairness at the margin implies a high value of the decrual, far from the values given by a linear calculus. (A replacement rate of 60 percent after 40 years of work gives an accrual rate of 1.5 percent.) Thus it is necessary to have a bend in the accrual curve of benefits. In other words, the concept of actuarial fairness at the margin can apply only 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 productivity gains change every year, the benefits accrual curve has to change as well.

Now consider the case of a system displaying both Beveridgian and Bismarckian elements. Every pensioner earns a pension compounded of two parts. One is proportional to his career (as previously) and one is a lump sum fixed independently of his career profile, not subject to the decrual. Such a system cannot be actuarially fair to every member simultaneously, as the benefits decrual rate is now a function of the wage and so depends on the wage profile of the individual. Because such minima exist in both the German and the French systems, actuarial fairness for the whole system is only a desideratum and cannot be reached.

The existence of a contributory ceiling is another point that moves the schemes away from actuarial fairness at the margin. This is particularly the case of Germany, assuming that a worker has a non-negligible probability of attaining this wage level by the end of his working life and that postponing his/her retirement has a very weak return. That means that when this is the case, i.e. when the contributory ceiling is rather weak, the accrual is nearly zero.

Another consideration is the cost of actuarial fairness at the margin. If leisure is valued highly, the value of the decrual (or the accrual) should be higher than the values given previously. That means that there is an infinite number of decruals/accruals, which provide actuarial fairness. A financial level, with a null value of leisure insures the financial equilibrium of the scheme. An individual level, with a bigger value of leisure, insures personal optimality. This is because: first, it is generally assumed that there is a decreasing relationship between life expectancy and value of leisure;⁶ second, there are non-Bismarckian elements in the pension scheme which imply a decreasing relationship between the individual wage and decrual. For these reasons, the optimal decrual for low incomes will be higher than the optimal decrual for high incomes. Thus if the government's wish is to retain high and low incomes on the labor market (which pools the longevity risks, as can be seen in table 10.2), the decrual should be quite high but very costly.

Actuarial fairness at the margin 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.

Table 10.2: Life Expectancy at Age 60, by Socio-professional Categories, in Years (the case of France)

Category	Males	Females
Executives, self-employed	22.5	26.0
Intermediate profession (technicians, etc.)	19.5	25.0
Artisan, shopkeepers, firm managers	19.5	25.0

Employees	19.0	24.0
Workers	17.0	23.0

Source: Mesrine, 1999.

In order to combine individual freedom, incentives, and financial equilibrium for all the ages, actuarial fairness on average seems to be a better concept than actuarial fairness at the margin. 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 labor incentive character is less distinct than in the case of actuarial fairness at the margin.

NDC: actuarial fairness on average

In an actuarially fair system on average, 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 is outside that logic. Those systems are left aside in the following analysis. As soon as the pension system allows for full freedom in retirement age, the respect of actuarial fairness on average necessarily implies the respect of actuarial fairness at the margin. In 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 on average does not imply budgetary balance in case of a demographic or economic shock.

Two kinds of pension systems can aim to attain that notion of actuarial fairness **on average**: the fully funded schemes and 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 or her pension contributions over his or her active lifetime. The hoarding of those contributions constitutes virtual capital, increased according to a specific rule of indexing. On the date of retirement, that virtual capital stock is converted into annuities according to a transformation coefficient that depends on the liquidation age and retirement life expectancy. In sharp contrast with the notion of actuarial fairness at the margin, fairness on average 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 ρ can so be defined as:

$$1 + \rho_t = \frac{P_{t+1}^i * s_{t+1}}{\tau_t w_t},$$

where s_{t+1} is the portion of period $t+1$ that is to be lived by the average retired individual:

$$s_{t+1} = \frac{\sum_i s_{t+1}^i}{N_t}. \text{ The value of that rate, as well as the contribution rate, are assumed to be the same}$$

for all the agents at the given date.

Of course, for an individual, one is able to compute his or her own personal internal return rate:

$$1 + \rho_t^i = \frac{P_{t+1}^i * s_{t+1}^i}{\tau_t w_t^i}$$

As soon as the system is of a PAYG nature, the earnings at date t of the system can be written as

$$R_t = \sum_i \tau_t w_t^i \text{ and the benefits paid amount to: } \quad (10.5)$$

$$E_t = \sum_i P_t^i * s_t^i, \quad (10.6)$$

with i denoting the individuals (active or pensioners).⁷ 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.

Consider 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 $t+1$:

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

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

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

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

$$E_{t+1} = R_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1}}{s_t} (1 + g_t) \frac{\tau_t}{\tau_{t+1}} \frac{\sum_i w_t^i}{\sum_i w_{t+1}^i} R_{t+1}. \quad (10.7)$$

As soon as the pension scheme contribution rate does not vary (which is generally the purpose of the switching from a “usual” PAYG toward a NDC PAYG), the indexing rule will try to provide an automatic stabilizing device to the pension scheme. At the first glance, there is no NDC or point pension scheme providing this kind of automatic stabilizer, 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.

There is a huge difference, on the one hand, between 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 stabilize *ex ante*. In other words, even if the stabilizer is adequate, it can be inefficient or even incapable of playing its role.

NDC and Resistance to Various Shocks

As a consequence of the above developments, actuarial fairness on average, which is **very close** to pure NDC, can be a source of unfairness. Moreover, it has no automatic stabilizing device. In other words, if the stabilization of this type of scheme is discretionary (for example, decreasing pension benefits to avoid imbalances) the condition of actuarial fairness is broken. This implies a perfect forecasting i.e. no discretionary adjustments once the unbalance cannot be avoided but a perfect planning of future variables.

As shown, there is a need for a “zero pillar” (Holzmann, chapter 11, this volume) in order to provide some redistribution towards the poorest.

A pure NDC—actuarially fair on average—is then far from being ideal. This chapter considers two actual cases, the French and German systems, to which, as a benchmark, is added the Swedish system, often presented as an ideal NDC..

Consider first the **Swedish system**: a PAYG scheme with virtual funding.

The basis of such a scheme is “virtual” capital, K , which arises through the accumulation of pension rights through contributions. This capital is re-evaluated each period, at the rate r , while A is the age when retiring, and C is the birth date, which identifies the cohort C and K_t^C can be written as follows:

$$K_t^C = K_{t-1}^C(1 + r_{t-1}) \text{ or } K_A^C = \sum_{t=t_0}^{A-1} \tau w_t (1 + r)^t$$

Note that in order to be closer to the effective scheme, the contributing period can be divided into sub-periods t . The virtual capital, K_t^C , comes from the past flows of contributions during the entire contributing period. At age A , an individual can draw a pension, which is supposed to be re-evaluated during the pension period (whose length is the cohort’s life expectancy at retirement). This—initial—actualized pension, P_A^C , is the capital divided by s_A^C , the life expectancy of cohort C when age A , which appears in this type of scheme as a central management parameter. This yields:

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

In the Swedish pension scheme, $r = 1.6$ percent. This is a parameter of a “yield in advance” given to the contributors, representing a benchmark of economic growth. During the pension period, the index g is close to the nominal growth rate of the per capita GDP from which this yield in advance is derived. Without any loss, is it later assumed 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 lead to:

$$E_{t+1} = R_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1}}{s_t} (1 + g_t) \frac{\tau_t \sum_i w_t^{iC}}{\tau_{t+1} \sum_i w_{t+1}^{iC}} R_{t+1}$$

where it is not only the period that is in 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: say, one year. The two-period model provides 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 that 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.

The same type of calculation in *the French case* provides different insights. Without any loss in the argument, let us denote the contribution rate as τ (instead of $\tau * coeff$, which means to replace the contractual rate multiplied by the calling rate by a single rate). In this case, equations 10.5 and 10.6 still hold. In addition to equation 10.1 and taking into account the indexing rule to the value of the point, the previous equation becomes:

$$E_t = \sum_i \sum_{t=t_0+1}^A \frac{\tau_{t-1} * W_{t-1}^j}{PP_{t-1}} * VP_t * s_i^t \text{ and then:}$$

$$R_{t+1} = E_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1} * VP_{t+1}}{s_t * VP_t} \sum_t \frac{\tau_t / PP_t}{\tau_{t-1} / PP_{t-1}} * \frac{\sum_i \sum_t W_t^i}{\sum_i \sum_t W_{t-1}^{i-1}} * \frac{\tau_t \sum_i W_t^i}{\tau_{t+1} \sum_i W_{t+1}^{i+1}} * R_{t+1}$$

$$\frac{VP_{t+1}}{VP_t} \sum_{t=t_0}^A \frac{\tau_t / PP_t}{\tau_{t-1} / PP_{t-1}} \text{ represents the adjustment parameters of the scheme.}$$

Some remarks are in order:

- First, there are three parameters: the contribution rate, the price of the point, and the value of the point. The transformation of one wage unit into n units of pensions depends on the relative evolution of the three parameters.
- The parameters can be changed every year, but the burden will not fall on the same persons. Changing the contribution rate, or the price of the point, or both will affect both the contributors and the pensioners (like a change in the contribution rate in a “normal” PAYG pension scheme); however, the “old” contributors will be affected during a shorter period. Changing the value of the point will affect both the young retirees (i.e. those who just retired during the last years) and the contributors, whose pension will be changed by this decrease or increase (this can be compared to 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 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 the adjustments 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 enlarged by 40 billion euros in provisions.
- The above result shows the need for yearly adjustments. The first term represents the change in

life expectancy between two cohorts and may be rather weak. The terms $\frac{\sum_i \sum_t w_t^i}{\sum_i \sum_t w_{t-1}^{i-1}}$ and

$\frac{\tau_t \sum_i w_t^i}{\tau_{t+1} \sum_i w_{t+1}^{i+1}}$, 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 remain:

$$P_{C+A}^i = \sum_{t=t_0}^A \frac{w_{t-1}^i}{\bar{w}_{t-1}} * \alpha^i * VP_{C+A}$$

$$VP_t = VP_{t-1} * \frac{\bar{w}_{t-1}}{\bar{w}_{t-2}} * \frac{x - \tau_{t-1}}{x - \tau_{t-2}} * \left(I - \frac{s_{t-2} * N_{t-3} / N_{t-2}}{s_{t-3} * N_{t-4} / N_{t-3}} \right) * 0.25 + I$$

, without any change in the reasoning (provided we take into account the fact that the contributions to the additional pension fund are exogenous, that the sensitivity of a FFS scheme to the demographic shocks is the same as the sensitivity of a PAYG to the same shock, or both. This leads to consider τ instead of $\tau + \mu$).

That implies the following:

$$P_{t+1}^i = P_t^i * \underbrace{\left[\frac{\bar{w}_t}{\bar{w}_{t-1}} * \frac{x - \tau_t}{x - \tau_{t-1}} * \left(I - \frac{s_{t-1} * N_{t-2} / N_{t-1}}{s_{t-2} * N_{t-3} / N_{t-2}} \right) * 0.25 + I \right]}_{(I+g_t)}$$

In other words, this yields the same NDC scheme as the one described in the second part of this chapter. It leads to a corroboration:

$$E_{t+1} = R_{t+1} \Leftrightarrow E_{t+1} = \frac{s_{t+1}}{s_t} (I + g_t) \frac{\tau_t}{\tau_{t+1}} \frac{\sum_i w_t^i}{\sum_i w_{t+1}^i} R_{t+1}. \quad (10.8)$$

$$\text{with } (I + g_t) = \frac{\bar{w}_{t-1}}{\bar{w}_{t-2}} * \frac{x - \tau_{t-1}}{x - \tau_{t-2}} * \left[\left(I - \frac{s_{t-1} / (I + n_{t-2})}{s_{t-2} / (I + n_{t-3})} \right) * 0.25 + I \right]$$

On the surface, this analysis leads to a notional interest rate, which is the growth rate of the net average wage. In fact, this formula deserves a rather long comment.

First, g_t depends on τ_t , which depends on the PAYG equilibrium in t , which mainly comes from g_{t-1} , yielding \bar{P}_t . Intuitively, there is a huge difference between the French and the German pension schemes. Any change in VP in the French pension scheme is a burden for contributors (as future pensioners—and not for the already pensioners whose pension has not been changed. By contrast, a change in VP in the German pension scheme is a burden shared between pensioners and contributors, since any change in τ_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 is rebalanced by an increase in τ_{t+1} (a burden for the contributors), which decreases g_{t+1} (a burden for both contributors and retirees: in other words, for current and future retirees). This mechanism will later be called the “return spring mechanism.” It corresponds to the left-hand side of the equation.

Second, the “Rürup formula”⁸ explicitly introduces the demographic ratio, which becomes quite easily a ratio depending on life expectancy, s , and labor force growth rate, n . How does that change if we compare the new formula (Rürup’s) with the “Riester formula”? First, it explicitly introduces demography: until now, the burden was shared between contributors and retirees, as described above. Now, the retirees pay 25 percent of the burden. This will limit the increase in g , and thus in τ . A second point is linked with the way the retirement pensions schemes are funded in Germany. With the previous formula, it would have been possible to increase the fiscal part of the funding,

leaving constant the contribution rates with no change in the point growth rate. Now, because exogenous data hold, this full “fiscalization” of the deficit is not possible.

The problem now is to explain two matters:

- How does the “return spring” work?
- How is the balance in PAYG achieved: Specifically, what are the links to financial stability of the NDC scheme?

How does the “return spring” work?

Consider the left-hand side of the equation, yielding $(1+g_t)$. Roughly speaking, the “return spring” mechanism is the following:

$$\left. \begin{matrix} \tau_t \\ \tau_{t-1} \end{matrix} \right\} \rightarrow I + g_t \rightarrow VP_{t+1} \rightarrow E_{t+1} \rightarrow \tau_{t+1} \rightarrow g_{t+1}$$

In its current formulation, [[**In this formulation?**]] it has two limits:

Limit 1 Manipulating the previous equations, and taking into account the PAYG equilibrium (with the fiscal resources denoted T):

$\tau_t * \bar{w}_t * N_t + T_t = \bar{P}_t * s_t * N_{t-1}$, where \bar{P}_t is the average pension in t . This implies:

$$1 + g_t = \frac{\bar{w}_t * x - \bar{P}_t * s_t / (1 + n_{t-1}) + T_t / N_t}{\bar{w}_{t-1} * x - \bar{P}_{t-1} * s_{t-1} / (1 + n_{t-2}) + T_{t-1} / N_{t-1}}$$

This shows that the notional interest rate is the rate of increase in the average wage, rate of increase which is adjusted in two ways:

- First, it is diminished by a share of the average pension. This share is the ratio of the probability to survive when retired to the increase in the labor force, n . In other words, the “reimbursed” share of the average pension increases when the life expectancy increases and it decreases when the labor force increases.⁹ Each time the average pension, or the life expectancy, or both increases (compared to the increase in the labor force), the “return spring” plays its part and the indexing is less favorable.

- Second, it is increased by the per capita fiscal part of the pensions scheme resources. This plays the exact opposite part compared with the average pension: the taxation allows a “neutral” increase in the indexing rate.

Limit 2. Again, the main problem is hidden in the use of the two-period model. The life expectancy of the retired persons is given as s_t . In fact, it is 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 an increase in the contribution rate.

This outcome helps partially answer the second question:

<>How is the balance in PAYG achieved: that is, how does it bear on the financial stability of the NDC pension scheme?

As noted, the notional interest rate depends partly on 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 (i.e. the wage bill multiplied by the contribution rate). That would imply taking into account a change in the wage bill, which obviously does not appear in the indexing rate formula. With respect to this remark, assumptions about the automatic stability are in conflict with a change – that means a change neither in the labor force nor in the wages. Their realism is therefore questionable.

Conclusion: Nobody is Perfect

One can clearly see the potential contradiction between the aims of actuarial fairness (insurance logic) and redistributive goals, since life expectancy strongly differs between socio-professional groups. Taking into account the average life expectancy of one population, the NDC obviously favors 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 (as 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 double protection against poverty in old age for unemployed or socially subsidized people. In addition to a minimum pension provided by the scheme, the social income (unemployment, disability subsidies,

or other sources) provide contributions to the pension schemes and then provide supplementary rights. In the end, these arrangements are not pure NDC schemes.

Even though these schemes are supposed to offer a high degree of freedom for individuals to choose their own retirement age, they cannot escape fixing a minimum retirement age. 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—situations 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.

In addition, the application of NDC to a real economy under uncertainty is problematic. That uncertainty as a major problem in the context of pensions is well-known. Various reports are full of illustrations of such uncertainty. In the German case, for example, forecasted contribution rates through 2004 can vary by 15 percent depending on the assumptions about active population,¹⁰ birth rates,¹¹ and life expectancies (Konrad and Wagner 2000).

Of course, the schemes can be periodically regulated according to changes in the forecasts.

In the French case, this is done yearly. This requires two things: The first are reliable and frequent forecasts (which are problematic, according to Lassila and Valkonen 2002). The second is total independence of the boards from retirees and even wage earners lobbies.

The German “return spring,” strengthened by the “Rürup sustainability factor,” is another mechanism in which the pension yield is lowered by the current contribution rate, which is a way to shift the burden on both the active and the retired population.

In both cases, the periodic changes in the parameters of the schemes obviously break the actuarial fairness.

A precautionary strategy would be to use the less favorable assumptions in order to adapt the parameters of the schemes. 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 has been demonstrated to be a useful tool for bringing about intergenerational equity.

To sum up, a pure NDC would be an actuarially fair on average. An ideal NDC would provide redistribution, incentives to work longer, transparency and automatic stabilizing. The chapter pointed out the lack of distributive properties of a pure NDC, the **lack of actuarial fairness** of the considered schemes, the need for a zero pillar and for a precautionary buffer fund, and the fact that

the economic and demographic uncertainties lead to break the actuarial fairness –i.e. any revision in the parameters induce a different individual balance-. Thus an ideal NDC cannot be a pure NDC. Then why promote NDC? If pensions schemes are made to promote individual responsibility, the preferred schemes are FFS (Fully Funded Schemes). If, in addition, the question is to promote “social responsibility,” a favorite choice is NDC schemes.

ANNEX A: Actuarial Fairness at the Margin

In the following simple model, the contribution rate is τ . If an agent who would be allowed to retire decides to postpone his retirement decision by one year, he renounces to quit at date $t-1$ and age A , but waits until date t and age $A+1$, he will pay his contributions, τw_{t-1}^A , i.e. the contribution rate τ multiplied by his wage w in $t-1$, 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 his entire retirement.

That may be summed-up by the following equation:

$$(10A.1) \quad -\tau w_{t-1}^A + \sum_{j=1}^N \frac{I}{(1+r)^j} \cdot p_{t+j-1}^{A+j} = \sum_{j=0}^N \frac{I}{(1+r)^j} \cdot (1-d) p_{t+j-1}^{A+j},$$

where d denotes the actuarially fair decrual in benefits and N is the last age of pension earnings while j is the time index.

To keep things simple, omit 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, risk-averse agents factor life expectancy uncertainty into their choices and behavior: whatever the decrual/accrual rate in pensions benefits associated with early/late retirement, an increase of this uncertainty has the effect of moving forward the retirement date.

The left-hand side of equation 10A.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 depend on their individual preferences. Let $R^{(1)}$ and $R^{(2)}$ stand for income equivalents of the welfare of agents in situation 1 (delayed retirement) or 2 (early retirement):

$$(10A.2) \quad R^{(1)} = w_{t-1}^A \cdot (1-\tau) + \sum_{j=1}^N \frac{I}{(1+\rho)^j} \cdot p_{t+j-1}^{A+j},$$

with ρ the discount rate of the individual considered.

$$(10A.3) \quad R^{(2)} = (p-d \cdot p)_{t-1}^A + \sum_{j=1}^N \frac{I}{(1+\rho)^j} \cdot (p-d \cdot p)_{t+j-1}^{A+j} + \ell_{t-1}^A,$$

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

Let π stand for the inflation rate, and θ , the productivity gains of the economy—gains supposed to pass on to real wages. Nominal wages then increase at the rate $\pi + \theta$. As done in Artus (2000), pensions benefits are assumed to be indexed at the rate $\pi + x\theta$, a rate that covers all potential indexing rules. If $x = 0$, pensions are indexed on inflation; if $x = 1$, they are indexed on gross wages. This upgrading rate is generally also the rate applied to activity wages for calculating pension benefits.

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

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

Equations 10A.2 and 10A.3 become:

/10A.2’/

$$\begin{aligned} R^{(1)} &= w_{t-1}^A \cdot (I - \tau) + p_{t+j-1}^{A+1} \sum_{j=0}^{N-1} \frac{(I + \pi + x\theta)^j}{(I + \rho)^j} \\ &= w_{t-1}^A \cdot (I - \tau) + \beta \cdot w_{t-1}^A \sum_{j=1}^N \left(\frac{I + \pi + x\theta}{I + \rho} \right)^j \end{aligned}$$

/10A.3’/

$$R^{(2)} = \beta \cdot (I - d) w_{t-1}^A \cdot \frac{I + \pi + x\theta}{I + \pi + \theta} \cdot \sum_{j=0}^N \left(\frac{I + \pi + x\theta}{I + \rho} \right)^j + \ell_{t-1}^A$$

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

$$/1’/ - \tau w_{t-1}^A + \beta \cdot w_{t-1}^A \sum_{j=1}^N \left(\frac{I + \pi + x\theta}{I + r} \right)^j = \beta \cdot (I - d) \cdot w_{t-1}^A \cdot \frac{I + \pi + x\theta}{I + \pi + \theta} \sum_{j=0}^N \left(\frac{I + \pi + x\theta}{I + r} \right)^j$$

Along with equations 10A.2’ and 10A.3’, it leads to the following, under the following assumptions:

- If $\rho = r$ and $w_{t-1}^A = \ell_{t-1}^A$, then $R^{(1)} = R^{(2)}$ and the worker perceives no difference between the early or delayed retirement. Either option, under the assumption of an actuarially fair scale at the margin, provides the same satisfaction.
- If $\rho = r$ 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 decrual in benefits.
- If $w_{t-1}^A < \ell_{t-1}^A$, what are the determinants of the retirement decision? Equations 10A.2’ and 10A.3’ yield equation 10A.4:

$$\begin{aligned}
R^{(1)} - R^{(2)} &= -\tau \cdot w_{t-1}^A + \beta \cdot w_{t-1}^A \cdot \sum_{j=1}^N \left(\frac{I + \pi + x\theta}{I + \rho} \right)^j - \beta \cdot (I - d) w_{t-1}^A \frac{I + \pi + x\theta}{I + \pi + \theta} \sum_{j=0}^N \left(\frac{I + \pi + x\theta}{I + \rho} \right)^j \\
(10A.4) \quad &= -\tau \cdot w_{t-1}^A + \beta \cdot w_{t-1}^A \cdot \sum_{j=1}^N \left(\frac{I + \pi + x\theta}{I + \rho} \right)^j - \left[-\tau \cdot w_{t-1}^A + \beta \cdot w_{t-1}^A \cdot \sum_{j=1}^N \left(\frac{I + \pi + x\theta}{I + r} \right)^j \right]
\end{aligned}$$

As soon as $\tau < \beta$, the contribution rate is less than the replacement rate, which is always the case, and; then $R^{(1)} > R^{(2)}$. In other words, when individuals have a high time discount rate, they prefer to retire early, as they 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:

$$R^{(1)} - R^{(2)} = (w_{t-1}^A - \ell_{t-1}^A) + w_{t-1}^A \beta \left(I - (I - d) \frac{I + \pi + x\theta}{I + \pi \theta} \right) \sum_{j=1}^N (I + \pi + x\theta)^{j-1} \left[\frac{I}{(I + \rho)^j} - \frac{I}{(I + r)^j} \right]$$

If $w_{t-1}^A > \ell_{t-1}^A$ and $\rho < r$, then $R^{(1)} > R^{(2)}$. But if $w_{t-1}^A > \ell_{t-1}^A$ and $\rho > r$, then is $R^{(1)} < R^{(2)}$ 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 individual's preference for the present is such that the financial gain induced by actuarial fairness at the margin does not mean much to him or her, and the agent retires early.

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

² The first of July, 2005, the value of the point is 1.1104 euros for an ARRCO point and 0.3940 for an AGIRC point. The purchasing prices are, respectively, 12.6600 euros (ARRCO) and 4.4163 euros (AGIRC).

³ These simplifications include ignoring the “comp” index and considering a weighed average for the contribution rate as for the price and value of the point.

⁴ Both schemes have permanent buffer funds. : In 2004, these amounted to 30 billion euros for ARRCO (to cover a 28 billion euro annual payment of pensions) and 10 billion euros for AGIRC (to cover a 14 billion euro annual payment of pensions).

⁵ For example, in the long run—with constant contribution rates for both PAYG and funded schemes—the formula leads to a gross wages indexing rule .

⁶ There is obviously a link between ρ (the internal rate of return of the system) and the life expectancy; it is included in the relationship between ρ and the value of leisure.

⁷ This analysis follows Valdés-Prieto (2000), but adds the consideration of life expectancy.

⁸ The mechanism of “return spring” is thus a sort of a balancing mechanism, reacting to potential disequilibria by feedback.

⁹ The Rurup report (summarized in Boersch-Supan, 2003) also suggests an increase in the pensionable age ; here we only discuss the point mechanism.

¹⁰ For example, the French Council for Retirement Schemes’ forecasts for 2040 are based on an assumption in which the active population was to increase by 10 million, while CEPII’s forecasts rely on an increase of only 1 million.

¹¹ That will affect the entire active population. In this area, divergences in statistical estimations world-wide are enormous.