A joint Initiative of Ludwig-Maximilians-Universität and Ifo Institute for Economic Research

Working Papers

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CESifo Working Paper No. 531

August 2001

Presented at CESifo Workshop on Public Pensions, May 2001

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ISSN 1617-9595

* A first draft of the paper was prepared for the CESifo Workshop on Public pensions. The authors thank the participants of the meeting for their helpful comments. Of course, the authors are fully responsible for the remaining errors.

CESifo *Working Paper No. 531*
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Abstract

This paper provides some results from a model built in order to study the linked impacts of demography and economy on the French pension scheme. The demo-economic model which is used is a neo-cambridgian model with two types of agents in a closed economy. Since it includes a very thin description of the French pension scheme, one of its main advantage is its lightness while its main originality is to permit a macroeconomic linkage whether with a endogenous growth function or with a exogenous one.

JEL Classification: E17, J11, H55.

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Construction and impact of a Buffer fund within the French PAYG pension scheme in a demo-economic model

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Life expectancy and fertility rates are the key factors of ageing populations in the world. The likely evolution of these factors suggests an unavoidable rise in the share of elderly people in the overall population. This sharp increase in dependency ratios will have large consequences for public finances, potential output, etc., and overall, for the financial equilibrium of retirement pension schemes.

These forecasted difficulties have induced a lot of political reactions. Policymakers have realised for some time that deficits of the pay-as-you-go (PAYG) pensions schemes will quickly reach unsustainable levels, if no changes are introduced, whether in benefits or in contributions, so that reforms are often planned (OECD, 2000).

These reforms are of two types: parametric reforms within the PAYG system or reforms that are based on a partial or full shift towards funded schemes.

- Parametric reforms of PAYG include rather marginal adjustments; with an increase in the number of potential beneficiaries the solutions appear to be rather simple: to pay more, to pay longer or to receive less. Increased contribution or decreased benefits, a rise in the pensionable age with strong incentives to postpone retirement decisions have been the main features of these adjustments. There have also been more structural changes, such as transformation to notional, defined-contribution accounts (Sweden, Italy, Poland, etc.) organised in order to strengthen the link between contributions and benefits;
- Moving towards funded schemes includes a mix of public and private components but also funded reserve elements (or buffer funds) within PAYG systems (France, Ireland, Spain, etc.), two reform schemes that would induce transition costs in terms of over-contributions for current or future taxpayers.

One of the main difficulties is to explore the more general consequences of these reforms. In fact, most of the models dealing with pensions simulations do not include a macroeconomic linkage that would allow their macroeconomic impact to be measured even though it has been shown that these reforms could have an important influence (Blanchet, 1992, Artus and Legros, 1999).

The aim of this paper is to present a simple demographic model of the French pension scheme with a macroeconomic linkage; this linkage being established with two different production functions. The first is of a simple usual form (CES), and the second one includes endogenous growth; the comparison of the results show rather interesting different consequences and the importance of the nature of economic growth.

Both an increase in the pensionable age and a reserve fund within the pay-as-you-go French pension scheme are introduced here and the impact of these reforms on the economic growth and further on the pension schemes themselves is evaluated.

The scope of the research is thus typical, as it deals with the problem of the introduction of a funded component into a pension scheme. The form of this funded part is particular: it consists in a buffer fund created with the surplus of the PAYG pension scheme that appears when the retirement age is

increased. This age is increased from 2008, when the labour force begins to decline. We opt for this process of financing instead of the usual processes that consist more or less of a transfer of public assets. This avoids dealing with intergenerational consequences (Disney, 2000).

The model is of a closed economy model: the funds that belong to the reserve fund are supposed to be invested in domestic assets whose returns are given by the domestic economic conditions. We are aware that this may be a major limit but it appears as a better approximation of the reality than a small open economy whose the interest rate is exogenous. The herein described closed economy is able to capture the economic impact of the ageing process while it adopts the assumption of a worldwide and similar ageing process. In addition, we can suppose that the financial investments of such a fund will suffer a domestic bias.

The demo-economic model includes detailed characteristics of the French pension scheme[1]; this permits a simulation of all the institutional changes that can be imagined within this pension scheme. The model is an equilibrium model with overlapping annual generations. As we said, the usual growth model – in which the accumulation only provides limited and transitory phenomena – is compared with an endogenous growth model. A particular attention has been provided to the endogenous growth process: on the one hand, a production function that can be empirically consistent with the French economy has been chosen; on the other hand, this production function has to own transitional characteristics. This model, that includes a labour market description, careers profiles and wages rigidities, is exposed in a first part of the paper while a second part will provide empirical results including the favourable economic dynamic that would result of an endogenous growth. The papers concludes with some political economy considerations relying on a study of the PAYG returns obtained by different cohorts according to the form of the reform and the economic growth characteristics.

Demography, pensions schemes and growth: the model

Box 2 provides the economic links used in our model. This model has a major characteristic: it has been especially built in order to study the pension schemes. That is why it includes a very detailed description of the pension schemes.

The wage-earners (contributors to the pension schemes) are ranked within a “real” pyramid of ages (which distinguishes the individuals according to their occupational status: occupied workers, unemployed, the disabled, etc.) supplemented by a nominal pyramid of ages (which integrates wages profiles, the computation of pensions, etc.) While ageing, the pyramid is deformed by:

– the impact of demographics that moves the cohorts and changes their size according to the fertility rate and life expectancies;
– the impact of wage profiles by ages;
– the impact of macroeconomic variables, that change prices, wages, yields *via* their impact on employment and capital stock, and, further economic growth.

The model is a neo-Cambridgian type, whose discussion can be found in Kessler *et al.* (1991), with two types of saving agents:

- The first are wage earners. They only save in order to face their retirement period. These savings are only dedicated to fill the reserve fund; it is constituted by the surpluses of the PAYG pension scheme (equation (7)).
- The second ones are inheritors (or so-called capitalists); in each period, they are assumed to re-save a constant share of the financial products provided by their inherited wealth. They realise the “non retirement” accumulation. This so-called structural capital is the sum of the old capital plus the re-investment of the products of this capital (equation (6)). The re-invested part (which is saved by the inheritors) is exogenous; when it is weak, it will place us below the golden rule (and thus at a high level of capital yield); when it is high, the capital rate of return will be low (Blanchet, 1992).

[1] The private sector French pens* Quantix, Paris, France.
ion scheme is composed of the accumulations of different forms to the PAYG pension schemes: a basic pension scheme relies on a usual PAYG scheme while a second tier (compulsory and complementary) relies on a notional account.

BOX 1: THE VARIABLES

In the **production function**, we shall note:
Y, output,
A, the production function parameter that reflects the technology,
g, the substitution parameter of the production function,
g, the rate of technical progress.

As usual the elasticity of substitution is: $\sigma = \frac{1}{1+\gamma}$

Wages, labour market and capital return rate

âr, the wage-earners' activity rate (the share of the population which is covered by the average worker's pension scheme)
P, the population
u, the unemployment rate

Let us note:
w, the gross average wage of the cohort (the *m* index is used for males and *w* for females)
L, the labour supply, which is equal to the demand, when in equilibrium
r_g , the gross rate of return of capital,
r_n , the net rate of return of capital,
d, the rate of depreciation of capital.

The capital stock

It is noted *K* and is given by *K=Ks+Kr*
with:
Ks : structural capital (belonging to the inheritors)
sv, share of the gross capital income which is reinvested
Kr : the retirement capital

This is compound by the surplus of the PAYG pension scheme. This surplus comes from the gap between $\hat{t}$ (which is the effective – observed – rate of contribution) and t^*, which is the equilibrium – technical – rate of the scheme (see Box 3).

The PAYG pension schemes are described in a specific box (box 3).

As usual, the variables written with a star (*) are equilibrium variables, while those that are distinguished by a ^ represent an effective variable.

The index *t* marks the temporal dimension while *s* represents the gender (whether *w or m*) and the *a* index represents ages.

The labour supply is exogenous; it only depends on the age pyramid that moves according to the demographic assumption as well as with the labour participation rate.

The labour market negotiations are represented by λ, so-called labour market flexibility parameter. If λ is equal to 1, the effective wage is equal to the equilibrium (equation (5)); while the gap between the effective wage and the equilibrium wage determines the effective labour quantity (equation (3)), the situation is at full employment only if λ = 1. This gap *vis-à-vis* the neo-classical model allows a better reality reflection. This will of course be useful when we shall simulate an increase in the pensionable age[2]. A gap between the male and female wages has been parametered. Of course, this gap can be changed.

[2]It may be noted than we group together here an increase of the pensionable age and an increase in the working period which is necessary to obtain a full rate pension. This means that an increase in the vesting period will be accompanied by a later departure from the labour market. This inturn means that such postponement will not have as counterpart an increase of the preference for leisure. In an average wage earners' pension scheme, this is not problematic since it means that the wage earners quit their job – on average – when they are 62.5 years old, by 2008.

BOX 2 : A QUICK DESCRIPTION OF THE MODEL

The model is a compound of a two-factor production function, the factors being capital and labour while the labour market is characterised by both a structural and a cyclical component. The model ignores temporary cyclical phenomena as it ignores the long run demand constraints.

The reference production function is of a CES type. The technical progress is supposed to be labour augmenting.

(1) $Y_t = F(K_t, L_t) = A\left[aK_t^{-g} + b\left((1+g)^{t-t_0} L_t\right)^{-g}\right]^{-1/g}$

A, α, and β are set to be consistent with a K/Y exogenous initial ratio, taken from French National accounts.

The production function with endogenous growth is written as follows:
at the micro-economic level: (the index i denotes the firm i) :

(2) $Y_{i,t} = K_{i,t}^{\ a}(AL_{i,t})^{1-a} = K_{i,t}^{\ a}((Be^{gt}K_t^{\ f})L_{i,t})^{1-a}$;

at the macro-economic level: (1bis) $Y_t = B^{1-a} e^{g(1-a)t} K_t^{\ a+f(1-a)} L_t^{\ 1-a}$

Wages, labour market and capital rate of return

Equation/ variable	Reference production function	Endogenous type production function
(3) w^*	$\frac{\hat{a}(1+g)^{(t-t_0)}}{A^{\tilde{a}}}\left(\frac{Y^*}{(1+g)^{t-t_0}.L^*}\right)^{1+\tilde{a}}$	$(1-a)[Be^{gt}]^{1-a} K^{a+f(1-a)} L^{-a}$
(4) r^*_g	$\frac{\acute{a}}{A^{\tilde{a}}}\left(\frac{Y}{K}\right)^{1+\tilde{a}} = (r_n + \ddot{a})$	$a[Be^{gt}]^{1-a} K^{(1-a)(f-1)} L^{1-a}$

Wages and labour market

The wages are supposed to be subject to a certain rigidity: they are not to be less than the equilibrium wage rate and the adjustment speed to these equilibrium wages is denoted l : (5) $\hat{w}_t = max[(1-\ddot{e})(1+g)\hat{w}_{t-1} + \ddot{e}w_t^*; w_t^*]$

Wages growth w_t/w_{t-1}, allows us to estimate the wage increase by sex with respect to the pyramid structure by sex and age. The gap between male and female wages is exogenous.
The effective employment volume comes from the effective wage rate. Its computation is iterative: we search the employment volume $\hat{L}_t$ that, from (3), leads to the wage $\hat{w}$.

Capital stock

The structural capital stock is determined by the accumulation equation (6) : $Ks_{t+1} = Ks_t[1-d+sv.r_{g,t}]$

The capitalists' savings behaviour consists of the re-investment of a constant share (*sv*) of their gross capital income. Different values of this share can be parameterised; it gives the capital rate of return, depending whether or not the golden rule prevails or whether or not there is a lack of capital. Of course, *Ko* is consistent with the initial observed level of K/L.

The retirement savings accumulated in the buffer fund (or reserve fund) are created from the surplus of the PAYG pension scheme.

(7): $Kr_t = Kr_{t-1}.(1-\ddot{a}+r_{gt}) + (\hat{a}r_t.(1-u_t).P_t).[t_t - t^*_t].w_t$

Of course, these retirement savings flows are aggregated. The resulting fund *Kr* decreases when the PAYG scheme needs funds. In this case, the reserve fund (to which financial products are added in each period) is reduced to complete the contributions of wage earners. In this case, the observed contribution rate is lower than the equilibrium rate and (7) is still valid.

PAYG pension schemes are described in Box 3.

BOX 3 : DESCRIPTION OF PAYG PENSION SCHEMES

The scheme presented here is a unique regime for average wage earners; the rules applied are those of French CNAV (Caisse nationale d'assurance vieillesse) for the basic scheme and those of French AGIRC-ARRCO for the occupational schemes (PAYG as well).

PAYG equilibrium

At each point in time, the PAYG equilibrium, when there are no reserves, implies that: (8)

contributions = benefits

As is known, this gives the so-called technical equilibrium of the scheme: (9)

*Equilibrium contribution rate = Macroeconomic replacement rate * Dependency ratio*

The macroeconomic replacement rate being the ratio of the average pension to the economy is average wage. The dependency ratio is the ratio of pensioners to contributors. The scheme may ask a contribution rate which is higher than the equilibrium rate; in this case the scheme produces a surplus. These surpluses are cumulated and capitalised and create a reserve fund.

Schemes' charges

When individual profiles are not available, the pension scheme's forthcoming charge estimation is not obvious. In order to by-pass this difficulty, and to estimate the amounts of rights vested by future generations of retirees, we deal with the activity rates by generation. Consider for instance the males of a given generation in a PAYG scheme. If the share of active males at the time t is ■%, one can consider that each man of this generation has contributed in ■% of the year t,in the regime.
If the activity rates are then cumulated over the whole active life of a generation, the result gives the average contribution period of a given individual of this generation. It is then possible to estimate for each generation the vested right in a given scheme. To compute the forthcoming generation's rights, it is necessary to forecast their unemployment and activity rates. The former ones are endogenous (Box 1) but the last ones are exogenous. The pensions are computed with reference to the wage rates. According to the French rules, wages are divided into two parts: below and above the social security ceiling. The pensions computation rules are different according to whether the wage earner is under or above this ceiling. Because of the lack of individual career profiles, it is necessary to determine which part of the wages are – or not – above the ceiling. We decided to consider that the wage variable (w) has a log-normal distribution. Then, knowing the schemes contributions distribution, we estimate the log-normal law parameters (mean and standard deviation) for each cohort.
For the forecasts, when the population is ageing, we assume that this distribution remains constant, around a computed average wage (equations (3) et (5)). The wage profiles are consistent with the observations (they have been estimated by (Colin, Legros et Mahieu, 2000)).As we know the wage levels, profiles and distributions it is now easy to compute the schemes' charges.

Schemes "by annuities"

The different steps to compute pensions are the following:

1- The computation of the average replacement rate when individuals are quitting their jobs:

Replacement rate = Min [å Activity rates ; contributing period for a full rate pension] annuity rate*

2- Average pension for a given generation:

*Average pension for a generation = Replacement rate * Reference wage * [Real wages growth rate]*$^{\theta}$

– θ : rate of link between pensions in real terms and wages (0 since 1993)
– reference wage = 10 best years until 1993, 25 since 1993 (+ 1 year per year).

3- Computation of the scheme's charges:

*Expenses = å [average pensions by cohort * cohort size adjusted by its activity rate]*

Schemes "by points"

French occupational pension plans are PAYG schemes, which are rather close to notional accounts (Valdes-Prieto, 2000).
As we have contractual contribution rates (i.e. points' prices historical series) we are able to compute – together with wages and activity rates – the number of points that a given generation has cumulated.

*Number of Points = å of the activity rates by cohort * [contributing wages *rate of contribution]/ purchasing price of a point*

This leads to have an expected income from the pension schemes for each period. These contributions have, of course, to compensate the expenses (the benefits). As soon as we have the contribution volume we have the replacement rate as well.

Note about the retirement age: according to the observations, the retirement age is exogenous (the authorities change it) but, in the model, there is a dispersion of the effective retirement ages around the legal age. This dispersion is assumed to follow a Weibull law.

The firms' behaviour will be simulated by the successive use of two production functions: a CES – so-called "reference production function" and an endogenous type production function.
The category of models to which this last production function belongs assumes that the capital is the major engine of the economic growth. It is also assumed that the capital accumulation creates positive externalities; for instance through learning-by-doing. The choice of this particular type of endogenous

function relies on that models' characteristics: it allows for endogenous growth from the usual production factors (as capital and labour; we do not need to introduce a human capital indicator whose remuneration is a source of uncertainty[3]) and they have been validated by empirical tests[4].

In addition, in the chosen equation, the knowledge accumulation is linked with the aggregate stock of capital, augmented by an exogenous technical progress rate. This exogenous rate of course weakens the endogenous character of the production function, but we use it in order to:

- Introduce a transitional dynamic when we substitute *K/L* to *K* in order to correct the function which is subject to a scale effect (an increase in the growth rate of the production can be the only source of an increase in the per capita income growth rate); in addition this does not create any explosive growth;
- If the positive externalities exist and have an important effect on the macroeconomic growth rate, then we can assume that some other effects exist (which unfortunately are not explicitly explained in our function).

Firms demand labour and capital; the labour cost includes the pension scheme contributions and the return on capital is gross of the depreciation rate. The factor demand depends upon the remunerations considered (equations (3) and (4)). The labour demand is constrained by the effective wage level (and its gap with the equilibrium wage); firms choose a constrained labour quantity while maximising profit.

The total stock of capital within the economy depends on accumulation behaviour. Savings are always invested and directed towards productive capital (the equality between savings and investment is realised *ex ante*). This means that a surplus in capital (due to an excess in savings) induces a decrease in the return on capital (equation (4)).

The retirement pension schemes receive contributions and pay benefits (with a strong link between contributions, benefits and the reserve fund) according to the PAYG principle.

Introducing the reserve fund modifies the pension scheme's technical equilibrium (Box 3):

$$Contributions_t = Benefits_t$$

becomes:

$$Contributions_t + (1+r_{n,t-1})\, RRF_{t-1} = Pensions_t + RRF_t$$

where RRF signifies "retirement reserve fund". The dynamic of the RRF is given by equation (7): the fund increases when the effective contribution rate exceeds the equilibrium contribution rate (defined in (9)), the fund decreases when the effective contribution rate is lower than the equilibrium rate.

The pension scheme, which is described here, is a composite of two schemes: a basic one, in "annuities" and a complementary one, organised by "points". The simulated scheme is a unique scheme for average wage earners. The expenses of the scheme and the forecasted expenses (the future pensions) are, of course, the core of the issue to be analysed. When we have no individual information, this type of simulation, with a single average wage-earner scheme is the best we can develop because it avoids perfect knowledge of the participation of wage-earners to the scheme (Malabouche, 1987).

[3] Barro-Sala-i-Martin (1995)
[4] Schmookler (1966) provided a link between the capital accumulation and the patent delivery (which is the material proof of knowledge).

The reserve fund and the increase in the contribution periods, according to two economic growth assumptions

The aim of this part of the article is to measure the consequences of a policy which would both increase the pensionable age and create a reserve fund with the surpluses created. An other aim is to compare the different impacts of different assumptions for the production function. The part also seeks to know how an endogenous growth production function may change the conclusions that the usual neo-classical model provides concerning the impact of demographic and pension policies on economic growth.

Unchanged legislation

This first analysis only recalls the nature and the size of the disequilibrium faced by the PAYG pension schemes; these forecasts will take place in a standard demo economic trend. The following economic assumptions (Table 1) are adopted for this forecast; they are consistent with the basic scenario adopted by the last, official French report (Rapport *Charpin*, 1999)

<< insert Table 1>>

We note that the "unchanged legislation" simulations presented here give the same results with both the production functions (Solow-reference or endogenous growth type). This occurs because the initial parameters g and ϕ of the production function $Y = K^{a} * (BgK^{f} L)^{(1-a)}$ have been initialised in order to have the same production dynamic as under exogenous technical progress; the economic growth trend is then 2% in the steady state[5].

Of course there is an infinity of solutions for ϕ that would satisfy the long run dynamic for Y. As our first estimations for g and ϕ, which were computed from a set of simultaneous equations with French National Account data, were questionable, we decided to parameterise ϕ .

Demographics and economics

The forecasted active population that we use in order to compute the pension scheme's expenses shows an improvement of the active population until 2005 (there will be around 27.5 million active individuals); from this year onwards the active population decreases to 24.5 million in 2040.

The occupied active population grows until 2010 as the unemployment rate decreases; thereafter, the variable follows the active population trend according to a constant rate of unemployment, 5% of the active population (Chart1).

The main macroeconomic variables follow a two-step walk. Between 2000 and 2015, production growth is superior to 2.5% while the wage growth increases from 1.6% to 2.1%, yearly. Because the active population decreases, production growth decreases through to 2015 and is stabilised around 1.6% (chart 2).

The net return on the physical capital, which is determined here in a situation where there is a lack of capital (so-called under accumulation situation), also has a two-period evolution; it grows until 2010 and decreases until the forecasting horizon, at this period, the capital stock is consistent with the active population (Chart 2).

Private sector wage earners' pension schemes

[5] g=1 and ϕ = 0.5, the GNP growth rate is then converging towards g/(1-ϕ), = 2%; this growth rate is the same as the technological growth rate in the Solow type function.

The evolution of the contributors/retirees ratio clearly yields difficulties for the pension schemes over the forthcoming forty years.

- If the retirement age is not changed, the number of retirees is set to double until 2040, while the active contributing population will be stable;
- The demographic dependency ratio will decrease from 1.6 contributor by retiree to 0.8 between today and 2020.

To meet this forecasted trend, the private sector pension schemes rules were changed in 1993. The reform[6] induced a progressive relative decrease of the pensions compared with the wages. The observation of the different cohorts' replacement rates during their retirement period provides some interesting lessons. On Chart 3, bold lines represent the replacement rates of selected cohorts during their retirement period[7]. For instance, in 1996, the wage-earner born in 1937 earnt a retirement pension equivalent to 57% of the average net wage. This replacement rate will decrease each year because of the indexation on the CPI instead of net wages. For the youngest generations, the impact of the reform will be more important because the initial replacement rate (when they quit their jobs) will be lower. If this legislation remains valid, the wage-earners of the 1966 cohort will receive, on average, a pension which is equivalent to 43% of the average current wage.

On the other hand, though the opposite is often put forward, the pensions which will be paid by the schemes will not decrease (in constant euros). With the same career profile and with a contributing period allowing a full rate pension, a wage earner who will quit his job within thirty years (up to 2030) will have a higher purchasing power than his colleague quitting today. In addition, the lengthening of the women's careers will weaken the force of the reform for two wage-earner households.

This will not hide the fact that the reform corresponds to a huge erosion of the relative position of retirees within the national income scale. In addition, it is well known that this degradation will be greater the higher productivity gains are.

Despite this erosion, the financing needs of the pension schemes will increase. From 2005, when the baby-boomers will quit the labour market, the gap between the schemes' expenses and contributions will increase.

Measured in points of thecontribution rate, the private sector deficit will be around 4 points in 2020 (around euros 21 billions). In 2040, which corresponds to the forecasting horizon, the deficit will be around 7 points of the contribution rate (euros 52 billions in constant terms) (Chart 4).

[6] Broadly speaking, the 1993 pension reform leads to an indexation of pensions on the CPI (and not on wages). In addition, the minimum contributing period was lengthened from 37.5 years to 40, and the reference wage for the computation of the first pension is now an average of the 25 best years of the career (instead of the best 10 years, previously). The application of the reform will last from 1994 to 2008.

[7] These replacement rates are defined here as the ratio between the average pension of a cohort and the average wage of the economy. It deeply differs from the usual replacement rate computed as the ratio of the first pension on the last wage.

<< insert Chart 1>>

<< insert Chart 2>>

<< insert Chart 3>>

<< insert Chart 4>>

The impact of an increase in the retirement age

We simulated an increase in the contribution period from 40 years to 42.5 years necessary to obtain the full pension rate. The contribution period increases by one quarter *per* year. It begins in 2004, the year in which the previous reform will be completed. In order to forecast the impact of such a policy, we assume that each generation changes its behaviour in order to quit the labour market, as soon as the pension provided reaches its maximum (full) rate. The empirical analysis supports such an assumption (Pelé and Ralle, 1999).

The increased contribution period modifies the active population's level and its variation. The relative increase in the active population, such as the relative decrease of the retired population leads to a change in the dependency ratio; this ratio being higher than in the reference simulation (with no reform). The dependency ratio would be 0.9 in 2040 – instead of 0.8– while it is 1.6 today. It must be noticed that – despite the increase in the retirement age – the active population is still decreasing; this confirms our assumption regarding the end of early-retirement policies (or other measures to encourage older workers to leave the labour market).

The financial balance profile is, in this case, less smooth than in the previous forecast: the deficit is first reduced. Subsequently, there are surpluses (Euros 9 billions in 2010). In a third period, a deficit appears and grows (Euros 33.5 billions in 2040, i.e. 4 contributions points - Chart 5).

<< insert Chart 5>>

Increase in the pensionable age and settlement of a reserve fund

The political will to bridle intergenerational transfers should lead the ageing countries to transfer liabilities towards funded saving schemes, in order to limit the PAYG contribution rate increases.

In France, a project has been put forward to create a buffer fund, whose aim is the consolidation of the first pillar of the pension scheme. The switch towards a mixed scheme with a strongly funded pillar appears not to be sufficient to limit the problem of financing retirement pension schemes: the problem of the transition is not solvable, and funded schemes do not provide any immunisation against such demographic changes when a numerous cohort is followed by a smaller generation.

The "pros - mix schemes" arguments generally rely on empirical past observation of better returns for financial assets than for PAYG pension schemes (the wage bill growth rate), consistent with the theory. The "anti–mixed schemes " argument claims that the superiority of financial returns will not stand up to demographic change; Artus and Legros (1999) argue that the demographic cycle, which will begin in 2005-2010, will paradoxically favour the PAYG schemes, especially if these funded schemes are invested in fixed income assets. The analysis is that the active population has been large in past years, this has involved high rates of unemployment, low levels of wages, low levels of consumption and weakness of the economic growth in Europe and Asia where the saving rates – pushed up by the increasing life expectancy and the uncertainty facing PAYG schemes – are great,

relative to investment rates. As the numerous generation of baby-boomers retires, the active population will slow down or decrease, after 2005-2010. Wages will then rise, consumption will be more dynamic and inflation higher. In addition, current cohorts of numerous baby-boomers who bought expensive assets will have difficulties to sell them back to the following, less numerous generation. High wages, low yields and higher inflation rates will paradoxically favour PAYG pensions schemes vis-à-vis fully funded schemes.

In addition, it has been argued that it is not possible to obtain higher financial yields by exporting saving flow surpluses, because the emerging countries are ageing as well. This argument confirms that it is better to model for a closed economy environment than in a small open economy, for which the interest rates are given exogenous.

In order to smooth-out intergenerational consumption, some policy makers have created trust funds (United States), provident funds (Singapore) or reserve funds (France). Whatever the name of these funds are, they are generally run by governments, and mobilise various forms of resources such as public assets, additional contributions, pension schemes surpluses, etc.

Here, the impact of a buffer fund on the economic growth is studied using our neo-cambridgian model, with two types of savers. Of course, in this article, within these two types, savers do not own personal saving accounts but participate in the buffer fund. In a first phase, this is a simple Solow-type model, while in a second phase we use an endogenous-growth-type production function, which explains the long term economic growth in an endogenous way by the influence of experience effects, such as positive externalities created by physical capital accumulation.

The reserve fund building principle has been described above; it results from the gap between the effective contribution rate (given by the authorities) and the equilibrium rate. When the equilibrium contribution rate decreases, the effective contribution rate remains stable, creating a surplus. The decrease of the equilibrium contribution rate comes from the higher retirement age.

This framework allows us to study simultaneously the impact of an increase in the pensionable age and of the creation of a buffer fund, when most policy-oriented reports study them separately.

Whatever the production function is, the PAYG surplus accumulation leads to a reserve fund and limits the deficit. The comparison of both types of models (Chart 6 for Solow and Chart 7 for the endogenous model) shows that the pensions are balanced until two different horizons: 2032 for the Solow-type model, and 2040 –and beyond- for the endogenous type model.

These differences can be explained by the different GNP growth rates as by the different factor yields (Charts 8 to 10).

In the Solow-type model, the production growth rate acceleration is transitory, while the fund is growing. Nevertheless the fund's effects are limited in time (transitory) because the decline of the physical return on capital leads to a lower weight of structural capital in production.

In the endogenous growth model, as in the Solow-type model, the impact of the fund accumulation is transitory but the relation between capital accumulation and growth is stronger and more durable.

Compared to the reference simulation (with no reform) the fund has a positive impact on the production for around 12 years in the Solow-type model, and for 30 years in the endogenous growth model.

In the long-run, the macro-economic impact of the funded scheme disappears. The dominant effects are due to the production function: with endogenous growth, the effects last longer. An crowding-out appears typical in this type of models: when the demographic structure is constant, funded schemes are mature; the structural capital is the only source of increase in capital. We show here the same phenomenon with the buffer fund (which will collapse, by definition).

The net return on capital weakens while the fund's stock increases but in both the models – according to the lack of capital assumption – the return on capital is higher than the instantaneous return on the PAYG scheme, which depends upon the demographics and the labour productivity. This return is even

higher than the level it would reach without buffer fund. Until 2035, the impact of the funded scheme on wages is higher in the endogenous growth model than in the Solow type model. In fact, this last model provides a low remuneration gap if compared to the reference model.

According to the link between capital accumulation and factor remuneration in the endogenous growth model, if savings equal investment, building such a buffer fund would ameliorate the PAYG equilibrium. At the end of the forecasting horizon, the GDP and wage growth provided by the endogenous growth model are weaker than in the Solow-type model. This is very understandable: in our endogenous model, the capital stock increase has a reinforced role; as soon as the capital stock is stable, this relatively weakens the economic growth.

In both models, the demographic effect due to an increase in the pensionable age helped by an increase in economic growth, which implies an increase in wages, (and this is particularly true in the endogenous growth scheme) contributes to a significant decrease in the PAYG deficit.

<< insert Chart 6 >>

<< insert Chart 6-a >>

<< insert Chart 7 >>

<< insert Chart 7-a>>

<< insert Chart 8 >>

<< insert Chart 9/Chart 10>>

An intergenerational balance

One of the limits of this model is that it is important to consider the individuals' preference for leisure. We can try to draw an individuals' welfare measure from the PAYG actuarial yield computation. This criterion takes into account a lot of characteristics, such as the income drawn from the pension scheme, the contributions paid during the all working period, and the dedicated time for retirement compared to the working time. It appears to be very useful to have a proxy of each cohort's welfare (given by the retirement scheme) in a transition period when the contributing period is lengthened, in order to maintain a high level of annuities. This proxy variable will also provide a useful measure of a particular type of intergenerational transfers: the "low contribution rate generations" contribute more in order to save the "high contribution rate generations". Let us add that this computation would not make sense if the buffer fund was created from public assets or from the public budget because it would imply future payments from future generations.

Chart 11 shows the huge deterioration of the PAYG returns as the contribution period increases. This shows the importance of the ratio of the retirement period in proportion to the active period. From 2032 onwards, the yields diagram is different and the "after reform actuarial rates of return" are better than the "no reform actuarial rates of return". These contribution rates are lower in case of reform. When the increase in the pensionable age is linked with the buffer fund build up, the contributions' increase is smaller than with no fund, and this leads to a higher individual welfare.

<< insert Chart 11 >>

<< insert Chart 12>>

The gap is at a maximum when compared to the endogenous growth model because this model provides higher wages while the fund lasts for a longer period.

We note that when the contribution period is increased without feeding any fund, welfare is higher during a transitory period: this is due to the fact that, in this case, the equilibrium contribution rate is equal to the effective contribution rate. The transitory welfare surplus is due to these smaller transitory contributions.

In comparing Chart 11 and Chart 12, strong resistance to an increase in the pensionable age (in France, Germany, Belgium, etc.) can be explained by the strong welfare loss that would result from the higher retirement age. But the translation of this resistance into policy hesitation can only explained by:

1- the huge political influence of today's old workers and retirees. This conclusion is consistent with the usual political economy conclusions arguing that the median voter's choice sets public pensions parameters (Casamatta *et al.*, 2000 and Casamatta, 2000).

2- the non-altruistic behaviour of these voters. If they were altruistic they would, of course, favour an increase in the retirement age that would push up the economic growth and concentrate yields (Chart 12).

These conclusions are consistent with Artus et Legros (1997) or Legros (2001) who show that if retirees' (or the near retirees' group) is overweighed in the public decision, and/or if they have the electoral majority, the contributors and forthcoming contributors will suffer higher contribution rates and a low retirement age. This will last until the PAYG return is much lower than the capital return.

Conclusion

The main lessons of this paper are the follows:

It first provides an interpretation of the macroeconomic impact of retirement funded schemes which differs from the usual neo-classical model. The effects of the buffer fund are transitory – as in a simple Solow model – but last longer with the endogenous-type model; the crowding-out effects are less violent in these models. The relationship between funding, production and factor remuneration is stronger and longer; this means that the economy offers better resistance to the demographic cycle, and this explains the longer life of the buffer fund. Of course, it will be necessary to continue to increase the pensionable age to face the new imbalance of the PAYG pension scheme but the reserve fund permits an easier financing process and a limited retirement age increase.

Of course, within the endogenous production function, an exogenous technical progress term still remains but our inclusion of partial externalities is enough to change the conclusion with regard to the basic model.

The first conclusion is that it appears very difficult to provide a clear diagnosis about the macroeconomic impact of a reserve fund, when the production function is not specified: it affects the rate of return, economic growth, and the duration of the fund, etc. For instance, factor yields are of course impacted by the demographic cycle and this is consistent with theoretical findings (Artus and Legros, 1999), but the impact is much stronger with an exogenous-type production function (simple Solow model) than with the endogenous growth model.

One of the limits of this model is that there is no utility function for the individuals who are subject to mandatory savings and the increase in the pensionable age. The main qualities of this model are linked to its defaults: it is a very light model compared to the usual MEGC models, the PAYG pension scheme is described well and that is why the actuarial yields can be easily computed to provide some policy-oriented conclusions.

Increasing the contribution periods and creating a reserve fund from the surpluses is an attractive solution from the pension scheme's view. It is more attractive in a period when life expectancies are still increasing while unemployment is decreasing, particularly because the firms will have to draw on the labour force in the older workers' segment. The main problem is a policy implementation problem: the measure appears to be profitable in the long run but unsellable in the short run.

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Table 1: Demographics and economics for the 2000-2040 period

Trend scenario	
Economy	
Rate of technical progress	2,0%
Rate of unemployment (long run)	5,0%
Share of wages in value added	72%
Demography	
Mortality	INSEE trend (2040: M: 80.9 – F: 89.2)
Fertility rate	1,8 children/woman
Net migration flows	50000/year

Chart 1

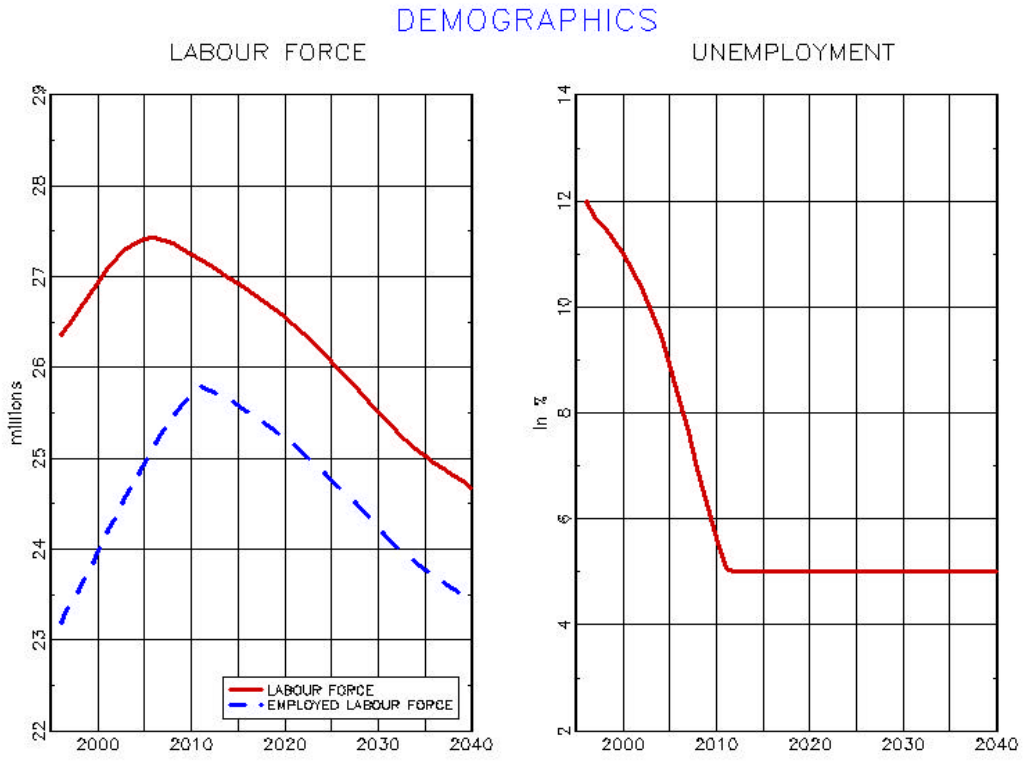

Chart 2

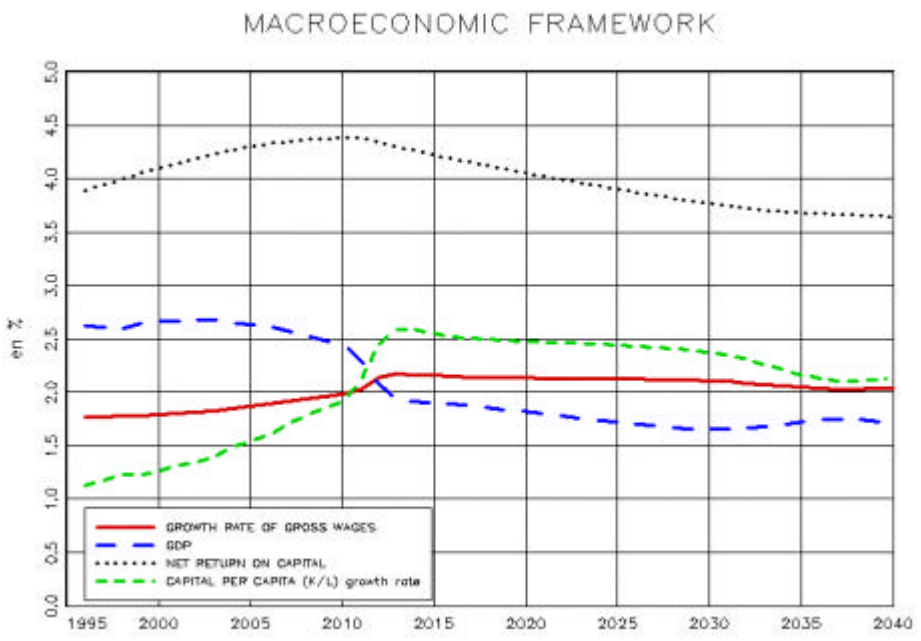

Chart 3

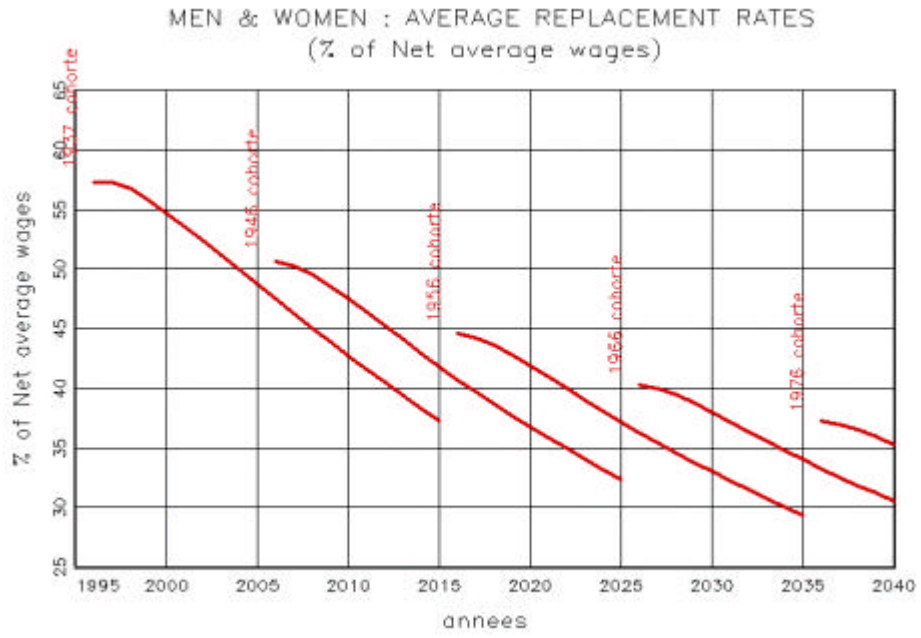

Chart 4

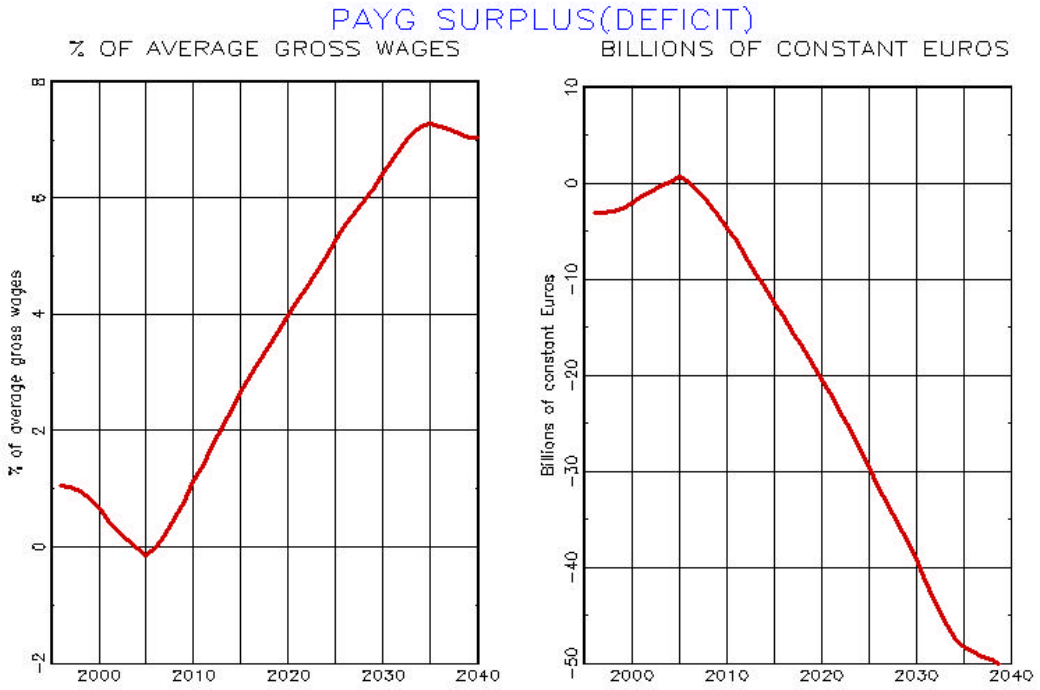

Chart 5

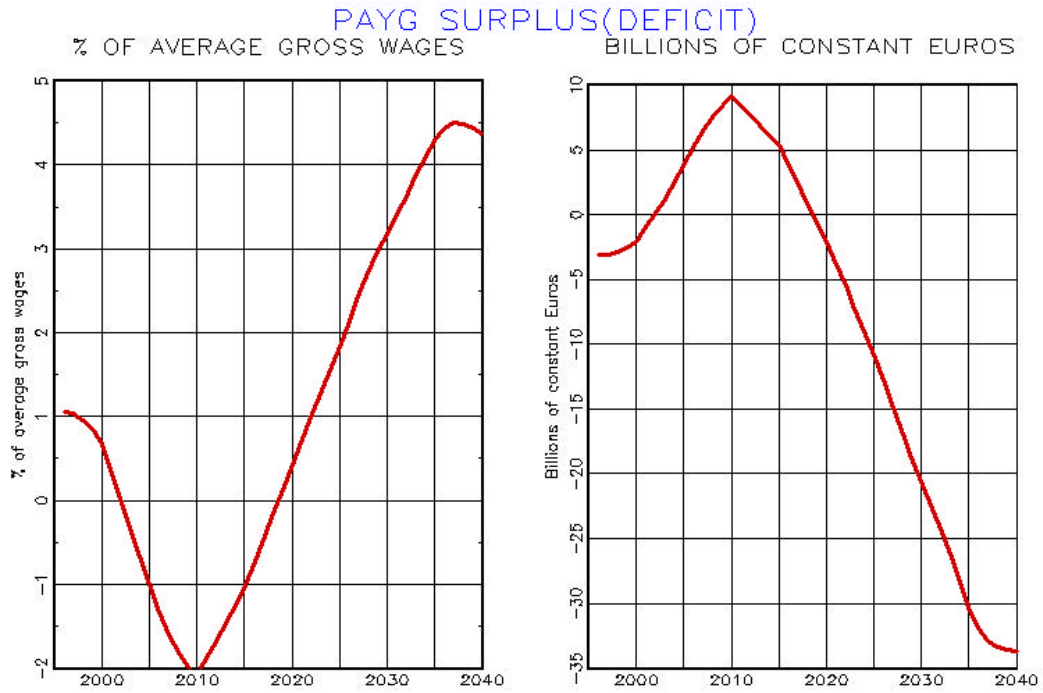

Chart 6 : A reserve fund in a Solow model

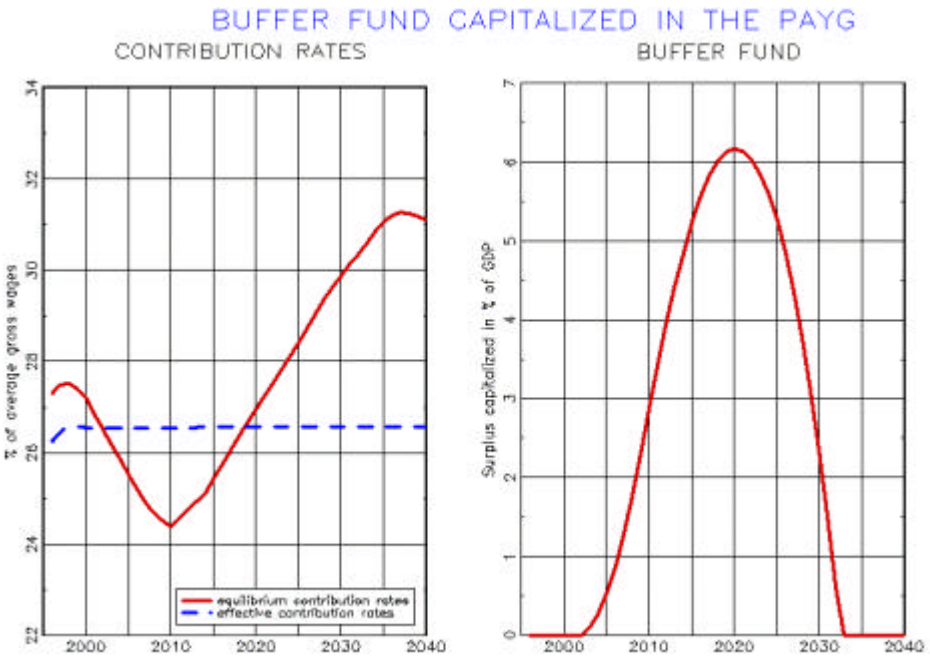

Chart 6-a : PAYG pension scheme in the Solow model

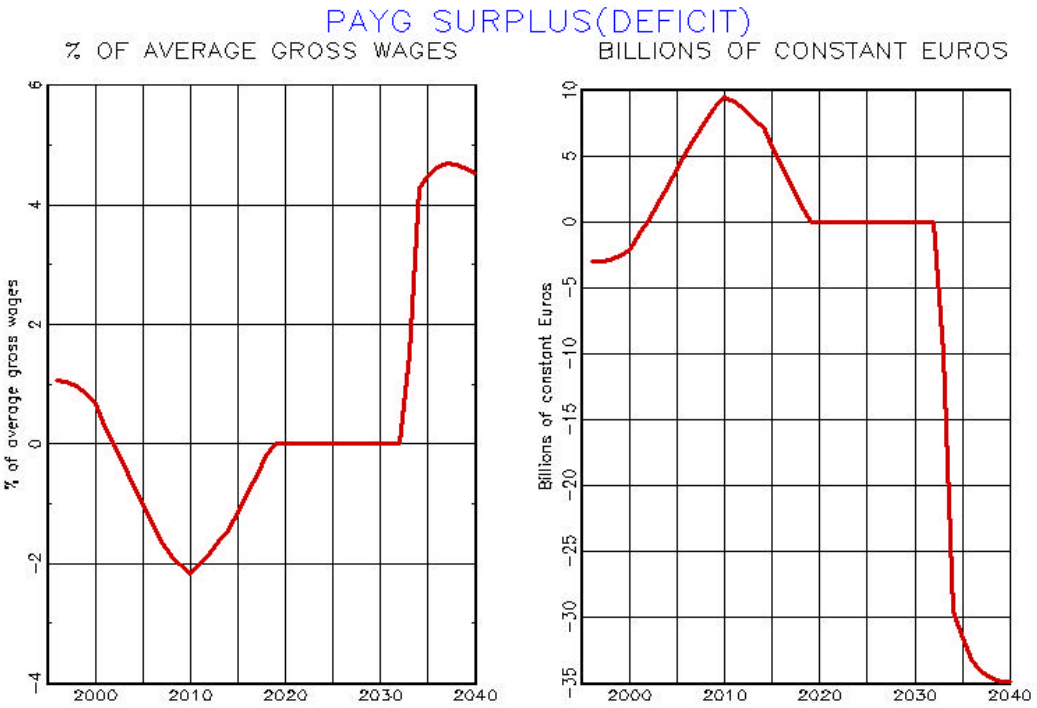

Chart 7 : The reserve fund in an endogenous growth model

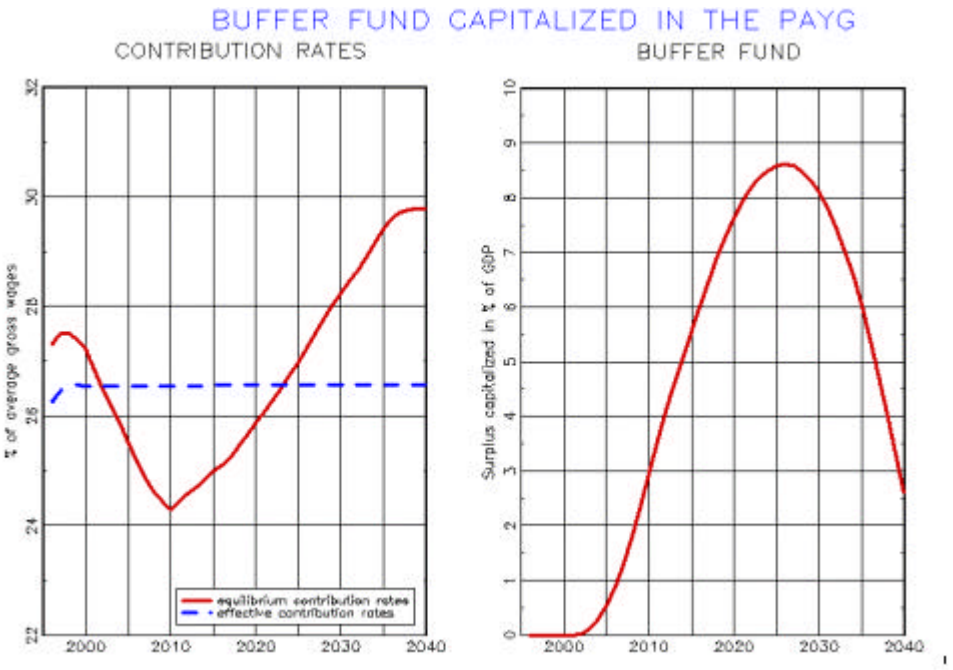

Chart 7-a : PAYG pension scheme in an endogenous growth model

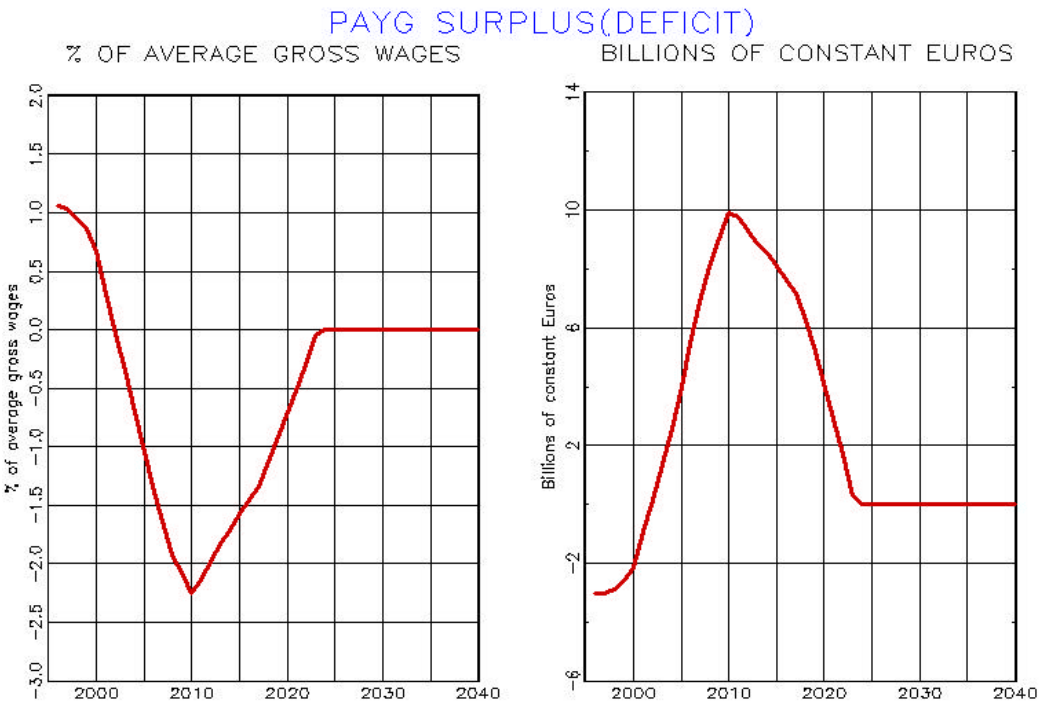

Chart 8

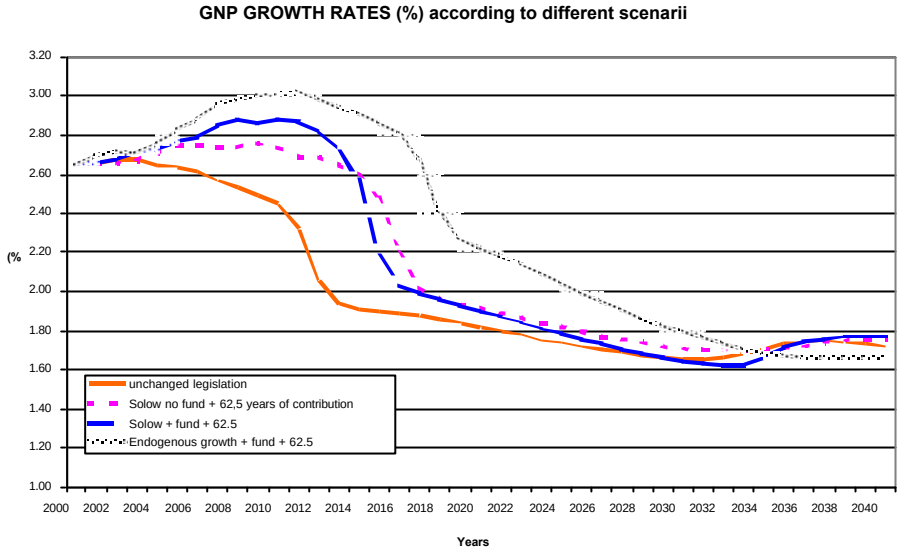

Chart 9

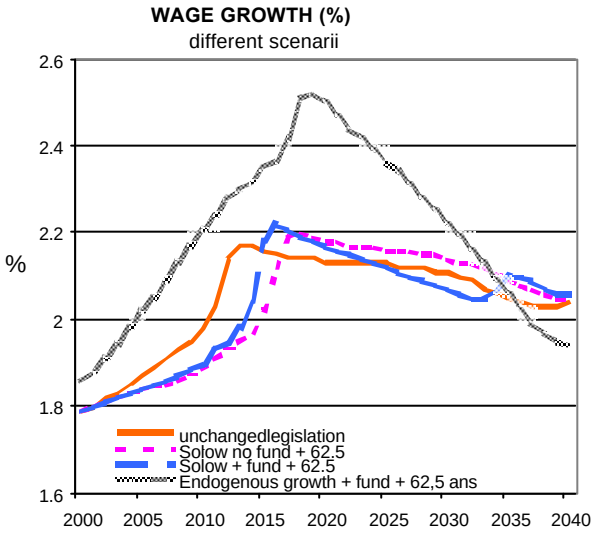

Chart 10

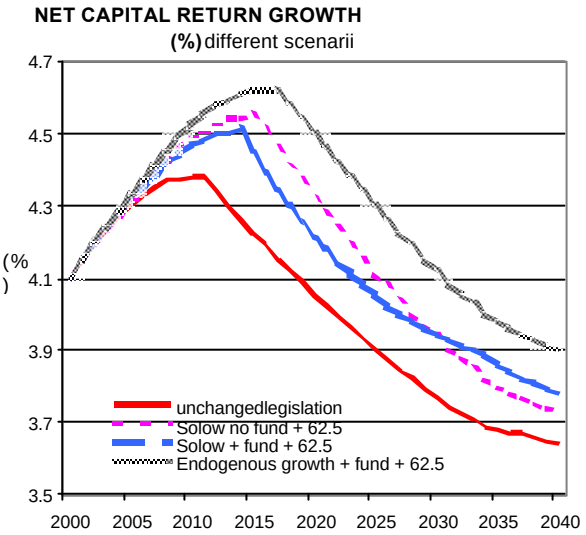

Chart 11

Actuarial yields of the different cohorts (%) according to different scenarii

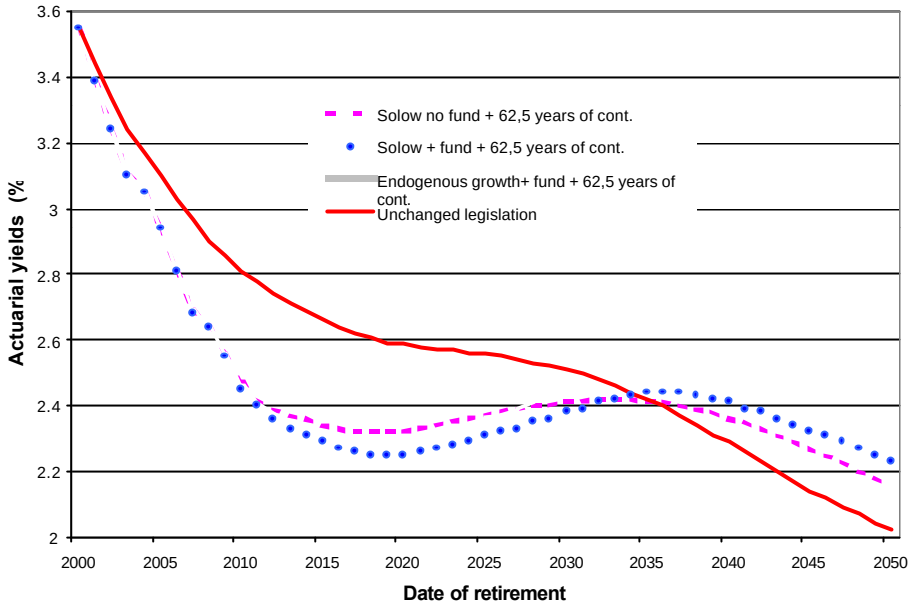

Chart 12

Actuarial yields distribution according to different scenarii