The French Pension Trust Fund:
Can it Cope with the Expected Financial Unsustainability of the PAYG Pension System?

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Abstract:

Current and expected demographic and economic trends are likely to jeopardise the financial sustainability of the French retirement pension scheme which mostly relies on a pay-as-you-go basis. In 1999, the French government set up a Pension Trust Fund *(Fonds de réserve des retraites, FRR)* whose main objective was to introduce some public funding in the PAYG basic pension scheme to cope with its expected financial unsustainability within the next decade. This paper presents some simulation results on the projected evolution of the French pension trust fund under various assumptions. The main idea is to optimise the profile of the trend in contribution rates needed to meet the objective of a balanced basic pension scheme of the period 2005-2050. Our simulations show that under plausible assumptions the amount of funding is likely to be less important than the Government expected at the FRR set up, about 115 billion euros. Some stress-tests show that severe shocks on financial markets may dramatically affect the funding profile of the FRR.

Keywords: pension trust fund, simulations,
Classification JEL: H550, J260

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Revised version; comments welcome

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1. Introduction

Current and expected demographic and economic trends are likely to jeopardise the financial sustainability of the French retirement pension scheme which mostly relies on a pay-as-you-go basis. The contributor/pensioner ratio, currently standing at 2:1, is expected to drop to 1.2:1 by 2040, and the scheme's deficit is forecast to top EUR15 billion by 2020, despite the recent parametric reforms adopted in the Pension Reform Act (*Loi 2003-775 du 21 août 2003*).

Besides the parametric reforms concerning the pay-as-you-go basic pension scheme, the 2003 Pension Act introduced some fiscal incentives to the development of pension vehicles based on individual and collective funding *(PERP* and *PERCO)*. But the Pension Trust Fund *(Fonds de réserve des retraites, FRR)* also provides a funding device. Set up in January 1999 by the socialist Government led by Lionel Jospin, this Pension Trust Fund was financed by the surpluses of the Fund for Old Age Solidarity *(Fonds de solidarité vieillesse)* and a "social solidarity" contribution levied on companies, with an initial endowment of EUR 300 million, and further proceeds of future privatisations and restructuring of savings banks estimated at EUR 1.5 billion. In 2000 and 2001 the Social Security Funding Act *(Loi de financement de la Sécurité Sociale)* extended the resources of the FRR including: the surpluses from the general pension scheme, part of the 2% tax levy on capital revenues, and the proceeds of the UMTS auctions. The reserves were to be invested in the financial markets and managed by the Government.

On April 2001, the Pension Trust fund has been transformed by the conservative Government led by Jean-Pierre Raffarin into an independent public management body. The reformed body's mandate was to accumulate funding until 2020 to buttress the basic pension scheme. The cumulated funding was then expected to be spent until 2040 to smooth the demographic hump associated with the massive post-WW2 baby-boomer generation. The 2001 bill set up a monitoring committee made up of 20 members of Parliament and representatives of social partners and the Government, and a directorate composed of three members appointed for a six-year term. The *Caisse des dépôts et consignations* (a financial institution controlled by the Parliament) was entrusted with the administrative management of the FRR, the financial management being allocated by auction to independent institutional investors in July 2003.

The 2001 bill did not address a widespread criticism concerning the funding of the FRR, namely its random, piecemeal and unstable resources. Indeed, the bill could have created a supplementary pension contribution on wages to abound the FRR. The purpose of this paper is to estimate the increase in pension contributions (and the associated evolution of the FRR) necessary to meet a year-by-year balance of the general pension scheme at the 2050 horizon under a set of demographic, institutional, economic and financial assumptions. In our paper, two different objectives are assigned to the FRR. The first one is a "smoothing" objective, the FRR being viewed as a transitory device to smooth the adverse consequences of the demographic baby-boom hump. The idea is to increase the pension contribution rates above the level needed to balance the public pension scheme accounts while the contributor/pensioner ratio is still high, and then to switch to a lower level when this ratio becomes unfavourable. The second one is a "structural" objective, the FRR being considered as a permanent device to add a funding component into the public pay-as-you-go pension scheme.

The paper is organised as follows. Section 2 presents the general methodology. Section 3 reviews the main assumptions and presents the dataset. Results are given in section 4. Section 5 concludes.

2. Methodology

The simulations are run on annual basis from 2005 to 2050. 2050 has been chosen as the final year of simulation with respect to the expected extinction of the last baby-boom generations.

In a previous paper, we used the methodology first developed by Vernière (1999). The FRR objective was to smooth year by year the evolution of the social contribution rates necessary to balance the accounts of the relevant pension regimes (the basic pension regime, *Caisse Nationale d'Assurance Vieillesse*, and the so-called "aligned" regimes (*régimes alignés: MSA, CANCAVA* and *ORGANIC*[1])). The optimisation programme was written as:

$$\underset{c(t)}{Min} \sum_{t=2}^{T} (c(t) - c(t-1))^2 + (c(T) - c^*(T+1))^2$$

$$s \begin{cases} F(t) - F(t-1) = a(t) + c(t) - p(t) + x(t)F(t-1) \\ F(t) \geq 0 \end{cases}$$

with (all variables per wage unit) :

c	smoothed contribution rate (or “funded pay-as-you-go” contribution rate) – endogenous
c*	targeted smoothed contribution rate at the end of simulation – exogenous
p	pension rate (or “pure pay-as-you-go” contribution rate) – exogenous
F	pension trust fund – endogenous
x	net (of the wage growth) return on capital – exogenous
a	lump sum contributions – exogenous

F(0) et F(T) are given. When F(T)=0, then c*(T+1)=p(T+1); when F(T)>0, then c*(T+1)=y (where y denotes a given fraction of the wage bill; for example, y=100% represents a year of wage bill. c(0) is given, or equivalently sc(0) is given with c(t)=p(t)+sc(t). The first constraint gives the evolution of the state-dependent variable, while the second constraint imposes a non-negative fund every year.

This methodology assumes that the purpose of the FRR is to minimise the year by year increase of the contribution rate. It follows that the actual contribution rates would have to be changed every year which seems fairly unrealistic since changes in contribution rates are costly[2]. To take into account this drawback we have introduced a third constraint: the number of contribution rate changes is limited (or equivalently, the number of years between two steps is limited). The optimisation programme becomes:

[1] MSA is the pension scheme for farmers, CANCAVA for craftsmen, and ORGANIC for self-employed workers in industry and general businesses. This means that the FRR has not been designed to cope with the financial difficulties of the compulsory complementary PAYG pension schemes (second pillar).

[2] In fact the last change in contribution rates occurred in 1992.

$$\underset{s(t)}{Min}\left[\sum_{t=1}^{T-1} s(t)^2\right] + p.\left[\gamma\left(\sum_{t=1}^{T-1} Max(0, F^*(t) - F(t)\right) + \delta\left(\left|F^*(T) - F(T)\right|\right)\right]$$

$$st \begin{cases} F(t) = (1 + r(t))F(t-1) + c(t).W(t) - P(t) + A(t) \\ s(t) = c(t) - c(t-1) \\ c(t) \neq c(t-1) \ \ if \ c(t) - c(0) = 0 \bmod(\lambda) \end{cases}$$

with:

c	adjusted contribution rate (or "funded pay-as-you-go" contribution rate) – endogenous
F	pension trust fund – endogenous
F*	targeted pension trust fund – exogenous
P	pensions – exogenous
W	wages on which are levied pension contributions – exogenous
r	real return on portfolio – endogenous
A	lump-sum contributions – exogenous
γ, δ	weights of the different objectives – exogenous parameters
p	optimisation step – exogenous parameter
λ	length (in years) of contribution step – exogenous parameter

For the simulations, the optimisation step p has been fixed such as $p = 0.001:0.01:100$. The γ, δ parameters have been set at 100 and 1 000 respectively. Starting from an initial $p_{initial} = p_1$, a vector of optimal contribution rates is determined for the whole period of simulation, jointly with the value of the optimal increase in the contribution rate. The same values are then determined for p_2. V_{p_1} is compared with V_{p_2}, the smallest value being kept and compared with the next one until p_{final}.

3. Main assumptions and data

The simulation programme is made of three modules: demographic, economic and financial. These modules have some exogenous data, some of them being preset, other being chosen by the programme user.

3.1. Demographic data and projections

Data and projections of population come from INSEE (2002). Since the FRR is designed to cover only the pensioners of the general regime, the population under simulation represents 80% of the total population. Mortality rates, fertility rates and immigration have been projected along three scenarios (baseline, optimistic, pessimistic).

The baseline assumption regarding mortality consists in extrapolating the observed mortality rate over the past 30 years for the next 50 years. The low mortality assumption consists in accelerating the reduction of the mortality rate of the elderly: the life expectancy would reach 86 for men and 94 for women in 2050. Under the high mortality assumption, life expectancy would be equal to 82.6 and 87.7 respectively.

In the baseline scenario, the fertility rate is set at 1.8 children per woman until 2050 (its value aver the past two decades). Starting at 1.8 in 2005, it is set at 2.1 from 2015 until 2050 in the optimistic scenario and at 1.5 in the pessimistic scenario over the same period. As regards immigration, the baseline scenario retains an inflow of 50 000 persons per year; in the optimistic and pessimistic scenarios, the inflows are 100 000 and 0 respectively.

3.2. Institutional and economic data

Institutional and economic data are crucial for the funding of the pension trust fund. For the simulations we set an "over-contribution rate" on the wage bill. We therefore need some assumptions on projected employment rates.

- Gross replacement rate

Our simulations rely on the gross replacement rate of the basic pension regime (*régime de base)*. It is very difficult to forecast the evolution of replacement rates on a 50 years horizon since these rates are conditioned by the individual labour supply behaviour and career on the one hand, and by institutional features on the other hand (number of years of career taken into account to compute the reference wage, minimal length of contributory period, level of full replacement rate and so on…). We have thus considered complete careers and set the replacement rate equal to its current level of 50% of the gross reference wage for the total simulation period (computed on the best 10 years of career before 1993, and progressively on the best 25 years of careers after the 1993 Pension Reform Act). The gross reference wage is computed under the social security ceiling: we have assumed that the social security ceiling increases along with labour productivity.

- Legal retirement age and length of contributory period

In our simulations, we have set the retirement age at its current value. For the length of contributory period needed to be entitled to a full replacement rate, we have taken into account the past pension reforms. Before 1993, it was equal to 37.5 years. After the 1993 pension reform act, it has been progressively increased to 40 years. With the 2003 reform, it will progressively increase to 41 years.

- Employment rate

Our simulations are based on the projections of employment rates by INSEE (2002). In the baseline scenario the unemployment rate is set to 8.9% (its level in March 2002). Three other scenarios are considered: an increase in female labour force participation (the French female employment rate reach the level currently observed in Sweden for the 30-54 age group); a low unemployment rate (the unemployment rate progressively declines to 5% until 2010, and then remains stable at this level until 2050); an increase in the length of employment period over the life-cycle (a five-year increase in the current employment rate profiles).

- Wages and labour productivity

The wage bill has been forecasted using an initial structure by professional status and gender in 2001 (Pouget and Skalitz, 2003). The distribution of wages across the population is maintained constant over the simulation period. We have assumed a constant growth of labour productivity over the simulation period; the growth of labour productivity is also assumed to be the same across the different categories of workers. In the baseline scenario, the growth of labour productivity is set to 1.3% (its average level over the past 20 years). In the optimistic scenarios, it is set to 1.6%, and in the pessimistic ones to 0.5%.

- Initial "over-contribution rate" and maximal contribution rate

Our programme runs with an initial over-contribution rate and a maximal contribution over the simulation period. In the baseline scenario the over-contribution rate is set at 0.5 point and the maximal rate at 18%.

3.3. Financial data

- Simulations without shocks on the financial markets

The 2001 bill has imposed some rules on the allocation of the pension trust fund portfolio: 38% in equities of the euro zone, 17% in equities outside the euro zone, 38% in bonds of the euro zone, and 7% in bonds outside the euro zone. We have thus four categories of securities in which the FRR portfolio can be invested. For each category of securities, the programme user chooses the forecasted return and risk for the whole simulation period. In the baseline scenario the return and risk have been set according to the observed values on the past fifty years (see table 1). The correlation matrix of returns between the four categories of assets is also set by the programme user: it has been assumed to be constant whatever the scenario (see table 2).

- Stress tests on financial performances

The preceding set of simulations has been enriched by stress-tests to take into account random but plausible shocks on financial markets. These tests enable to assess the robustness of our results and to measure the sensibility of the FRR to unexpected low returns and risk increases.

  - Stress-test 1: we simulate the consequences of a 10% loss of the FRR portfolio during the year in which it has accumulated its maximal amount of reserves;
  - Stress-test 2: we impose a random 10% loss of the FRR portfolio on each period of ten years; on the 45 years of simulation we therefore have 5 losses of 10% on the return of the FRR portfolio;
  - Stress-test 3: in this test we take into account a 20% loss due to exchange rate according to the same principle as in stress-test 1. The loss is limited since the total exposure to foreign exchange risk is limited to 24% by the 2001 bill.
  - Stress-test 4: the management of the FRR has been delegated by auction to 27 independent institutional investors. In this test we assume the bankruptcy of two managers of the fund at random dates.
  - Stress-test 5: this test takes into account a progressive and steady modification of the correlation matrix between returns on the four classes of securities. 100 000 simulations are run and the worst is retained.
  - Stress-test 6: this test assumes a perfect correlation across returns of the four classes of securities. In other words the FRR portfolio is no longer diversified. This stress-test enables to measure the impact of portfolio diversification on the cumulated reserves of the fund and the associated contribution rates.

4. Results

We first present the results of the simulations under the assumption of an exhausted pension trust fund in 2050. We then turn to a "structural objective" of one year of pension benefit assigned to the fund.

4.1. Simulations under the assumption of an exhausted pension trust fund in 2050

- Baseline scenario (graph 1 to 3)

In the baseline scenario (the length between two changes in the contribution rate is equal to 5 years) the pure PAYG contribution rate steadily increases from 13.3% to 19.0%. The adjusted contribution rate is below the pure PAYG contribution rate until 2024 where it reaches 16.2%. Between 2025 and 2050, the adjusted contribution rate jumps from 16.6% to 17.4% (less than the binding contribution rate). The evolution of the FRR is characterised by an unsteady growth until 2032 where the fund reaches its maximal value equal to 113.4 billion euros.

When the length between two changes in the contribution rate is equal to 10 years instead of 5 years, the adjusted contribution rate reaches its maximal value in 2045. The first increase happens in 2015, where the adjusted rate goes from 13.8% to 15.8%. This significant jump enables a less important accumulation of reserves in the fund whose shape is no longer concave (graph 2, scenario 6).

The stress tests 3 and 4 hardly modify the shape of FRR accumulation (graph 3). On the contrary the stress tests 1, 2 and 6 induce a significant drop in the accumulation of reserves in the fund. A non-diversified fund is the worst situation.

- Optimistic scenarios (graph 4 and 5)

Optimistic scenarios combine several favourable demographic, economic and financial assumptions (see table 1).

Compared with the baseline scenario, scenario 1 assumes a decelerating life expectancy, a high fertility ratio, an increase in female labour employment rate, a high labour productivity growth, higher financial returns and lower risks. The fund is also assumed to receive some lump-sum contributions in 2010 and 2015. The maximum contribution rate is set at 16% (see table 1). Under these assumptions the pure PAYG contribution rate steadily increases from 13.2% in 2005 to 16.9% in 2050 while the adjusted rate increases from 13.5% to 15.4% in 2025, the year from which the adjusted rate becomes inferior to the pure PAYG. This upward trend in the optimal contribution rate enables a weaker accumulation in the fund (the cumulated amount is maximal in 2028 and reaches a peak of 94.4 billion euros).

Compared with the baseline scenario, scenario 3 postulates a massive immigration and a low rate of unemployment (steady decrease of the unemployment rate until 2010 and stabilisation from then on at a 5% level). The mortality rate, the labour productivity growth, the financial variables and the lump-sum contributions are set at the same level as in scenario 1 (see table 1). This scenario 3 is slightly less favourable than the scenario 1 since the pure PAYG contribution rate increases from 13.2% in 2005 to 17.2% in 2050, and the adjusted rate from 13.7% to 15.4% in 2025. The cumulated amount in the fund is lower than in the baseline scenario with a maximum equal to 108.4 billion euros in 2033.

To sum up, the optimistic scenarios enable a moderate adjustment of the contribution rates about 3 to 4 percentage points over the simulation period and a significantly lower accumulation of reserves in the FRR.

- Pessimistic scenarios (graph 6 and 7)

Scenario 2 combines an increase in life expectancy, a low fertility ratio, a weak growth of labour productivity, lower returns and higher risks compared with the baseline scenario (see table 1). Under these assumptions, the pure PAYG contribution rate would rise from 13.4% to 24.8% (i.e. + 11.4 percentage points). Imposing a maximum 22% contribution rate and an initial over-contribution equal to 0.75 point, the adjusted contribution rate sharply increases in the first decade which allows an important accumulation of reserves in the fund which tops up to 140.7 billion euros in 2032.

Scenario 4 differs from scenario 2 with respect to immigration which is assumed to be nil and with respect to fertility ratio which is assumed to be the same as in the baseline scenario. Imposing a maximum 20% contribution rate, the profile of contribution rates is not significantly different from the profile exhibited in scenario 2. The accumulation of reserves culminates at 144.4 billion euros in 2032.

- Comparison of the different scenarios (graph 8 and 9)

The profile of the contribution rates under the baseline scenario, the optimistic scenario 1 and the pessimistic scenario 2 can be compared in graph 8. Graph 9 gives the evolution of the pension trust fund under the same scenarios.

4.2. Simulations under the assumption of a pension trust fund accumulation equal to one year of pension benefits in 2050 (graph 1 and 2)

Scenario 5 has the same demographic, economic and financial assumptions as in the baseline scenario (see table 1). The only difference is that we have imposed the accumulation of one year of pension benefits in the fund in 2050. The pension trust fund is thus assumed to have a "structural" objective of introducing permanent funding in the pure pay-as-you-go pension system. Under this assumption, the adjusted contribution rates are 0.1 to 0.3 percentage points higher than in the baseline scenario (see graph 1). The FRR culminates at 192.2 billion euros in 2040 and ends at 173.8 billion euros in 2050 (see graph 2).

4.3. Maximal delaying period to meet the financial sustainability of PAYG (graph 10)

The French pension trust fund is still not abounded by steady contributions, but rather by lump-sum and random resources. Assuming that the contribution rate is set to 18% over the whole period of simulation, until which date can the Government wait to meet its final objectives? Graph 10 features the profile of the minimum fund required to meet the two different objectives (smoothing and structural) under the baseline scenario, the optimistic scenario 1, and the pessimistic scenario 2.

5. Conclusion

This paper has presented some simulation results on the projected evolution of the French pension trust fund under various assumptions. The main idea was to optimise the profile of the trend in contribution rates needed to meet the objective of a balanced basic pension scheme of the period 2005-2050.

When the pension trust fund was implemented in 1999, the French government expected an accumulation of reserves for an amount of 150 billion euros to meet the "smoothing objective" of the fund. Our simulations show that the amount of funding is likely to be less important under plausible assumptions, about 115 billion euros. Stress-tests show that severe shocks on financial markets may dramatically affect the accumulation profile of the FRR.

The main limit of ours simulations is that the number of independent parameters is still too high. An extension would be to nest ours simulations in a macro model to account for the link between the return on capital and the demographics.

Table 1: assumptions in the different scenarios

Assumptions	Baseline scenario	Scenario 1 (optimistic)	Scenario 2 (pessimistic)	Scenario 3 (optimistic)	Scenario 4 (pessimistic)	Scenario 5 (central)	Scenario 6 (central)
Demographic module							
Mortality (a)	1	**3**	**2**	**3**	**2**	1	1
Fertility and immigration (b)	1	**2**	**3**	**5**	**4**	1	1
Economic module							
Labour force participation (c)	1	**2**	1	**3**	1	1	1
Productivity growth (%)	1,3	**1,6**	**0,5**	**1,6**	**0,5**	1,3	1,3
Financial module							
Return on equities - euro zone (%)	6,0	**7,0**	**5,0**	**7,0**	**5,0**	6,0	6,0
Return on bonds - euro zone (%)	2,0	**3,0**	**1,0**	**3,0**	**1,0**	2,0	2,0
Return on equities – outside euro zone (%)	8,0	**9,0**	**7,0**	**9,0**	**7,0**	8,0	8,0
Return on bonds – outside euro zone (%)	3,0	**4,0**	**2,0**	**4,0**	**2,0**	3,0	3,0
Risk on equities - euro zone (standard deviation %)	20,0	**18,0**	**22,0**	**18,0**	**22,0**	20,0	20,0
Risk on bonds - euro zone (standard deviation %)	3,0	**2,0**	**4,0**	**2,0**	**4,0**	3,0	3,0
Risk on equities – outside euro zone (standard deviation %)	25,0	**23,0**	**27,0**	**23,0**	**27,0**	25,0	25,0
Risk on bonds – outside euro zone (standard deviation %)	4,0	**3,0**	**5,0**	**3,0**	**5,0**	4,0	4,0
Assumptions on FFR							
Initial amount (billion €)	16	16	16	16	16	16	16
Lump-sum contributions (year)	2010	**2006, 2010, 2015**	**-**	**2006, 2010, 2015**	**-**	2010	2010
Lump-sum contributions (amount)	5	**3, 3, 5**	**-**	**3, 3, 5**	**-**	5	5
Amount of funding in 2050 (in number of years of benefits)	0	0	0	0	0	**1**	0
Parameter							
Initial over contribution rate (percentage pt)	0,5	**0,25**	**0,75**	0,5	0,5	0,5	0,5
Maximal contribution rate (%)	18	**16**	**22**	16	20	18	18
Length of steps (in years)	5	5	5	5	5	5	**10**

(a) mortality: assumption 1: mortality trend observed over the past thirty years projected on the next fifty years; assumption 2: deceleration in the reduction of the mortality rate of the elderly: the life expectancy would reach 82.6 for men and 87.7 for women in 2050; assumption 3: acceleration in the reduction of the mortality rate of the elderly: the life expectancy would reach 86 for men and 94 for women in 2050.

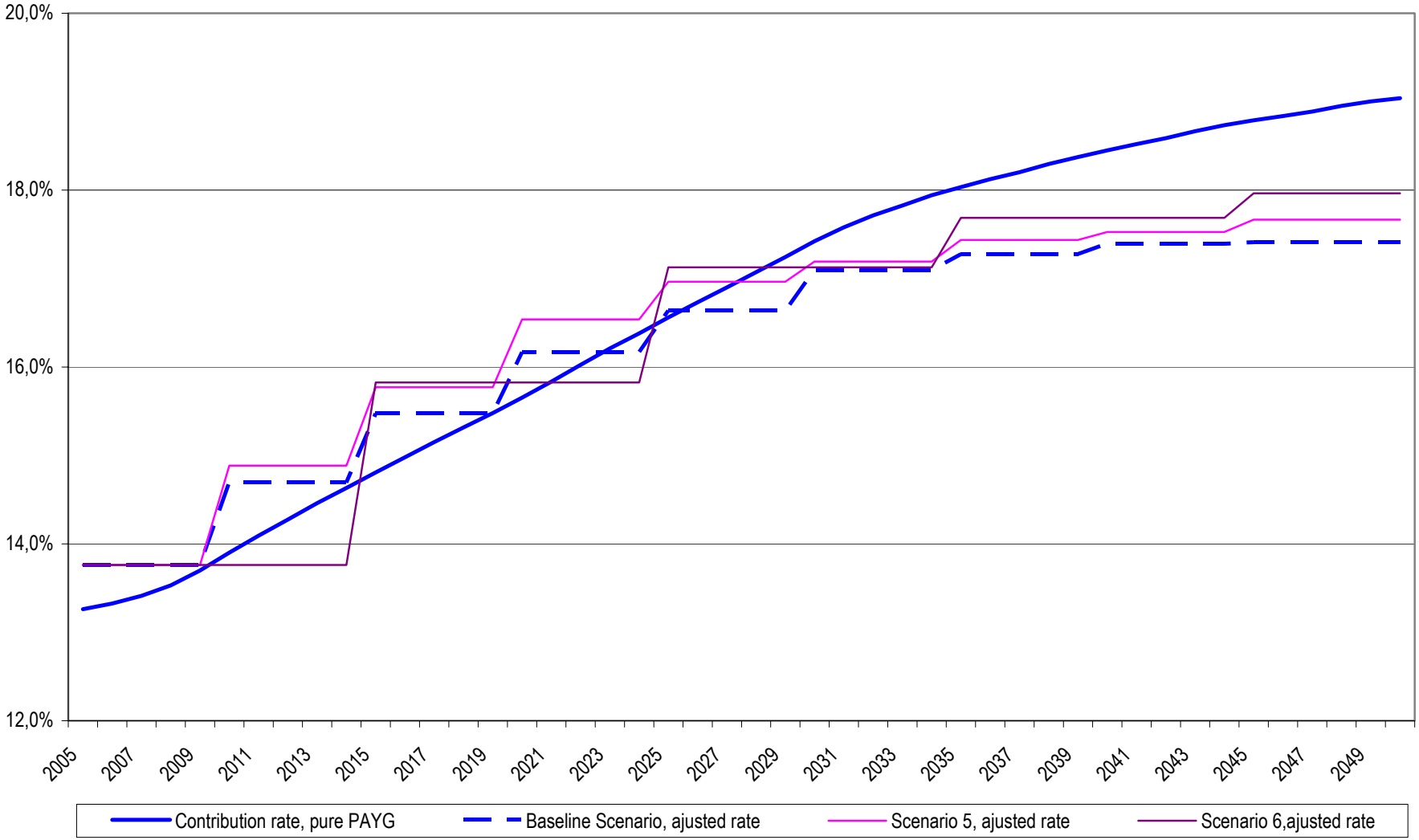
(b) fertility and immigration (joint hypothesis): assumption 1 : 1,8 children per woman et 50 000 immigrants per year; assumption 2 : 2,1 children per woman from 2015 and 50000 immigrants per year; assumption 3 : 1,5 children per woman and 50 000 immigrants per year; assumption 4 : 1,8 children per woman et 100 000 immigrants per year; assumption 5 : 1,8 children per woman et 0 immigrant per year.

(c) labour force participation: assumption 1: unemployment rate equal to 8.9%; assumption 2: increase in female labour force participation (the female employment rate progressively reaches the level currently observed in Sweden for the 30-54 age group); assumption 3 : low unemployment rate (the unemployment rate progressively declines to 5% until 2010, and then remains stable at this level until 2050).

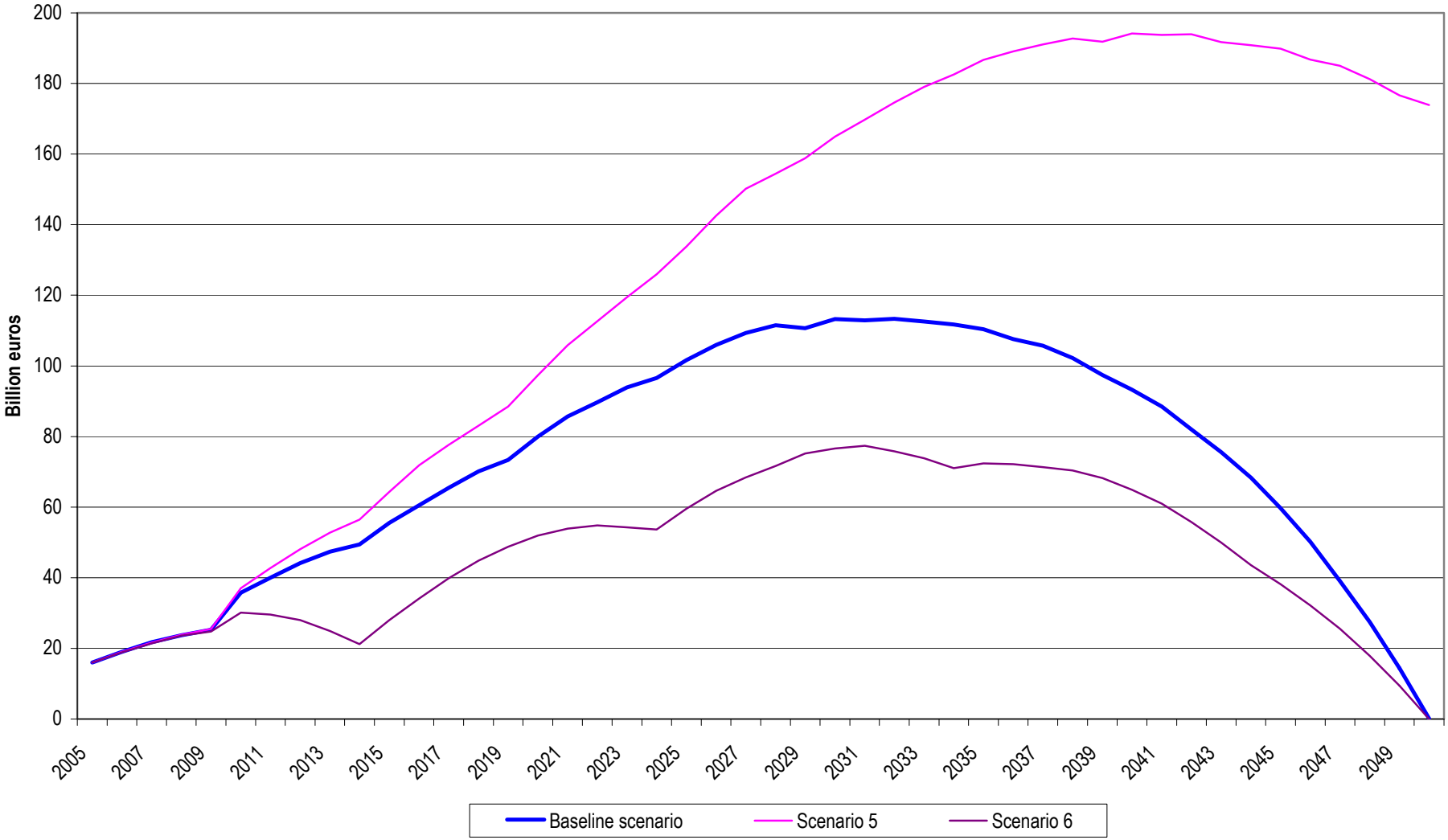
Table 2: correlation matrix of the returns on four classes of securities

	Equities – euro zone	Bonds – euro zone	Equities – outside euro zone	Bonds – outside euro zone
Equities – euro zone	100%			
Bonds – euro zone	85%	100%		
Equities – outside euro zone	80%	25%	100%	
Bonds – outside euro zone	25%	70%	75%	100%

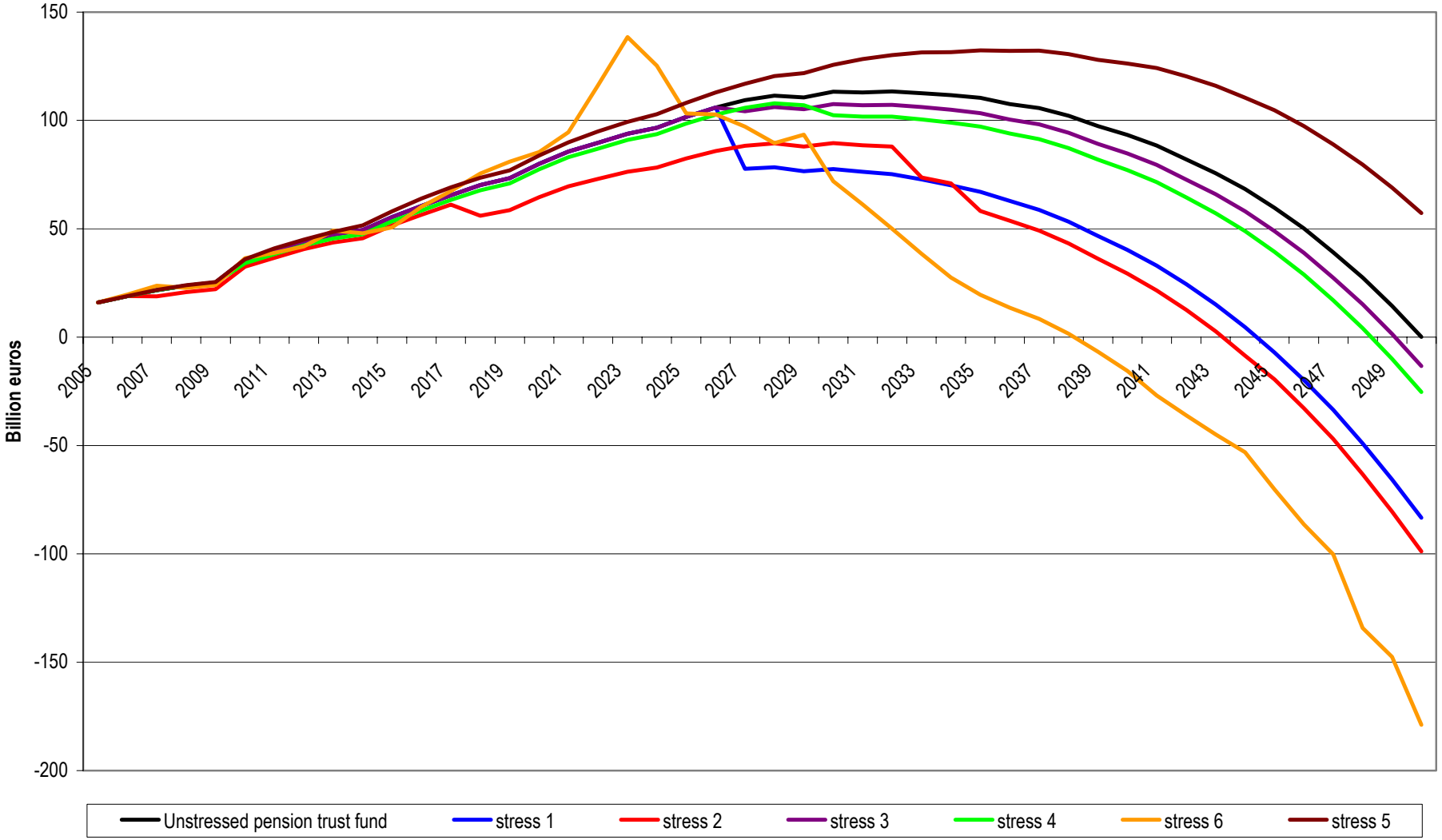
Graph 1: Contribution rates, baseline scenarios



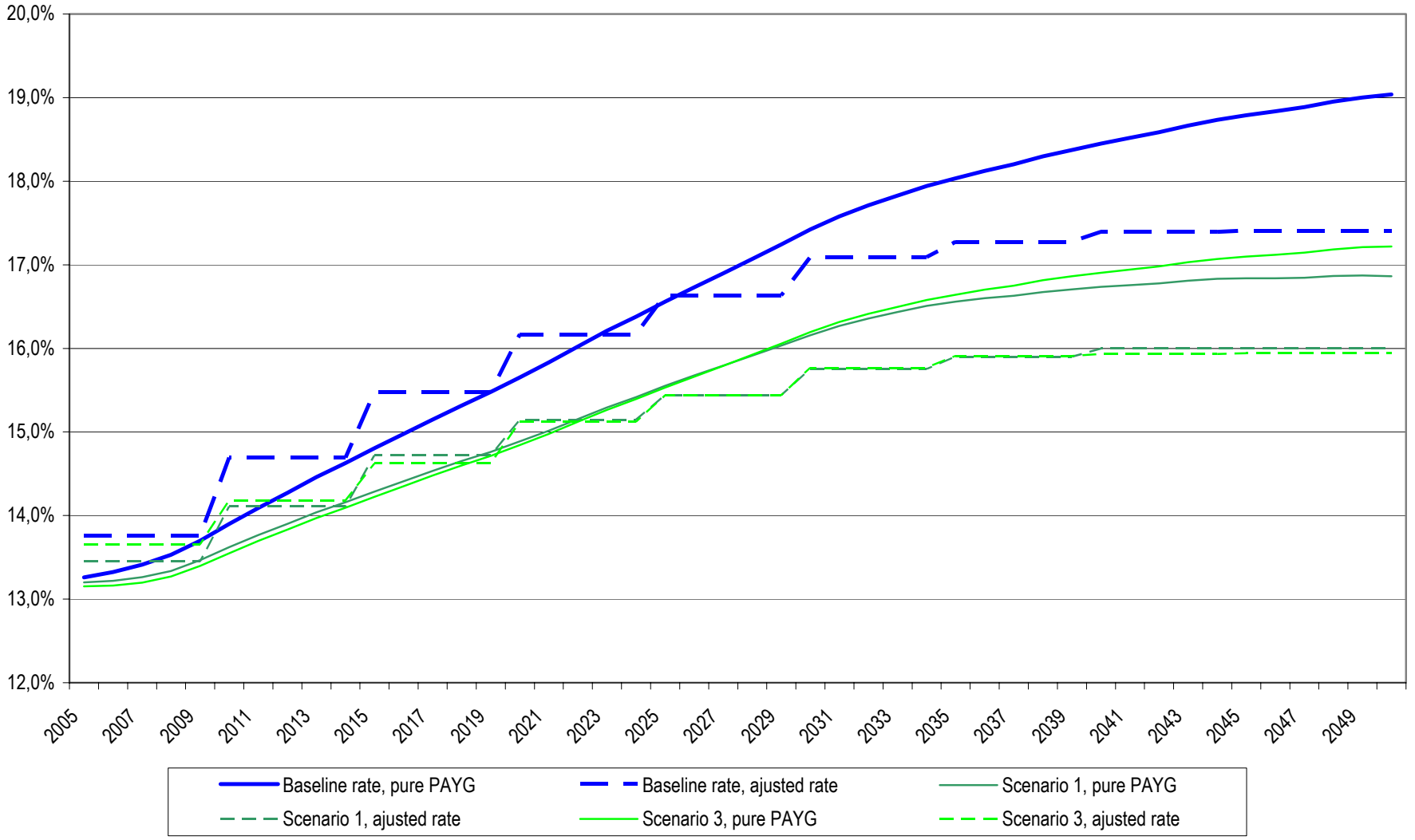
Graph 2: Evolution of the pension trust fund, baseline scenarios



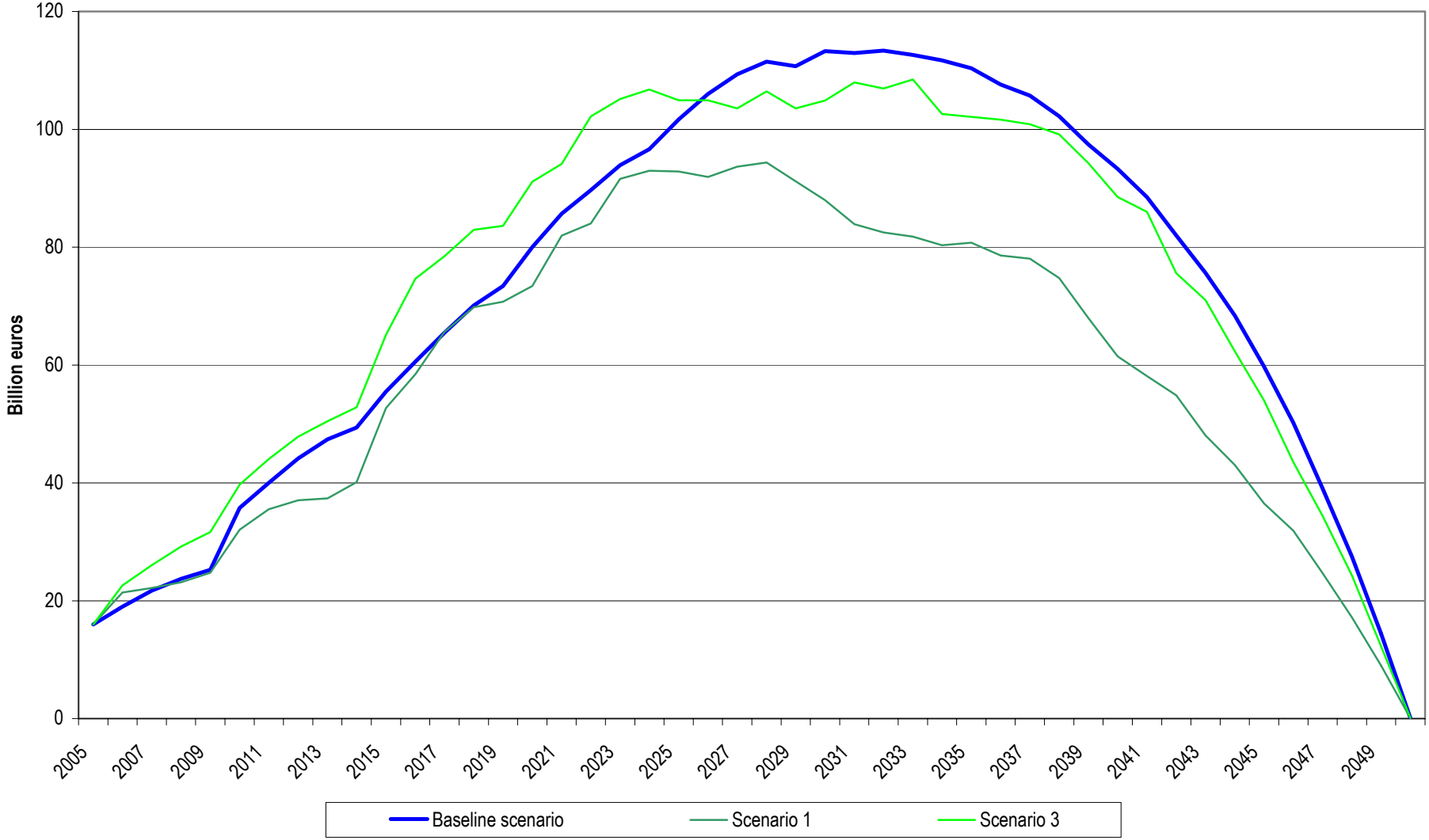
Graph 3: Stress tests on the pension trust fund



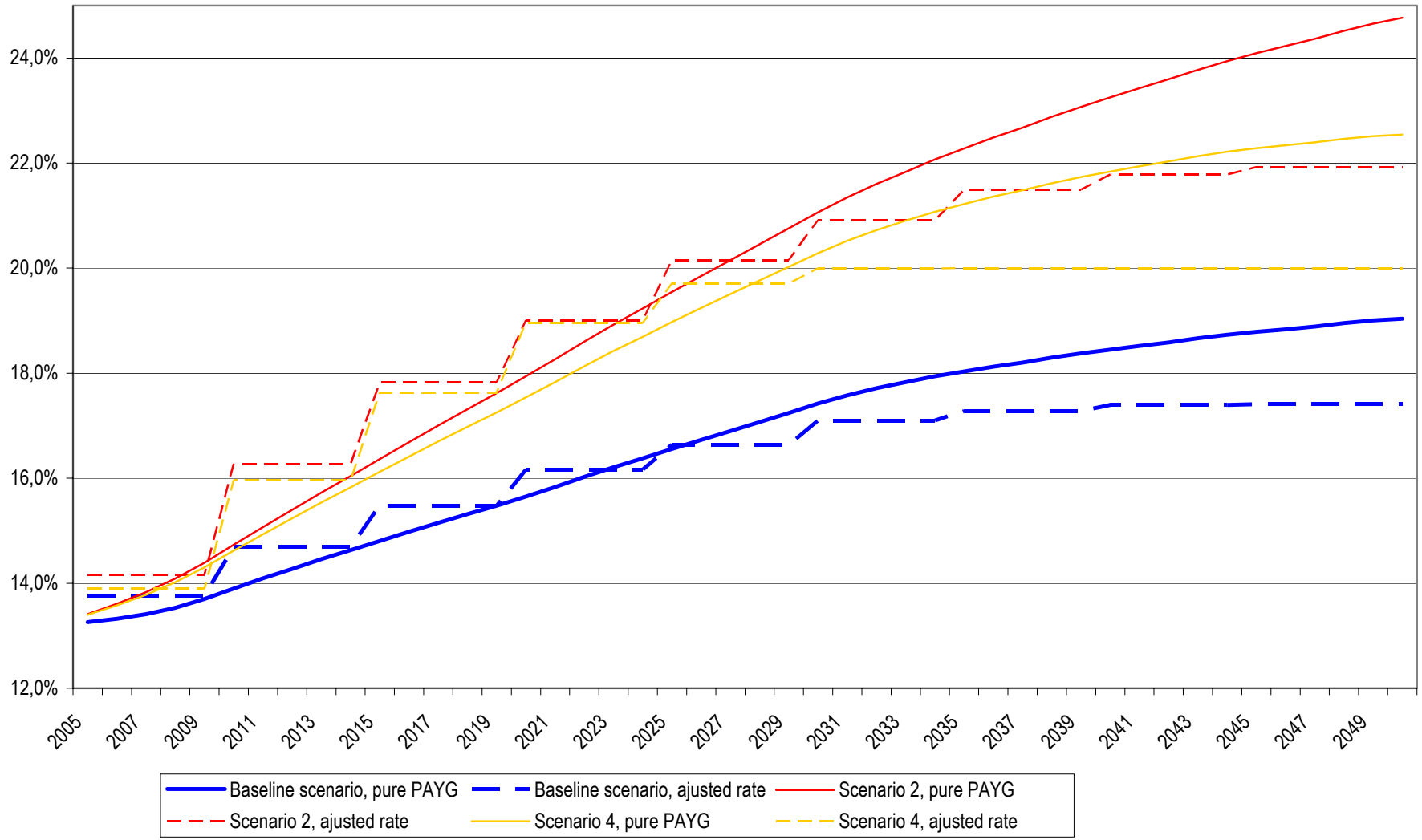
Graph 4: Contribution rates, optimistic scenarios



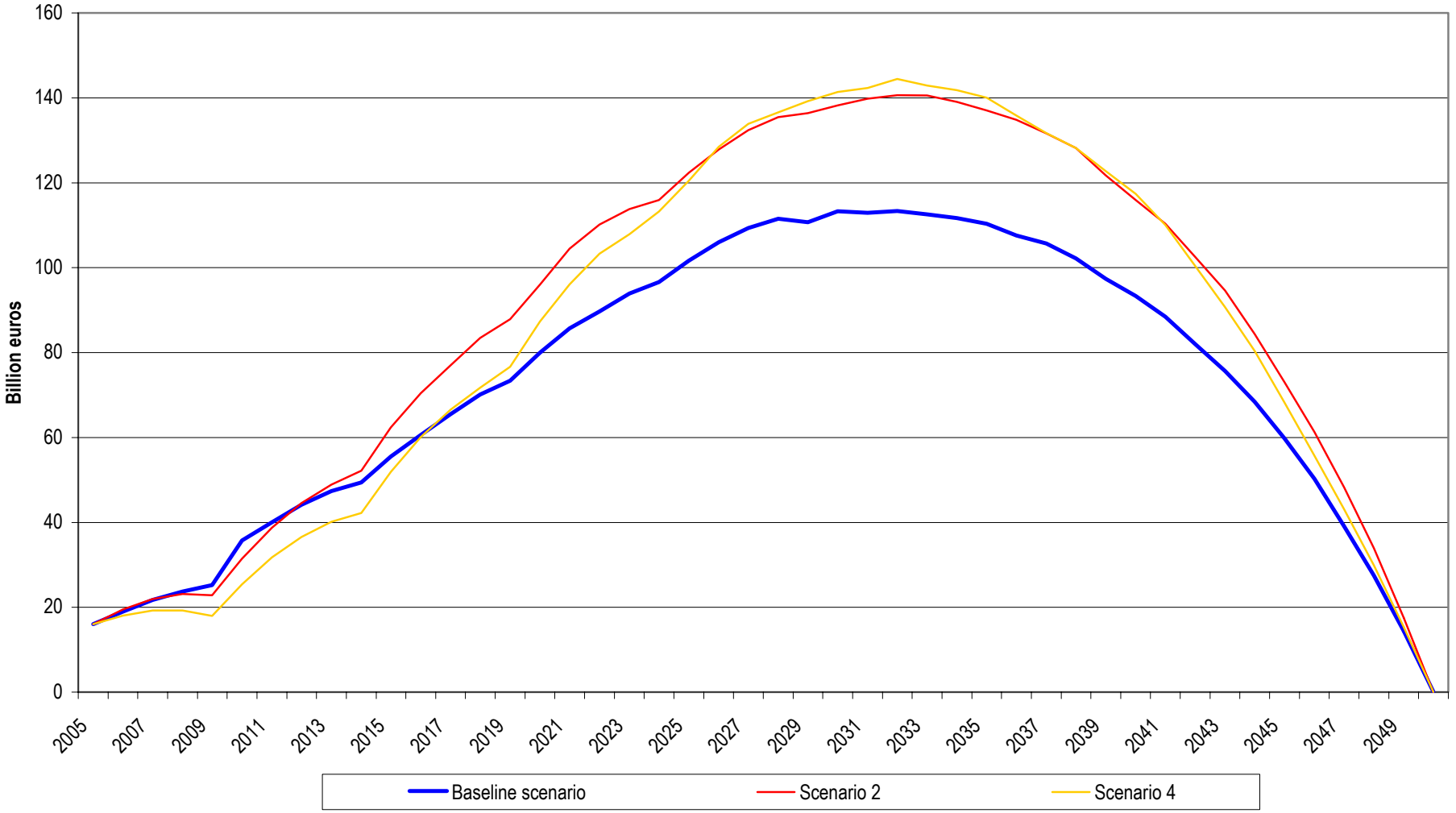
Graph 5: Pension trust fund, optimistic scenarios



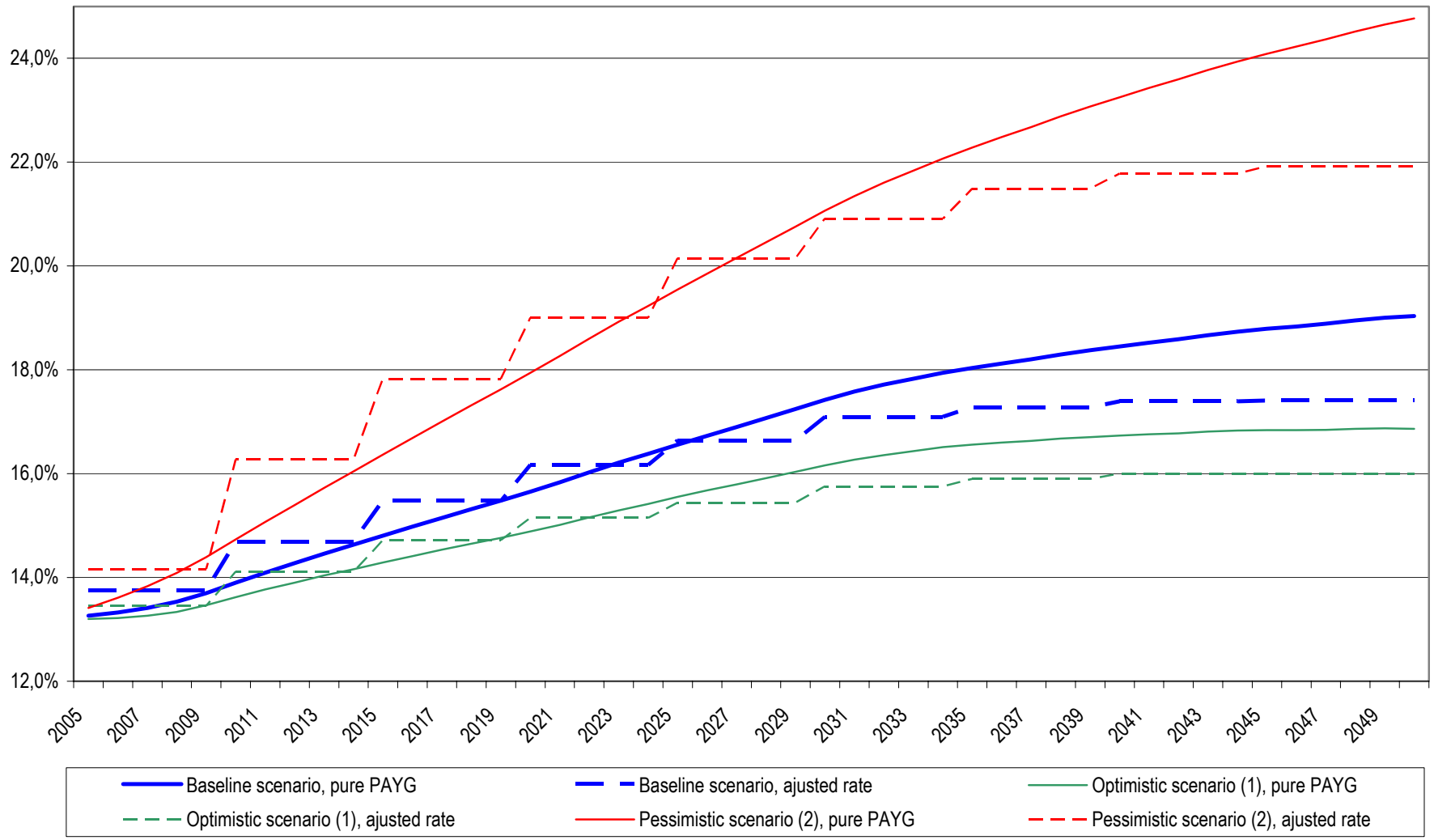
Graph 6: Contribution rates, pessimistic scenarios



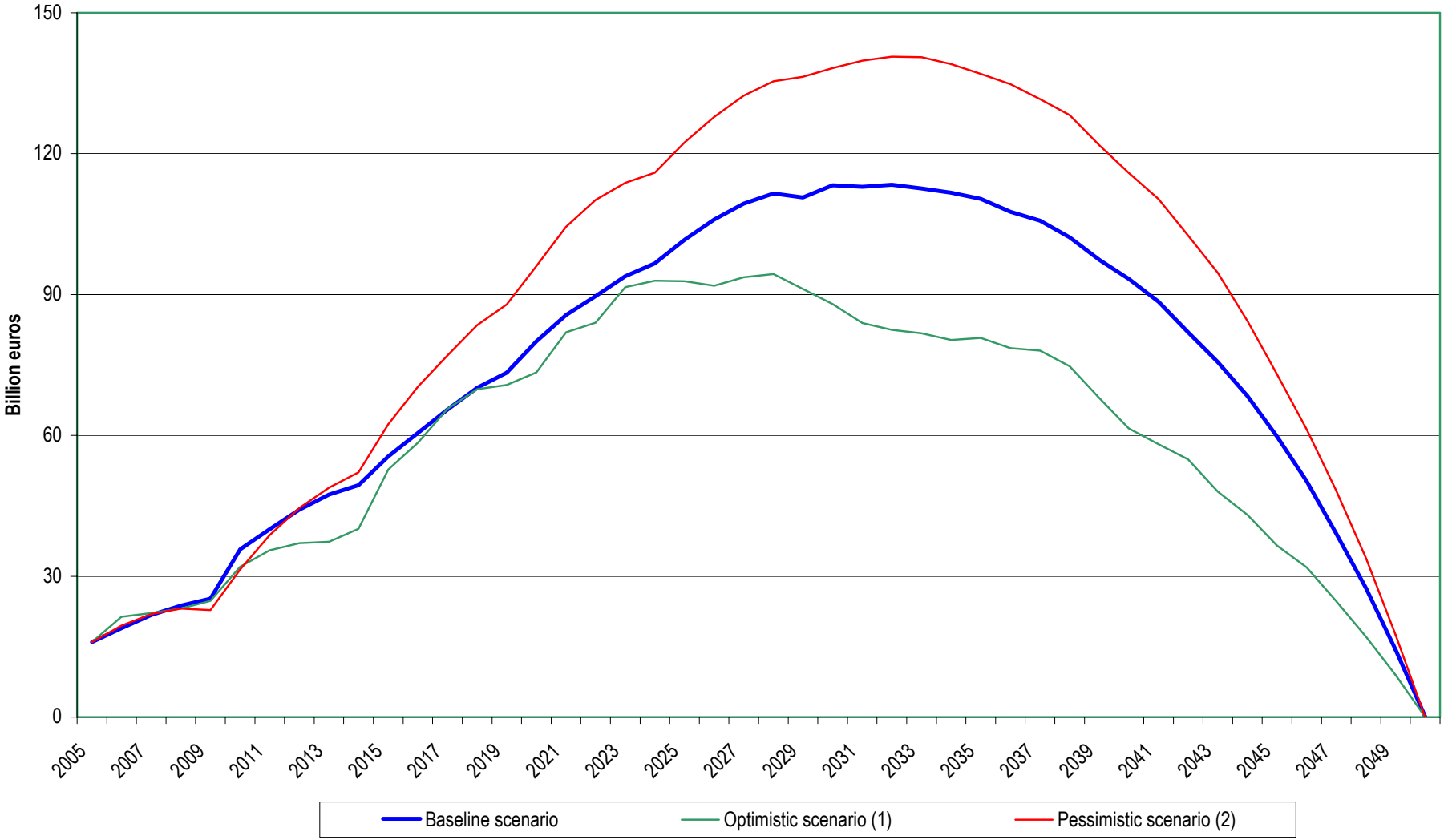
Graph 7: Pension trust fund, pessimistic scenarios



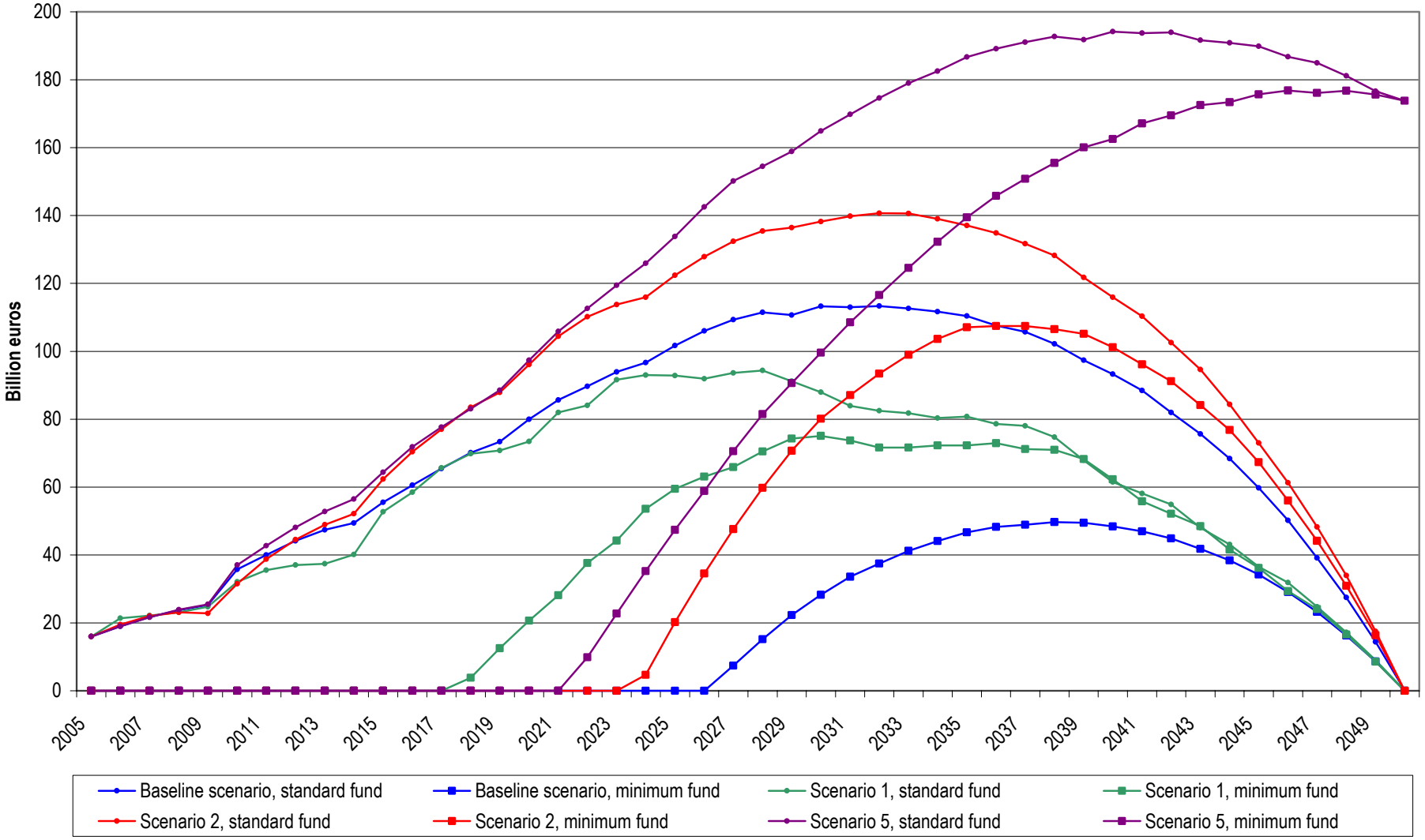
Graph 8: Contribution rates, baseline scenario, optimistic scenario (1), pessimistic scenario (2)



Graph 9: Pension trust fund, baseline scenario, optimistic scenario (1), pessimistic scenario (2)



Graph 10: Pension trust fund, standard and minimum



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