Public pension system projections - Italy's fiche[*]

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Contents

Introduction

This paper aims to illustrate the projection of the Italian public pension system made by the model of the Department of General Accounts (Ragioneria Generale dello Stato - RGS), on the basis of the scenario hypotheses defined within the second round of budgetary projections promoted by the Economic Policy Committee - Working Group on Ageing (EPC-WGA). The main objective of the working group is to provide more in depth analyses on the impact of ageing populations on public finances across EU-countries through a set of comparable indicators. The results of the previous round of budgetary projections were finalised in November 2000 and published the following year. Since then, the projections of the Italian pension system, based on EPC-WGA assumptions, have been yearly revised to take into account the updating of the starting data and any changes to the legal-institutional framework legislated afterwards. Such projections have been regularly utilised in the Stability and Converging Programmes of Italy, in the section devoted to the analysis of the mid-long term sustainability of public finances.

The first paragraph provides a description of the Italian pension system in which particular attention is paid to the reform process starting from 1992.

The following paragraph is aimed at illustrating the main features of the forecasting model. Besides a description of the main methodological aspects, this section provides informations concerning the coverage of pension projections.

The third paragraph is devoted to reporting the demographic ad macroeconomic assumptions agreed within the EPC-WGA as the baseline scenario and explaining the results of the projection through suitable indicators.

The last paragraph is devoted to the sensitivity test analysis. Several projections are compared with the baseline, made on the basis of alternative demographic and macroeconomic hypotheses.

In the annexes, more in depth analyses are provided, concerning specific aspects related to the scenario assumptions and pension projection results.

1.Description of the pension system

1.1.The legal- institutional framework - An overview

The Italian pension system is almost entirely composed of a compulsory, public component that is financed as a pay-as-you-go system. In addition, it is fragmented into over fifty different schemes. The five largest schemes cover more than 9/10th of the total pension expenditure. Most of the other schemes involve very few workers or pensioners. About 73% of the Public Pension System is administered by INPS (Social Security Institute for the private sector), about 24% is administered by INPDAP (Social Security Institute for the public sector), and the remaining 3% is administered by a number of small institutions.

In 2003, the public pension expenditure accounted for 14,2% of GDP gross of tax revenue on it. Discarding the component of social pensions, the public pension expenditure was attributed to direct pensions (old age, seniority and disability) for 83% and to survivors' pensions for the remaining 17%. Moving on to the decomposition by sectors, 61% of pension expenditure was assigned to the privately employed, 24% to the publicly employed and 15% to the self-employed.

The legal-institutional framework of the Italian public pension system has been heavily reformed since 1992. In particular, four major reforms have been adopted, respectively in 1992 (Law 503/92), 1995 (Law 335/95), 1997 (Law 449/97) and 2004 (Law 243/2004). More specifically, the 1995-reform provide a process moving from the earnings-related regime towards a new one called "contribution-based regime"- mainly involving changes in the calculation method. The latest reform, has tighten further the eligibility requirements to be entitled to a pension starting from 2008.

In addition to this reform process, we should mention the disability pension reform approved in 1984, (Law 222/84) which significantly reduced the number of newly awarded pensions, and is still producing effects in terms of a steady reduction of the related stock of pensions.

The official projections of the Italian pension system indicate that such reforms tend to curb the effects of demographic trends on the ratio of pension expenditure to GDP, although they cannot avoid an

increase of about 1.5 percentage points in the next 30 years. The measures that have contributed most to that result are:

- the elimination of the indexation of pensions to real earnings (Law 503/1992). Now pensions are indexed only to prices;

- the introduction of the contribution based method, which significantly reduces the size of pensions, especially for the self-employed (Law 335/1995);

- the tightening of the minimum eligibility requirements (Laws 503/1992, 335/1995, 449/1997 and 243/2004);

- the continuing decrease in the number of disability pensions as a consequence of the 1984 reform (Law 22/84).

As of today the funded part of the pension system is not well developed. The reforms approved in 1993 (Legislative Decree 507/1993) and in 1995 (Law 335/1995) introduced legislation to regulate and foster supplementary, funded schemes with the aim of building a multi-pillar pension system. Since then the number of insured workers to private funds has increased, although its relative weight is still low. More recently, additional measures have been adopted in order to augment such a trend up to the latest pension reform (Law 243/2004) which has provided important novelties in terms of fiscal incentives and the transfer of the employee severance pay ("trattamento di fine rapporto") to private funds.

1.2. The public pension system

1.2.1. Calculation rules

As a result of the reform enacted in 1995, the Italian Pension System is moving gradually to a new regime applied to all labour market entrants after 31 December 1995. The main feature of this regime concerns the method of calculation (see Table 1). Unlike the preceding method, this one takes into account both the amount of contribution paid throughout the whole working life and the life expectancy of the pensioner at retirement age, according to actuarial equivalence.

More specifically, under the contribution-based regime the amount of pension is calculated as a product of two factors: the total lifelong contributions, capitalised with the nominal GDP growth rate (five-year geometric average) and the transformation coefficient the calculation of which is mainly based on the probabilities of death, the probabilities of leaving any widow or widower and the number of years that a survivor's benefit will be withdrawn. As a consequence, benefits are strongly related to retirement age - the lower the age, the lower the pension and vice versa.

The transformation coefficients are available for the age bracket 57-65, but workers may not retire earlier than 65 unless they have reached the eligibility requirements stated by the current legislation and an amount of pension not less than 1.2 times the old age allowance (see next paragraph). In all cases, at 65 people will be at least entitled to the old age allowance, as long as they do not possess other incomes (pensions included).

The new regime will be fully phased in after 2030-2035. Meanwhile, there will be a transition period which only affects workers already employed at the end of 1995. In particular, two different calculation methods will be used depending on the years of contribution at the cut-off date.

Workers with at least 18 years of contribution at the end of 1995 will maintain the earnings-related method but, for the contribution years after 1992, the number of years of annual earnings involved in the benefit calculation will increase gradually to reach the last 15 years for the self-employed and the last 10 years for others. Before the 1992 reform, these were 10 years for the self employed, 5 years for the private employees and the last monthly salary for the public employees.

However, a so-called pro-rata, mixed regime will be applied to workers with less than 18 years of contribution at the end of 1995. Accordingly, the pension is obtained as a sum of two components: the first one, related to the contribution years before 1995, is calculated following the earnings related method with reference wages, for the contribution years between 1993 and 1995, gradually extended to the entire career; the second one is calculated according to the contribution based method described above.

Acting on the legislation in force before 1992, both groups of workers are provided with an additional, means-tested income as long as the calculated amount of pension is less than a minimum (5,358.34 Euro a year, in 2004).

1.2.2. Eligibility requirements

According to the current legislation, the eligibility requirements required to be entitled to public pensions are described in Table 2. As shown, eligibility requirements are gradually increasing for all regimes. In order to make clear the effect of the latest reform (Law 243/2004), which provides a significant increase in the eligibility requirements starting from 2008, it is useful to distinguish the legislation in force before and after the cut-off date for the three regimes.

Under the earnings-related and mixed regimes, the age requirement to be entitled to an old age pension is 65 for men and 60 for women jointly with a minimum contribution period of 20 years. Before 1992, the minimum retirement age was, respectively, 60 and 55 in the privately employed sector and the minimum contribution period was 15 years.

Up to 2007, the following eligibility requirements will be necessary, as far as seniority pensions are concerned [1]:

- for the employed, either 35 years of contribution at the age of 57[2] or 38 years of contribution for the period 2004-2005 increased by 1 year for the period 2006-2007. Before 1992, there was only a contribution requirement of 35 years, for the privately employed, and of 20 years for the publicly employed that could be reduced to 15 for married women with children;

- for the self-employed, either 40 years of contribution or 35 years of contribution at the age of 58, starting from 2001. Before 1992, there was only a contribution requirement of 35 years.

In 2008, the eligibility requirements to qualify for seniority pensions become either 40 years of contribution or 35 years of contribution in conjunction with an age of 60, for the employed and 61 for the self-employed. The age requirement is subsequently increased by 1 year in 2010 and another one in 2014 thus reaching the final level of 62 for the employed and 63 for the self-employed[3].

For the period 2008-2015, women are allowed to receive a seniority pension having satisfied the requirements laid down by legislation before Law 243/2004 as long as they choose the less favourable pension treatment calculated according to the contribution-based method.

Under the contribution-based regime seniority pensions are no longer provided. Up to 2007, retirement age for an old age pension ranges from 57 to 65, but workers may not retire earlier than 65 unless they have reached an amount of pension of at least 1.2 times the old age allowance (4,783.61 Euro a year, in 2004). The possibility to retire before 57 is allowed but it is subject to a contribution requirement of at least 40 years.

Beginning in 2008, the possibility to receive a pension at an age lower than 65 for males and 60 for females is allowed to those with 40 or more years of contributions, or to those with no less than 35 years of contributions and of 60 years of age, in the case of the employed, and 61 for the self-employed. The age limit is to rise by a year from 2010 and another year from 2014, thus reaching 62 and 63 years of age for the employed and the self-employed, respectively. Between 60 and 65, women may retire with 5 years of contributions. In any case, the prerequisite of an amount of pension of at least 1.2 times the old age allowance is still necessary to retire before 65, for both genders.

A further postponement of pension payment is envisaged with respect to the moment in which the requirements are met, by way of the so-called "exit windows". Before Law 243/2004, "exit windows" were applied only to seniority pensions, under the earnings-related and mixed regimes. The new

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[1] For the period 2004-2007, Law 243/2004 also provides an intervention aimed at encouraging the postponement of retirement. For details, see Annex1.

[2] For the period 2004-2005, the age requirement is reduced by 1 year for blue-collar workers.

[3] Those who would have satisfied the requirements envisaged by the precedent legislation before the 31st December 2007 would be entitled to a pension under the requirements previously in force (the so-called 'certezza dei diritti').

legislation has significantly increased the postponement through "exit windows" and has applied such a rule also to pensions under the contribution-based regime, starting from 2008.

1.2.3. Indexation of pensions

Both in the transition and fully phased in period, pensions are indexed to price developments, unlike the scheme applied before 1992, which also provided, for the employed, a link to real wage growth. In particular, the current legislation maintains a differentiated indexation of pensions according to their amount. These are: 100% of the inflation rate for the part of pension up to three times the minimum pension, 90% for the part between three and five times the minimum, and 75% for the part above five times the minimum.

1.2.4. Contribution rates

Contribution rates actually paid to the public pension system are differentiated by category of workers according to the following:

- Private and public employees. The contribution rate is 32.7%, of which about $1/3^{rd}$ paid by the employee and $2/3^{rd}$ by the employer;

- The self-employed. As for artisans and shopkeepers, the contribution rate is increasing up to 19% starting from, respectively, 17.2% and 17.6% in 2005. The target level is achieved in 2014 for the former and in 2013 for the latter. As for farmers, the contribution rate is 20%;

- Atypical workers. The contribution rate is increasing up to 19% starting from 17.5%, in 2005. Such a contribution rate is reduced to 12.5% in case of atypical workers already entitled to a pension and to 10% in case of a contextual contribution to other public pension schemes.

1.2.5. Taxation of pensions

All pensions are taxed as labour-income, allowing for deductions inversely correlated with the income level. Pension income below 7,500 Euro per year are tax-exempt (no tax-area).

In 2004, total revenues on pension incomes, provided by the public pension system, accounted for about 14.5% of the total expenditure which, in turn, corresponded to nearly 2.1% of GDP.

Contributions paid to the public pension system are fully deductible from income before taxes.

1.3. Funded component of the pension system

Reforms establishing funded pension schemes have also been enacted in order to foster a multi-pillar pension system. In particular, the 1992-1993 and 1995 reforms respectively introduced and improved legislation on supplementary, funded schemes. During the 1990's measures have also been progressively introduced with the aim of regulating financial markets (1991, 1996 and 1998) and reforming the taxation of income from financial assets (1997).

An further incentive toward a funded system should have come from the reduction in pension coverage as a consequence of the introduction of the contribution method in the public system (see paragraph 3.3). Such a reduction will be especially pronounced for younger people (for whom the contribution based-method will be totally or almost integrally applied) and for the self-employed.

Subsequently, additional measures have been approved aiming to increase the amount of savings invested in pension funds (Law 133/99 and related Legislative Decree for fiscal treatment of contributions paid to private funds). Moreover, workers could assign their annual severance pay entitlements to pension funds investing in company stocks, as long as they apply for it.

Despite the legislative intervention mentioned above, the number of worker enrolled in a private pension fund is still low. For this reason, the pension reform recently passed (Law 243/2004 and legislative decree 252/2005) has introduced further measures in order to foster the development of the second pillar. This is done through two kind of intervention, coming into force from 2008: a) higher fiscal incentives and b) silence-as-assent for the transfer of the private severance pay ("trattamento di fine rapporto"). In particular, the latter means that the current severance pay accumulation is supposed to be transferred to private pension funds, unless he/she applies for communicating his/her refusal. However, enrolments in the private pension funds remains on a voluntary basis.

Table 1: calculation method

	Earnings-related regime (workers with at least 18 years of contribution at the end of 1995)	Mixed regime (workers with less than 18 years of contribution at the end of 1995)	Contribution-based regime (new entrants into the system after 1995)
Old age, early retirement (seniority), late retirement and disability pension[1]	The pension (P) is calculated using the earnings related method according to the following formule. **P = 2% x(C1 x W1+ C2 x W2)** where: W1 and W2 = reference wage C1 e C2 = years of contribution a) for contribution before 1992 (C1), W1 is the last monthly wage for public employees and the average of the last 5 or 10 years, respectively, for private employees and the self- employed[2]. b) for contribution after 1992 (C2), W2 is the average of the last 10 years for private and public empoyees[3] and 15 years for the self-employed (starting from 2002)[4]. The percentage ratio for each year of contribution is 2% up to a fixed threshold of the reference wage[5]. For amounts beyond this limit, such a percentage decreases to 1% in the case of W1 and to 0.9% in the case of W2.	'The pension (P) is obtained as a sum of two components (P = PA+ PB). The former (PA) is calculated by using the earning-related method while the latter (PB) the contribution-based method. In particular: **PA = 2% x (C1 x W1+ C2 x W2)** where: W1 and W2 = reference wage C1 e C2 = years of contribution before 1995 a) for contribution before 1992 (C1), W1 is last montly wage for public employees and the average of the last 5 or 10 years, respectively, for private employees and the self- employed [2]. b) for contribution between 1993-1995 (C2), W2 is the average wage of the number of last years progressively increasing[4]. The percentage ratio for each year of contribution is 2% up to a fixed threshold of the reference wage[5]. For amounts beyond this limit, such a percentage decreases to 1% in the case of W1 and to 0.9% in the case of W2. **PB = ct x M** (for explanation, see the box in the right hand).	The pension is calculated using the contribution-based method according to the following formule. **P = ct x M** where: ct = tranformation coefficient M = the total of contribution accrued during the whole working life capitalized at the rate of growth of nominal GDP The conversion coefficients range from 4.72% at the age of 57 to 6.14% at the age of 65. Over 65 years of age (late retirement) the conversion coefficients are set equal to the one at 65. Such coefficients are adjusted every 10 years according to changes in life expectancy. The contribution percentage applied to income to calculate the amount of contribution yearly accrued is 33% for the private and public employees and 20% for the self employed. Contributions are due, and therefore accrued, up to a maximum threshold of taxable income[6].
survivors' pensions	'- 60% of the pension calculated as above, if a survivor is a widow or widower of an employed; - 60% of the deceased's pension, if a survivor is a widow or widower of a pensioner. The percentage is reduced by 25%, 40% or 50% if the survivor total income exceeds, respectively, 3,4 or 5 times the minimum pension.	- 60% of the pension calculated as above, if a survivor is a widow or widower of an employed; - 60% of the deceased's pension, if a survivor is a widow or widower of a pensioner. The percentage is reduced by 25%, 40% or 50% if the survivor total income exceeds, respectively, 3,4 or 5 times the minimum pension.	- 60% of the pension calculated as above, if a survivor is a widow or widower of an employed; - 60% of the deceased's pension, if a survivor is a widow or widower of a pensioner. The percentage is reduced by 25%, 40% or 50% if the survivor total income exceeds, respectively, 3,4 or 5 times the minimum pension.

(1) Disability pensions include the "*assegno ordinario di invalidità* " and the "*pensione di inabilità* ". As for the latter, extra contributions are generally accrued (up to the maximum that the pensioner would have been able to reach if he/she had continued to work).
(2) The wages used in the reference wage calculation are indexed to prices.
(3) For the public employees, starting from 2008. In December 2003, the reference salary was calculated on the last 81 monthly salaries.
(4) The wages used in the reference wage calculation are indexed to prices, plus 1%.
(5) This threshold is 38,641 euros in 2005.
(6) This threshold is 84,049 euros in 2005.

Table 2: eligibility requirements

		Earnings-related and mixed regimes (workers already insured as of 1995)		Contribution-based regime (new entrants into the system after 1995)	
		2004 - 2007	Starting from 2008 (Law 243/2004)	up to 2007	Starting from 2008 (Law 243/2004)
Old age pensions		65 years of age for male, 60 years of age for female and 20 years of contribution for males and females.	as before.	Eligibility requirements range from age 57 to age 65. At least 5 years of contribution are required. A worker is allowed to retire before 65 only if he/she is entitled to a pension of at least 1.2 times the old age allowance. The possibility to retire before 57 is subject to a contribution requirement of 40 years. Incentives to postpone the retirement age are implicitly considered according to the actuarial equivalence of the contribution based method (see Table 1).	For males, the possibility to receive a pension at an age lower than 65 is allowed to those with 40 or more years of contributions, or to those with no less than 35 years of contributions and of 60 years of age, for the employed, and 61 for the self-employed. The age limit is to rise by a year from 2010 and another year from 2014, thus reaching 62 and 63 respectively. For females, the possibility to receive a pension is allowed at 60 with 5 years of contribution or, alternatively, with 40 or more years of contributions regardless of the age. For both males and females, the amount of pension must be at least 1.2 times the old age allowance.
Early retirement (seniority) pensions	Private sector employees	35 years of contribution and 57 years of age[1] or, alternatively, 38 years of contribution, in the period 2004 - 2005, and 39 in the period 2006 - 2007[2].	35 years of contribution and 60 years of age. The age limit is to rise by a year from 2010 and another year from 2014, thus reaching 62 years of age, or 40 years of contribution[3][4].	no seniority pensions.	no seniority pensions.
	Public sector employees	35 years of contribution and 57 years of age[1] or, alternatively, 38 years of contribution, in the period 2004 - 2005, and 39 in the period 2006 - 2007[2].	35 years of contribution and 60 years of age. The age limit is to rise by a year from 2010 and another year from 2014, thus reaching 62 years of age, or 40 years of contribution[3][4].		
	Self employed	35 years of contribution and 58 years of age or 40 years of contribution[2].	35 years of contribution and 61 years of age. The age limit is to rise by a year from 2010 and another year from 2014, thus reaching 63 years of age, or 40 years of contribution[3][4].		
Disability pensions[5]		5 years of contribution 3 of which accrued in the last five years. The entitlement of the pension depends only on the amount of disability and not on labour market conditions.	as before.	as before.	as before.
Survivors' pensions		15 yeras of contribution, or alternative, only 5 years of contribution 3 of whic accrued in the last five years.	as before.	as before.	as before.

(1) The age requirement is reduced to 56 for blue-collar workers in the period 2004 - 2005.
(2) A further postponement of the retirement date is provided with the so-called "exit windows". The postponement ranges from 3 to 11 months.
(3) For the period 2008-2015, women are allowed to retire having satisfied the requirements laid down by legislation before Law 243/2004, as long as their pension is calculated according to the contribution-based method.
(4) From 2008, the further postponement through "exit window" is increased ranging from 6 to more than 12 months.
(5) It includes "assegno ordinario di invalidità" and "pensione di inabilità", which are provided to people whose reduction of ability to work was at least 2/3rds for the former and 100% for the latter.

2. The projection model

2.1. Updating and Institutional utilization

The RGS pension model has been updated yearly since 1999. The updating procedures have always involved the base year of projection while demographic and macroeconomic scenario assumptions have been changed only depending on the availability of new data and information which called for a revision. Methodological improvements have also been introduced through time. Any changes to the projecting model and the scenario assumptions have been commented in the annual report released by RGS concerning the analysis of the mid-long term trends of health care and pension systems. Since 2002, a standardised set of tables have also been added for reporting analytical data of projections and this way improve comparability through time and amongst different scenario assumptions. The latest report refers to the 2004-updating of the model and embodies the analysis of the financial effects of the latest pension reform passed in 2004[4].

Projections of the Italian pension system, based on EPC-WGA scenario assumptions, are regularly presented within Italy's Stability Programmes, in the section devoted to analysing the mid-long term sustainability of the public finances. Projections based on national scenarios were also reported in special boxes of the Economic and Financial Planning Document (EFPD)[5].

The RGS pension model has been constantly utilised to assess the financial effects of both pension reform proposals and those actually passed. It has also been utilised, at the national and international levels, within research programmes concerning the analysis of the financial implication of ageing and structural pension reforms as well as within the institutional relations with international organizations such as OECD and IMF.

2.2. Coverage

The definition of "public pension expenditure" underlying both national and EPC-WGA pension system projections includes the expenditure of the whole compulsory public pension system and that for social pensions (old-age allowances, if awarded after 1995). The first component, which insures workers against old age, disability and survivors' risks, comprises all the pensions awarded on the basis of a contribution requirement that is generally also related to age. The second component has been included in view of its close relationship with the ageing of the population. In fact, in addition to being means-tested, social pensions are not awarded until a persons reach the age of 65.

The Eurostat definition of pension expenditure (ESSPROS statistics) includes old-age pensions (both means-tested and not), survivors' pensions, disability pensions whose award is subject to contribution requirements, and social pensions (old-age allowances, if awarded after 1995). These are the same components as those of the public pension expenditure definition described above. However, the Eurostat definition also includes some benefits among survivors' and disability pensions whose award does not depend on the satisfaction of contribution requirements and which, at the same time, are not related to old age (benefits paid to the disabled and the deaf and dumb below 65 years old, war pensions, work injury annuities and merit awards). It also includes supplementary pensions paid by private pension funds, which, of course, are not public pensions.

The additional components referred to above accounted for about 0.8% of GDP in 2002, which corresponds to about 5% of the Eurostat definition of pension expenditure.

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[4] See, Ministero dell'economia e delle finanze-RGS (2005), "*Le tendenze di medio-lungo periodo del sistema pensionistico e sanitario. Previsioni elaborate con i modelli del Dipartimento della Ragioneria Generale dello Stato aggiornati al 2005*", Rapporto n.6, December, Roma (the report can be downloaded from the following website: http://www.rgs.mef.gov.it/VERSIONE-I/Norme-e-do/Spesa-soci/ATTIVITA--/Presentazione.doc_asc1.pdf).

[5] Such a document is prepared each year by the Ministry of Economy and Finance and presented by the Government to Parliament.

Analysis of the difference between Eurostat and National definition of public pension expenditure
(values as a percentage of GDP)

	2000	2001	2002
Eurostat pension expenditure[1]	**14.7**	**14.7**	**14.9**
National pension expenditure	**13.8**	**13.8**	**14.1**
Total difference	**0.9**	**0.9**	**0.8**
1.Benefits paid to the disabled and the deaf and dumb below 65 years old, war pensions, work injury annuities and merit awards	*0.6*	*0.6*	*0.6*
2.Survivors' war pensions and survivors' work injury annuities	*0.1*	*0.1*	*0.1*
3.Supplementary pensions paid by private pension funds	*0.1*	*0.1*	*0.1*

*(1) Source: Eurostat (2003-2005), Social protection: expenditure on pensions.*

According to the decomposition reported above, the benefits under points 1 and 2 of the Table above represent compensatory lump sums because of disability or work injury which bear no relation to pension contributions and, therefore, to the sphere of risks covered by public pension systems. This is the reason why these components can in no way be included in the definition of the public pension expenditure. However, they might be placed under a different area of the welfare system and as such be considered by the WGA for a separate projecting exercise.

2.3.The methodology

2.3.1.The general outline

The RGS pension model has been devised with the objective to cover the whole public Pension System and to be able to reproduce accurately the main features of the legal and institutional framework. The latter has been assuming an increasing importance in Italy in consideration of the several pension reforms enacted during the last 15 years, which have involved extremely gradual solutions (see paragraph 1). Furthermore, the model is provided with some methodological solutions finalised to guaranteeing, at the same time, the consistency with demographic and macroeconomic scenario assumptions.

The pension component of the model (hereafter simply "pension model") is strictly interrelated with three other sub-models referring, respectively, to the demographic, labour market and productivity components, according to the outline reported below:
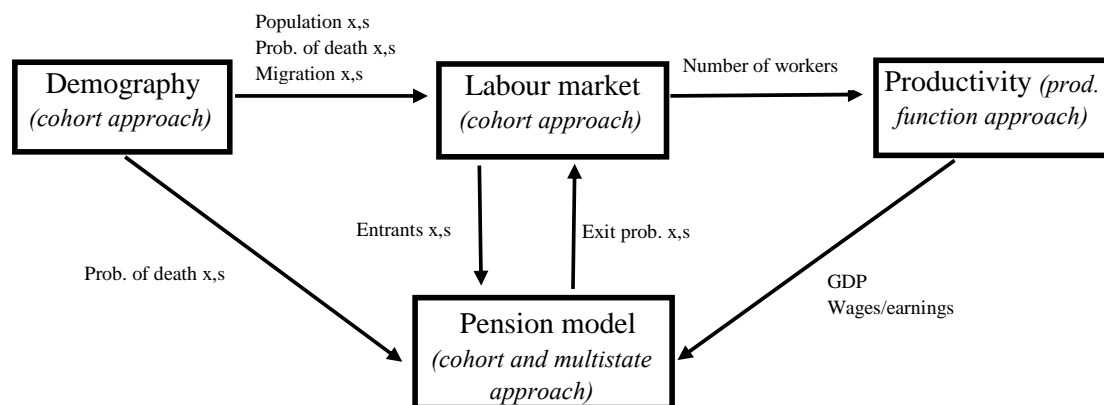
As can be seen, the pension model receives directly: i) the probabilities of death, by age and sex (x, s) from the demographic component; ii) the new entrants into employment, from the labour market component, still by age and sex, and iii) the dynamics of wages/earnings and GDP from the productivity component. In turn, the pension model provides the labour market component with the probabilities of exiting because of retirement.

The interrelation among the three sub-models sees, at the first step, the demographic component providing the labour market with population, probabilities of death and migration flows, all distributed by age and sex. Then the total number of workers are utilised for an estimate of the capital deepening component of productivity growth rates.

The demographic sub-model adopts the traditional cohort component approach according to which the number of people by age and sex are projected on the basis of probabilities of death (or surviving), total fertility rates and net migration flows. The latter, in turn, is obtained as a difference between emigrants (probabilities of emigrating multiplied by population) and the number of immigrants.

The Labour market sub-model is mainly based on a projection of the labour force to which unemployment rates are subsequently applied in order to calculate the corresponding employment rates. The labour force sub-model combines the dimensional effect of the working age population, derived from the demographic projection, and the cohort evolution of the participation rates specific by age and sex. The latter, in turn, is obtained combining the cohort trend in the propensity to enter the labour market on a permanent basis, as extrapolated from the past data on workforce, and the further effects brought about by any endogenous factors which can significantly alter the evolution of participation rates. In this regards, reference is made to the interrelationship of participation rates with the following three factors: i) the direct and indirect effects brought about by the evolution of enrolment rates, the latter through changes in the educational achievements, ii) the fulfilment of the eligibility requirements to be entitled to a pension, taking also into account the evolution of workers distributed by age and contribution years and iii) changes in the labour market equilibrium caused by the dimensional decrease in the working age population.

Unemployment rates, distributed by age and sex, are supposed to change trough time converging to its average target value taking into account the evolution of the working age population: the higher the labour force reduction the faster the converging process towards a lower average level.

The Productivity sub-model bases its projection on a sum of two components: i) an exogenous assumption of the growth rate of Total Productivity Factors (TPF), which is kept constant to its long term level after an initial adjustment, and ii) the additional contribution due to changes in the ratio of capital stock to workers (capital deepening). Because of the well-known demographic trends in working age population and its effects on employment, the latter component causes the productivity growth rates to increase especially during the first thirty years of the forecasting period.

2.3.2. The pension component of the model

The pension model adopts a multistate approach involving a large number of "discriminating" variables, i.e variables which are relevant for the rules of the legal-institutional framework to be applied. Such variables are divided into two groups: state and monetary variables.

The first group contains variables that identify the distinct positions within the system. For each segment of the system (fund or specific group of workers), members are distinguished among pensioners, contributors, dormants and pensioner-contributors[6]. Members also differ in terms of their sex, age, category of pension (old age/seniority, disability) and contribution period (annual classes).

All the possible combinations of the variables listed above are kept distinct for the three different regimes provided for people with a contribution period at the end of 1995, respectively, greater or equal to 18 years, between 0 and 18 years, and equal to 0 years (earnings-related, mixed and contribution-based). This distinction was made necessary by the reform measures that provide for different treatments depending on the contribution period matured at that date (see paragraph 1).

State variable	Specifications
Fund	Private sector (10 schemes), public sector (4 schemes)
Sex	Male , female
Age	[15-107]
Type of contributor	Contributor, dormant, pensioner-contributor
Contribution years	[0-49]
Regime	Earnings-related, contribution based, mixed
type of pension	Disability (2 types), old age/seniority (2 types)

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[6] Members are pensioners if they are entitled to a direct pension and are not simultaneously contributors. They are contributors or dormant members depending on whether or not they have paid contributions during the reference year. They are pensioner-contributors if they are entitled to a direct pension and simultaneously have paid contributions in the reference year.

At any time it is possible to identify members of the pension system in terms of their belonging to one of the possible combinations of the state variable specifications. The history of each member can be expressed as a sequence of positions. The sequence starts with the person joining the pension system, *i.e.* with the payment of the first contribution; it ends with the death of the member. In the normally long interval between these two events, the person will move from one state to another. Obviously, the number of people belonging to each cohort involved is yearly updated by applying the corresponding probabilities of surviving underlying the demographic projection. More specifically, the forecast of members is calculated according the following general equation:[7]

$$\underbrace{a_{t,s,x,f}}_{members} = \underbrace{a_{t-1,s,x-1,f}}_{members}\ \underbrace{\varphi_{t-1,s,x-1,f}}_{\substack{probability \\ of\ surviving}} \times \underbrace{T_{t-1,s,x-1,f}}_{\substack{transition \\ matrix}} + \underbrace{e_{t,s,x,f}}_{entrants} \qquad \forall s, f, 15 \le x \le \omega$$

where, for each sex *s*, age *x* and fund *f*: *a* indicates the row vector of the ensured distributed by different states at the end of the year *t* ("time *t*"), φ is the surviving probability at time *t*, *e* indicates the row vector of entrants to the pension system in the year *t-1/t* (it contains non-null values only in the first few elements) and *T* is the matrix of transition probabilities serving to calculate the changes in the states of members already enrolled at time *t-1* and still alive at time *t*.[8] The general element $t_{i,j}$ of the transition matrix represents the probability that member belonging to state *i* at time *t-1* will transit to state *j* at time *t*.

New entrants, i.e those ensured for the first time in the Pension System, are set equal to the cohort increase of the number of employed people within a year, suitably transformed into new contributors. The former component, in turn, is calculated by applying both participation rates and unemployment rates to a projected population. Afterwards, the number of entrants by age and sex attributed to each fund, or other appropriate aggregation of workers, is determined, by single age and sex, on the basis of specific distributions of probability.

Monetary variables, such as wages/earnings, amounts of pension etc., are associated to each of the possible combinations of the state variable specifications as an average value referring to the corresponding set of people. The combination of the frequency associated with each position and the corresponding average value of the monetary variables makes it possible to calculate the pension expenditure or wage/earnings with the same level of disaggregation as that corresponding to the specifications of the state variables.

It should be noted that many of the algorithms used to update the monetary variables involve the application of a multiplier to the individual amounts, either because prescribed by law or because required by the forecasting technique. Consequently, the updating of the average value coincides exactly with the average of the updating of the corresponding individual values. There are some cases, however, in which the information on the distribution influences the updating of the average value. In these cases, the mean value is supplemented with an index of variability (the variation coefficient) and a distribution function[9].

The adoption of a multistate approach requires that in every period each member should belong to one and only one of the positions identified by the state variables. This clearly cannot be applied in the case of people entitled to a survivors' pensions. In fact, the latter may be ensured in the pension system as

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[7]Denoting the number of ages by *n*, the number of contribution periods by *k*, and the number of categories of direct pension by *z*, for each fund the line vector of members will have *6n(3k+z)* elements and, consequently, the transition matrix will be a square *(18nk+6nz)* order matrix. Since the sex and contribution period at the end of 1995 do not change over time, it is possible to decompose the vector of entrants into 6 line vectors with n(3k+z) elements and the matrix of transition probabilities into 6 square *(3nk+nz)* order matrices. Furthermore, since age increases from year to year with a probability of 1, it is possible to divide the vector of members further into *n* vectors with *(3k+z)* elements. Consequently, the order of the matrix of transition probabilities decreases to *(3k+z)*. These matrices, of course, are replicated for each age, sex and regime. In order to simplify the presentation, the latter variable has been omitted.

[8]The entrants and exits owing to death refer to an interval of one year. It is possible to eliminate the dead before applying the transition probability matrix since they constitute a *cul de sac* state, *i.e.* a state that does not permit transition to other states.

[9]In particular, such an approach makes it possible to give adequate treatment to the mechanism for topping up pensions to the minimum level under the earnings-related and mixed regimes, the indexation of pensions by size bracket, and the eligibility requirement for retirement under the contribution-based regime since an amount of pension of at least 1.2 times the old-age allowance must be achieved.

contributors, dormant members or recipients of a direct pension. In practice, for the purpose of determining survivors' pension expenditure it is usually of no importance whether or not a survivors' pension is paid to a member of the pension system. Similarly, where the beneficiary is a member, his or her position within the system (pensioner, contributor, etc.) is irrelevant. This makes it possible to treat survivors' pensions separately[10].

The consistency of the model with the legal-institutional framework is guaranteed insofar as people ensured in the pension system are grouped according to the specifications of the state variables devised in order to provide, dynamically, all relevant information to calculate the number of pensions and their amounts. Furthermore, the model is able to take on board all available data concerning workers already ensured in the system at the beginning of the forecasting period including dormant members who are no longer contributing but would be able to claim a pension later, on the basis of past contributions.

Consistency between the pension component of the model and the demographic and occupational ones is surely favoured by the cohort approach coherently adopted for all three components. More specifically, these are the most relevant mechanisms through which such consistency is sought:

- as far as mortality is concerned, the coherence is assured by applying the probability of death to all ensured people (contributors, pensioners etc), i.e. those already within the system at the beginning of the forecasting period and those entering afterwards;

- as regards the Total Fertility Rate (TFR) and net migration flows below 42, consistency is guaranteed through the calculation of the workers entering for the first time into the pension system as new contributors;

- net migration flows from 42 to 60 are also transformed into new contributors according to the employment rates forecast for the corresponding age and sex. Immigrants above 60 are not considered either as contributors or as pensioners entitled to a direct pension;

- consistency with the employment rates is pursued, for ages up to 42, by calculating the new entrants into the pension system, which depend on the cohort profile of participation and unemployment rates. For ages above 42, consistency is assured insofar as the probabilities of exiting from the labour market are endogenously calculated by the pension model itself according to the pension legislation and retirement behaviour estimated on past data.

2.4. Consistency with the EPC-WGA assumptions

The methodological approach underlying the RGS pension model allows us embody the demographic and macroeconomic assumptions agreed within the EPC-WGA without relevant alterations to the internal coherence of the model. It can be easily argued from the general outline of the model described above. In fact:

- the projections of population and employment rates adopted within the EPC-WGA (see next paragraph) are based on a cohort approach which represents a binding condition to calculate the new entrants into the pension system according to the methodology underlying the RGS pension model;

- the output of such projections share the same level of disaggregation as that adopted by the pension model, in terms of distribution by sex and individual age;

- the greatest part of demographic and macroeconomic inputs, including some parameters utilised for projections, are exogenous with respect to the pension model, the only exception being the probabilities of exiting from the labour market.

As for the latter, there is no doubt that the methodological approach utilised by the Commission does not guarantee in itself the consistency with the probabilities of retiring underlying the pension model. However, through a bilateral consultation, a satisfactory approximation of the exit probabilities was achieved, at least as an order of magnitude, allowing some minor differences in terms of distribution by age, gender and time profile.

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[10] In particular, the number of survivors' pensions is determined by adding the newly awarded ones to those of the previous year still being paid out. The newly awarded pensions are calculated by applying the probabilities of death and the probabilities of leaving a survivor to people receiving direct pensions and contributors who have matured the minimum requirement. Lastly, a permutation matrix is applied to attribute an age to the survivor based on the age of the deceased.

As a result, the number of contributors evolves substantially in line with the total employees along the whole forecasting period, allowing minor adjustments by sector. Analogously, the number of pensioners are consistent with the population projections. In this regard, any comparison should be made taking into account the following:

- the definition of population underlying the demographic projections refers to resident people, while pensions are also paid to non-resident people. In 2003, non-resident pensioners of 65 and over accounted for about 4% of the population in the same age bracket;

- a quota of immigration flows concerns people above 60 who do not have the possibility to mature pension rights sufficient to be entitled to an old age pension. Differently, people leaving the country in the same age bracket are likely to take with them a pension entitlement. Only if the number of the two groups of people equalise, is there a sort of compensation: non resident pensioners are counterbalanced by resident people without pension rights because of their entering the country at an old age. In the case of Italy, the latter tend to exceed the former during the forecasting period, accordingly to the assumptions on net migration flows. At the beginning of the forecasting period, however, non-resident pensioners do not have an appraisable compensation as Italy has only recently moved from a net sending country to a net receiving one.

The consistency with other EPC-WGA macroeconomic assumptions is also pursued, through the following:

- the cohort dynamics of income subject to contribution (contribution base) is made to be consistent with the productivity assumptions. As a result, the average contribution base (contribution base divided by the number of contributors) evolves substantially in line with productivity;

- since the number of contributors evolve in line with the number of employees, as recalled above, the contribution base to GDP ratio will remain almost unchanged throughout the forecasting period allowing slight, temporary deviation mainly due to the differences between the probabilities of exiting from the labour market assumed by the Commission and those calculated by the RGS pension model.

3.The EPC-WGA baseline scenario

3.1.Demographic assumptions

Following a request by the EPC-WGA, Eurostat has produced a set of demographic projections for all EU-member states to be utilised within the new round of budgetary projection exercises concerning the main items of public, age-related spending. At the end of a long process involving discussions at NSIs, WGA and EPC levels, the WGA has decided to adopt the so called "ad hoc WGA variant scenario" as the baseline, considering it sufficiently consistent among EU-countries and able to ensure an acceptable degree of comparability in terms of budgetary projection results.

For the EU-15 member states, the new set of demographic projections can be regarded as an updating of the precedent release utilised for the 2001-round of budgetary projections[11]. The revision has concerned all three demographic parameters:

- the annual net flow of immigrants has been increased from 80,000 to 150,000

- life expectancy at birth in 2050 has been raised by 1.8 years for both genders thus reaching the level of 82.8 for males and 87.8 for females;

- the total fertility rate has been somewhat lowered from 1.5 to 1.4 as convergence value in 2050[12].

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[11] Economic Policy Committee (2001), *Budgetary challenges posed by ageing populations*. The impact on public spending on pensions, health and long term care for the elderly and possible indicators of the long term sustainability of public finances. EPC/ECFIN/655/01-EN final, October, Brussels.

[12] The available evidence, however, shows an increasing trend in fertility rates as a result of the experienced postponement of the average age at which a woman chooses to bear their first child.

Although the revision of the demographic parameters is not negligible, the old age dependency ratio (people of 65 and more to people 15-64) has undergone no significant change with an increase of about 1 percentage point in 2050, thus moving from 61.3 to 62.2. Such a result stems from a compensation effect between the higher level of working age population, due to the revision of migration assumptions, and the almost proportional higher level of the elderly, due to the increase in life expectancies.

3.2. Macroeconomic assumptions

3.2.1. Productivity, GDP deflator and inflation

The growth rate of productivity per employed person is one of the most important variables to be set within the macroeconomic scenario assumptions. It directly affects the growth rate of GDP and determines the amount of pensions a few decades later as the calculation rules in any case involve the level of wages. In order to define productivity assumptions, the EPC-WGA has opted for the production function approach which allows us to interpret the growth rate of productivity in terms of its main components, namely the Total Factor Productivity (TFP) and the Capital Deepening (CD). While the former measures the effect strictly related to technical progress, which increases the productivity of all production factors, the latter expresses the effect to labour brought about by changes in capital stock.

Such an approach surely improves upon the mechanical one utilised in the previous round of budgetary projection which assumed the growth rate of productivity converging to the same level of 1.75% for all member states. From the methodological point of view, the improvement mainly concerns both a higher level of transparency in terms of contributions by different driving forces and the possibility to capture endogenously the interrelationship with demographic trends affecting the level of employees.

Mid-long term projections of productivity have been made on the basis of the production function devised within the Output Gap Working Group (OGWG) that the Commission regularly adopts for its short term projections. The main features of methodology and parameters involved are reported in Annex 3.

As for TFP component, the EPC-WGA has decided to assume a converging process of the growth rate towards 1.1%, for all EU-15 countries, starting from 2030. The target value is to be interpreted as an estimate of the long term growth rate for the US. For two countries, Italy and Spain the end of the converging period is anticipated to 2015 to avoid that the particularly low initial level would affect excessively the average growth rate in the whole forecasting period. Diversely, the end of the converging period is postponed for the new EU-10 countries in order to take account of their relatively lower initial level of productivity, and their corresponding higher growth rates of TFP.

The CD component is projected according to the production function methodology (see Annex 3) and depends on the capital dynamics and the growth rate of employees. In turn, the capital dynamics depends on the percentage of capital depreciation and the level of investment to GDP. As for the latter, three assumptions have been considered depending on the forecasting period:

- up to 2010, the ratio is kept constant at its 2006 level, (investment rule);
- from 2030 on, the ratio is assumed to change in order to compensate for the impact on the capital deepening brought about by the evolution of the number of employees (capital stock rule);
- from 2010 to 2030, a gradual shift from investment to capital stock rule has been assumed.

The adoption of the capital stock rule is mainly justified by the objective to equalize the growth rates of productivity amongst member states in the long run. However, this rule is such to completely nullify the sole interrelation between productivity and demographic trends involved by the production function. The implication of this is that the sharp reduction of working age population will result in a significant reduction of gross investment to GDP ratio which may imply even a reduction in real levels.

The average growth rate of productivity (see Figure 1b), in the period 2005-2050, accounts for about 1.6%, a bit lower than that assumed in the previous budgetary exercise (1.8%). However the converging path is completely different. New assumptions on productivity involve an increasing trend converging to 1.7, while the previous ones postulated a decreasing trend moving from an initial level significantly higher than the convergence figure (1.75%).

According to an agreement reached in the EPC-WGA, the growth rate of the GDP deflator has been set to 2% starting from 2005. The same assumption has been made for the growth rate of Consumer Price Index (CPI).

3.2.2. Labour market

The labour market assumptions to be used for pension projection concern both participation and unemployment rates.

As for the former, the EPC-WGA agreed on adopting the so called "cohort approach" method for projecting labour force in the mid-long term. Such a method consists in modelling the evolution of participation rates by single cohort and forecasting year. This was preferred insofar as the propensity to enter the labour market, on a permanent basis, mainly depends on generational behaviour which has been changing significantly especially for females. Furthermore, the cohort approach represents the most suitable method to embody relevant endogenous factors such as the interrelationship of participation rates with the effects brought about by the evolution of enrolment rates and the fulfilment of the eligibility requirements to be entitled to a pension.

Unfortunately, the labour force projections provided by the Commission, does not seem to have fulfilled properly the objectives mentioned above.

One of the major criticisms hinged upon the estimate of the probabilities of entering the labour force. It is quite a shortcoming that such an estimate does not take somehow into account past trends, especially when making mid-long term projections of workforce. Such a choice heavily penalises those countries, such as Italy, which has experienced a dramatic increase of female participation rates although the current level is still well below the EU average (see Annex 4).

As for the probabilities of exiting from the labour force, the Commission has adopted a common methodology based on an estimate of past behaviour which takes somehow into account the future effects brought about by any pension reform already legislated. The fact that the contribution years were neglected in order to assess the fulfilment of eligibility requirements as well as its interaction with the evolution of the workers by age and sex, does not guarantee in itself the consistency with the probabilities of retiring underlying pension projections, at least in the case of Italy. However, through a bilateral consultation, a satisfactory approximation to the outcome of the pension model was achieved, allowing some minor differences in terms of distribution by age, gender and time profile.

According to the EPC-WGA labour force projecting, Italy will experience an increase in the participation rate of 7.3 percentage points in the age bracket 15-64 moving from 62.9 in 2003 to 70.2 in 2050. Such an increase is mainly due to women (10.2 percentage point against 4.2 of male). The overall rise of participation rate has resulted about 4 percentage points lower than that assumed in the previous round of projections.

As regards unemployment rates, the EPC-WGA established to utilize, as structural level, the Commission estimates for the NAIRU up to 2008, as agreed upon in the OGWG. Thereafter, the unemployment rate is kept constant, allowing a convergence towards the EU-15 average by 2015 for those countries with an unemployment rate higher than the average, in 2008. The convergence will take 20 years for new member states with a NAIRU above the EU-15 average. As a result of this assumption, the unemployment rate of Italy decreases during the first decade settling on 6.5% in 2015 and then it is kept constant until the end of the forecasting period. Compared with the previous budgetary exercise, the structural unemployment rate is a bit lower (6.5% versus 7%), although moving from an initial level of some 3 percentage points below.

3.3. The results

Figure 2 shows the forecast ratio of pension expenditure, (gross of tax revenues on it), to GDP obtained on the basis of the EPC-WGA baseline scenario and in accordance with pension legislation in force at the end of 2004 .

After a slight increase with respect to the initial level of 14.2 in 2004, the ratio decreases significantly from 2008 to 2012 mainly because of the tightening of the eligibility requirements introduced by the latest pension reform (see Table 2) which also contributes to the substantial stability thereafter projected up to 2020. Afterwards, pension expenditure to GDP ratio starts to rise rapidly and reaches the peak of 15.9% in 2040 with an increase of about 1.7 percentage points compared with the initial level. During the

last decade, the ratio falls first rather slowly and then much quicker till it reaches the final level of 14.7% in 2050, which is 0.5 percentage points higher than that in 2004.

The decomposition of the ratio of pension expenditure to GDP as the product of the "demographic" component, "pension ratio" (the ratio of pensions to employed people) and the "legal-institutional" component, "benefit ratio" (the ratio of the average pension to labour productivity) makes it possible to analyse better the reasons for the pattern[13].

The slight rise of pension expenditure to GDP ratio up to 2008 is mainly due to an increase in the benefit ratio because of the low growth of productivity assumed at the beginning of the forecasting period. The reasons for the subsequent decrease up to 2012 and the relatively steadiness until 2020 is to be found partly in the tightening of the eligibility requirements, which contains an increase in the pension ratio, and partly in the progressive improvement in the dynamics of productivity which stop and invert the increasing trend in the benefit ratio.

Starting from 2020, the ratio of pensions to employed people rises more sharply than before because of well known demographic reasons. In that period, the baby boom generations are expected to cross the threshold of 65 moving from the working-age population (denominator of the ratio) to elderly people (numerator of the ratio) while the employment rate stops increasing. At the same time, however, the ratio of the average pension to productivity decreases significantly because of the gradual introduction of the contributions-based regime. In fact, in these years most new pensions are awarded under the mixed regime. However, such an effect is not such to offset the rapid rise in the ratio of pensions to employees.

This will happen in the last decade of the forecasting period when the ratio of pension expenditure to GDP falls very sharply owing to the gradual shift from the mixed regime to the contributions-based one, fully phased in by that date[14]. This time, the effects of the legal institutional framework are accompanied by a slowdown in the rise of pension ratio which settles on 121% in 2050. The latter mainly results from the progressive elimination of the pensions paid to the baby boom generations and the tendency of employment to stabilise.

As noted above, the reduction of the benefit ratio is mainly due to normative reasons. Besides the fact that pensions are indexed only to inflation (see paragraph 1.2.3)[15], an important role is played by the gradual shift from the earnings-related to the contribution-based system enforced by the ten-year revision of transformation coefficients in accordance with the mortality assumptions.

The effect brought about by the new calculation rules can be also assessed at a microeconomic level by calculating the gross replacement rate, i.e. the ratio between the initial amount of pension and the last wage, for the whole forecasting period. The results are reported in Figure 3 for two groups of workers: the private employees and the self-employed. In fact, the two differ significantly in terms of notional contribution rate, on the basis of which contributions are accrued (see Table 1)[16]. The underlying assumptions are fully consistent with the EPC-WGA baseline scenario and the methodology is the same as that agreed within the Indicator Subgroup of Social Protection Committee. As expected, the gross replacement rates are almost stable for the first decade of the forecasting period and dramatically decreasing afterwards. The reduction up to 2050 accounts for about 26%, in the case of the private

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[13] A decomposition of pension projection results based on a large set of consistent indicators is reported in Annex 6.

[14] Such a decline could give rise to the question of the social and political sustainability of the contributions-based regime. However, it is worthwhile pointing out that such decline is mainly obtained reducing the amount of pension of those workers who would have most benefited of the previous regime in terms of Internal rate of return. In fact:

a) in comparison with benefits calculated exclusively on earnings in the final years before retirement, a system based on life long contributions automatically produces a redistribution of resources in favour of the weakest workers with static and discontinuous careers;

b) unlike the earnings-based system, the contributions-based system allows workers to increase their own amounts of pensions substantially by delaying retirement. For example, postponing retirement by 5 years increases the pension by more than 30%;

c) in the contributions-based system workers must qualify for a minimum benefit (set as equal to 1.2 times the old-age allowance) in order to be able to retire before reaching the age of 65;

d) on reaching the age of 65, workers who are in conditions of poverty will be able to obtain an old age allowance.

[15] It is worthwhile pointing out that social pensions and old age allowances have been indexed to nominal GDP, although not stated by the current law, starting from 2006.

[16] As the notional contribution rate is exactly the same for public and private employees, the figures reported for the latter can be referred also to the former .

employees, and for about 46%, in the case of the self-employed. It can be also seen that gross replacement rates would be about 20% higher should the revision of the transformation coefficients not be applied[17].

Figures 2c-2f help us understand better the evolution of the ratio of pensions to employees compared with the evolution of the elderly dependency ratio. As emerges from the comparison, the former ratio is expected to grow significantly less than the latter. It depends on both a decrease of the ratio of pensions to people of 65 and over (Figure 2d) and an increase of the ratio of employees to people in the age bracket 20-64 (Figure 2e).

The first phenomenon is due to several factors, the most important of which are the following: i) a reduction in disability pensions as a consequence of the reform enacted in 1984, which is still producing its effects; ii) the increase of the eligibility requirements according to the reform process of the last decade; iii) a substantial constancy of the survivors' pensions apart from the effects deriving from the dimension of generations. This is why a higher life expectancy does not raise for the widow or widower the average period of their outliving their spouse; iv) the number of pensions in the starting year comprises direct supplementary pensions[18]. The evolution of all these components are shown in Figure 4.

The second phenomenon is partly due to an increase in the eligibility requirements, as noted above[19], and partly to the assumptions about the labour market, which provide for an increase of employment rates in the central age bracket, especially for women.

3.4. The relevance of 2005-revision of the baseline scenario

It seems quite interesting to analyse the effects in terms of pension expenditure to GDP brought about by the new set of macroeconomic and demographic assumptions in comparison with those underlying the previous round of projections. However, a simple comparison with the baseline projection released in 2001 would not fit the purpose, as since then there have been relevant changes in the legal institutional-framework besides the yearly update of the starting data. Therefore the 2001 and 2005 baseline projections should be preliminary aligned in terms of legal background and forecasting period before comparing them to assess the effects due to the revision alone of the macroeconomic and demographic assumptions. The updating of the baseline projection included in the 2004-Stability and Convergence Programme of Italy is such to guarantee a good degree of alignment.

In fact, differences between this projection and that made in 2001 mainly depends on changes in pension legislation due to the latest pension reform (Law 243/2004), while differences with the 2005-baseline pension projection measure the impact brought about by the revision of the macroeconomic and demographic assumptions. Figure 5a allows us to disentangle the two driving factors comparing 2001and 2005 baseline pension projections with the 2001 baseline projection updated to 2004 (hereafter "2004-update" projection).

As can be seen, the revision of macroeconomic and demographic assumptions makes the 2005-ratio settle above the 2004-update ratio during the first 15 years of the forecasting period; thereafter, it settles a bit below in the central part and again above in the last decade. The difference is 0.1 percentage points in the peak and 0.3 percentage points in 2050.

The reasons for the differences are mainly to be found in i) the time profile of GDP growth and its decomposition in terms of productivity and employment (the average growth rate is almost the same, around 1.3% in real terms), and ii) the revision of life expectancies.

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[17] It is worthwhile noting that the reduction of the benefit rate is significantly lower if calculated net of taxes and contributions. For more details concerning different typology of workers and the comparison between gross and net replacement rates, see, Ministero dell'economia e delle finanze-RGS (2005), "*Le tendenze di medio-lungo periodo del sistema pensionistico e sanitario. Previsioni elaborate con i modelli del Dipartimento della Ragioneria Generale dello Stato aggiornati al 2004*", Rapporto n.5, May, Roma, chapter 4 (the report can be downloaded from the following website: http://www.rgs.mef.gov.it/VERSIONE-I/Norme-e-do/Spesa-soci/ATTIVITA--/Presentazione.doc_asc1.pdf.)

[18] Such pensions, which are calculated also during the transition period, are going to become nil moving towards the end of the forecasting period, when the contributions-based method is fully phased in and entirely applied to new entrants into the system after the starting year.

[19] A large part of direct pensions are available to people under 65 in the starting year as they have been awarded before the reform process of the pension system.

As for the former (Figure 5b), it is interesting to notice that the real GDP level implied by the new scenario assumptions is somewhat lower than that implied by the old one, in the first 15 years of the forecasting period, while thereafter they almost overlap. This explains the correspondent higher level of pension expenditure to GDP since the consequent effect of GDP growth on expenditure is significantly delayed. Besides, the initial lower GDP growth is due to the dynamics of productivity only partly compensated for by a higher increase in employment.

It should be noted that the delayed effect of productivity on pension expenditure comes gradually according to the newly awarded pensions (which are in some way related to the final level of earnings) while, in the case of employment, it will take some three decades to occur. For this reason, from 2020 to 2035, the level of GDP being almost the same, the 2005-projection of pension expenditure to GDP settles below that of 2004-update, notwithstanding the increasing push brought about by the higher level of life expectancy.

In the last 15 years of the forecasting period, when pension expenditure has completely absorbed the delayed effect stemming from the initial differences in GDP and its components, the divergence between the two projections is almost entirely explained by the revision of mortality assumptions (Figures 5c and 5d).

The comparison between 2001 and 2004 pension expenditure projection expresses the saving effects due to the 2004-pension reform consistently with the estimates in the technical report to the law (see annex 1). Specifically, the reform will produce a significant reduction of expenditure to GDP ratio for about 30 years, beginning in 2008. The savings will be at its greatest, of around 0.7 percentage points of GDP, nearly from 2012 to 2020, dropping slightly to 0.6 points in the following fifteen years. It is only in the final years of the forecasting period, during the decreasing phase of the ratio of pension expenditure to GDP, that a worsening of the curve of some 0.3 percentage points is produced.

4.The sensitivity analysis

4.1.List of sensitivity tests

The sensitivity tests on pension projections agreed within the EPC- WGA can be summarised as follows:

- Demography: higher level of life expectancy (decrease of 15% in age-specific mortality rates by 2050);

- Productivity: annual growth rate increased and lowered by 0.25 p.p. from 2015. Such a change is gradually implemented from 2010 to 2015;

- Labour force: higher employment rates by 5 percentage points in the age bracket 55-64 (older workers) through an increase of participation rates. Such an increase is gradually implemented from 2005 to 2025;

- Unemployment rate: higher employment rates by 1 p.p. through a change in the unemployment rate. Such an increase is gradually implemented from 2005 to 2015;

- Interest rate: higher and lower level by 1 p.p. during the whole forecasting period.

As for sensitivity tests concerning demography, productivity and unemployment, projections have been made fully consistent with the assumptions provided. However, the sensitivity test concerning an increase in participation rates among the older workers has raised some concerns in order to guarantee the consistency between pension results and assumptions exogenously given. The solution actually followed to overcome this shortcoming will be explained in the reference paragraph.

Projections concerning the sensitivity test on interest rate have not been reported insofar as the funded component of the Italian pension system, besides being very limited at present, is not covered by the definition of the public pension expenditure (see chapter 1).

4.2.Higher life expectancy

Before moving on to the pension system projections, it is worthwhile illustrating the differences in the structure of the population implied by changes in life expectancy. For this purpose, it is quite interesting to analyse the elderly dependency ratio calculated as the ratio of people 65 years old and over to working-age population in the age bracket 20-64 (Figure 6f). While the denominator tends to remain

almost unchanged, the numerator reflects the differences in life expectancy hypotheses starting from the beginning of the forecasting period[20]. That is why the number of elderly people tends to be increasingly higher with respect to the main variant scenario. At the end of the forecasting period, the elderly dependency ratio is 3 percentage points higher (70% against 67%).

Moving on to the results of the projections, Figure 6a shows the ratios of pension expenditure to GDP obtained on the basis of the high life expectancy scenario produced by Eurostat. As emerges from Figure 6a, the latter scenario causes the ratio to increase a bit more rapidly than that under the baseline assumptions until it settles 0.3 percentage points above, towards the end of the forecasting period. During the last decade, the divergence tends to stabilize insofar as the increasing deviation between the ratios of pensions to employees (Figure 6c) is compensated for by the effect on the average amount of pension due to the revision of the transformation coefficients. Figure 6d, allows us to single out the effect of the sensitivity test under consideration in terms of an increased number of pensions.

4.3.Different hypotheses on productivity

The second sensitivity test concerns the growth rate of productivity. Following the indications agreed within the EPC-WGA, the sensitivity analysis on productivity concerns two distinct projections that assume, alternatively, an increase and a decrease of 0.25% in the growth rate of productivity compared to the baseline scenario. Such a correction has been gradually implemented from 2010 to 2015 when it becomes 0.25 and is kept constant for the remainder of the forecasting period. As a consequence, the growth rate of GDP will result in a shift in either direction of exactly the same size, given that no change in employment has been envisaged.

Because of the higher (lower) level of growth rate of GDP, the ratio of pension expenditure to GDP is going to be lower (higher) than the baseline one. The deviation increases from 2010 till about 2035. Afterwards the gap remains almost unchanged for some ten years before shrinking slightly towards the end of the forecasting period.

To help us understand such trends, it is useful to recall the following general pattern that is working every time pensions are indexed only to prices, as is the case of Italy. An increase (decrease) in the growth rate of productivity will result in an increase (decrease) in the growth rate of GDP of the same size in the year in which the augmentation is assumed. Differently, as regards the pension expenditure, the effect is very slight at the beginning because it only concerns the newly awarded pensions which are in some way related to the final level of earnings and, indirectly, to the growth rate of productivity[21]. Generally it will take 20-30 years until the structural change in the growth rate of productivity is entirely transferred to pension expenditure evolution. That is why for a long period the differences in the growth rates of GDP, which follow changes in productivity assumptions, are higher than the ones of pension expenditure. Yet, as the initial stock of pensions is replaced by the newly awarded ones, the growth rate of both pension expenditure and GDP is going to be the same.

However, the legal framework of the Italian pension system provides a gradual shift from the earnings-related to the contribution-based method. We have to remember that the latter assumes the growth rate of GDP to capitalise the contributions paid. Thus, while final earnings are moving according to labour productivity, the replacement rate is going to move in the opposite direction, although the latter effect is a great deal lower than the former. All this explains why the deviations of the ratio of pension expenditure to GDP, with respect to the baseline scenario, are slightly shrinking approaching the end of the forecasting period[22].

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[20]It is worthwhile noting that an increase in life expectancy is supposed to produce no significant effect on young and working age population.

[21]The amount of a pension can always be expressed as a product of final earnings and the replacement rate. The former factor goes according to the growth rate of productivity, the latter one depends on the calculation formula provided by the legal framework.

[22]It is useful to point out that the transformation coefficients of the contribution based method have been calculated assuming a difference of 1.5% between the internal rate of return figuratively accrued on the contribution paid and the annual percentage of indexation. Since the legal framework of the Italian pension system allows indexation only to prices, and the internal rate of return is assumed to be the growth rate of GDP, it follows that the transformation coefficients remain as they were calculated on the basis of 1.5% growth rate of GDP. Thus, the projections based on alternative hypotheses of productivity will not guarantee an internal rate of return equal to the underlying growth rate of GDP, but lower in the case where it is higher than 1.5% and higher in the opposite case.

Besides, it is interesting to remark that the deviations from the baseline scenario of the two alternative projections are not perfectly symmetrical. That mainly depends on the fact that replacement rates within the earnings-related method, which will be applied for the whole transition period, are inversely related to the growth rate of productivity[23].

As expected on the basis of the previous considerations, the differences among the lines of Figure 7a are due to the different evolutions of the ratios of average pension to labour productivity. The ratios of pensions to employees (Figure 7c) and its decompositions (Figure 7d-7f) are going to change imperceptibly because of a rule of the contribution system that does not allow workers to retire until they have reached an amount of pension not less than 1.2 times the old age allowance[24].

4.4. Different hypotheses on older workers' participation rate

As anticipated, the sensitivity test concerning an increase in participation rates among the older workers has raised some concerns in order to guarantee the consistency between pension results and assumptions exogenously given. This is mainly due to the following two reasons:

- participation rates of older workers mainly depends on their retirement behaviour, which in turn depends on pension legislation. Of course, it is always possible to assume changes in worker behaviour, aimed at prolonging their working lives, but there is no chance that the effects on participation rates fit exactly, in terms of time profile and age bracket, those assumed exogenously and in a mechanical way, in defining the sensitivity test assumptions. This aspect is of major relevance when, as in the case of Italy, the current legislation provides a tightening of the eligibility requirements just in the middle of the period chosen for the increase in the older worker participation rates;

- secondly, workers can prolong their working lives either postponing retirement or going on working after retirement. The choice depends, once again, on legislation besides personal convenience.

Since it seems logical to assume that changes in the older worker behaviour should be consistent with the legal framework, which is embodied in the model, the projection on the sensitivity test under consideration has been made trying to approximate, as far as possible, to the indication exogenously given, without renouncing to the consistency between older worker retirement choices and pension legislation.

The prolonging of working lives has been achieved partly through a postponement of retirement ages and partly through an increase of pensioner-contributor positions. As for the former, the pension model calculates the corresponding lower number of pensions. In both cases, however, it takes into account the subsequent increase in the average amount of pension because of the higher level of contribution.

Ex-post, the increase in the employment of older workers, brought about by changes in the retirement behaviour, has resulted substantially in line with that provided in 2025 onwards, although some differences remain in the transition phase between 2005 and 2025.

The difference in the projected ratios of pension expenditure to GDP stemming from an increase of older worker's participation rate (Figure 8a), mainly reflects changes in employment (and, this way, in GDP growth rates) and in the number of pensions, during the first two decades of the forecasting period (Figure 8c). Moving towards 2050, these effects tend to be counterbalanced by higher amounts of pensions because of longer working lives and, under the contribution-based system, higher transformation coefficients (Figure 8b). In the last ten years of the forecasting period the latter effect overcome, temporary, that brought about by the reduction in the ratio of pensions to employees.

4.5. Different hypotheses on unemployment rate

As regards the unemployment rate, the sensitivity analysis proposed by the EPC-WGA consists of applying a correction to the structural level in order to make it fall to 1 percentage point lower than that assumed in the baseline starting from 2005. As the unemployment rate in the baseline scenario is

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[23]In fact, the annual earnings involved in the calculation of the reference wage are capitalised with the inflation augmented by a fixed rate of 1% to take into account the growth rate of real wage.

[24]Obviously the number of the workers impelled to put off the retirement age changes in relation to the growth rate of productivity assumed.

assumed to fall to 6.5% by 2015, the alternative implies a convergence value of 5.5%. As a consequence, the growth rate of GDP is going to increase slightly, coherently with the deviation of the growth rate of employees.

The effects on the ratio of pension expenditure to GDP are illustrated in Figure 9. As expected, the higher reduction of the unemployment rate causes the ratio to settle just below the baseline one for the thirty-year period between 2010 and 2040. This outcome is mainly due to the higher growth rate of the employees (Figure 9c), which is not counterbalanced yet by the corresponding higher number of pensions (Figure 9c). As emerges from Figures 9d-9e, in the year 2050 it is still too early for the lower level of unemployment to result in a corresponding increase in the number of pensions.

4.6. Different hypotheses on interest rate

The sensitivity analysis on the interest rate is of major importance for those countries in which the second and third pillars of the pension system are significantly developed, replacing a large part of the pay-as-you-go system. That is not the case of Italy. As already explained (chapter 1), the funded part of the pension system is very limited at present and, therefore, the interest rate is relevant neither for the equilibrium of the public pension system in itself nor for the impact of its balances on public deficit.

Figure 1: real GDP growth rate and its decomposition
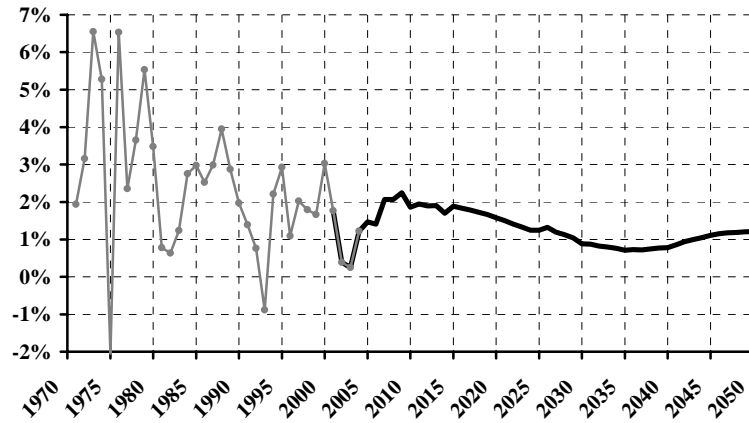*Past time series and EPC-WGA forecasts*

Figure 1a: real GDP growth rate

Figure 1b: real productivity growth rate

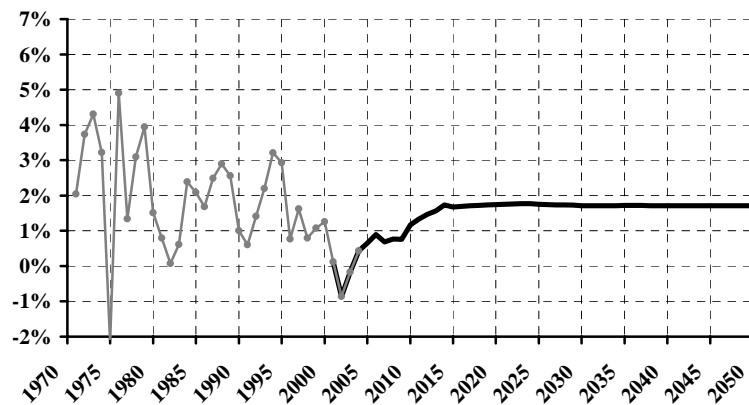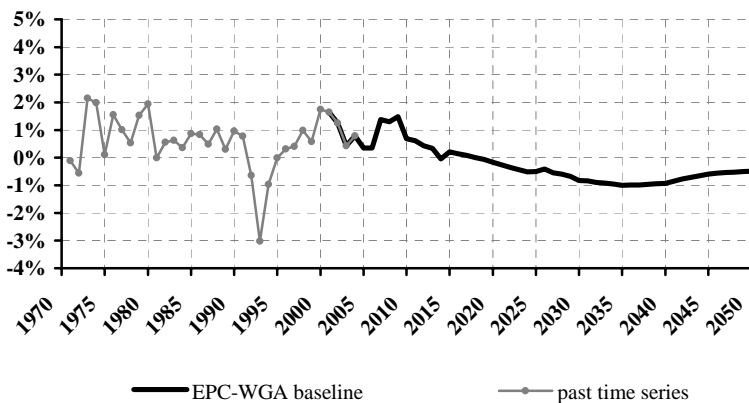**Figure 1c: employment growth rate**

EPC-WGA baseline   past time series

Figure 2: pension expenditure as a percentage of GDP and its decomposition

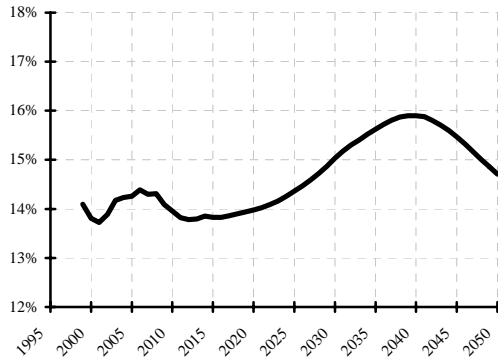**Figure 2a: percentage ratio of expenditure to GDP**

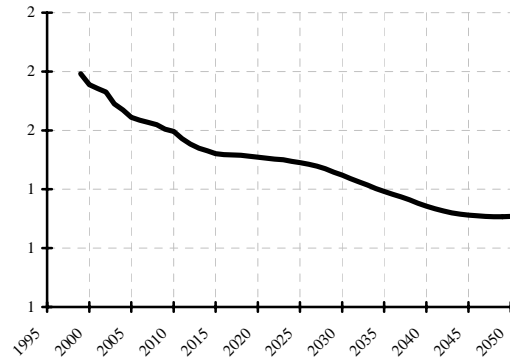**Figure 2d: percentage ratio of pensions to people of 65 and over**

Figure 2b: percentage ratio of average pension to labour productivity
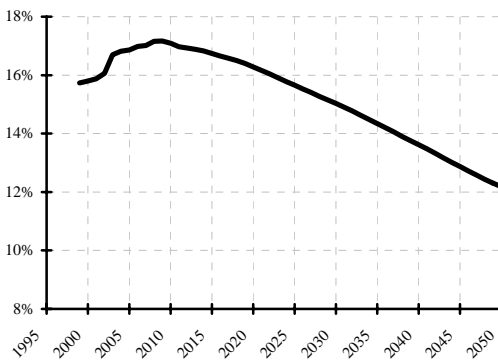
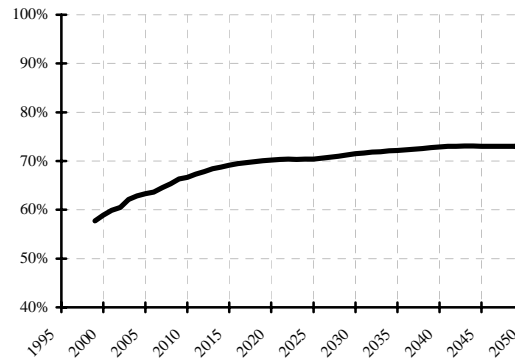**Figure 2e: percentage ratio of people employed to population aged [20-64]**

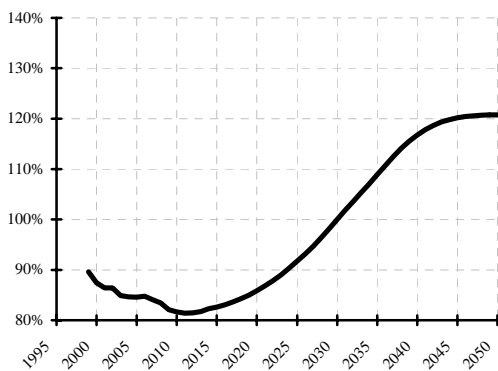**Figure 2c: percentage ratio of pensions to employees**

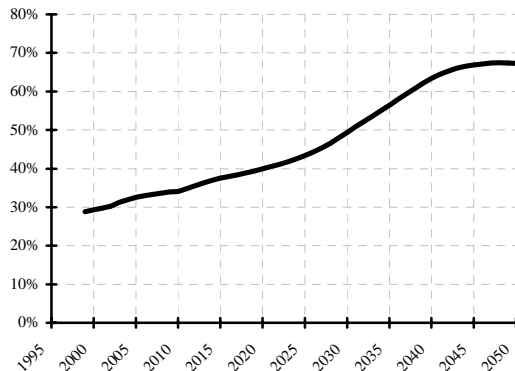**Figure 2f: percentage ratio of people of 65 and over to population aged [20-64]**

Figure 3: gross replacement rates[1]
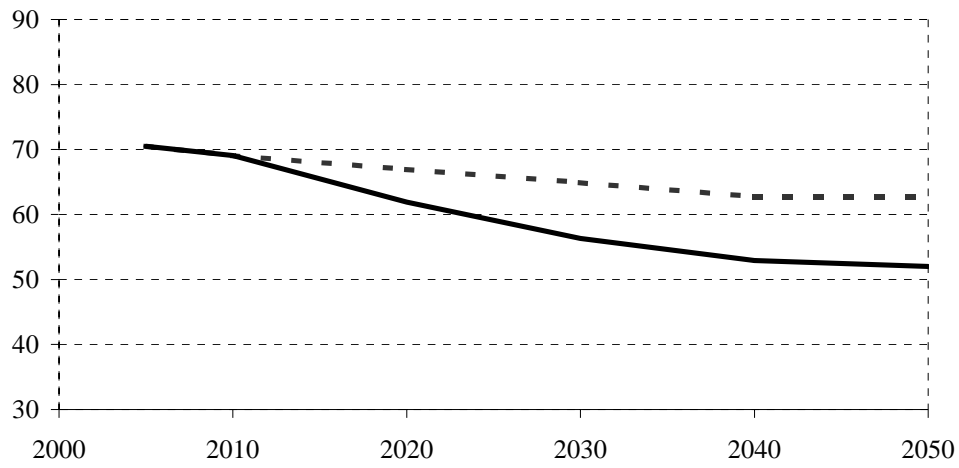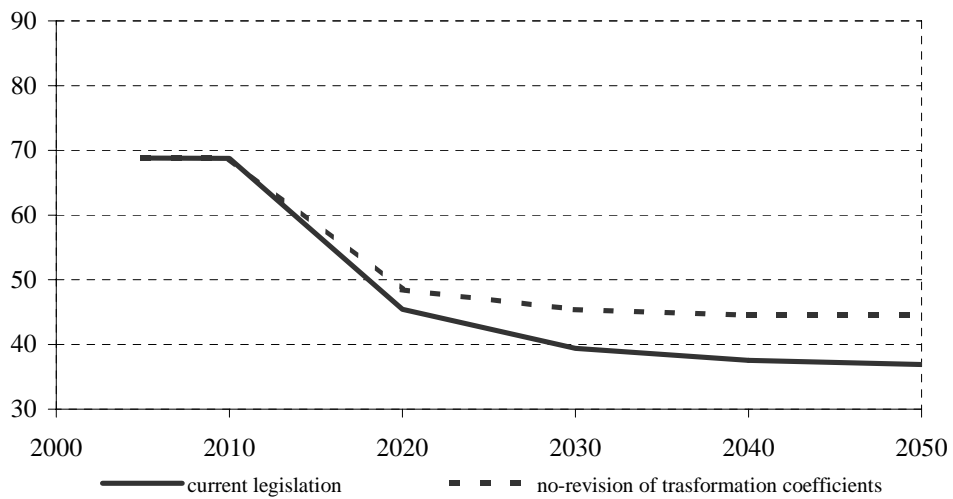
Figure 3a: private sector employees

Figure 3b: the self-employed

current legislation · · · no-revision of trasformation coefficients

(1) The underlying assumptions are: annual growth rate of wage (or income) 1.6% in real terms; annual growth rate of GDP 1.3% in real terms; inflation and GDP deflator 2%; age of retirement 63; contribution years 35.

Figure 4: ratio of pensions to people of 65 and over and its decomposition
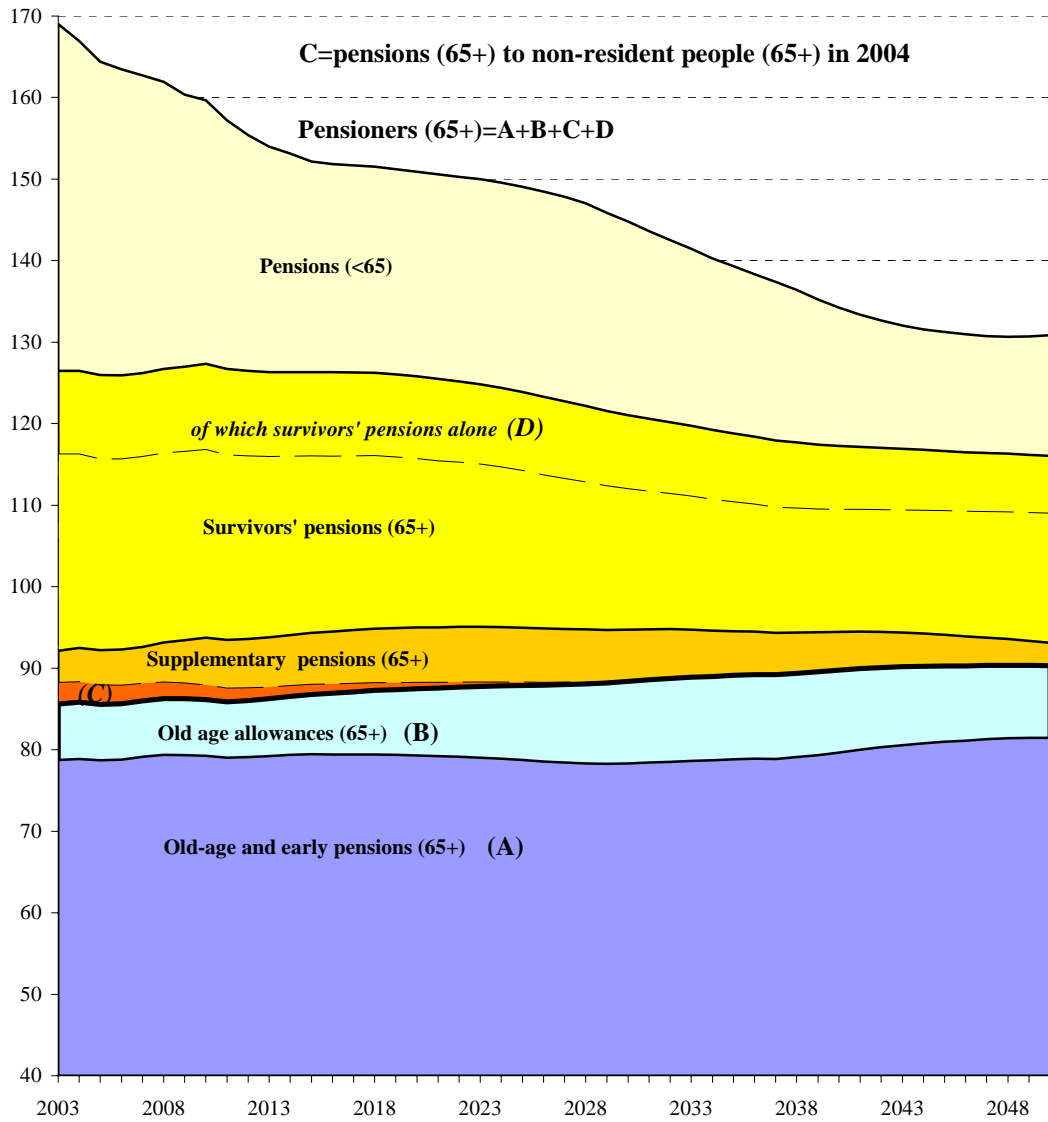
Figure 5: comparision between 2001 and 2005 EPC - WGA baseline scenarios

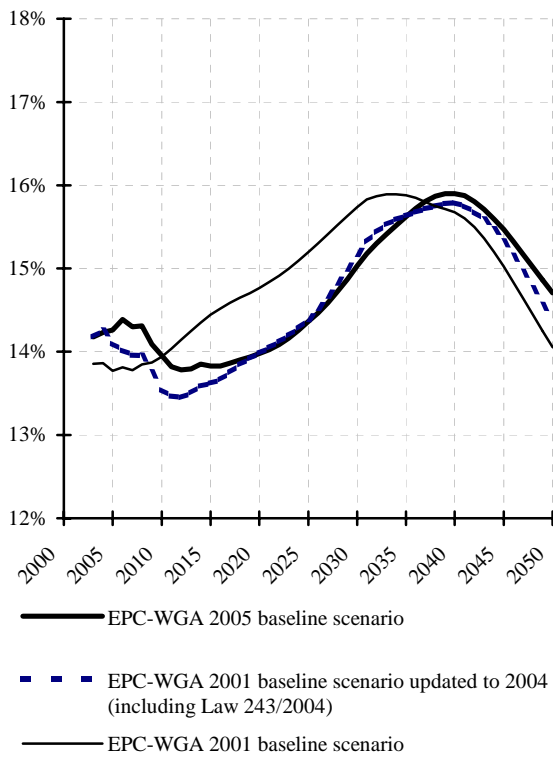**Figure 5a: percentage ratio of expenditure to GDP**

— EPC-WGA 2005 baseline scenario

- - - EPC-WGA 2001 baseline scenario updated to 2004 (including Law 243/2004)

— EPC-WGA 2001 baseline scenario

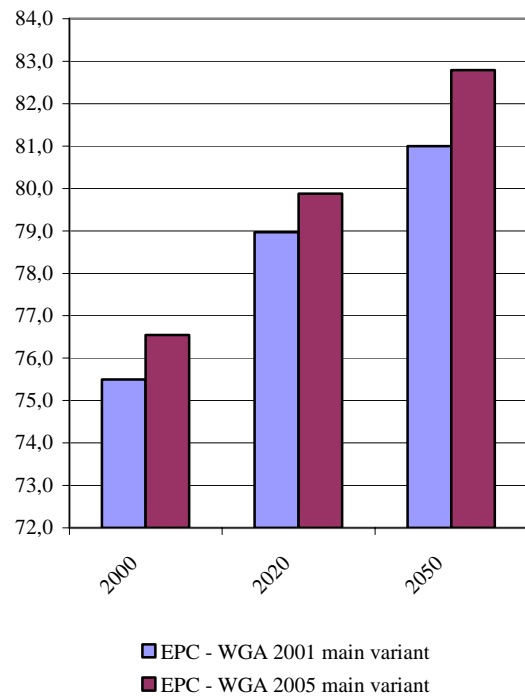**Figure 5b: comparision between EPC - WGA 2001 and EPC - WGA 2005 scenario assumptions - differences in growth rates**

- - - GDP   — Productivity   — Employment
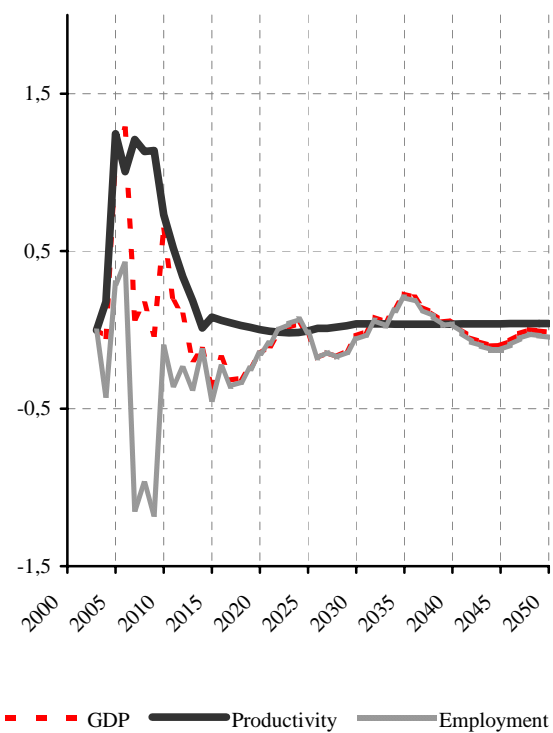
Figure 5c: life espectancy at birth - male

☐ EPC - WGA 2001 main variant
☐ EPC - WGA 2005 main variant

Figure 5d: life espectancy at birth - female

☐ EPC - WGA 2001 main variant
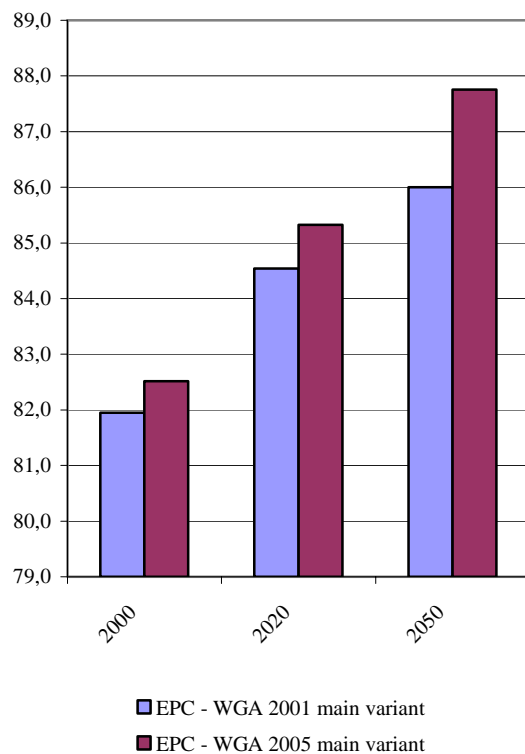☐ EPC - WGA 2005 main variant

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Figure 6: pension expenditure as a percentage of GDP and its decomposition
A comparison between two hypotheses on demography

Figure 6a: percentage ratio of expenditure to GDP

Figure 6d: percentage ratio of pensions to people of 65 and over

Figure 6b: percentage ratio of average pension to labour productivity

Figure 6e: percentage ratio of people employed to population aged [20-64]

Figure 6c: percentage ratio of pensions to employees

Figure 6f: percentage ratio of people of 65 and over to population aged [20-64]

—— baseline

—— baseline + higher life expectancy (decrease of 15% in age-specific mortality rates by 2050)

Figure 7: pension expenditure as a percentage of GDP and its decomposition
A comparison between three hypotheses on productivity

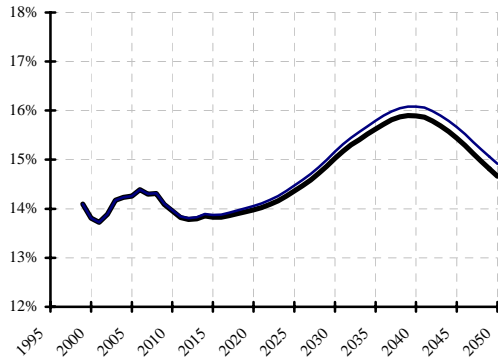**Figure 7a: percentage ratio of expenditure to GDP**

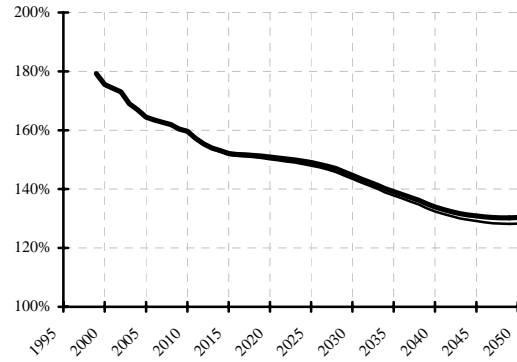**Figure 7d: percentage ratio of pensions to people of 65 and over**

Figure 7b: percentage ratio of average pension to labour productivity

Figure 7e: percentage ratio of people employed to population aged [20-64]

Figure 7c: percentage ratio of pensions to employees

Figure 7f: percentage ratio of people of 65 and over to population aged [20-64]

baseline

baseline + productivity growth increased by 0.25 p.p. from 2015

baseline + productivity growth lowered by 0.25 p.p. from 2015

Figure 8: pension expenditure as a percentage of GDP and its decomposition
A comparison between two hypotheses on participation rates

Figure 8a: percentage ratio of expenditure to GDP
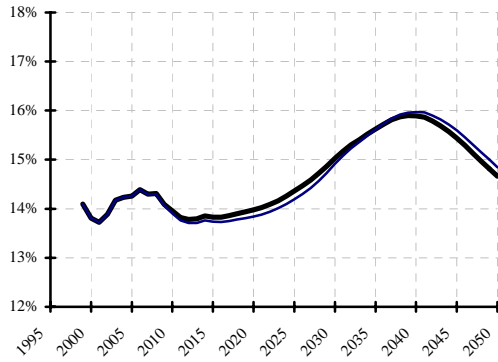
Figure 8d: percentage ratio of pensions to people of 65 and over

Figure 8b: percentage ratio of average pension to labour productivity
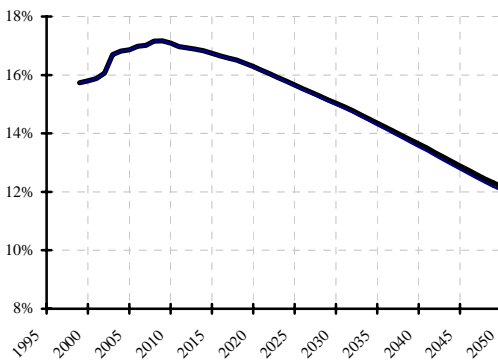

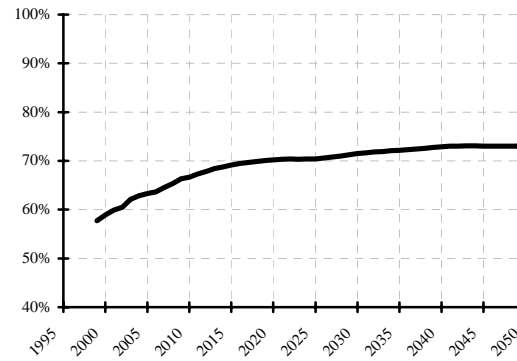**Figure 8e: percentage ratio of people employed to population aged [20-64]**

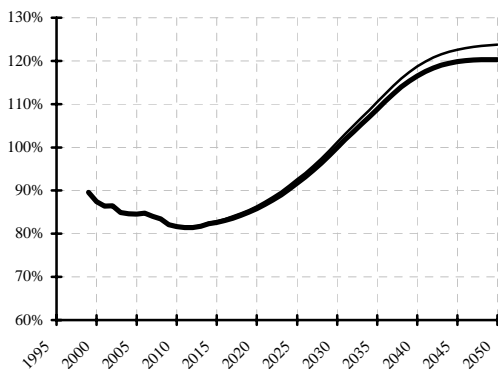**Figure 8c: percentage ratio of pensions to employees**

Figure 8f: percentage ratio of people of 65 and over to population aged [20-64]

———— baseline ———— baseline + older workers' partecipation rate increased by 5 p.p. from 2005 to 2025

Figure 9: pension expenditure as a percentage of GDP and its decomposition
A comparison between two hypotheses on unemployment rate

Figure 9a: percentage ratio of expenditure to GDP
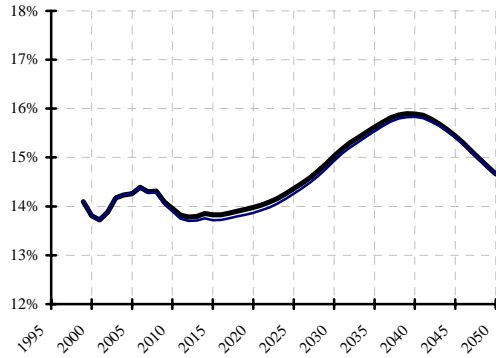
Figure 9d: percentage ratio of pensions to people of 65 and over
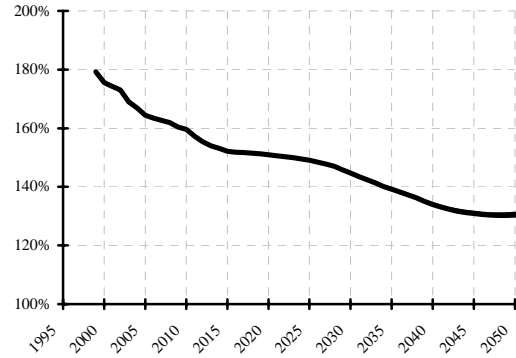
Figure 9b: percentage ratio of average pension to labour productivity
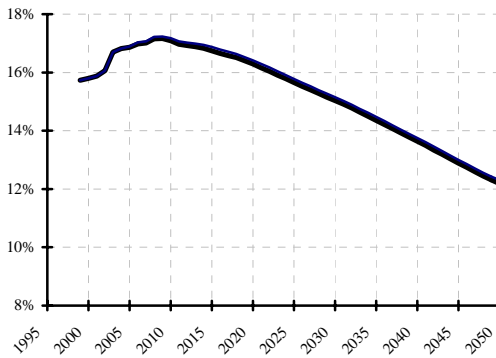
Figure 9e: percentage ratio of people employed to population aged [20-64]
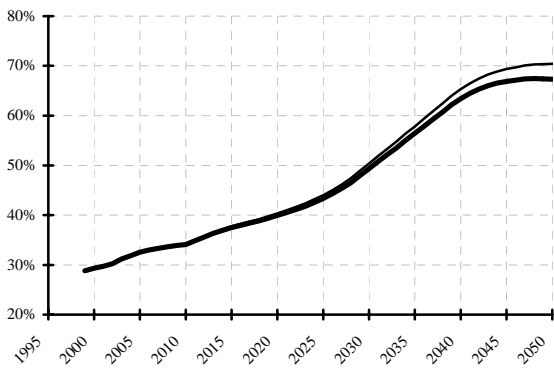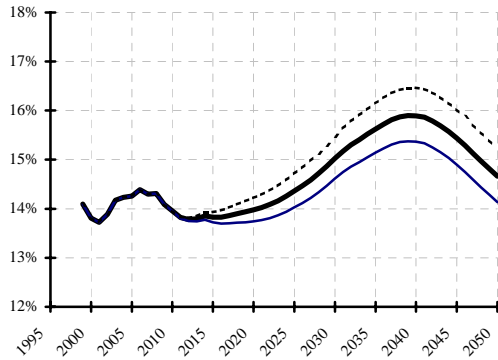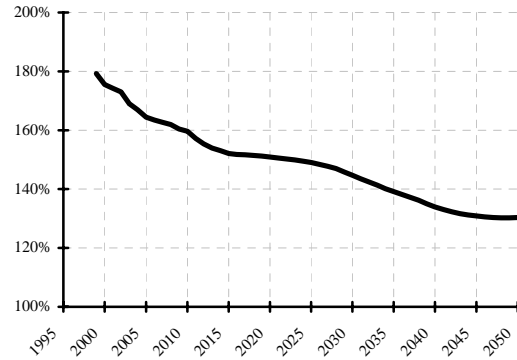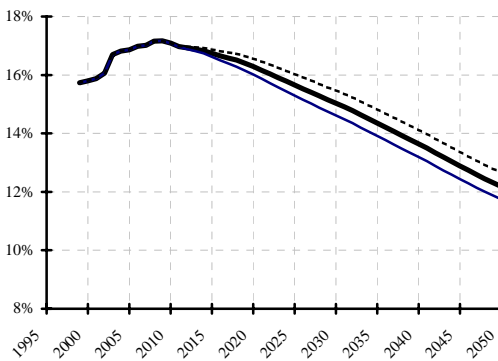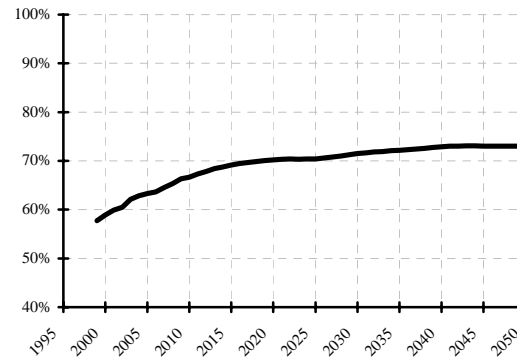
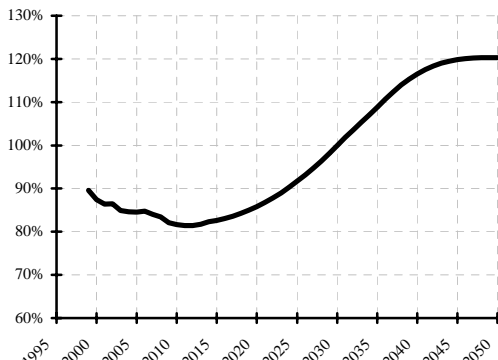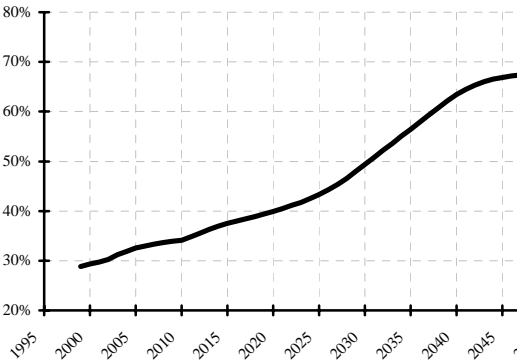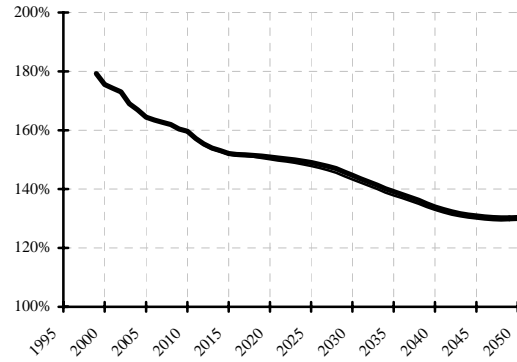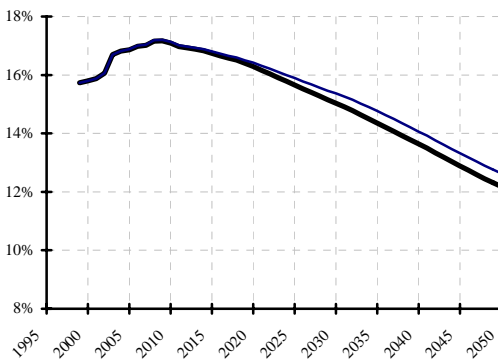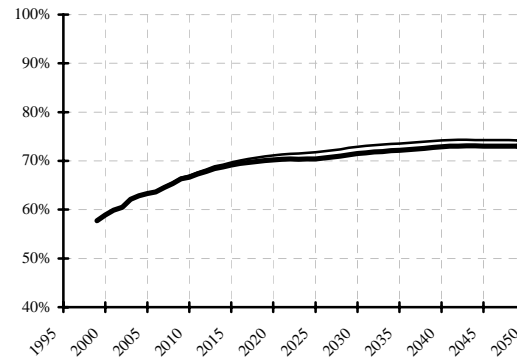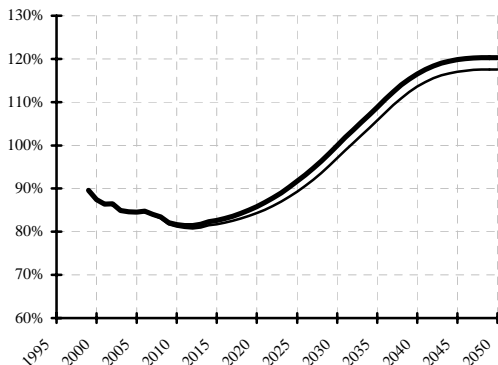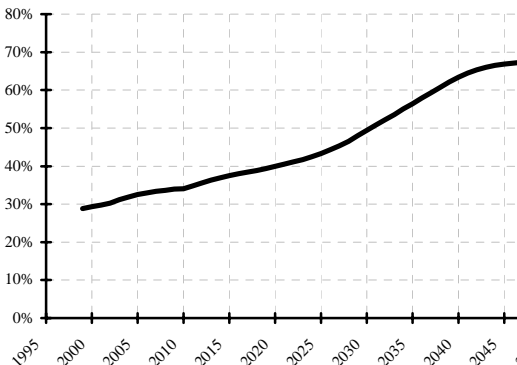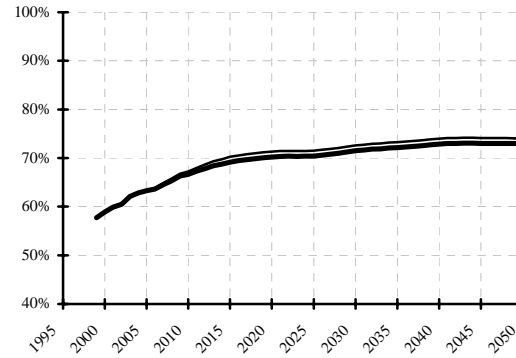**Figure 9c: percentage ratio of pensions to employees**
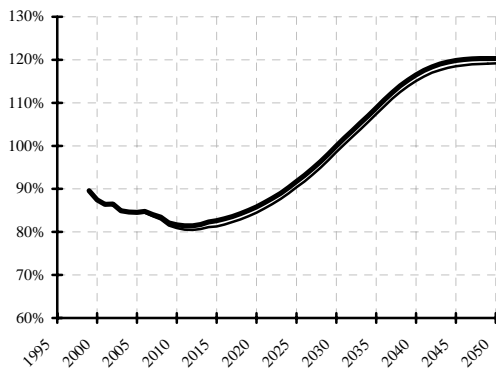
Figure 9f: percentage ratio of people of 65 and over to population aged [20-64]
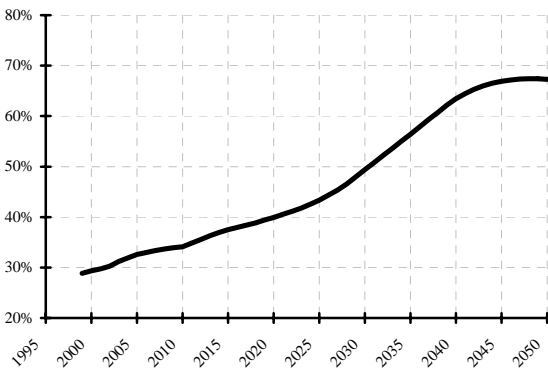
baseline —— baseline + unemployment rate lowered by 1 p.p. from 2005 to 2015

Annex 1 - The latest pension reform (Law 243/2004)

The Law 243/2004 envisages two main interventions to the public pension system: one with short-term effects (incentives to put off retiring) and one with structural effects noticeable in the medium-long term (alterations to the requirements for pension entitlement)

The short-term intervention lays down that, for the period 2004-2007, those employed in the private sector who have satisfied the minimum requirements for a seniority pension may opt for a different regime providing:

- an additional pay, corresponding to the whole pension contribution (paid by both the employer and the employee), which is no longer to be paid to the social security system;

- the total tax exemption of this additional income;

- a pension amount calculated according to the contribution years matured at the date of the option and indexed to inflation for the period until retirement.

The intervention with structural effects lays down that:

- those who would have satisfied the requirements envisaged by the current legislation before the 31st December 2007 would be entitled to a pension under the requirements currently in force (the so-called 'certezza dei diritti');

- beginning in 2008, the possibility to receive a pension at an age lower than 65 for males and 60 for females is allowed to those with 40 or more years of contributions, or to those with no less than 35 years of contributions and of 60 years of age, in the case of the employed, and 61 for the self-employed;

- the age limit is to rise by a year from 2010 and another year from 2014, thus reaching 62 and 63 years of age for the employed and the self-employed, respectively;

- a further postponement of pension payment is envisaged with respect to the moment in which the requirements are met, by way of the so-called 'finestre';

- the same postponement is also applied to workers under the contribution-based system;

- for the period 2008-2015, the possibility to receive a seniority pension having satisfied the requirements laid down in the current legislation (that is, at least 35 years of contributions and a minimum age of 57 for the employed and 58 for the self-employed) is provided only for women who choose a pension treatment calculated according to the contribution-based method.

The financial effects of the measure tightening the minimum requirements for pension entitlement are laid out in the Table below, which shows mid-long term variations in the ratio of expenditure to GDP.

Reduction of pension expenditure as a share of GDP in the mid-long term (*as a percentage*)

2008	2009	2010	2011	2012	2013	2014	2015	2019	2020	2025	2030	2035	2040	2045	2050
0.0	0.2	0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.0	-0.3	-0.3

The forecasts have been made using the RGS model and assuming the national baseline scenario. The values shown indicate a reduction in the ratio of pension expenditure to GDP of some 0.7 percentage points from 2012 to 2019 and of 0.6 from 2020 to 2030. The savings effect tends to be nullified in the following decade, whilst in the closing years of the forecasting period it produces a worsening in the ratio of expenditure to GDP of around 0.3 percentage points.

Annex 2 - Transformation coefficients: formula and assumptions

The timing and methodology for the revision of transformation coefficients is governed by paragraph 11 of article 1 of the Law 335/95. This paragraph lays down that the aforesaid coefficients must be determined anew every ten years on the basis of the results of demographic surveys and of the effective performance of GDP in the long term, with reference to the dynamic underlying those incomes subject to the public pension system contributions, as shown by Istat (Italian National Institute of Statistics). The formula used to calculate the transformation coefficients and the values of the underlying parameters are given below. As may be seen from the formula, the transformation coefficients take into account survivors' pensions and are applicable both to males and females. Amongst the parameters utilised is the probability of survival, the updating of which forms the basis of the ten-yearly revision of the transformation coefficients. A discount rate of 1.5% may be noticed which expresses the differential between the yield of the scheme and the percentage of indexation of the pension.

A.   Formula

$$TC_x = \frac{1}{\Delta_x}$$

$$\Delta_x = \frac{\sum_{s=m,f} a_{x,s}^{v(t)} + A_{x,s}^{v(t)}}{2} - k$$

Average present value of direct pension awards[25]:

$$a_{x,s}^{v(t)} = \sum_{t=0}^{w-x} \frac{l_{x+t,s}}{l_{x,s}} \left(\frac{1+r}{1+\sigma} \right)^{-t}$$

Average present value of reversibility pension awards:

$$A_{x,s}^{v(t)} = \sum_{t=0}^{w-x} \frac{l_{x+t,s}}{l_{x,s}} q_{x,t,s} \left(\frac{1+r}{1+\sigma} \right)^{-t} \Theta_{x+t,s} \eta \delta_s \sum_{\tau=1}^{w-x-t+\varepsilon_s} \frac{l_{x+t+\tau-\varepsilon_s,s}^{ved}}{l_{x+t+1-\varepsilon_s,s}^{ved}} \left(\frac{1+r}{1+\sigma} \right)^{-\tau}$$

Where :

TC = transformation coefficient

Δ = divisor

$s = m, f$

$\dfrac{l_{x+t,s}}{l_{x,s}}$ = probability of surviving between ages x and $x+t$

x = retirement age

w = maximum age

$q_{x+t,s}$ = probability of death between ages $x+t$ and $x+t+1$

$\Theta_{x+t,s}$ = probability of leaving a family of a person at the age $x+t$

$l_{x+t,s}^{ved}$ = probability for a widow or widower to be eliminated because of death or new marriage.

k = adjustment owing to how pension is withdrawn (one month in advance, two months in advance, a year in advance and so on)

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[25] It is worthwhile noting that for $r = \sigma$ and $k = 0.5$, $a_{x,s}^{v(t)} - k$ coincides with the life expectancy of the pensioner at the retirement age

$\varepsilon_s =$ difference between the pensioner's age of sex s and the spouse's age

$\eta =$ percentage of reversibility

$\delta_s =$ average percentage of reduction of the survivor's pension owing to income requirements.

$r =$ internal return rate

$\sigma =$ indexation rate

$\left(\dfrac{1+r}{1+\sigma}-1\right) =$ discount rate

B. Assumptions

$l_{x,s}, q_{x,s}$: function of surviving and probabilities of death in 1990 made by Istat (source : *Annuario Statistico Italiano 1994*)

$l_{x,s}^{ved}$: function of surviving in 1990 made by Istat , and probabilities of new marriage made by INPS (source: Istat, *Annuario Statistico Italiano 1994*; INPS, *Il modello Inps e le prime previsioni al 2010*, 1989)

$\Theta_{x,s}$: probabilities of leaving a family made by INPS (source : INPS, *Il modello Inps e le prime previsioni al 2010*, 1989)

$x =$ from 57 to 65

$\varepsilon_s = \begin{cases} +3 \ if \ s=m \\ -3 \ if \ s=f \end{cases}$

$\eta = 0{,}6$

$\delta_s = \begin{cases} 0{,}9 \ if \ s=m \\ 0{,}7 \ if \ s=f \end{cases}$

$\dfrac{1+r}{1+\sigma} = 1{,}015$

$k = \dfrac{1}{2} - \dfrac{6}{13n} = 0.423 \quad for \ n = 6$ [26]

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[26] The parameter *n* indicates the number of monthly awards paid in advance within a year, which was 6 in 1995.

Annex 3 - Production function specification

The WGA agreed to utilise the OGWG production function to project labour productivity growth in the long run. As known, the production function adopted by the OGWG is based on a Cobb Douglas which can be expressed as follows:

$$Y = C \, L^{1-\alpha} \, K^{\alpha}$$

where: $Y=GDP$; $C=TFP$, L=labour input; K=capital input

In terms of growth rates, the previous equation becomes

$$\dot{y} = \dot{c} + (1-\alpha)\dot{l} + \alpha \dot{k}$$

and, finally, the growth rate of productivity is:

$$\dot{\pi} = \dot{y} - \dot{l} = \dot{c} + \alpha(\dot{k} - \dot{l})$$

In turn, the capital growth rate is calculated according to the following expression:

$$\dot{k} = \frac{K_{t-1}(1-\delta) + \lambda Y_t}{K_{t-1}}$$

where: δ is the yearly percentage of capital depreciation and λ expresses the percentage of gross investment to GDP.

As for the capital dynamics, three rules have been considered:

1) <u>Investment rule scenario</u>. It consists in keeping constant the ratio of investment to GDP (parameter λ) throughout the whole forecasting period;

2) <u>Capital stock rule scenario</u>. It consists in equating the growth rate of capital stock to the growth rate of labour input and TFP, the latter divided by *(1-α)*, according to the above specification of the production function. Analytically: $\dot{k} = \dot{l} + \dfrac{\dot{c}}{(1-\alpha)}$

3) <u>Compromise scenario</u>. It consists in applying rule 1 up to 2010, rule 2 from 2030 onwards and a transition phase from 2010 to 2030 in which a gradual shift from the former to the latter takes place.

The values of the parameters utilised for mid-long term projections are based on those estimated for and applied in the short term projections made by the Commission (Spring forecasts, 2005). Accordingly, it is: $\alpha = 35\%$; $\lambda = 20.67\%$; $\delta = 4.45\%$. The capital level in 2004 is 3,504 mln euro in 1995 prices and 4,500 mln euro in current prices.

It can be demonstrated that rule 2 (and rule 3, from 2030 and partly between 2010 and 2030) implies a constant ratio of capital stock to GDP, regardless of the employment dynamics. Given the yearly percentage of capital depreciation is constant, this result implies, in turn, a strong, positive correlation between investment and labour input. In other words, all else being equal, the lower the level of employment (because of demographic reasons) the lower the level of investment.

Annex 4 - The probability of entering the labour market: the evidence for Italy

Figure 10 shows the past trends of participation rates in Italy during the last ten years, for two relevant age brackets and both genders. As can be seen, the female participation rate has been increasing dramatically at the pace of almost ¾ of a percentage point a year, in the age bracket 15-64, and at the pace of about 1 percentage point a year, in the age bracket 25-54.

The same outcome can be found comparing the cross section age profiles of participation rates in 1993, in 1998 and in 2003 (see Figure 11). Regardless of the level of aggregation by age (single age or five-year age bracket), the increase of female participation rates after the age 25 is quite relevant (about 7 percentage points, as an average, in the age bracket 30-40). At the same time the reduction of the participation rates under the age 25 appears quite evident for both genders, because of an increase in the enrolment rates. This factor is one of the reasons for female participation rates rising after a certain numbers of years starting from the age 25.

The cohort profiles of the probabilities of entering the labour force, estimated according to the same methodology adopted by the EPC-WGA[27] over two groups of years: 1993-1998 and 1998-2003, allows us to interpret the evolution of participation rates in terms of cohort behaviour. In fact, the comparison of the two cohort profiles averaging, respectively, in the central year of the two periods mentioned above, shows the differences in the cohort behaviour of two generations of people born with a five-year lag from each other (see Figure 12)[28].

As expected, the youngest cohort presents a lower level of participation rates in the school ages, for both genders. Instead, in the subsequent ages, the participation rates of women are much higher, consistently with the evidence shown in the other graphs previously presented. Such a result can be interpreted as follows: after school ages, a cohort of women is expected to reach a level of participation rates 6 percentage points higher than that of the cohort of women five years older.

It is worthwhile noting that an increase in participation rates is also evident for males, although to a lesser extent than females. The Figure 12 also highlights that the net probabilities of entering the labour force are positive up to 43. Beyond this age, the cohort profile of participation rates tends to decline slowly[29].

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[27]Denoting $\pi_{x,s}^{\bar{a},a}$ as the net probability for people to move from the non-workforce position ($\bar{a}$) to the workforce one (a), for a given age (x) and sex (s), the probability of entering can be estimated as an average of the cohort changes calculated on the basis of the labour force data according to the following formula:

$$\pi_{x,s}^{\bar{a},a} = \frac{1}{t_2 - t_1} \sum_{j=t_1}^{t_2-1} \frac{a_{j+1,x+1,s} - a_{j,x,s}}{1 - a_{j,x,s}} \qquad 14 \leq x < x^{**}$$

where t1 and t2 represent, respectively, the first and the last year of the period utilised for the estimate, while x** is the age from which the cohort participation rates start to decline because of retirement. In order to summarize the behaviour concerning the propensity to access permanently the labour market, it is useful to define the cumulative probability function which only depends on the probabilities referred above according to the following formula:

$$G_{x,s}^a = 1 - \prod_{j=0}^{x-14} \left(1 - \pi_{13+j,s}^{\bar{a},a}\right) \qquad 14 \leq x < x^{**}$$

[28] The period 1993-2003 refers to the longer one for which homogeneous labour force time series are available. By chance, it also corresponds to the last ten yearly generational changes of participation rates.

[29] This is mainly due to retirement after being entitled to a disability pension. As can be noted, the cohort profile estimated over the period 1993-1998, presents a more evident decline in participation rates after 45. This is mainly due to the fact that before 1998 civil servants were allowed to claim seniority pensions with very low contribution requirements. Starting from 1998, the civil servant's requirements were almost equalised to those stated for employees of the private sector.

Figure 10 - Participation rates in different age brackets[1]
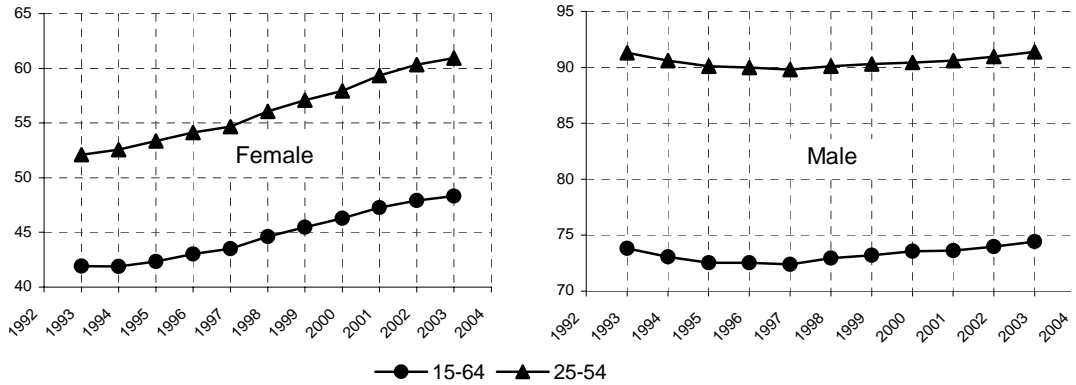
Figure 11 - Cross section profile of participation rates in 1993, 1998 and 2003[1]
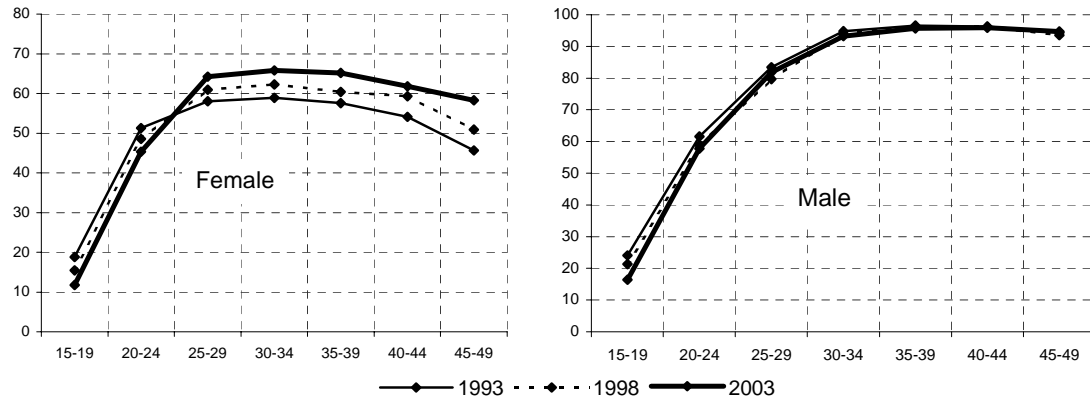
Figure 12 - Cohort profile of participation rates estimated over the periods 1993-1998 and 1998-2003[1]
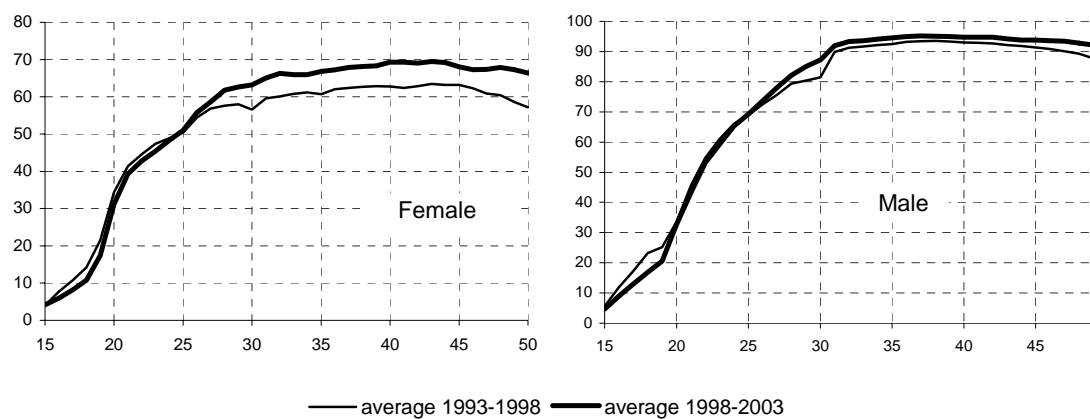
(1) Source: Istat, Quarterly Labour Force Survey Database (Laboratorio Adele), annual average. The age is calculated as a difference between the reference year and the one at birth.

Annex 5 - Moving from the Quarterly to the Continuous Labour Force Survey

Istat (Italian National Institute of Statistics) has recently moved from the Quarterly Labour Force Survey (QLFS) to the Continuous Labour Force Survey (CLFS). The year 2003 is the only one in which both surveys were carried out contextually, although the latter was a pilot version that year. Starting from 2004, the CLFS alone will be carried out[30].

The discrepancy emerging from the results of these two surveys in the year 2003, both in terms of participation rates and unemployment rates, do not express any updating of the estimates but are rather the effects deriving from the application of a different survey methodology and definition of variables.

Considering that from 2004 on only the CLFS will be available, for the sake of coherence with the Figures provided in the official documents (Economic and Financial Planning Document, Stability and Growth pact Document) data, estimates and forecasting Figures need to be revised applying some conversion coefficients to be derived from the comparison of the LF results released by the two surveys, in 2003.

Such a point was raised by the Italian delegation in the WGA meetings, under the item concerning the transformation of LF statistics into NA Figures. It was agreed that such a problem could be solved applying the same methodology as that suggested for the conversion of LF statistics into NA ones, namely by applying some conversion coefficients to be kept constant through time.

More specifically, the transformation of QLFS statistics (*q*) into CLFS equivalent statistics (*c*), for each forecasting year (*t*), gender (*s*) and age (*x*), can be made on the basis of the following two equations referring, respectively, to participation rates (*pr*) and employment rates (*er*)

$$pr^c_{t,s,x} = pr^q_{t,s,x}\ \alpha_{s,x} \qquad\qquad [1]$$

$$er^c_{t,s,x} = er^q_{t,s,x}\ \beta_{s,x} \qquad\qquad [2]$$

where: $\alpha_{s,x} = \dfrac{pr^c_{2003,s,x}}{pr^q_{2003,s,x}}$ and $\beta_{s,x} = \dfrac{er^c_{2003,s,x}}{er^q_{2003,s,x}}$

Consequently, the unemployment rates (*ur*) can be calculated as follows:

$$ur^c_{t,s,x} = 1 - \dfrac{er^c_{t,s,x}}{pr^c_{t,s,x}} \qquad\qquad [3]$$

This methodology is able to shape the age profile of participation and employment rates, according to the differences registered in 2003, without altering sensibly labour force and employment dynamics and, therefore, the growth rate of GDP. In this regard, the only alteration might stem from the interaction between the distribution, by age and sex, of LF correction coefficients and that of the forecasted population. Given that the corrections are not of particular relevance, especially from the age 25 on, such an effect is likely to be negligible.

In any case, the latter can be completely eliminated applying further correction coefficients to parameters *α* and *β* which only depend on the forecasting year. Denoting them as c^α_t and c^β_t, respectively, and indicating with *Pop* the population, equations [1] and [2] can be rewritten as follows:

$$pr^c_{t,s,x} = pr^q_{t,s,x}\ c^\alpha_t\ \alpha_{s,x} \qquad\qquad [4]$$

$$er^c_{t,s,x} = er^q_{t,s,x}\ c^\beta_t\ \beta_{s,x} \qquad\qquad [5]$$

where:

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[30] See http://www.istat.it/Lavoro/Storico/index.htm

$$c_t^\alpha = \frac{\sum\limits_{s,x} pr_{t,s,x}^q\, Pop_{t,s,x}}{\sum\limits_{s,x} pr_{2003,s,x}^q\, Pop_{2003,s,x}} \; \frac{\sum\limits_{s,x} pr_{2003,s,x}^q\, \alpha_{s,x}\, Pop_{2003,s,x}}{\sum\limits_{s,x} pr_{t,s,x}^q\, \alpha_{s,x}\, Pop_{t,s,x}} \quad \text{and}$$

$$c_t^\beta = \frac{\sum\limits_{s,x} er_{t,s,x}^q\, Pop_{t,s,x}}{\sum\limits_{s,x} er_{2003,s,x}^q\, Pop_{2003,s,x}} \; \frac{\sum\limits_{s,x} er_{2003,s,x}^q\, \beta_{s,x}\, Pop_{2003,s,x}}{\sum\limits_{s,x} er_{t,s,x}^q\, \beta_{s,x}\, Pop_{t,s,x}}$$

It can be proved that, applying equations 4 and 5, projections of participation and employment rates (and, consequently, of unemployment rates, through equation 3), which are consistent with QLFS statistics, can be converted into CLFS equivalent, without altering employment and labour force dynamics and, therefore, without affecting the level and the growth of GDP in each year of the forecasting period[31].

In Table 3, the differences between the QLFS and the CLFS are shown, in terms of participation and employment rates. As can be seen, the age brackets are too large to assume the conversion coefficients be constant within each of them, without implying possible discontinuities moving from one bracket to the following. To avoid this, an estimate of the coefficients α and β has been made, by single age and sex, which are consistent with the data reported in Table 3[32].

Figure 13, allows us to assess how the application of such coefficients affects the age profile of participation, employment and unemployment rates. This is done comparing QLFS statistics, in 2003, with CLFS equivalent ones, calculated applying the conversion coefficients.

Table 3 - A comparison between Quarterly and Continuous Labour Force Survey results in the year 2003[1]

		males					females					total				
		7	25-64	15-64	65+	total	15-24	25-64	15-64	65+	total	15-24	25-64	15-64	65+	total
QLFS	Employees *(a)*	8	12.480	13.438		252	13.690	657	7.616	8.272	92	8.365	1.615	20.095	21.710	344	22.054
	Unemployed *(b)*	306	686	992	4	996	293	802	1.095	5	1.100	599	1.488	2.087	9	2.096
	Labour Force *(c)=(a)+(b)*	1.264	13.166	14.429	256	14.685	950	8.418	9.368	97	9.465	2.214	21.583	23.797	353	24.150
	Participation rates	38	82	74	6	62	30	52	48	2	37	34	67	61	3	49
	Employment rates	29	78	69	6	58	21	47	43	2	33	25	62	56	3	45
	Unemployment rates	24	5	7	2	7	31	10	12	5	12	27	7	9	3	9
CLFS	Employees *(a)*	1.034	12.251	13.284	260	13.544	744	7.882	8.626	71	8.697	1.777	20.132	21.910	331	22.241
	Unemployed *(b)*	267	663	930	6	936	284	827	1.111	2	1.112	551	1.490	2.041	7	2.048
	Labour Force *(c)=(a)+(b)*	1.301	12.913	14.214	266	14.480	1.028	8.709	9.736	73	9.809	2.328	21.622	23.950	339	24.289
	Participation rates	42	81	75	6	62	34	54	51	1	39	38	68	63	3	50
	Employment rates	33	77	70	6	58	25	49	45	1	34	29	63	58	3	46
	Unemployment rates	21	5	7	2	6	28	9	11	2	11	24	7	9	2	8

(1) Units are expressed in thousands and ratios in percentage points

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[31] The level of GDP in 2003 is given. Therefore, differences in employment are compensated for by a corresponding change in the level of GDP per worker.

[32] Such an estimate is based on data provided by both surveys, which actually refers to an average over the 2nd, 3rd, 4th quarters of 2003 and the 1st quarter of 2004.

Figure 13 - A comparison between QLFS and CLFS equivalent statistics, in 2003

Partecipation rates - Male

— QLFS03   — CLFS equivalent

Partecipation rates-Female

— QLSF03   — CLFS equivalent

Employment rates - Male

— QLFS   — CLFS equivalent

Employment rates - Female

— QLFS03   — CLFS equivalent

Unemployment rates - Male

— QLFS   — CLFS equivalent

Unemployment rates - Female

— QLFS   — CLFS equivalent
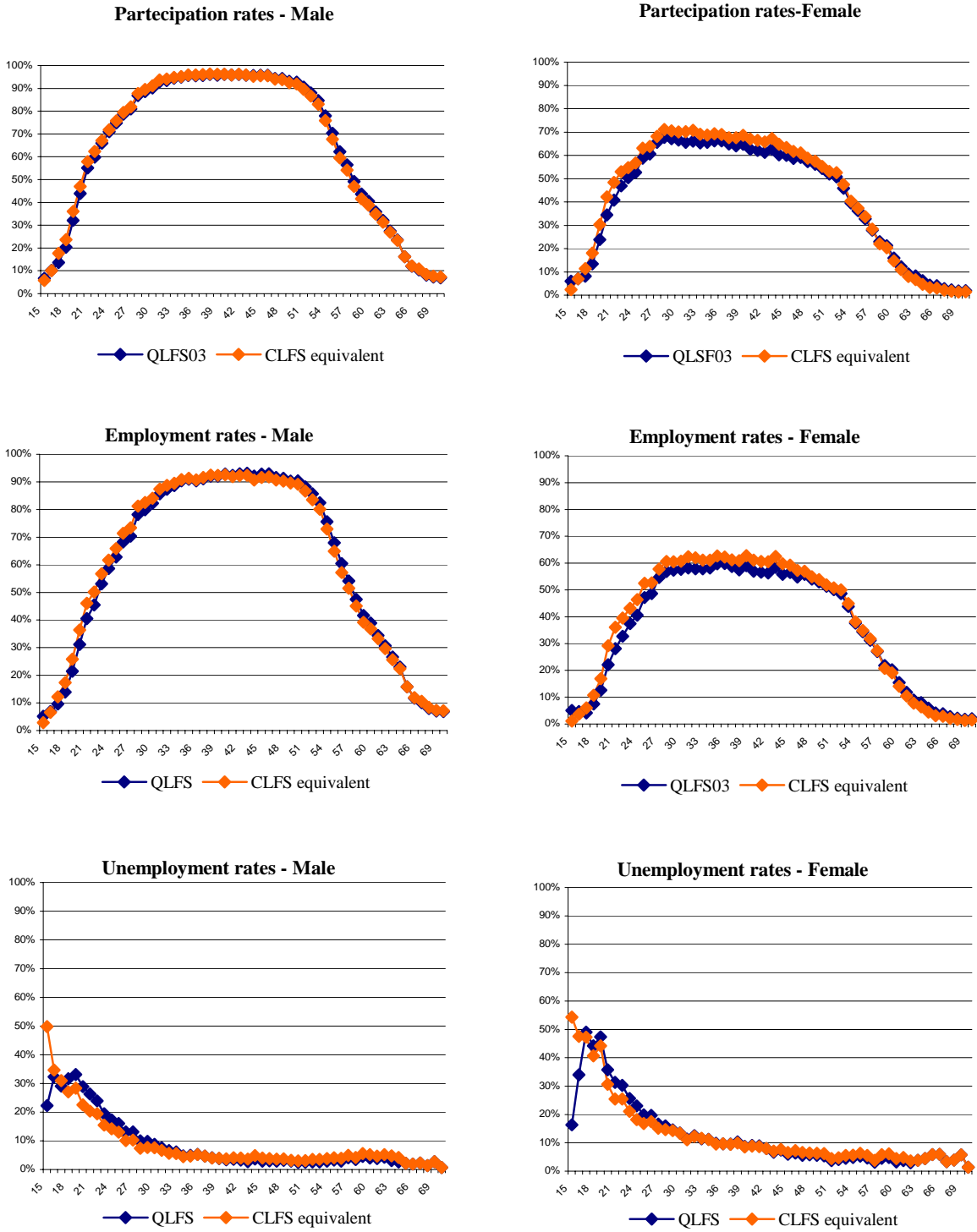
Annex 6 - The decomposition of pension projection results – a set of consistent indicators

The ratio between pension expenditure and GDP (ψ) can be decomposed as follows:

$$\psi = \frac{P}{\Pi} \ \frac{V}{E} \ \frac{E}{L} \ \frac{R}{V} \qquad\qquad [1]$$

where: P stands for the average pension amount, Π for GDP per worker, V for the old-age population (65 and over), E for the population in working age (20-64)[33], L for the number of employees and R for the number of pensions. Moreover, setting: $P/\Pi = \lambda$, $V/E = \delta$, $E/L = \alpha$ and $R/V = \beta$, the ratio can be rewritten according to following formula:

$$\psi = \lambda \ \delta \ \alpha \ \beta \qquad\qquad [2]$$

Furthermore, β can be decomposed as follows:

$$\beta = \beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less} \qquad\qquad [3]$$

where: β^{dir} stands for the number of pensioners of 65 and over entitled to a direct pension (any kind of pensions other than survivor's ones) divided by the old-age population; β^{sup} stands for the number of supplementary pensions of 65 and over divided by the old-age population. Supplementary pensions refer to the additional direct pensions entitled to the same person (second, third and so on direct pensions) which are, generally, of a small amount insofar as they are calculated on the contribution years other than those already utilised for the main direct pension; β^{sur} stands for the number of survivor's pensions of 65 and over divided by the old-age population; β^{less} stands for the number of pensions, regardless of the kind, below 65 divided by the old-age population.

In turn, the latter can be further decomposed as a product of two factors:

$$\beta^{less} = \beta^{less}_{norm} \ \beta^{less}_{dem} \qquad\qquad [4]$$

where: β^{less}_{norm} is the ratio between the number of pension below 65 and the population in the age bracket (50-64)[34] while β^{less}_{dem} is defined as the ratio between the population in the age bracket (50-64) and the old age population.

Finally, from equations [2]-[4], we have:

$$\psi = \lambda \ \delta \ \alpha \cdot (\beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less}_{dem} \cdot \beta^{less}_{norm}) \qquad [5]$$

It is worthwhile pointing out that:

- the indicators: α, δ and β^{less}_{dem} do not depend on pension model results but only on labour market and demographic assumptions agreed within the EPC-WGA;

- the indicator λ reflects the features of the legal framework of pension systems as far as the calculation and indexation rules are concerned. Therefore, the analyses on replacement rates carried out within the Indicator Subgroup of SPC (which are based on the EPC-WGA macroeconomic and demographic assumptions), may represent an useful bench-mark to be used as reference;

- the indicator β^{less}_{norm} mainly reflects the effects of changes in the eligibility requirements already legislated;

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[33] The age bracket (15-64) could also be assumed as an alternative.

[34] The age bracket (55-64) could also be assumed as an alternative.

- the evolution of indicator β^{sur} may be almost entirely explained in terms of demographic drives, namely: the increase in life expectancy for both gender and the mortality rate (number of deaths to population) in the age bracket 65 and over;

- finally, the indicator β^{dir} allows us to assess the consistency between the projection of the elderly and that of the number of pensioners in the same age bracket.

It can also be seen that, by calculating the percentage rates of change for a given interval of time, the equation [2] becomes:

$$\frac{\Delta\psi}{\psi} = \frac{\Delta\delta}{\delta} + \frac{\Delta\lambda}{\lambda} + \frac{\Delta\beta}{\beta} + \frac{\Delta\alpha}{\alpha} + \nu \qquad\qquad [6]$$

where ν measures the interaction effect amongst the percentage rates of variation of the explicative variables.

As for the baseline scenario, the decompositions described in equations [5] and [6] are reported in Tables 1a and 1b, respectively. Analogous tables are provided of each of the sensitivity test as well.

Table A: 2005 EPC-WGA projections – baseline scenario

Table A1: break-down of pension expenditure to GDP

	2004	2010	2020	2030	2040	2050
Pension expenditure / GDP $\quad(\psi)$	14.2%	14.0%	14.0%	15.0%	15.9%	14.7%
Average pension / GDP per worker $\quad(\lambda)$	16.8%	17.1%	16.3%	15.0%	13.6%	12.2%
Pensions / employees $\;(\psi/\lambda = \alpha\;\delta\;\beta)$	84.6%	81.7%	85.8%	100.0%	116.5%	120.3%
Old age dependency ratio (pop(65+)/pop(20 - 64)) $\quad(\delta)$	31.9%	34.1%	39.9%	49.4%	63.4%	67.3%
Pop(20 - 64) / employees $\quad(\alpha)$	159.1%	150.0%	142.4%	139.9%	137.2%	137.1%
Pensions / pop(65+) $\quad(\beta = \beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less})$	166.9%	159.7%	150.9%	144.7%	134.0%	130.4%
Direct pensioners[1](65+) / pop(65+) $\quad(\beta^{dir})$	88.4%	87.9%	88.2%	88.6%	89.7%	90.1%
Direct supplementary pensions[2](65+) / pop(65+) $\quad(\beta^{sup})$	4.1%	5.8%	6.7%	6.2%	4.7%	2.8%
Survivors' pensions(65+) / pop(65+) $\quad(\beta^{sur})$	34.0%	33.6%	30.8%	26.3%	22.8%	22.9%
Pensions (< 65) / pop(65+) $\quad(\beta^{less} = \beta^{less}_{norm} + \beta^{less}_{dem})$	40.5%	32.3%	25.1%	23.7%	16.8%	14.5%
Pensions (< 65) / pop(50 - 64) $\quad(\beta^{less}_{norm})$	43.0%	34.9%	26.4%	28.3%	28.2%	26.9%
Pop(50 - 64) / pop(65 +) $\quad(\beta^{less}_{dem})$	94.2%	92.7%	94.9%	83.8%	59.4%	54.1%

[1] People entitled to a direct pension (every kind of pension other than survivor's ones).
[2] Number of additional direct pensions entitled to the same person.

Table A2: break-down of pension expenditure to GDP growth rate

	2010/2004	2020/2010	2030/2020	2040/2030	2050/2040
Pension expenditure / GDP $\quad(\Delta\psi / \psi)$	-1.9%	0.1%	7.6%	5.7%	-7.7%
- Pop(65+) / pop(20 - 64) $\quad(\Delta\delta / \delta)$	7.0%	17.1%	23.6%	28.4%	6.1%
- Average pension / GDP per worker $\quad(\Delta\lambda / \lambda)$	1.7%	-4.7%	-7.7%	-9.3%	-10.6%
- Pensions / pop(65+) $\quad(\Delta\beta / \beta)$	-4.4%	-5.5%	-4.1%	-7.4%	-2.6%
- Pop(20 - 64) / employees $\quad(\Delta\alpha / \alpha)$	-5.7%	-5.1%	-1.8%	-2.0%	0.0%
- Interaction $\quad(\nu)$	-0.5%	-1.7%	-2.6%	-4.0%	-0.5%

Table B: 2005 EPC-WGA projections – sensitivity test on higher life expectancy

Table B1: break-down of pension expenditure to GDP

	2004	2010	2020	2030	2040	2050
Pension expenditure / GDP (ψ)	14.2%	14.0%	14.1%	15.2%	16.1%	14.9%
Average pension / GDP per worker (λ)	16.8%	17.1%	16.3%	15.0%	13.5%	12.1%
Pensions / employees $(\psi/\lambda = \alpha\ \delta\ \beta)$	84.6%	81.7%	86.4%	101.2%	118.7%	123.8%
Old age dependency ratio (pop(65+)/pop(20 - 64)) (δ)	31.9%	34.2%	40.4%	50.4%	65.3%	70.4%
Pop(20 - 64) / employees (α)	159.1%	150.0%	142.4%	139.9%	137.2%	137.1%
Pensions / pop(65+) $(\beta = \beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less})$	166.9%	159.5%	150.2%	143.5%	132.5%	128.3%
Direct pensioners[1] (65+) / pop(65+) (β^{dir})	88.4%	87.9%	88.3%	88.6%	89.8%	90.2%
Direct supplementary pensions[2] (65+) / pop(65+) (β^{sup})	4.1%	5.8%	6.7%	6.2%	4.7%	2.9%
Survivors' pensions(65+) / pop(65+) (β^{sur})	34.0%	33.5%	30.5%	25.7%	21.9%	21.5%
Pensions (< 65) / pop(65+) $(\beta^{less} = \beta^{less}_{norm} + \beta^{less}_{dem})$	40.5%	32.2%	24.7%	23.1%	16.0%	13.6%
Pensions (< 65) / pop(50 - 64) (β^{less}_{norm})	43.0%	34.9%	26.3%	28.1%	27.7%	26.3%
Pop(50 - 64) / pop(65+) (β^{less}_{dem})	94.2%	92.5%	93.9%	82.2%	57.8%	51.8%

[1] People entitled to a direct pension (every kind of pension other than survivor's ones).
[2] Number of additional direct pensions entitled to the same person.

Table B2: break-down of pension expenditure to GDP growth rate

	2010/2004	2020/2010	2030/2020	2040/2030	2050/2040
Pension expenditure / GDP $(\Delta\psi / \psi)$	-1.8%	0.6%	7.9%	6.0%	-7.2%
- Pop(65+) / pop(20 - 64) $(\Delta\delta / \delta)$	7.2%	18.2%	24.8%	29.7%	7.7%
- Average pension / GDP per worker $(\Delta\lambda / \lambda)$	1.6%	-4.8%	-7.9%	-9.6%	-11.0%
- Pensions / pop(65+) $(\Delta\beta / \beta)$	-4.5%	-5.8%	-4.4%	-7.7%	-3.2%
- Pop(20 - 64) / employees $(\Delta\alpha / \alpha)$	-5.7%	-5.1%	-1.8%	-2.0%	0.0%
- Interaction (ν)	-0.5%	-1.9%	-2.8%	-4.3%	-0.7%

Table C: 2005 EPC-WGA projections – sensitivity test on higher productivity growth

Table C1: break-down of pension expenditure to GDP

	2004	2010	2020	2030	2040	2050
Pension expenditure / GDP (ψ)	14.2%	14.0%	13.7%	14.6%	15.4%	14.1%
Average pension / GDP per worker (λ)	16.8%	17.1%	16.0%	14.6%	13.2%	11.7%
Pensions / employees $(\psi/\lambda = \alpha\ \delta\ \beta)$	84.6%	81.7%	85.8%	100.0%	116.5%	120.3%
Old age dependency ratio (pop(65+)/pop(20 - 64)) (δ)	31.9%	34.1%	39.9%	49.4%	63.4%	67.3%
Pop(20 - 64) / employees (α)	159.1%	150.0%	142.4%	139.9%	137.2%	137.1%
Pensions / pop(65+) $(\beta = \beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less})$	166.9%	159.7%	150.9%	144.7%	134.0%	130.4%
Direct pensioners[1] (65+) / pop(65+) (β^{dir})	88.4%	87.9%	88.2%	88.6%	89.7%	90.1%
Direct supplementary pensions[2] (65+) / pop(65+) (β^{sup})	4.1%	5.8%	6.7%	6.2%	4.7%	2.8%
Survivors' pensions(65+) / pop(65+) (β^{sur})	34.0%	33.6%	30.8%	26.3%	22.8%	22.9%
Pensions (< 65) / pop(65+) $(\beta^{less} = \beta^{less}_{norm} + \beta^{less}_{dem})$	40.5%	32.3%	25.1%	23.7%	16.8%	14.5%
Pensions (< 65) / pop(50 - 64) (β^{less}_{norm})	43.0%	34.9%	26.4%	28.3%	28.2%	26.9%
Pop(50 - 64) / pop(65+) (β^{less}_{dem})	94.2%	92.7%	94.9%	83.8%	59.4%	54.1%

[1] People entitled to a direct pension (every kind of pension other than survivor's ones).
[2] Number of additional direct pensions entitled to the same person.

Table C2: break-down of pension expenditure to GDP growth rate

	2010/2004	2020/2010	2030/2020	2040/2030	2050/2040
Pension expenditure / GDP $(\Delta\psi / \psi)$	-2.0%	-1.5%	6.3%	5.1%	-8.0%
- *Pop(65+) / pop(20 - 64)* $(\Delta\delta / \delta)$	7.0%	17.1%	23.6%	28.4%	6.1%
- *Average pension / GDP per worker* $(\Delta\lambda / \lambda)$	1.6%	-6.3%	-8.8%	-9.8%	-10.9%
- *Pensions / pop(65+)* $(\Delta\beta / \beta)$	-4.4%	-5.5%	-4.1%	-7.4%	-2.6%
- *Pop(20 - 64) / employees* $(\Delta\alpha / \alpha)$	-5.7%	-5.1%	-1.8%	-2.0%	0.0%
- *Interaction* (ν)	-0.5%	-1.8%	-2.7%	-4.1%	-0.5%

Table D: 2005 EPC-WGA projections – sensitivity test on lower productivity growth

Table D1: break-down of pension expenditure to GDP

	2004	2010	2020	2030	2040	2050
Pension expenditure / GDP (ψ)	14.2%	14.0%	14.2%	15.5%	16.5%	15.2%
Average pension / GDP per worker (λ)	16.8%	17.1%	16.6%	15.5%	14.1%	12.7%
Pensions / employees $(\psi/\lambda = \alpha\ \delta\ \beta)$	84.6%	81.7%	85.8%	100.0%	116.5%	120.3%
Old age dependency ratio (pop(65+)/pop(20 - 64)) (δ)	31.9%	34.1%	39.9%	49.4%	63.4%	67.3%
Pop(20 - 64) / employees (α)	159.1%	150.0%	142.4%	139.9%	137.2%	137.1%
Pensions / pop(65+) $(\beta = \beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less})$	166.9%	159.7%	150.9%	144.7%	133.9%	130.4%
Direct pensioners[1] (65+) / pop(65+) (β^{dir})	88.4%	87.9%	88.2%	88.6%	89.7%	90.1%
Direct supplementary pensions[2] (65+) / pop(65+) (β^{sup})	4.1%	5.8%	6.7%	6.2%	4.7%	2.8%
Survivors' pensions(65+) / pop(65+) (β^{sur})	34.0%	33.6%	30.8%	26.3%	22.8%	22.9%
Pensions (< 65) / pop(65+) $(\beta^{less} = \beta^{less}_{norm} + \beta^{less}_{dem})$	40.5%	32.3%	25.1%	23.7%	16.7%	14.5%
Pensions (< 65) / pop(50 - 64) (β^{less}_{norm})	43.0%	34.9%	26.4%	28.3%	28.2%	26.8%
Pop(50 - 64) / pop(65+) (β^{less}_{dem})	94.2%	92.7%	94.9%	83.8%	59.4%	54.1%

[1] People entitled to a direct pension (every kind of pension other than survivor's ones).
[2] Number of additional direct pensions entitled to the same person.

Table D2: break-down of pension expenditure to GDP growth rate

	2010/2004	2020/2010	2030/2020	2040/2030	2050/2040
Pension expenditure / GDP $(\Delta\psi / \psi)$	-1.9%	1.8%	8.8%	6.4%	-7.4%
- Pop(65+) / pop(20 - 64) $(\Delta\delta / \delta)$	7.0%	17.1%	23.6%	28.4%	6.1%
- Average pension / GDP per worker $(\Delta\lambda / \lambda)$	1.7%	-3.1%	-6.6%	-8.7%	-10.3%
- Pensions / pop(65+) $(\Delta\beta / \beta)$	-4.4%	-5.5%	-4.1%	-7.5%	-2.7%
- Pop(20 - 64) / employees $(\Delta\alpha / \alpha)$	-5.7%	-5.1%	-1.8%	-2.0%	0.0%
- Interaction (ν)	-0.5%	-1.6%	-2.4%	-3.9%	-0.5%

Table E: 2005 EPC-WGA projections – sensitivity test on older workers' participation rate

Table E1: break-down of pension expenditure to GDP

	2004	2010	2020	2030	2040	2050
Pension expenditure / GDP (ψ)	14.2%	13.9%	13.8%	14.9%	16.0%	14.8%
Average pension / GDP per worker (λ)	16.8%	17.1%	16.4%	15.4%	14.1%	12.6%
Pensions / employees $(\psi/\lambda = \alpha\ \delta\ \beta)$	84.6%	81.2%	84.3%	97.1%	113.6%	117.6%
Old age dependency ratio (pop(65+)/pop(20 - 64)) (δ)	31.9%	34.1%	39.9%	49.4%	63.4%	67.3%
Pop(20 - 64) / employees (α)	159.1%	149.3%	140.6%	137.1%	134.7%	134.8%
Pensions / pop(65+) $(\beta = \beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less})$	166.9%	159.5%	150.2%	143.3%	132.9%	129.6%
Direct pensioners[1](65+) / pop(65+) (β^{dir})	88.4%	87.9%	88.3%	88.5%	89.7%	90.2%
Direct supplementary pensions[2](65+) / pop(65+) (β^{sup})	4.1%	5.8%	6.7%	6.1%	4.7%	2.8%
Survivors' pensions(65+) / pop(65+) (β^{sur})	34.0%	33.6%	30.8%	26.3%	22.9%	22.9%
Pensions (< 65) / pop(65+) $(\beta^{less} = \beta^{less}_{norm} + \beta^{less}_{dem})$	40.5%	32.1%	24.4%	22.3%	15.7%	13.6%
Pensions (< 65) / pop(50 - 64) (β^{less}_{norm})	43.0%	34.7%	25.7%	26.7%	26.4%	25.2%
Pop(50 - 64) / pop(65+) (β^{less}_{dem})	94.2%	92.7%	94.9%	83.8%	59.4%	54.1%

[1] People entitled to a direct pension (every kind of pension other than survivor's ones).
[2] Number of additional direct pensions entitled to the same person.

Table E2: break-down of pension expenditure to GDP growth rate

	2010/2004	2020/2010	2030/2020	2040/2030	2050/2040
Pension expenditure / GDP $(\Delta\psi / \psi)$	-2.3%	-0.5%	7.7%	7.1%	-7.0%
- *Pop(65+) / pop(20 - 64)* $(\Delta\delta / \delta)$	7.0%	17.1%	23.6%	28.4%	6.1%
- *Average pension / GDP per worker* $(\Delta\lambda / \lambda)$	1.9%	-4.2%	-6.4%	-8.5%	-10.2%
- *Pensions / pop(65+)* $(\Delta\beta / \beta)$	-4.5%	-5.8%	-4.5%	-7.3%	-2.5%
- *Pop(20 - 64) / employees* $(\Delta\alpha / \alpha)$	-6.1%	-5.9%	-2.4%	-1.8%	0.1%
- *Interaction* (ν)	-0.5%	-1.8%	-2.5%	-3.8%	-0.5%

Table F: 2005 EPC-WGA projections – sensitivity test on unemployment rate

Table F1: break-down of pension expenditure to GDP

	2004	2010	2020	2030	2040	2050
Pension expenditure / GDP (ψ)	14.2%	13.9%	13.9%	14.9%	15.8%	14.7%
Average pension / GDP per worker (λ)	16.8%	17.2%	16.4%	15.2%	13.8%	12.3%
Pensions / employees $(\psi/\lambda = \alpha\ \delta\ \beta)$	84.6%	80.9%	84.5%	98.5%	115.1%	119.2%
Old age dependency ratio (pop(65+)/pop(20 - 64)) (δ)	31.9%	34.1%	39.9%	49.4%	63.4%	67.3%
Pop(20 - 64) / employees (α)	159.1%	148.7%	140.2%	137.7%	135.1%	135.0%
Pensions / pop(65+) $(\beta = \beta^{dir} + \beta^{sup} + \beta^{sur} + \beta^{less})$	166.9%	159.7%	150.9%	144.9%	134.4%	131.1%
Direct pensioners[1](65+) / pop(65+) (β^{dir})	88.4%	87.9%	88.2%	88.6%	89.9%	90.6%
Direct supplementary pensions[2](65+) / pop(65+) (β^{sup})	4.1%	5.8%	6.7%	6.2%	4.7%	2.8%
Survivors' pensions(65+) / pop(65+) (β^{sur})	34.0%	33.6%	30.8%	26.3%	22.9%	23.0%
Pensions (< 65) / pop(65+) $(\beta^{less} = \beta^{less}_{norm} + \beta^{less}_{dem})$	40.5%	32.3%	25.1%	23.8%	16.9%	14.7%
Pensions (< 65) / pop(50 - 64) (β^{less}_{norm})	43.0%	34.9%	26.5%	28.5%	28.5%	27.2%
Pop(50 - 64) / pop(65+) (β^{less}_{dem})	94.2%	92.7%	94.9%	83.8%	59.4%	54.1%

[1] People entitled to a direct pension (every kind of pension other than survivor's ones).

[2] Number of additional direct pensions entitled to the same person.

Table F2: break-down of pension expenditure to GDP growth rate

	2010/2004	2020/2010	2030/2020	2040/2030	2050/2040
Pension expenditure / GDP $(\Delta\psi / \psi)$	-2.3%	-0.2%	7.7%	6.0%	-7.4%
- *Pop(65+) / pop(20 - 64)* $(\Delta\delta / \delta)$	7.0%	17.1%	23.6%	28.4%	6.1%
- *Average pension / GDP per worker* $(\Delta\lambda / \lambda)$	2.1%	-4.4%	-7.7%	-9.2%	-10.6%
- *Pensions / pop(65+)* $(\Delta\beta / \beta)$	-4.4%	-5.5%	-4.0%	-7.3%	-2.4%
- *Pop(20 - 64) / employees* $(\Delta\alpha / \alpha)$	-6.5%	-5.7%	-1.8%	-1.9%	0.0%
- *Interaction* (ν)	-0.5%	-1.7%	-2.5%	-4.0%	-0.5%