“Building a simplified model to assess the impact of population ageing, employment trends and immigration levels on pension sustainability in the EU-25 Member States”

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1. Introduction: The need for a simplified model to ensure sufficient comparability between countries

Demographic projections indicate that the ageing of the European population will become more pronounced over the next four decades. This demographic trend will have economic and social consequences in a number of areas with important policy implications. For instance, population ageing has raised a great deal of interest among policy makers in the field of pensions, in particular in relation to the future sustainability of pension systems across the European Union. As most of the European public pension schemes are pay-as-you-go (PAYG) systems where present workers pay the pension of current retired people, the future decrease of the working age population and the future increase of the number of retired people is supposed to threaten the equilibrium of pension systems.

An important indicator of the ageing process, particularly related to the sustainability of pension systems, is the ratio of the number of retired people to the number of employed. This is often referred to as the economic dependency ratio (EDR). At the European Union level, the pressure on the economic dependency ratio will increase after 2010 as the baby boom generation will start crossing the age of retirement. Consequently, the EDR will probably keep increasing until about 2040, all other factors being constant. The pressure of the baby boom effect on the dependency ratio will then start decreasing. Only an important growth of the working age population due to an increase in fertility levels or, more probably, a continuous inflow of (young) immigrants could help to compensate the tendency to ageing.

However, an examination of the financial sustainability of pension systems can not be limited to the sole effect of demographic factors. It needs to take into account other factors also playing a major role in funding pensions, such as the employment level, the economic performance in terms of productivity (GDP per employed person), and the main characteristics of the pensions systems in relation to the level of contributions and the relative level of pensions.

At national level, a considerable amount of research has already been devoted to examine the sustainability of pension systems, notably by measuring the ageing impact. Many sophisticated models for pension forecasting already exist in the majority of the European Union Member States taking due account of the specificities of national pension systems. Nevertheless, it is very difficult to make comparisons between countries owing to the differences in the models used in terms of their structures and basic assumptions and of course the different types of pension systems existing across Member States[1]. Several attempts have also been made in the past to provide a common framework at European level from the analytical models used in the different countries. However, their complexity and lack of comparability at national level limit the use of their results.

A suggestive way to overcome this obstacle, used in this paper, is to define a model using simplified assumptions, which does not intend to give precise pension expenditure forecasts, but rather assess the demographic effect of ageing on the balance between contributions and benefits, keeping all other factors unchanged. At the same time, the model sheds light on the implications of a range of demographic and economic measures that could be used to assure the financial sustainability of pension systems.

2. Presentation of the broad framework of the model

The model presented in this paper improves and extends up to 2050 and for the 10 new Member States the one used by the European Commission, Directorate-General of Employment and Social Affairs, in the internal working paper "Pension Sustainability, Ageing and Labour Supply"[2] (Gil, Math, 2000). I developed that model, at a macro-economic level, on the basis of the previous one proposed by G. Calot *et al.* in "Le vieillissement démographique dans l'Union Européenne à l'horizon 2050. Étude d'impact du viellissement démographique" (study financed by DG Employment and Social Affairs, European Commission). All these models integrate the key elements necessary to assess the funding sustainability and are based on the same principle: a PAYG system is in an equilibrium situation when there is a balance between the total contribution to pensions and the total benefits received by retired people. If the number of retirees increases due to ageing, the volume of pensions will increase and the system will be put into difficulties unless the other variables of the model change to recover the initial financial equilibrium.

The model uses demographic projections for the period 2004-2050 to foresee the future evolution of retired people: this is the initial input of the model[3]. The implication of ageing on the balance of contributions and benefits (keeping all other factors unchanged) is therefore examined, as well as the required change(s) in terms of the other key factors, to ensure an equilibrium between the total contributions to pensions and the total benefits received during the analysed period. These compensatory measures are the outputs of the model.

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[1] D. Franco and T. Munzi present a survey of national estimates and models in "Public pension expenditure prospects in the European Union: A survey of national projections", in European Economy, No. 3, 1996, Ageing and Pension expenditure prospects in the Western World, pp.1-126. See also: "Ageing and fiscal policies in the European Union", in European Economy N°4 1997, The Welfare State in Europe - Challenges and reforms, pp.239-388.

[2] This paper was written by the author with the key contribution of Antoine Math and the collaboration of Costas Fotakis, Edit Corominas and James Battye. I would like to express them my gratitude.

[3] Other alternative inputs can be also used to analyse, for instance, which are the implications of a change in the number of employed people, or in the share of GDP to finance pensions, or in the level of the average pension. As this paper is mainly interested in the implications of ageing, the other measures are only considered as outputs to rebalance the system.

In this way, the model provides an insight on how the implications of ageing on pension systems may be compensated by examining possible evolutions (separately or together) of other key factors such as: increasing the effective retirement age (which primarily leads to a lower number of retirees and therefore expenditure, and may secondarily increase the number of employed people and consequently the total contributions), decreasing the pension levels (and thus the expenditure), increasing the number of people at work and their productivity (which both imply an increase in total contributions), and increasing their average contributions to the pension system.

3. Formal description of the model

At the macroeconomic level, the funding of pensions is a question of redistribution of the Gross Domestic Product (GDP) from those who are participating in economic life to those who are in retirement. A pension system can be described as in equilibrium when the volume of contributions levied on workers equals the amount of pensions paid to retired people.

(1) **Volume of contributions = volume of pensions**

or

(2) $\mathbf{GDP \times c = R \times p}$

where

- **GDP =** the wealth produced (gross domestic product).
- **c** = the share of gross domestic product necessary to finance pensions, comprising all forms of contribution to the system, i.e. employers and employees contributions, taxes and other contributions[4].
- **R =** the number of retired people.
- **p =** the average pension.

(2) is equivalent to

(3) $\mathbf{E \times GDP/E \times c = R \times t \times GDP/E}$

where:

- **E** = the number of people in employment (in full-time equivalents), i.e. the people that produces the GDP from what the pensions are financed.
- **GDP/E** = the average gross domestic product per employed person (GDP divided by the number of people in work).
- **t** = the "transfer ratio" or ratio of average pension to average gross domestic product per employed person (t = p / (GDP/E))[5].

As the number of retired people (R), the number of people in employment (E) and the weight of contributions in percentage of GDP (c) is known for a particular year, t can be estimated by assuming the equilibrium between expenditure and receipts.

(4) $\mathbf{t = E/R \times c.}$

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[4] This broad definition of "c" is resulting from the underlying assumption that people in employment are the only producers and contributors within the system and hence there is no difference between systems financed more through taxation and systems financed more through social contributions.

[5] This is different that the net replacement rate which is the ratio of average pension to average wage.

In this model, pension sustainability is achieved when the total resource equals the total expenditure at the macroeconomic level during the considered period (in this case, 2004-2050). Within this framework, it is not relevant whether the schemes are based on a pay-as-you-go (PAYG) system or on funded schemes[6].

4. Assumptions in relation to the variables and data used in the model

- Pension schemes are assumed to be in financial equilibrium in the starting year (2004). Therefore all findings should be related to this starting year as the point of reference.
- The only external shock unbalancing the system is assumed to be the change in the number of retired people due to population ageing.
- Data on population by age for the period 2000-2050 are taken from Eurostat demographic scenarios (last revision in 2005). Three different scenarios are used: baseline, low, and high variants.
- **E**, the number of people in employment and contributing to the system, is calculated by using the full-time equivalent (FTE) rate of employment. Indeed, taking the FTE rate provides a better and more comparable insight, between countries and over time, of the ability of employed people to create wealth and to contribute to the funding of pension systems[7].
- **c**, the share of GDP levied to finance pensions, is estimated by the total expenditure on old age and survivors' benefits as a percentage of GDP, as given by Eurostat ESSPROS database[8].
- **R**, the retired population, is assumed to be the part of the population above the average effective retirement age ("**era**"). This assumption is acceptable as most of the older people actually have direct or derivative rights to pensions. The average effective retirement age has been estimated for each country by Eurostat from the Labour Force Survey data on age-specific activity rates.
- **t**, the transfer ratio, is equal to E/R ^{x} c when the system is in equilibrium (see equation 4). "t" provides a proxy measure to assess the evolution of the relative level of pension.

[6] The problem of redistribution of GDP at macro level between those in work and those who are retired is the same for PAYG and funded schemes, since there is no escaping the fact that current GDP is shared every year between those who receive income directly from their participation in economic life and those who do not. If there are more elderly retired people, the share of pensions in GDP is likely to be greater, whatever the funding base of the pensions, contributions, taxes or financial yields.

[7] Part-time workers contribute less than full time ones regardless of the type of pension system funding: directly through social contributions (since those are mostly more or less proportional to earnings), or indirectly through general taxation. Furthermore, taking FTE enables a more reliable comparison between countries, given the wide dispersion within the Union in relation to the prevalence and average duration of part-time employment.

[8] The ESSPROS (European System of Social Protection Statistics) database on social protection expenditure and receipts has been compiled by Eurostat on a new system of classification since 1997. The database is designed to provide a comparable indication of the scale of expenditure and receipts in different EU countries as well as of developments over time. Presently, it is the most reliable and homogenised source of data about social protection in the European Union, although some problems of comparison between Member States remain, especially in relation to the division of spending between functions.

The values of the parameters of the model in 2004 for the 25 Member States, as well as for EU15 and EU25, can be seen in Table 1. This table also shows the figures for related indicators such as the economic dependency ratio, the employment rate and the average effective retirement age –which is significantly lower than the "legal" retirement age in most countries.

Table 1. Main parameters of the model in 2004 in the EU Member States and in EU-15 and EU-25

	R	E	c	t	EDR (%)	er	era	wap
Belgium	2434281	3679000	0,11	0,17	66,2	54	58,7	6818862
Czech Republic	1971225	4526500	0,08	0,19	43,5	63	60	7233788
Denmark	978445	2399500	0,11	0,27	40,8	67	62,1	3575484
Germany	18583984	31194500	0,13	0,21	59,6	56	61,6	55509566
Estonia	280830	553000	0,06	0,12	50,8	60	60,8	916480
Greece	2172162	4155000	0,13	0,25	52,3	56	63,2	7472057
Spain	8568028	16213000	0,09	0,17	52,8	56	61,4	29050463
France	12709000	22126500	0,13	0,22	57,4	57	59,6	38969032
Ireland	468665	1651500	0,04	0,13	28,4	60	64,4	2737975
Italy	13815840	20699000	0,16	0,23	66,7	54	61	38549342
Cyprus	103498	314500	0,12	0,37	32,9	63	62,5	497346
Latvia	505165	938500	0,08	0,15	53,8	59	60,3	1587310
Lithuania	579222	1356500	0,07	0,16	42,7	58	63,3	2319179
Luxembourg	88087	169500	0,08	0,16	52,0	56	59,3	303165
Hungary	1947167	3785500	0,09	0,17	51,4	55	61,6	6943535
Malta	76679	139500	0,09	0,17	55,0	51	58,8	274860
Netherlands	2983093	6195000	0,11	0,23	48,2	56	60,4	10991174
Austria	1878773	3368500	0,14	0,25	55,8	61	58,8	5530619
Poland	7326275	12779000	0,12	0,21	57,3	48	58	26659118
Portugal	2072906	4613500	0,10	0,23	44,9	65	62,1	7064293
Slovenia	490973	885500	0,12	0,21	55,4	63	56,2	1404768
Slovakia	977618	2114000	0,07	0,16	46,2	55	57,8	3815286
Finland	1066894	2215000	0,09	0,20	48,2	64	60,3	3486440
Sweden	1733562	3743000	0,12	0,27	46,3	64	63,1	5835426
United Kingdom	10735776	23898000	0,12	0,27	44,9	61	63	39217962
EU 15	79977373	145923500	0,12	0,22	54,8	57	61,4	255111860
EU 25	94485336	173317500	0,12	0,22	54,5	56	61	306763530

Source: Eurostat database

Definitions:

R	retired persons (people over average effective retirement age). Source: own calculation
E	employed people in full-time equivalents. Source: Eurostat Labour Force Survey
c	expenditure (% of GDP) in old age and survivors pensions. Source: Eurostat ESSPROS database, 2002 or more recent available data
t	transfer ratio calculated in order to ensure equality in formula (1)
EDR	Economic Dependency Ratio (number of retired persons by 100 employed people)
er	employment rate (employed persons / working age population) in full-time equivalents
era	average effective retirement age. Source: Eurostat
wap	working age population (persons aged 15-64 years old). Source: Eurostat

Table 1 shows a wide range of "starting" positions in 2004 in relation to the different parameters:

- Parameter "c", that has remained quite stable in the Union at around 12% in the last years, varies widely between countries, from just 4% in Ireland to around 16% in Italy (last figures available).

- The transfer ratio is significantly below the European average in Ireland and Estonia, and relatively high in Cyprus, Denmark, Sweden and the UK.

- The lowest economic dependency ratio can be found in Ireland and the highest in Italy, while employment rates varies between Poland (48%) and Denmark (67%).

- Finally, in Ireland the average effective retirement age is already above 64 years, whereas in Belgium, Malta, Austria and Poland it is just below 59.

5. Different measures to compensate the impact of ageing

In a first step, the model examines the impact of ageing and more specifically the growth of the number of retired people, R[9], on the equilibrium between expenditure and receipts during the period between 2000 and 2050, all other key factors remaining constant. The model's outputs show magnitude of the changes needed in the different key factors to maintain the system in equilibrium, and thereby counteract the effect of ageing. These compensatory changes are examined one by one (approach *ceteris paribus*) to assess the individual compensatory effect to ageing that each key factor could play, for instance by:

- Increasing the number of employed persons (E') to compensate for the growth of retired people –secondarily, the number of required immigrants is estimated by comparing E' and the projected activity levels applied to the projected working age population;
- Increasing the effective retirement age (era): this results in a decrease of the number of retired (R) and secondarily in an increase of the number of potential contributors;
- Increasing the share of GDP to finance pensions (c), by increasing social contributions and/or taxes;
- Decreasing the transfer ratio (t), by making the average pension increase by a smaller percentage than the GDP per employed person (productivity) [10].

The magnitude of these compensatory actions required to re-balance the European countries' pension systems are shown in Table 2. The variation in these parameters between Member States reflect, to some extent, the margins of manoeuvre and flexibility that each country has to address the impact of ageing on pension systems.

In a second step, different future values for the key factors are also introduced in the model as inputs, establishing different prospective scenarios combining changes in three key factors:

- modifying the demographic scenario and therefore the number of retired people (R) or in the working age population (wap);
- increasing the number of employed people (E); and
- increasing the effective retirement age (era);

In this final exercise, the number of employed people (E) is transformed from an output into an input to show how significant employment growth (and consequently immigration levels) in the next years could be in alleviating the imbalances brought about by ageing. In the same way, the impact of an increase in the effective retirement age up to 70 years old is analysed as well as the consequences of changes in the demographic scenarios (from baseline to high and low variants).

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[9] The exact number of retired people is determined by the value of "era" (that in this first exercise is constant between 2004 and 2050) and the variation of the age structure determined by Eurostat baseline scenario.

[10] The evolution of t reflects the evolution of the relative level of the average pension (t = p / (GDP/E), so decreasing t may be the result of a relative increase of the GDP per employed person (i.e., an increase of productivity), or of a relative decrease of the average absolute pension (p). Therefore, maintaining the relative level of average pension implies that the absolute level of average pension (p) should evolve at the same pace as the productivity.

Table 2. Compensatory actions (ceteris paribus) maintaining the equilibrium of contributions and pensions in 2050

	R'	EDR' (%)	E'	Eg (%)	er' (%)	immigr	cera	ct	cp (%)	c'
Belgium	3835249	104,2	5796323,87	0,99	92	1082767	11,0	0,63	-36,5	0,18
Czech Republic	3385385	74,8	7773818,41	1,18	155	4006775	10,9	0,58	-41,8	0,14
Denmark	1484811	61,9	3641292,04	0,91	111	1188127	8,9	0,66	-34,1	0,17
Germany	26982810	86,5	45292509,2	0,81	107	13638471	8,6	0,69	-31,1	0,18
Estonia	363580	65,7	715948,225	0,56	107	213095	4,7	0,77	-22,8	0,08
Greece	3547060	85,4	6784960,93	1,07	116	2382264	9,8	0,61	-38,8	0,21
Spain	17139610	105,7	32432725,1	1,52	143	15450001	13,8	0,50	-50,0	0,18
France	21990858	99,4	38286310,5	1,20	102	10217125	12,7	0,58	-42,2	0,22
Ireland	1474320	89,3	5195266,3	2,52	164	2820466	15,1	0,32	-68,2	0,11
Italy	21157002	102,2	31697586,6	0,93	112	10546556	10,8	0,65	-34,7	0,24
Cyprus	290990	92,5	884233,077	2,27	150	441440	15,0	0,36	-64,4	0,34
Latvia	628053	66,9	1166802,41	0,47	105	336035	4,1	0,80	-19,6	0,10
Lithuania	846840	62,4	1983243,83	0,83	116	695798	6,6	0,68	-31,6	0,10
Luxembourg	182619	107,7	351401,688	1,60	89	56208	14,6	0,48	-51,8	0,17
Hungary	2905177	76,7	5647973,46	0,87	109	1761608	8,2	0,67	-33,0	0,13
Malta	168351	120,7	306276,353	1,72	99	74650	13,7	0,46	-54,5	0,20
Netherlands	5006242	80,8	10396480,8	1,13	98	2470209	10,7	0,60	-40,4	0,18
Austria	3159396	93,8	5664561,62	1,14	120	2135977	12,3	0,59	-40,5	0,24
Poland	13456973	105,3	23472591,2	1,33	121	8923659	11,6	0,54	-45,6	0,22
Portugal	3550481	77,0	7902019,72	1,18	144	3775490	10,7	0,58	-41,6	0,17
Slovenia	810589	91,5	1461947,11	1,10	137	663243	12,4	0,61	-39,4	0,19
Slovakia	1916695	90,7	4144658,99	1,47	151	2089109	12,6	0,51	-49,0	0,14
Finland	1701066	76,8	3531617,19	1,02	117	1271380	10,1	0,63	-37,3	0,15
Sweden	2713658	72,5	5859162,75	0,98	97	1314483	8,9	0,64	-36,1	0,19
United Kingdom	18770343	78,5	41783067,8	1,22	111	13459506	10,9	0,57	-42,8	0,22
EU 15	132626240	90,9	241984506	1,11	111	79178250	11,1	0,60	-39,7	0,20
EU 25	157521468	90,9	288946711	1,12	113	97788373	11,0	0,60	-40,0	0,20

Definitions:

R'	retired persons (people over average effective retirement age) in 2050 determined by Eurostat baseline scenario
EDR'	Economic Dependency Ratio (number of retired persons by 100 employed people) in 2050
E'	employed people in full-time equivalents maintaining the system in equilibrium in 2050
Eg	annual employment growth between 2004 and 2050 maintaining the system in equilibrium
er'	employment rate (employed persons / working age population) in full-time equivalents in 2050
immigr	number of immigrants needed between 2004 and 2050 maintaining the system inequilibrium
cera	change in average effective retirement age between 2004 and 2050 maintaining the system in equilibrium
ct	coefficient multiplying 2004 transfer ratios maintaining the system in equilibrium in 2050
cp	change in average pension between 2004 and 2050 maintaining the system in equilibrium
c'	expenditure (% of GDP) in old age and survivors pensions maintaining the system en equilibrium

6. Results

Table 2 shows the compensatory changes in the key factors (approach *ceteris paribus*) for the simplest scenario, where the only change is the number of retired people (R) due to ageing. Since the assumptions used have a necessary element of arbitrariness, the results shown in table 2 must be treated with a degree of caution. They do not provide projections but rather illustrations of the roles played by the different factors on the sustainability of pension systems.

6.1. Considerations at EU-25 level (I): The magnitude of changes to counteract ageing

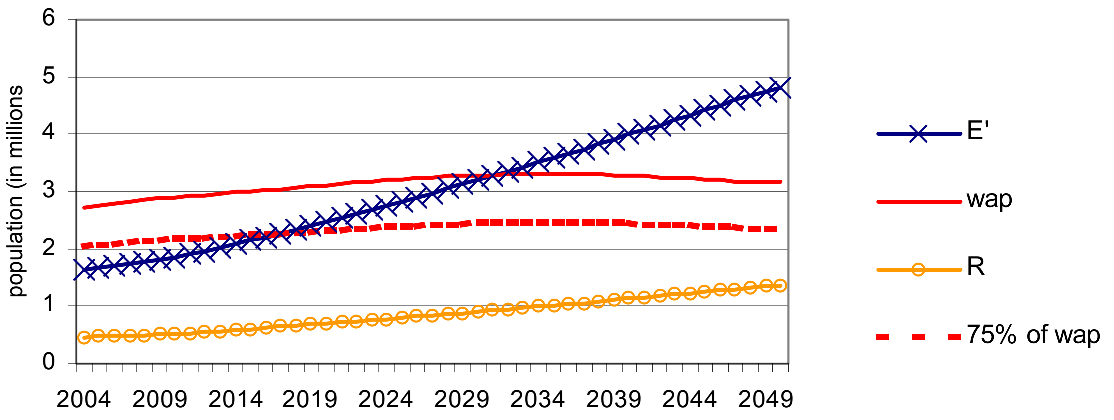
Under the assumptions of the baseline scenario[11] and a constant effective retirement age of 61 years, the number of retired people in the whole European Union will pass from 94.5 millions in 2004 (Table 1) to 157.5 millions in 2050 (Table 2, first column). It means that the EDR will increase from 54.5 to 90.9 retired persons per 100 employed persons in 2050 (*ceteris paribus*, i.e. if employment level is constant), a very significant increase that would put pension systems under pressure.

The results in the other columns of Table 2 show the alternative compensating changes required by each key factor to counteract the sole impact of ageing for the period ending

[11] Baseline scenario is characterised by a moderate increase in fertility and life expectancy level across the analysed period, together with an annual net migration level of around 0.8 million immigrants up to 2050.

in 2050. The most important outcome is that the **employment growth** required to counteract ageing is 1.12% p.a., meaning an increase from 173 to 289 millions of employees (in full-time equivalents). In other terms, this is somewhat less than the average employment growth that the EU requires between 2000 and 2010 in order to fulfil the Lisbon targets (estimated at around 1.2% p.a.), except here it is assumed to be maintained until 2050. The resulting employment rate in 2050 (113%) means that the regressive evolution of the working age population will suppose a limitation in achieving the required employment level to compensate ageing: in Graph 1 the change between 2004-2050 in retired people and the number of employees maintaining the pension system in equilibrium is compared to the size of the working age population.

Graph 1. Change in working age population (wap), retired (R) and employed maintaining the system in equilibrium (E') if effective retirement age does not change. EU-25



Note: change in wap and R determined by Eurostat baseline scenario

If we consider that an employment rate of 75% (in full-time equivalents) is a plausible limit of employability for the European Union –this is even higher that the level existing in the EU country with the highest employment rate, Denmark– then a deficit of workforce will exist from around 2022 onwards.

The magnitude of the employment growth required to compensate ageing is so important that **the role of immigration** is emphasised. Let's estimate the number of required immigrants as the difference between E' (total employment in full-time equivalents maintaining the system in equilibrium) and a level of 75% of the working age population projected by the baseline scenario. In that case, almost 98 million immigrants will be required; the figure would really be around the double, as the current activity rate of immigrants is 61.3% (Eurostat LFS data, 2002) and the number of immigrants outside the working age should also be taken into account. We should also addition around 36 million immigrants between 2004 and 2050 inside the baseline scenario (which implies an annual average of around 0.8 million immigrants) resulting in almost 230 million immigrants during the whole period considered, i.e. an entry of more than 5 million of net migrants in a yearly basis up to 2050 (in 2003, last year with available data, the entry of immigrants was estimated in around 2 million).

This scenario shows that neither employment growth alone nor complemented with immigration will be able to counteract ageing at EU level: the required employment creation and the level of immigrants needed are clearly not sustainable during a period of 45 years.

The other alternative measures to compensate the effects of ageing are the following:

- The **average effective retirement age**, which is estimated at around 61 years old in 2004 at EU-25 level, should increase 11 years by 2050 (so reaching a level of 72 years) in order to maintain the model in equilibrium –by fixing the number of retired people in 94.5 millions like in 2004, all the other parameters remaining equal. It is without doubt an important increase, but not very different from growth in life expectancy since 1960, at a pace of 2 additional years per decade. A policy framework which promotes employment growth, but at the same time encourages people to remain in work longer and subsequently improve the employability of older workers is therefore required.
- The **transfer ratio** (t) should be multiplied by 0.6 (coefficient ct, Table 2), that is, decreasing the average pension by 40% (coefficient cp, Table 2) which means making productivity grow more quickly than pension absolute levels between 2004 and 2050.
- Finally, the **GDP contribution to pensions** (c) should increase from 12% in 2004 to 20% in 2050 (column c', Table 2), a 66.7% increase across the studied period.

Of course, these changes required to ensure sustainability have to be seen as extreme values since the real evolutions are likely to be a mix of changes in all the factors. For instance, a future decrease in transfer ratios and a growth in "era" should be taken for granted given the measures already taken in most Member States to limit pension growth which will lead, if unchanged, to a decrease of the relative pension levels and an increase in the effective retirement age.

6.2. Considerations at EU-25 level (II): The impact of changes in key compensatory measures

In the second phase of the analysis, the parameters of the equation (3) are modified, first, and combined, then, to check the feasibility of measures compensating ageing. This exercise has been done for all the Member States and EU-15, although only the results for EU-25 are presented here.

- *modifying the demographic scenario;*

If Eurostat baseline demographic scenario is replaced by high or low variants, the number of persons in retirement (R) or in the working age population (wap) is therefore modified. As the high scenario implies higher fertility but also higher life expectancy, both R' and E' are higher than in the baseline scenario: 171 and 314 millions, respectively. The resulting economic dependency ratio (EDR) is even worst than in the baseline scenario: 98.8% compared to 90.9%.

The opposite trends (with lower fertility and lower life expectancy) appear in the low scenario, where R' = 146 millions and E' = 268 millions, resulting in a EDR of 84.2%.

It appears that a modification in demographic trends does not produce important changes and ageing will be an unavoidable trend in the next four decades.

- *increasing the number of people in employment (E);*

An annual employment growth of 1.2% would result in a decrease of the EDR from 54.5% in 2004 to 52.5% in 2050, but the employment rate (in full-time equivalents) would achieve a level as high as 118% !

More realistic seems an average employment growth of 0.6% p.a. during the studied period: in that case, the EDR would experience a moderate increase, up to 69 retired per 100 employed persons, although the resulting employment rate, 90% is still very high.

Finally, a 0.3% annual employment growth would result in a more feasible 78% employment rate combined with an EDR of 79.2. What the model shows is that an increase in employment is an important measure to assure pension system sustainability, but the size of the potential workforce (the working age population) limits the capacity of growth of the number of people in employment. Therefore, it has to be combined with additional measures like an increase in the age of exit of the labour market.

- *increasing the effective retirement age (era);*

If the "era" is delayed from the current 61 years to 65 in 2050, the EDR would move from its present level of 54.5 retired per 100 employed, to 77.6. It's an important level, but much lower than the resulting 90.9 if the average exit age remains unchanged. Much better is the resulting EDR (61%) if "era" in delayed up to 70 years in 2050: we have however to recognise that it is not easy to obtain such a significant delay in retirement age even in a context of growing life expectancy.

More realistic seems to combine different measures in order to avoid financial deterioration of pension systems: for instance, employment growth with delaying retirement age. Indeed, the higher the increase in effective retirement age, the lower the employment growth needed to maintain the equilibrium. Or the other way around, the higher the growth in employment, the lower the increase in effective retirement age needed to compensate ageing.

If an average 0.3% employment growth p.a. is combined with a delay in the "era" of 5 years, until 66 years, then R' and E' would result, respectively, in 129 million and 198 million persons in 2050, with a resulting EDR of 64.7%, which seems a plausible level (EDR is currently higher in Belgium and Italy, see Table 1). The resulting employment rate in full-time equivalents, 78%, is still high, but the deficit of workforce can be compensated with a very moderate level of immigration: only 8 million of additional immigrants (or around 16 million including inactive immigrants) between 2004 and 2050.

In this context, the system equilibrium can be achieved, if GDP contribution to pensions (c) is constant (12%), through a limited decrease (-16%) in transfer ratio. Or what it is the same, a feasible increase of productivity (GDP/employee) of 19% in a period of 45 years. But if we decide that the transfer ratio should remain constant, then is "c" what has to be experience a 19% increase, resulting in an expenditure in pensions (expressed as a percentage of GDP) of 14% in 2050, similar to the current level in Austria and lower than the share presently existing in Italy (see Table 1).

The results demonstrate that the longer term sustainability of pension systems appears to be a challenge that can be overcome only if the European Union achieves high, but nonetheless feasible, levels of employment growth over the next decades, combined with other complementary measures. However, owing to differences between the ageing process and other relevant factors across Member States, some compensatory measures may be more appropriate for some countries than others.

6.3. Considerations at national level

When looking at national outcomes from the model (Table 2), more caution should be taken in interpreting the results as the model does not take on board the particular features of each national system. The following are the main findings:

- None of the Member States can expect to escape the trend of an ageing population. The baby boomers will arrive at retirement age and despite national differences in fertility rates, the younger cohorts entering the labour market will be unable to compensate the number of older people entering retirement schemes.

- The common trend towards ageing will present important differences in terms of timing and intensity of the process for each Member State. Table 2 shows the national impact of ageing, if all other factors, including current employment rates, remain unchanged (initial scenario). In this case, Ireland, Cyprus, Luxembourg, Malta and Spain will face the highest pressure in terms of compensation for the impact of ageing on pension schemes. On the contrary, the three Baltic States and Hungary will be the least affected by changes in dependency between 2004 and 2050.

- Differences in the ageing process between Member States will clearly have an impact upon the appropriate policy options. In addition, there are significant differences in the current levels of the different key factors (Table 1 shows the actual values for some of the relevant parameters at national level). Therefore, measures to preserve the financial equilibrium will not have the same impact in each Member State.

- Aside from their potential impact, some measures are difficult to apply in some Member States, owing to the current levels of the parameters, but are more appropriate for others (see Table 1). In Member States like Ireland, Sweden, Greece and Cyprus, where the "era" is currently delayed, an additional increase in the average effective retirement age could be more difficult to implement than in other countries like Slovenia, Slovakia or Belgium, where the exit of the labour market is, on average, at younger ages; hence, other measures may need to be taken in the former group of countries. Similarly, in countries with current high employment rates like Denmark, Finland or Sweden, it seems more difficult to consider job creation as the key compensatory measure than in Poland, Malta, Italy or Belgium, with low employment levels. Whereas a decrease in the transfer ratio could have significant stabilising effects in some Nordic countries (in Denmark and Sweden the actual level of pension in relation to GDP per employee presents some margins for manoeuvre), the lower share of GDP to finance pensions in Ireland shows that an increase of "c" is a possible measure to be used by this country to maintain equilibrium. Finally, an additional means to stabilise the system may be to increase the number of employed people through migration, in particular for those Member States like Spain where the margins of manoeuvre of other measures are already rather tight due to the intensity of ageing.

7. Conclusions

The model shows that the impact of ageing on the sustainability of pension systems over the next 45 years is significant at EU level and for the 25 Member States. This challenge can be overcome through a combination of different policies regarding employment, retirement age, economic productivity and level of pensions. This question has been assumed by European policy-makers, as there is significant pressure across the European Union to increase labour market participation, through a delay in the average retirement age, and employment level, and this should help financing pensions in the future. Such a policy implies that early exits from the labour market should not remain as high as they are today. A policy framework is therefore required which promotes employment growth, but at the same time encourages people to remain in work longer and subsequently improve the employability of older workers.

The model shows the existence of a wide range of national situations in terms of the appropriate policy measures required in each Member State to maintain the equilibrium of the pension systems. This is due to differences in timing and intensity of ageing process but also to the diverse initial levels of the main factors affecting pension sustainability across Member States: employment rates, transfer ratios (and relative pension levels), and GDP share to finance pensions.

Therefore, the pension challenge is different for each Member State. Those with a high average effective retirement age and high employment rates may need to adjust the GDP contribution and pension levels in order to compensate for the ageing impact. Their margins of manoeuvre appear somewhat smaller than other countries with lower labour market participation and earlier exit from activity: these countries appear to have more scope for adjustments by increasing the average effective retirement age and the employment rates. Finally, immigration seems a complementary resource when all the other compensatory measures are difficult to implement or are not sufficient due to the magnitude of ageing.

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